THE EFFICACY OF STATIC MAGNETIC THERAPY AS AN ADJUNCT TO CHIROPRACTIC MANIPULATION FOR THE TREATMENT OF MECHANICAL LOW BACK PAIN.

BY

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I, Lynette Vanessa Terry do hereby declare that this dissertation is representative of my own work.

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CONTENTS

DEDICATION

I dedicate this dissertation to my family who has given me inspiration, guidance and encouragement to follow my dreams, to keep looking to the future and achieve my goals. Thank you for your constant loving support and belief in me.

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ABSTRACT

Waddell (2000) describes low back pain as a 20th century medical disaster as, despite the efforts, skills and resources available today, the management of simple backache has not reduced the rate of chronic back pain and disability. Foster (1989: 9) indicates that as many as 60-80% of the general population experience LBP during adult life, with between 12-35% suffering from it at any one time. Waddell (2000: 301) states that while 90% of acute or recurrent attacks settle within 6 weeks, 60% of people have at least one re-occurrence within the next year. Swenson (1998: 108) estimates that mechanical disorders of the spine represent at least 98% of LBP cause.

Waddell (2000: 305) believes the aim of primary management is to provide symptomatic control of pain and prevention of disability. A large number of therapeutic options may be considered to provide symptomatic relief however, there is no good, scientific evidence that these options produce lasting benefits or that they change the natural history of back pain. He believes that symptomatic measures are only valuable if they facilitate active exercise and rehabilitation.

Waddell (2000: 303) states that there is considerable evidence that manipulation can provide short-term symptomatic benefit in patients with acute back pain without nerve root pain of less than 1 month's duration. Manipulation may be equally effective in dealing with recurrent attacks, however there is limited evidence for the effectiveness of manipulation in patients with chronic LBP and nerve root pain.

With the rising popularity of magnetic field diagnostic techniques such as MRI (magnetic resonance imaging), magnets and electrical devices are beginning to gain mainstream medical

acceptance as diagnostic and treatment tools. Permanent magnets have become a popular treatment for various musculoskeletal conditions, including LBP, despite little scientific support for therapeutic benefit (Null 1998). The fundamental physics of magnetism have been known for centuries and the healing effects are only recently been under scrutiny in scientific research studies.

Modern medicine requires proof of effectiveness and rejects unsubstantiated claims and inadequate definition of methodology in studies. The objective of this study was to determine the effectiveness of combining SMT with magnetic therapy as compared to SMT and a matching placebo device, in the treatment of mechanical LBP.

This randomized placebo-controlled clinical trial consisted of sixty voluntary subjects between the age of 18 and 60, who were diagnosed as either suffering from a posterior facet syndrome, a sacroiliac syndrome or a myofascial pain dysfunction syndrome or a combination of two or all three of these syndromes. Patients were randomly divided into two groups of thirty subjects who either wore a placebo belt (Group A) or magnetic belt (Group B) at nighttime for duration of two weeks. All patients had a maximum of six consultations where they received lumbar sacral manipulation during a two-week period.

Subjective and objective measures were taken before each treatment on the first, fourth and sixth consultations. The outcome measures included the response of subjects to the Numerical Pain Rating Scale-101, the Revised Oswestry Low Back Disability Questionnaire, the Short-form McGill Pain Questionnaire, the 11-point Box Scale and the Symptom Diagram. Objective data were gathered from the Orthopaedic Rating Scale and Algometer readings.

Parametric statistical analysis, using the Unpaired t-test for inter-group analysis and the Paired t-test for intra-group analysis was used to test for the mean of the differences. Non-parametric analysis, using the Mann-Whitney U-test was used for inter-group comparison and the Friedman's t-test was used for intra-group comparison and then analyzed using the Dunn Procedure to find, where in the treatment period a difference occurred. All results were analyzed at a 5% level of significance, i.e. $\alpha = 0.05$.

Statistically, both groups showed improvements, subjectively and objectively, with regards to mechanical LBP. Inter-group analysis showed no differences between Group A and Group B by the final consultation. Intra-group analysis of the Symptom Diagram showed that both treatment groups improved significantly between the initial and final consultations. The Dunn Procedure indicated that significant differences occurred between the initial and final consultations, except for the Orthopaedic Rating for Sacroiliac syndrome in Group A.

The overall results lead to the assumption that both treatment groups responded equally and favourably in terms of subjective and objective measures to SMT and a placebo or a magnetic belt in the treatment of mechanical LBP. To gain conclusive results, it is recommended that more research be carried out.

TABLE OF CONTENTS

CHAPTER ONE – INTRODUCTION

CHAPTER TWO - REVIEW OF RELATED LITERATURE

CHAPTER THREE - MATERIALS AND METHODS

CHAPTER FOUR - THE RESULTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

H_O	-	Null Hypothesis
H_a	-	Alternative Hypothesis
LBP	-	Low Back Pain
Me.	-	Median
MFPDS	-	Myofascial Pain Dysfunction Syndrome
NRS-101	-	Numerical Pain Rating Scale-101
Oswestry	-	Oswestry Low Back Pain Disability Index
PEMF	-	Pulsed Electromagnetic Field
P-value	-	Level of Significance
RCT	-	Randomised Control Trial
Sd.	-	Standard Deviation
Se.	-	Standard Error
SMT	-	Spinal Manipulative Therapy
SWD	-	Short Wave Diathermy

DEFINITION OF TERMS

Mechanical Low Back Pain - This is defined as pain resulting from the inherent susceptibility of the spine to static loads due to muscle, gravity forces and to kinetic deviation from the normal function (Gatterman 1990: 129). In this study, the low back is defined as the area between the lowest ribs and inferior gluteal fold.

Dysfunction - The dysfunction implies that one of the three components off the joint is not functioning normally. It refers to any joint where there is decreased or aberrant mobility for which manipulation is indicated (Kirkaldy-Willis and Burton 1992: 105).

Fixation - The state whereby an articulation has become temporarily immobilized in a position that, it may normally occupy during any phase of physiological movement (Haldeman 1992: 623).

Chiropractic - Chiropractic is that discipline within the healing arts especially concerned with the etiology, pathogenesis, diagnostics, therapeutics and prophylaxis of functional disturbances, pathomechanical states, pain syndromes and neuromusculoskeletal system, particularly those related to the spine and the pelvis (Schafer & Faye 1990).

Manipulation - A passive manoeuvre in which specially directed manual forces are applied to vertebral and extra-vertebral articulations of the body, with the object of restoring mobility to the restricted areas (Gatterman 1990: 410).

Adjustment - A specific form of direct articular manipulation using, in the case of this study, short lever techniques with contacts, characterized by a dynamic thrust of controlled velocity, amplitude, and direction (Gatterman 1990: 405).

Negative pole - The side or end of a magnet causing the same reaction as the earth's North Pole. Since opposites attract, this is also known as the South-seeking pole. The earth's North Pole attracts the south/positive pole of a magnet. (Rinker1997: 28)

Positive pole - The side or end of a magnet causing the same reaction as the earth's South Pole. Since opposites attract, this is also known as the North-seeking pole of a compass. The earth's South Pole attracts the north/negative pole of a magnet. (Rinker1997: 28)

Bipolar - Negative and positive poles used together. Describes a magnet or magnetic field that provides a pattern of alternating north/negative and south/positive fields. This effect can be produced with permanent magnets used in an alternating (bipolar) pole pattern or with PEMF in an oscillating wave pattern. (Rinker1997: 28)

The Hall Effect- The generation of an electric potential perpendicular to both an electric current flowing along a thin conducting material and an external magnetic field applied at right angles to the current upon application of the magnetic field. [After Edwin H. Hall (1855 – 1938)]. The Hall Effect explains the effect of polarity alignment placed at right angles to the blood flow. Since blood flows in all directions in the body, any alternating pole alignment will produce the some general effect. (Rinker1997: 43)

Tesla - The unit for the magnetic flux density *B* is equal to a flux of one weber per square meter inside a magnetized body. One Tesla = 10,000 gauss. (Encyclopaedia Britannica 1975: 315)

Objective Clinical Findings-These are defined as those clinical findings ascertained using a full case history, physical examination, orthopaedic and neurological examinations including pain sensitivity – using an Algometer and, specific orthopaedic tests – creating an orthopaedic rating scale.

Subjective Clinical Findings-These are defined as those clinical findings ascertained using the patient's perception of the pain, including: the Revised Oswestry Low Back Pain Disability Questionnaire, the Short-form McGill Pain Questionnaire, the Pain Sensitivity Scale and, the Numerical Pain Rating Scale-101.

Magnetic Therapy- Based on the primary law of magnetism, that opposite poles or charges attract and similar ones repel, treatment is applied to the body with the use of electromagnetic or static magnetic fields.

APPENDICES

CHAPTER ONE

1. INTRODUCTION

1.1 THE PROBLEM AND ITS SETTING

Not only is LBP a common, self-limiting disorder with a high rate of spontaneous recovery, Foster (1998: 12) states that as many as 60-90% of patients suffer a relapse, with each recurrence having the potential to be more severe and long lasting. Estimates suggest that around 80-90% of acute back syndromes improve within 1 or 2 months regardless of treatment however approximately 3-8% of acute episodes of LBP progress to develop chronic LBP and utilize 90% of available resources. Foster (1998: 12) estimates the number of people with chronic pain problems range from 5% to 20% of the population.

Manga (2000: 119) estimates that musculoskeletal disorders rank first in prevalence as the cause of chronic health problems, long-term disabilities, and consultations with a health professionals and rank second for restricted activity days and use of both prescription and nonprescription drugs. The progressive disability and chronic nature of low back pain (LBP), has caused a strain on medical funds and economy due to reduced work efficiency and absenteeism. Waddell (2000: 388) estimates that in the US, back pain is the fifth most common reason for an office visit to a physician and the most common reason for seeking alternative medicine, 36% of those with back pain have sought some form of alternative medicine in the past year. The number seeking chiropractic care has doubled in the last 15-20 years.

The clinical guidelines of the U.S., U.K. and New Zealand agree on early management with the aim of pain relief and prevention of disability. Besides psychosocial management, patients are advised to rest only if essential and be encouraged to be active and have an early return to work. It is recommended that patients continue ordinary activity, which can give equivalent or faster symptomatic recovery from an acute attack and lead to less chronic disability and less time off work. Symptomatic measures found effective includes simple analgesics and NSAIDs although iatrogenic complications place some patients at risk of developing side effects with prolonged use. There is considerable evidence that manipulation can provide short-term symptomatic benefit in some patients with acute back pain of less than 1 month's duration and without nerve root pain. Manipulation may be equally effective in dealing with recurrent attacks although there is more limited evidence for the effectiveness of manipulation in patients with chronic low back pain. Manipulation should not be used in patients with severe or progressive neurological deficit in view of the rare but serious risk of neurological complication.

There is a growing dissatisfaction with health care for back pain throughout the Western world which Waddell (2000: 1) claims is a 20th century medical disaster. Waddell (2000: 404) states that the use of ineffective treatments consumes large amounts of health care resources. Waddell (2000: 406) suggests that there should be a shift of resources from medical specialist services to support management of simple backache in primary care. The evidence of early intervention in practice shows conflicting results as to whether it is effective and cost effective. Waddell (2000: 259) suggests that changing from a passive strategy of rest to a more positive, active strategy could improve clinical outcomes and reduce the personal and social impact of back pain.

Manga et al. (1993b) reviewed extensive literature on clinical and related research on the effectiveness of manipulation for LBP and found that spinal manipulation applied by chiropractors to be a more effective than many alternative treatments and as safe and, many times safer than medical management. An opinion survey from 50 clinical LBP experts by

Ernst and Pittler (1999: 87) on the clinical effectiveness of complementary/alternative therapies, for four defined categories of LBP, showed osteopathy and chiropractic to be effective for acute uncomplicated LBP, whilst acupuncture was judged to be of some value for chronic, uncomplicated LBP. Gatterman (1982: 60) reports that while some chiropractors only use spinal manipulation as a singular method of treatment, many others employ a variety of adjunctive procedures with the fundamental aim to promote natural physiological function and to hasten the healing processes. Commonly sought affects are thermal and cryogenic changes, and electro-kinetic, electrochemical, kinetic and mechanical stimulation of body tissues.

Livingston (1996: 217) states that the electrochemical processes of the body are extremely complex and incompletely understood, and effects of magnetic fields cannot be ruled out. Magnetic therapy has been used successfully to step up vascularization, as seen by thermographs, but the real validity of studies is in question. It is claimed that organs and systems of the body depend on magnetic energy that can be increased with a positive field and decreased with a negative polarity. Washnis and Hricak (1993) state that the medical profession has shied away from the use of magnets for therapeutic purposes due to the lack of knowledge and support from the medical association although, the application for diagnostic purposes has convinced the FDA to declare magnets in human diagnosis and therapy as "not essentially harmful," leading to further study and trials in medical magnets without the need of additional toxicity evaluation

Research into magnetic therapy is divided into two distinct areas: pulsed electromagnetic therapy and static magnetic therapy. Probably 85 to 90 % of the scientific literature is on pulsed bioelectric magnetic therapy; the remainder is on therapy with fixed solid magnets. Null (1998: 1) noted that a positive result from pulsed electromagnets will not automatically translate to a positive result from fixed magnets, and therefore there is a need for more studies in this area.

Magnetic therapy is relatively new to scientific evaluation as evidenced by the few controlled studies. The marketing of magnetic products with unsubstantiated claims and overpriced devices is unprofessional and should be discouraged, even if no side effects have been demonstrated so far. Washnis and Hricak (1993) agree that the negative polarity is a more appropriate field to use as it adds to the negative energy produced by the system in an effort to heal an injury. It is believed that the negative pole mimics the action of the brain when is feeds signals for negative energy to the site of injury.

Just as there is still no clear explanation of the mechanisms by which manipulation relieves LBP, similarly the effects of magnetism are still being studied and claims to their healing powers need to be examined. Numerous articles have been written on the subjects of magnetotherapy however; more needs to be done in research, controlled studies, and clinical observation of the benefits and risks of magnetic fields. Washnis and Hricak (1993: 90) state that if it is not approached sensibly with proper testing and validation, this extraordinary method of healing may be relegated once again to the graveyard history.

1.2 AIMS AND OBJECTIVES OF THE STUDY

The purpose of this investigation is to evaluate the relative effectiveness of spinal manipulative therapy combined with magnetic therapy compared to spinal manipulative therapy combined with placebo, using subjective and objective measures, in the management of mechanical LBP.

The first objective was to evaluate the relative effectiveness of spinal manipulative therapy combined with magnetic therapy compared to spinal manipulative therapy combined with placebo, in terms of subjective clinical findings, in the management of mechanical LBP.

The second objective was to evaluate the relative effectiveness of spinal manipulative therapy combined with magnetic therapy compared to spinal manipulative therapy combined with placebo, in terms of objective clinical findings, in the management of mechanical LBP.

The third objective was to integrate the results of objective one and two in order to determine whether either of the two treatments was more effective in terms of subjective and objective clinical findings.

1.3 MOTIVATION AND BENEFITS OF THE STUDY

Physical therapists of today must ask the question whether modulating pain by using expensive procedures, medication, surgery, costly therapies and extended treatment programs is better for the patient and society as a whole than dispensation of relatively inexpensive alternatives. Brunarski (1984: 243) says that philosophically and historically, chiropractic has been uniquely orientated toward an emphasis on preventative care and health maintenance with a mechanistic and hands-on model for treatment. Instead of reductionism, chiropractors focus on holism, non-invasiveness and the sharing of the responsibilities for healing between doctor and patient. Magnetic energy has been known for centuries for its healing and pain relief mechanisms. Doctors and therapists have attempted to use this energy to cure every disease imaginable. Almost no illness is omitted from their list of therapeutic attempts and every claim known has probably been made for magnetotherapy. A number of controlled studies and scientific reports exist for electromagnetic devices in fracture healing, sprains and bodily pains, but few controlled studies are available on permanent magnets for other ailments. No studies have been conducted in South Africa to date with reference to permanent magnets, let alone double-blind placebo controlled studies.

Chiropractic philosophy was founded upon magnetic healing and it could fall into this professions' responsibility to determine the effectiveness of this treatment modality. The scope for new studies is unlimited as magnetic therapy is relatively new and the mechanism of action on the biological system is still a mystery. Chiropractors educated in magnetic therapy can play an important role by supplying patients with information to avoid adverse effects and to get the best results.

It is the author's opinion that there is a growing market for the use of magnetic products for humans as well as the veterinary field as evidenced on the Internet and in magazines. They are relatively inexpensive when considering that a magnet's power remains constant, does not require additional power source and can be used almost indefinitely unless it is exposed to some other intense magnetic fields, subjected to excessive heat or mechanical shock such as pounding with a hammer. The potential economic advantage is that a magnet is reusable and can be used for various minor ailments or chronic conditions. No side effects have been demonstrated and therefore the costs of iatrogenic medical side effects are avoided.

Magnets do not restrict an active lifestyle as any additional attachments, such as; electrical cables, batteries, gels or liniment, need not be applied. The magnets are placed on the intended area and secured by tape or within appliances such as braces, shoe insoles, facial masks, mattresses, pillows and car seats. In addition to providing support, magnets within a brace will focus on the intended site. Magnets can also be disguised in the form of jewellery such as necklaces and bracelets. Magnetised water is used for whole body treatment.

To the working industry it represents earlier return to work and money saved because of less 'down' time. To the athletes it often represents faster return to the sport due to quicker and more effective healing of injuries, whether they are fractures, torn tendons, ligaments, or muscle injuries, acute or chronic. More serious illnesses such as arthritis, diabetes, nerve disorders, stroke, respiratory problems, high cholesterol, blood pressure, and cancer, has been claimed to be helped by magnetic therapy. Less life threatening but chronic problems such as neck and back pain, headaches, depression, insomnia, intestinal disorders, ulcers etc have also been treated successfully.

Preventative health care and treatment of minor aliments with self-applied magnets at home could improve the cost of health care as it will reduce the need for analgesic medication, improve overall health and allow people to learn to take control of their bodies. Magnets are easy to use, inexpensive, long lasting and are free of side effects. The results of this pilot study may provide some evidence for further studies; magnetic therapy might prove to be the answer to common medical problems by addressing the biophysical nature of the body.

When all the mysteries of the basic functioning of magnetic fields are resolved, and if a proper documentation of the success of magnetotherapy is achieved, then this technology could flourish and expand due to its non-invasive nature and its ease of use. A conventional methodology needs to be developed so that the basic life force receives the critical consideration and evaluation it deserves. Washnis and Hricak (1993: 169) state that although much has been written on the subject, it is difficult to draw absolute conclusions in several controversial areas, even though the evidence appears to rest more logically in one direction than the other.

Backache has a tendency towards natural recovery, but management must actively support and encourage recovery and act positively to prevent chronic pain and disability. Management must not do anything that interferes with natural recovery; iatrogenic disability must be avoided. Once chronic back pain and disability are established, any form of treatment is more difficult and has a much lower chance of success. The importance of primary management of backache within the first 6 weeks cannot be over-emphasized. Early management sets the whole strategy and very largely determines the final outcome. It has a powerful influence on the patient's and family's attitudes and beliefs about the problem and how it should be dealt with. (Waddell 2000: 297).

In this study, the treatment will consist of spinal manipulation to the lumbar spine on each of the six visits and at night time, use of a lumbar sacral belt with magnetic or placebo discs for a two-week period. Although Collacot et al. (2000) found no significant difference in LBP in a pilot study using bipolar magnets, the effect of using a unipolar magnet, as an adjunct to spinal manipulation has not yet been examined so far. Magnets are easy to use and further research will provide information for more effective complementary treatment of LBP

CHAPTER TWO

2. REVIEW OF RELATED LITERATURE

2.1 INTRODUCTION

In reviewing the related literature, the reader will be presented with information related to the common condition of low back pain (LBP) and the chiropractic treatment thereof. It has been observed that magnetic therapy has been regaining popularity and numerous products are available, although their effectiveness for LBP has not yet been scientifically proven. The historical evidence of magnetism and chiropractic gives a theoretical and practical understanding of the subtle energy system and how it has led to modern practices. The role that spinal manipulative therapy (SMT) and magnetic therapy play in the management of LBP will be discussed together with the possible advantages in incorporating them into complementary/alternative therapy.

2.2 EPIDEMIOLOGY OF LOW BACK PAIN

2.2.1 ETIOLOGY

The etiology of LBP is multi-factorial and includes both a mechanical and an inflammatory basis. The causative agents or processes which have been hypothesized as promoting vertebral subluxation include: physical trauma, poisons acquired through inhalation, food, drink, or otherwise, postural aberrations, congenital and developmental anomalies, tension within the cord and meninges, and inappropriate expression of sensory engrams. Other effects stemming from vertebral subluxation have been postulated to include: disc degeneration and arthritides, as well as a myriad of physiological dysfunctions. The etiology is not a simple cause and effect relationship, but rather a cycle in much the same way in which depression and perception of quality of life are linked.

Borenstien et al. (1995: 25) believes that the anthropometric data is contradictory with no strong relationship between height, weight, body build, and LBP. Physical factors found to be associated with increased risk of LBP include heavy work, static work postures (prolonged sitting or standing), bending and twisting, and vibration. Psychological and psychosocial work factors including monotony at work, job dissatisfaction, and poor relationship with co-workers have been found to increase the incidence of LBP. Physical fitness is not a predictor of acute LBP, but the physically fit have lesser risk of chronic LBP and a more rapid recovery after a pain episode.

Swenson (1998: 108) estimates mechanical disorders of the spine represent at least 98% of LBP cause and states that they have many features in common. Typically, there is clear–cut worsening in certain positions. For example, postures that load the spine, such as sitting, commonly exacerbate the pain. These positions preferentially load (either by compression or traction) the damaged tissues, thereby reproducing the patient's symptoms. However, the ability to detect specifically the injured tissue by such positions (or by orthopaedic tests) is limited by the fact that all movements of the spine necessarily involve multiple tissues.

2.2.2 INCIDENCE AND PREVALENCE

After heart disease and arthritis, Forster (1998: 9) indicates that LBP complaints comprise the second or third largest diagnostic group seeking care from family physicians, and that as many as 60-80% of the general population in Western society will experience LBP during adult life, with between 12-35% suffering from it at any one time. In South Africa, van der Meulen (1997) and Docrat (1999) found the lifetime incidence of LBP amongst Indians was 78.2%, blacks 57.6% and, Coloureds was 76.6%.

In the literature reviewed by Magna et al. (1993b: 222), LBP was found to be most common between the ages of 25 and 55, while the average age for filing a workers' compensation claim in Canada and the United States fell between 33 and 35. There was a historical trend in workers compensation statistics for a higher incidence and prevalence in men than women. However, with the constant increase in participation the labor force of females since World War II, the difference has narrowed substantially. Variations in the occurrence of LBP were found based on age, race, region, education and smoking habits.

2.2.3 RECURRENCE, CHRONICITY AND COSTS

Koes et al. (1996: 2860) report that episodes of mechanical LBP are self-limiting, and most patients (90%) recover within 6 weeks, regardless of the type of treatment given. Foster (1998: 12) claims that as many as 60-90% of patients suffer a relapse, with each recurrence having the potential to be more severe and long lasting. Foster (1998: 12) estimates 3-8% of acute episodes of LBP progress to develop chronic LBP, which is 5% to 20% of the population who utilize 90% of available resources. In addition, little is known about the relevant prognostic indicators however, there is some suggestion that spontaneous recovery may only apply to acute LBP, and those with chronic pain show less spontaneous improvement. Kirkaldy-Willis (1983) advises that treatment is more likely to result in a return to a symptom-free state and to have more long-term benefit in the earlier stages of the degenerative process.

Costs can be divided into direct (such as payments for medical care and compensation for lost wages) and indirect costs, (such as lost production time, the training of replacement personnel and legal costs). Foster (1998) states that most of the cost will be caused by 1% of the population who are totally and permanently disabled whereas Manga et al. (1993a: 25) reported that 75% of costs could be attributed to 5% of people who become temporarily or permanently disabled from back pain. Manga et al. (1993a: 25) further cites Spengler et al. (1986) who indicated that back injuries were three times more costly than non-back injuries, and that back injury claimants tended to have multiple claims compared with non-back injury claimants.

When Burton and Cassidy (1992:2) compared the total direct and indirect cost of LBP with the cost to worker's compensation in the United States, they found that this entity was not only a unique liability to the business community but also that LBP represents "the single greatest and most inefficient expenditure of health care resources in our society today". Manga et al. (1993a: 14) report that although health care standards were higher in Canada, it was only second to the United States in 1989 in health care expenditure worldwide and in per capita terms. They suggest that health care systems in other industrialized countries are facing similar problems.

2.3 PATHOPHYSIOLOGY

Waddell (2000: 9) states that the diagnosis is the foundation of management and is based on a careful history and examination. Waddell (2000: 10) developed a system of diagnostic triage for back pain and classified symptoms and signs into: simple backache, nerve root pain and serious spinal pathology. He claims that a definite diagnosis of pathology can be found in about 15% of patients with back pain.

This study focuses on the 'non-specific' LBP that Waddell (2000: 10) describes as simple backache. The clinical presentation is usually between the age of 20-55 years where pain is located in the lumbosacral region, buttock and thighs. It is described as 'mechanical' pain of musculoskeletal origin in which symptoms vary with physical activities and time. Simple backache may be related to mechanical strain or dysfunction, although it often develops spontaneously. There is little correlation between the anatomic identification of 'pain generators', clinical syndromes or actual pathology. He does note that 'non-specific' includes a variety of different disorders although there is an overlap between the clinical subgroups.

Loeser and Melzack (1999) state that clinically significant acute pain always involves tissue damage; the central and peripheral nervous systems are dynamic, not static, and are modulated by tissue damage and by changes in the central nervous system and stress-regulation systems that occur in response to such damage. Although most of these modulations are of short duration, some may persist and lead to chronic pain states. They feel that it is not the duration of pain that distinguishes acute from chronic pain but the inability of the body to restore its physiological functions to normal homoeostatic levels. As chronic pain is unrelenting, it is likely that stress, environmental, and affective factors may be superimposed on the original damaged tissue and contribute to the intensity and persistence of the pain. As chronicity increases, the pain becomes increasingly dissociated from the original basis, and there is often little objective evidence of any remaining nociceptive stimulus. Chronic pain differs from acute pain because therapies that provide transient pain relief do not resolve the underlying pathological process. Chronic pain continues when treatment stops.

In his review of the literature, Dishman (1988: 100-101) explains that in normal jointed tissue, nutrition and fluid exchange is dependant upon mobility and points out that the residual effect of chronic pathomechanics includes fibrosis, contractures, adhesions, deformity and structural derangements. Other causes of restricted inter-articular mobility are locking due to internal derangement of the synovial meniscoid villus, tightened or taut articular capsules, ligaments or fascia; shortened muscles from spasm or fibrosis, loss of glycosaminoglycan molecules, displaced disc fragments, disc resorption, tears or fibrosis of the anulus or the nucleus pulposus. He goes on to say that immobilization is detrimental to joints and leads to poor healing of articular cartilage and that movement is essential for the prevention of contracture and adhesions and is also necessary for proper orientation of collagen fibers as they form.

Kirkaldy-Willis and Burton (1992: 105-119) establish a pathology-based system of diagnosis and categorizes LBP into three separate stages namely: dysfunction, instability and stabilization. Kirkaldy-Willis and Burton (1992: 105) states that the relatively "benign" phase of dysfunction is usually initiated by trauma and shows facet subluxation, synovitis and segmental muscle spasm and if not dealt with effectively from its onset it has the ability to progress into disability associated with the instability and stabilization phase. The less-recognized causes of LBP; posterior facet joint syndrome, sacroiliac syndrome, Maigne's syndrome, and myofascial syndromes are frequently over-looked as they usually do not demonstrate abnormalities radiographically. Bernard and Kirkaldy-Willis (1987: 266) noted that the clinical presentation of these syndromes frequently mimics other well-known lesions such as nerve root compression, herniated nucleus pulposus, lateral spinal stenosis, central spinal stenosis, and instability.

Kirkaldy-Willis and Burton (1992: 121-129) describe the signs and symptoms of each stage however, it was found that in the clinical setting, reaching a definitive diagnosis for mechanical LBP was not always possible as the following factors relate:

1) The etiology is multifactorial and includes both an inflammatory and a mechanical cause.

2) Pain arising from certain tissues does not follow a specific anatomical pattern.

3) A particular pathologic process can give differing patterns of symptoms and signs.

Subsequent development of other conditions may complicate the initial condition at a later stage.

Kirkaldy-Willis (1983: 133) describes the pathophysiology associated with dysfunction syndromes as follows:

1) Facet joint inflammation resulting in the production of inflammatory metabolites that stimulate pain sensitive nociceptors,

2) Muscle spasm resulting in ischemia and pooling of metabolites, the associated chemical irritation may then also stimulate the pain sensitive nerve endings,

3) Joint dysfunction which results in disturbed proprioception and gate control which then augments the perception of pain, this is a sclerotogenous pain and may therefore be referred or localized, and

4) The effect of disc pathology, if severe enough, may result in nerve root irritation following radicular pain characteristics.

For many years the effect of the chiropractic adjustment was believed to be the "releasing of impinged nerve roots" which occurred within the confines of the intervertebral foramina between two misaligned vertebrae, but the exact effects are still not known today. The rationale that Koes et al. (1996: 2860) give ranges from; reduction of disc bulge/herniation, correction of the internal displacement of disc fragments, freeing of adhesions around a prolapsed disc of facet joints, inhibition of transmission of nociceptive impulses, relaxation of entrapped synovial folds or plica, to relaxation of hypertonic muscles by sudden stretching, unbuckling motion segments that have undergone disproportionate displacements.

2.4 TREATMENT INTERVENTION

Waddell (2000: 259) summarized the principles of management as follows: Acute – avoid developing physical dysfunction and illness behaviour by simple symptomatic measures and advise to continue ordinary activities as normally as possible; Subacute – overcome guarded movements and improve flexibility, reduce negative beliefs and coping strategies and illness behaviour, and increase activity levels and return to work; Chronic – established physical dysfunction and illness behaviour which are more difficult to reverse. In the practice of chiropractic, Manga et al. (1993a: 28) further cited Vernon (1991: 385-6) who outlined four stages in the management of LBP patients:

Vernon's first stage consists of decreasing pain, by attempting to reduce entry-level pain, inflammation, muscle spasm and compression on joints or nerve roots. Treatments offered to accomplish this objective include recommending rest, ice or heat therapy, low force manual soft tissue therapy and passive joint mobilization. Patients are also taught to improve their illness behaviours and are encouraged to do treatments and exercises at home.

The second stage deals with the recovery of function, such as the convalescence of normal muscle tone and extensibility, of normal joint flexibility and joint play and the promotion of nerve healing. Chiropractic treatment will include spinal manipulation, extremity mobilization and manipulation, and use modality treatments and passive motion apparatus. Additionally, they may prescribe home treatments such as low-level exercise, and stress to the patient the need to reduce abnormal illness behaviours.

Rehabilitation is the third stage, whereby the chiropractor attempts to recondition the patient's muscle tone and strength, and fully restore active range of motion and joint play and the patient's overall dynamic functional harmony. The treatments used to meet these objectives include spinal manipulation, conditioning, flexibility and aerobic exercises, postural retraining, ergonomic awareness and orthotic therapy, and continued educational intervention to reduce the patient's abnormal illness behaviour.

The final stage of management for LBP, reinforcement, consists of initiating a full-scale preventative program and discharging the patient from active care. The chiropractor continues to encourage wellness behaviours by the patient after a full recovery has been made.

2.4.1 SPINAL MANIPULATIVE THERAPY

2.4.1.1 THE ORIGIN OF CHIROPRACTIC

Andrews and Courtenay (1999: 3) mentions that D.D. Palmer was attracted to the philosophical concepts of magnetic healing and learned the skill from Paul Caster. His magnetic healing method was achieved by passing his hands over heated or inflamed parts, toward the extremities or cold parts. Wardwell (1992: 53) mentions that, in a textbook on magnetic healing discovered by Gielow (1981: 53) in D.D.'s library, the right hand, which was believed to be positive, was placed on the hot part, and the left, or negative hand, on the cool, on the principle that forces flow from positive to negative. He had been practicing magnetic healing for 10 years before he encountered his patient Harvey Lillard and developed the system of hands-on therapy know as chiropractic in 1895.

Waddell (2000: 58) states that D.D. Palmer founded chiropractic on science and vitalism, with emphasis on the mind-body relationship. They mention that the mechanical side was the manipulation of subluxations and, vitalism gave an equally strong metaphysical and spiritual side. Palmer saw this as a life force, expressed in the individual as *innate intelligence*, which controls and coordinates bodily activity and influences health and illness. It is the fundamental ability of the body to heal itself.

Boone and Dobson (1996/7: 20) point out that the significance of the "adjustment" established by D.D. Palmer led to the development of the Early Vertebral Subluxation Model by B.J. Palmer. Four fundamental, but hypothetical components were outlined: (1) vertebral misalignment, (2) occlusion of spinal or intervertebral foramen, (3) pressure on nerves, and (4) interference with the quantity of flow of the *mental impulse*. It was hypothesized that the nervous system was the medium through which *mental impulses*, the coordinating force of all life function, was conveyed.

Boone and Dobson (1996/7: 20) explain that when the information from contemporary research was sorted relative to the hypothesis of the *mental impulse*, processes such as axoplasmic flow, volume transmission, the ephaptic effect (other than synaptic transmission), neurohormonal communication, and the action potential, all represented various aspects of the physical medium of the nervous system through which the *mental impulse* might be conveyed. They further point out that the definition of subluxation by International Chiropractor's Association and the American Chiropractic Association are both functional but neither mentions the theoretical considerations of the *mental impulse*.

Manga et al. (1993a: 29) cites Haldeman, S.C. (1993) who mentioned that in the past, "spinal manipulation" was broadly defined and included "all procedures where the hands are used to mobilize, adjust, stimulate or otherwise influence the spinal and paraspinal tissues with the aim of influencing the patient's health". Manga et al. (1993a: 29) further cites Cassidy and Kirkaldy-Willis (1985; 1988) who summarized the process of spinal manipulation in point form and defined manipulation as a "passive maneuver during which the three-joint complex is suddenly carried beyond the normal physiological range of movement without exceeding the boundaries of anatomical integrity. The usual characteristic is a thrust – a brief, sudden, and carefully administered 'impulse' given at the end of the normal passive range of movement and is usually accompanied by a cracking noise".

Andrews and Courtenay (1999: 3) mentions that the first theory of chiropractic was broad both in its scope of disease presumed amenable to its methods, and broad in terms of the anatomical target of manipulative interventions. Through the trials and tribulations its philosophies and theories have grown and developed into a new medical profession backed by numerous scientific investigations and the positive results it achieves.

2.4.1.2 EFFECTIVENESS

Following a review of 50 studies by Brunarski (1984) from 1930 to 1983, examining patient responses to SMT in the management of neuromusculoskeletal conditions, only the randomized control trial (RCT) were considered to provide the strongest evidence regarding the true effectiveness of SMT. A list of requirements for a valid study was recommended for further investigations.

Di Fabio (1992) identified 11 valid studies that demonstrated the efficacy in the treatment of LBP. They primarily pointed to immediate and short-term symptomatic relief of LBP for the manipulated group, where as the long-term effects on the manipulated and control groups did not differ significantly.

In the bulk of the 28 methodologically sound RCTs reviewed by Manga et al. (1993a) from 1974 to 1992, SMT applied by chiropractors was shown to be more effective than many alternative treatments for LBP. The clinical evidence was further corroborated by six descriptive studies from 1930 to 1992, six case-control trials from 1955 to 1987, eleven meta-analyses from 1980 to 1992, and from highly respected clinical guideline panels. It was noted that no clinical or case-control studies demonstrated or implied that chiropractic SMT was unsafe and was suggested to be safer than medical management.

Mohseni-Bandpei et al. (1998) reports that although Anderson et al. (1989) concluded from 23 RCTs that SMT was more effective in the treatment of LBP than other comparison interventions, Koes et al. (1996) concluded from a review of 36 trials from 1966 to 1995 that the efficacy of SMT had not been convincingly demonstrated through methodological sound RCTs. There were indications that SMT might be effective in some subgroups of patients. Overall, 19 trials (53%) reported 'positive' results and a further five trials (14%) reported 'positive' results in one or more subgroups. Eleven trials compared SMT with some placebo therapy, with inconsistent results.

Mohseni-Bandpei et al. (1998) believed that most RCTs with better methodological design were carried out since 1985, and could have affected the Koes et al. study. They reviewed 25 relevant studies from 1985 to 1997 measuring the effect of SMT in the treatment of LBP. The results of 17 trials (68%), in which the authors reported positive effects in favour of manipulation in total subjects and in a subgroup of the population, indicated that manipulation was more effective than other interventions. Six studies (24%) reported there was no superior effect of manipulation over referenced treatments, and only two studies (8%) failed to report a conclusion. Although methodological flaws precluded strong conclusions, they felt that manipulation appeared to be more effective than other interventions in the treatment of LBP, both in short- and long-term effects.

Assendelft et al. (1992) identified five chiropractic RCTs from 1985 to 1990, of which four reported favourable results, while one refrained from drawing conclusions. The small number of studies and poor general methodological quality precluded drawing strong conclusions, however chiropractic manipulation seemed to be an effective treatment of back pain. It was further stated that more studies with better research methodology were still needed.

In a clinical guideline and evidence review for the management of LBP, Waddell (2000) presented the guidelines in United States, United Kingdom and New Zealand, where SMT was recommend as safe and effective for patients within the first four to six weeks of acute and recurrent LBP without radiculopathy. For patients with symptoms lasting longer than one month, manipulation was believed to be safe but its efficacy was still unproven.

One of the highest-ranking trials rated by Assendelft (1992: 491) was by Meade et al. (1990) who compared chiropractic manipulation to hospital outpatient treatment, consisting of physiotherapy, in a major multicenter randomized controlled trial in Britain. Patients that received manipulation for chronic LBP were significantly better than the controls on the assessment scores at 3 year follow up. However, Assendelft (1991: 281) criticized this research as the groups differed in duration of treatment, number of sessions, level of experience of the therapist, and health care setting.

Hurwitz (1994) compared chiropractic management to medical management of LBP of musculoskeletal etiology in a multispeciality group practice. He found that chiropractic patients were more likely to perceive their treatment to be successful in reducing LBP and functional disability compared to medical patients. This was confirmed by Verhoef (1997: 235) with a follow-up study showing a high level of satisfaction with the care received from chiropractors for resolving or ameliorating pain and functional impairments for back and/or neck pain.

Results from a survey by Ernst and Pittler (1999: 87), designed to generate opinion from 50 clinical experts on LBP on the clinical effectiveness of complementary/alternative therapies for four defined categories of LBP, demonstrated that osteopathy and chiropractic to be effective for acute uncomplicated LBP whilst acupuncture was judged to be of some value for chronic, uncomplicated LBP. The difference between physicians' opinion and that of LBP experts was highlighted as an earlier study by Cherkin et al. (1995) that showed fewer than half of US physicians considered spinal manipulation effective for acute or chronic LBP.

2.4.1.3 COST EFFECTIVENESS

In Oregon, Nyiendo (1991) concluded that workers' compensation claimants with disabling low back injuries attending chiropractors were found to have more treatments over a longer duration and at a greater cost than claimants attending medical physicians with similar presentations. The findings were attributed to: a) a higher proportion of claimants with chronic or recurrent low back conditions in the DC group, resulting in more difficult cases; b) a higher proportion of DC claimants with low back risk factors which may have adversely affected the course of recovery (obesity, extremity syptomatology, exacerbation); c) differences in age and gender of DC and MD claimants; d) differences in treatment philosophy and therapeutic modalities employed; and e) the reimbursement permitted under Oregon workers' compensation law.

Simarily, Carey et al. (1995) found that among patients with acute LBP, the outcomes were similar whether they received care from primary care practitioners, chiropractors, or orthopaedic surgeons. The mean total estimated outpatient charges were highest for the patients seen by orthopaedic surgeons and chiropractors and were lowest for the patients seen by health maintenance organizations and primary care providers. Satisfaction was greatest among the patients who went to the chiropractors.

Smith and Stano (1997: 5-10) concluded that patients who "cross over" between providers for multiple episodes of LBP are more likely to return to chiropractic providers. Their analysis confirms earlier findings for the cost-effectiveness of chiropractic care and suggest that a higher retention of chiropractic patients across multiple episodes, probably resulting from greater patient satisfaction, may result in a long-term "shifting" phenomenon of chronic, recurrent cases to chiropractic care.

Manga et al. (1993a) suggest that chiropractic management of LBP is more cost effective than medical management although most studies reviewed suffered from one or more design shortcomings. The literature showed savings came from fewer and lower costs of auxiliary services, fewer hospitalizations, and a significant reduction in chronic problems, as well as in the level and duration of disability. Workers' compensation studies reviewed reported that injured workers with the same specific diagnosis of LBP returned to work sooner when treated by chiropractors than by physicians, which leads to reductions in direct and indirect costs.

In Sweden, Skargren et al. (1998: 1875-1884) compared chiropractic and physiotherapy as primary treatment for patients with back and neck pain, with special reference to subgroups, improvement in health, recurrence rate, additional health care use and cost at follow-up evaluation 12 months after treatment. The findings were similar to previous studies: no differences were detected between the total population, but some differences were seen according to subgroups. According to the subgroups, patients with acute uncomplicated problems gained more from chiropractic than from physiotherapy at the same cost. On the other hand, patients with more chronic problems gained more from physiotherapy, and the average direct cost tended to be lower for physiotherapy for two of the subgroups (patients with similar problems previously and an Oswestry score of less than 40% at entry). Nearly 60% of the patients reported two or more recurrences, with more patients in the chiropractic group (59%) than in the physiotherapy group (41%) seeking additional health care. As back pain is typically a recurrent condition, long-term follow-up studies were recommended to assess the efficacy of SMT in patients with LBP in terms of costs to society.

Manga (2000: 120) noted that despite the recognition and acceptance of chiropractic care by the public, the lack of insurance coverage and high out-of-pocket payment could be a major deterrent to the use of chiropractic services. It was stated that 70% of the expenditure of non-medical care was borne by the patients themselves, with insurers and governments paying the remaining 30%. In contrast, only 17% of the total medical services expenditure was paid out-of-pocket. He further believes that chiropractic care is *own-labor* intensive (i.e., hands on therapy) and the cost is inclusive and accurate whereas, medical management is more complex and costly (medication, referral to specialists and physiotherapists, diagnostic tests, diagnostic imaging, and sometimes hospitalization). By not fully integrating chiropractic into the health care system, Magna (2000) feels that patients are steered toward medical doctors, often resulting in higher costs and possible sub-optimal health outcomes.

2.4.1.4 SAFETY

Whilst Twomey and Taylor (1995: 618) mention that there are recorded instances of mortality and morbidity associated with cervical manipulation, lumbar spinal manipulation appears to be relatively benign. There were recorded instances of increases in LBP and functional disorder after lumbar manipulation, and rare cases of disc herniation. Most complications follow poor diagnosis that misses conditions such as spinal osteoporosis, fracture, or a bony tumour where lumbar manipulation is potentially very dangerous.

A survey by Dvorák et al. (1993) of all members of the Swiss Medical Association of Manual Medicine was undertaken for the year 1989. Informative data was given by 425 respondents on the frequency of complications of manipulation as related to the spine. One hundred and seventy-five patients (ratio 1:1,955) reported a transient increased pain immediately after the manipulation of the lumbar spine. Seventeen patients (ratio 1:20,125) presented, in addition to increased pain, a transient sensorimotor deficit with precise radicular distribution. The average age of those patients was 44.6 years (range 32-58 years). Nine of the 17 patients (ratio 1:38,013) developed a progressive radicular syndrome with sensorimotor deficit and radiologically verified disc herniation and had to be referred for surgery. All patients except one recovered completely after surgical intervention. The majority of patients confronted with a radicular syndrome after manipulation are patients with chronic or recurrent low back pain, in some cases successfully treated for acute exacerbations over the years with manipulation.

According to a study by Senstad et al. (1996: 444) examining the predictors of side effects to SMT, women were more likely to report unpleasant reactions and were more susceptible to local and radiating reactions after treatment to the lumbar spine. The greatest number of reported reactions per area treated was for the thoracic spine and the lowest for the lumbar spine. They found that the common reactions (local discomfort, radiating discomfort, headache and fatigue) could be predicted to some degree.

2.4.1.5 CONTRAINDICATIONS

Cassidy et al. (1992: 283) believe that the relative contra-indications may call for a modification of techniques and are case dependent. These conditions include: osteopenia, spondyloarthropathies, patients on anticoagulant medication, bleeding disorders and psychological overlay. In the presence of an absolute contra-indication such as: destructive lesions of the spine, ribs, and pelvis, healing fracture or dislocation, gross instability, cauda equina syndrome, large abdominal aneurysm and visceral referred pain however, no manipulative therapy should be employed under any circumstances.

2.4.2 MAGNETIC THERAPY

2.4.2.1 BIOENERGETIC MEDICINE

Dr. Zimmerman (1991: 14), president of the Bio-Electro Magnetics Institute of Reno, Nevada, explains that in conventional science, the term biomagnetism refers to the weak magnetic fields produced from and emitting from biological systems, and the term magnetobiology refers to the study of the effects of magnetic fields upon living systems. Bioenergetic medicine is described by Stefanatos (1998: 228) as the study of human and animal bodies as dynamic electromagnetic fields, existing in an electromagnetic environment - the universe. Although biomagnetic therapy is not new, Null (1998) states that it is becoming one of the most promising new therapeutic interventions today.

Stefanatos (1998: 228) states that the scientific search for the human subtle energy system has been intensive, although the evidence has often been elusive and experimental efforts have been frequently clouded with controversy and inconclusive. An "energetic force" creates order in living systems and constantly rebuilds and renews cellular components. When the "energetic force" leaves the body at death, the physical body slowly decays and becomes a disorganized collection of chemicals and molecules. The "energetic force" is the unique feature distinguishing living from non-living systems and people from machines, although they still require electricity to function. Energetic concepts of medicine have been described in all traditional medical philosophies throughout the world. In traditional Chinese medicine, the primal energy is known as *Qi* (also *Chi* or *Ki*) or life energy force. In Ayurvedic medicine, it is commonly called *Prana*; in homeopathy, it is known as the *Vital force* and, in chiropractic, the *mental impulse* or *innate intelligence*. Stefanatos (1998: 228) proposes that the principles of energy medicine are based on Einstein's theories of quantum physics, and that these energetic concepts are being integrated into medicine for a comprehensive approach to disease diagnosis, prevention, and treatment. Einstein's equation of $E = mc^2$ explains that mass and energy are interchangeable; matter being a concentrated form of energy.

Washnis and Hricak (1993:95) state that biological energies come from a variety of sources including: air we breathe, food and water through the digestive system, sleep that recharges our negative ions, absorption of the Earth's magnetism and, piezoelectric energy from bone stress and exercise. Human cells oscillate and resonate with the background 7.8-cycle-per-second hum of the earth's magnetic field (which is located in the mid-alpha-theta brainwave range, a frequency associated with relaxed waking consciousness and creative reverie or daydreaming). Gerber (2000: 306) agrees that our cells are attuned to this magnetic background rhythm and, perhaps the "earth hum" acts as an "inner timing" rhythm to the direct current (DC) electrical-control systems of the body as described by Dr. Becker, an orthopaedic surgeon and a pioneer of electromagnetic medicine. It has been noted that the system had its own oscillating circadian rhythm, which seems to have been tied to planetary geomagnetic rhythms and solar magnetic activity. Brennan (1993: 17) reports that Hiroshi Motoyama of Tokyo, founder of the International Association for Religion and Parapsychology, has electrically measured the state of acupuncture meridians and uses the results to diagnose for acupuncture treatment.

Gerber (2000: 300, 302) reports that a few researchers have actively sought out evidence supporting the idea of the possible subtle magnetic connection to health and illness. For example, in 1959, Dr. Marcel Poumailloux, a French physician, and Dr. R. Viart, a meteorologist, found a correlation between increases in heart failure, solar activity peaks, and periods of agitated geomagnetic activity. They pointed to an increased tendency towards blood-clot formation during times of maximal solar and earth magnetic activity. Dr. Robert Becker (1987: 244), working with psychiatrist Dr. Howard Friedman, found that there were more admissions to psychiatric wards and more psychotic behaviour among inpatient schizophrenics and manic-depressives during active magnetic storms, a phenomenon frequently associated with abnormal geomagnetic patterns. Becker (1987: 250) suggested that energy cycles in the solar system might affect life on earth and the outbreak of disease. For example, the last six peaks of the eleven-year sun spot cycle have coincided with major flu epidemics. In addition, he mentions a study by a Soviet group, under Yu. N. Achkasova at the Crimean Medical Institute, working with astronomer B.M. Vladimirsky of the Crimean Observatory, who found that *Escherichia coli* bacteria grew faster when the sun's field was positive and slowed down when it was negative.

Later Becker (1987: 244) recognized that this ability of magnetic fields to alter activity within the nervous system might translate into potential therapeutic benefits. Becker studied different aspects of human and animal physiology with an eye toward better understanding how certain control mechanisms and healing systems within the body may be energetically based as opposed to being strictly biochemical in nature (Becker and Snelden 1985, Gerber 2000: 304). In his experimental work, Becker (1987: 245) found slowed reaction times in humans and a generalized stress response in rabbits exposed to fields ten or twenty times the normal strength of the earth's field and, was able to induce complete anesthesia in a salamander using only magnetic fields. Gerber (2000: 304) mentions that Becker is best known for his work using electrical and electromagnetic fields to stimulate the healing of broken bones.

Apart from behavioural changes and pathological alterations in cardiovascular function, Gerber (2000: 302) believes abnormal geomagnetic activity may even contribute to certain degenerative and inflammatory diseases, such as arthritis and cancer. Similarly, Coghill (1998) agrees that before thunderstorms the atmosphere contains a larger number of positive ions, where arthritic patients claim they can sense the oncoming storm 'in their bones' as their joints begin to ache. It is of his opinion that aches and pains, especially LBP, is a reflection of impoverished oxygen delivery coupled with a low negative ion atmosphere. Coghill (1998) goes on to state that as all chemical reactions rely on exchanging electrons, so there are inevitably subtle electromagnetic fields emanating from any living creature generated by the chemical reaction within the cells and the ionic currents in the nervous system.

Everyday electrical devices create magnetic fields as does the electrical wiring and the power lines that supply them. Gerber (2000: 293) cites that Dr. Nakagawa suggested that time spent in buildings and cars reduced the exposure to the natural geomagnetic fields of the earth and interfered with health. This condition, which he called magnetic field deficiency syndrome, can cause headaches, dizziness, muscle stiffness, chest pain, insomnia, constipation, and general fatigue. In general then, magnetic changes in the environment are believed to affect the electromagnetic balance of the human organism and contribute to disease. However, Gerber (2000) does suggest that magnetic therapy can be used to counter the effects caused by the electromagnetic pollution in the environment.

2.4.2.2 ESTABLISHED LAWS OF MAGNETISM

Earth has been described as a huge magnet with its poles approximately at the North and South geographical poles. When a bar magnet (compass) is suspended within the Earth's magnetic field, the end that points to the earth's North pole is designated as the north pole of the compass, the other end is its south pole. More correctly, Norris (1995: 10) indicates that these magnet poles are called the north-seeking and south-seeking poles respectively. The end of the magnet pointing North is actually south, or the positive polarity being attracted by the North pole. Washnis and Hricak (1993: 182) point out that direction in itself is of no consequence, what is significant is whether a particular side of the magnet is negative (north) or positive (south). A magnetometer should be the standard method of determination.

Hudson and Hudson (1998) define magnetism as the alignment of magnetic, or permeable material so that the molecules face in a uniform direction (i.e. north/ negative facing one direction, and south/ positive facing the opposite direction). The primary law of magnetism states that opposite poles attract and similar ones repel. Both the composition and size of the magnet affect its strength, or intensity of field. Magnets exhibit lines of force emanating from the surface and can be measured and quantified in units of *gauss*. Hudson and Hudson (1998: 276) propose that these lines of force flow from negative to positive, showing the strongest magnetic field near the end points and least at the center, where the two fields are the closest.

Hudson and Hudson (1998) point out that the first magnets found were naturally occurring loadstone, or magnetite rocks. Of all the 92 elements known, only iron, cobalt, and nickel are affected by magnetic fields however, a number of alloys, or combination of materials, also display magnetic characteristics. Static, or permanent magnets, are manufactured from a combination of neodymium, ceramic, aluminum, nickel, iron, and cobalt. Ceramic or ferrite magnets are made from barium-ferrite and strontium-ferrite powders that are compressed together, fired and then magnetized to hold a permanent magnetic field. Those made of neodymium, iron and boron generally have a higher gauss rating.

The molecular theory of magnetism states that no matter how many times a magnet is divided, it will always present a north and a south pole. Null (1998: 4) suggests that this phenomenon could be carried on down to molecular level, giving so-called 'molecular magnets'. In a non-magnetized state, the molecular magnets are arranged in a haphazard way and cancel out one another's effects. In a magnetized state, the molecular magnets are ordered so that one end exhibits a negative pole and the other a positive pole.

The two classifications of magnets used in therapy are pulsed electromagnetic field (PEMF) magnets and permanent/static/fixed magnets, which can have a unipolar or bipolar configuration. The difference between the two is explained by Null (1998) in that a fixed magnet emits a magnetic field, while electromagnetic apparatus gives off an electric field, magnetic field and electromagnetic radiation. An electric field is measured in volts per meter or volts per centimetre, and a magnetic field, which is measured in units called teslas, or gauss. One tesla equals 10, 000 gauss.

2.4.2.3 THE ORIGINS OF MAGNETIC HEALING

Hudson and Hudson (1998:277) believe that Magnetic therapy could be one of the oldest forms of physical therapy known. Whilst the earliest reference date from 2800BC, the first direct reference to magnets in medicine occurs in the *Yellow Emperor's Book of Internal Medicine*, in 2000 BC. In addition to using needles and moxa, lodestones were placed over acupuncture points to assist in balancing the meridians. Cleopatra (69-30 BC) reportedly used magnets to offset the effects of old age.

In the mid-1400s, alchemist and physician Paracelsus, is credited as being one of the first to argue the miraculous healing powers of magnets and postulated that the earth itself was a great magnet. Gielow (1981: 35) stated that Paracelsus believed all matter, organic and inorganic, to be endowed with its own spirits and, that a "magnetic field" exuded from people which could be guided by their wills, influencing the minds and bodies of others. Livingston (1996: 203) highlights that, although controversial in his time, many physicians and healers of the ensuing centuries were strongly influenced by Paracelsus's writings. Gerber (2000: 288) reports that Paracelsus not only advocated magnets for healing specific disorders but also detailed the different healing effects of the north and south polarities on living systems.

Hudson and Hudson (1998) point out that magnetic medicine became more scientific and less astral when William Gilbert, the physician to Queen Elizabeth I, wrote *De Magnette* (1600). Gilbert distinguished magnetism from electricity and also described the Earth as a huge magnet that caused a compass to point north. A near contemporary of Gilbert, Luigi Galvani (1737-1798) concluded from his practice as an anatomist and obstetrician that biologic electricity is the vital energy force in living beings. Livingston (1996: 211) reports that in eighteenth-century England, Gowen Knight (1713-1772) developed permanent steel magnets stronger than lodestone. Knowledge of Knight's magnets reached Father Hall, a Jesuit priest and Professor of Astronomy at the University of Vienna who claimed many successes in treating patients with steel magnets shaped to conform to the size of the organ or external anatomy.

Gardner and Mosby (2000: 233) state that the theory of magnetic healing evolved from the work of Franz Anton Mesmer, M.D., whose 1776 doctoral dissertation discussed the "laying on of the hands" and the use of magnetized iron rods to increase the vital forces believed to be depleted in the sick. He hypothesized that both nerves and cells conducted "*fluidum*" to all areas of the body, revitalizing the body's organ systems. Mesmer believed that illness and disease was a result of disharmony in the body's magnetic field and that recharging and re-balancing of the body with "*fluidum*" was essential to healing. Livingston (1996: 207) states his theory was discredited but nevertheless, his practice methods flourished throughout the European continent. It was not until 1831, the French Academy of Science once again looked into Mesmer's work and found that it was convincing. Although his work was never highly regarded, the ideas presented were simply ahead of the time, and he should be credited with the first plausible theory for the existence of the "human subtle energy field".

Gerber (2000: 290) notes that Samuel Hahnemann, the developer of homeopathy, experimented with magnets for healing and advocated the use of magnets for treating a variety of health disorders. While the use of magnets for healing began to grow throughout Europe, interest in magnetic therapies began to rise in popularity in the United States as well. Gielow (1981: 41) reports that in 1839, Charles Poysen introduced magnetic healing to the United States where it became widely practiced and even licensed magnetic healers as professionals in a few states (Iowa not included). Gardner and Mosby (2000: 234) confirm that the practice of magnetic healing (evolved from the work of Anton Mesmer) was popular in the Midwest in the second half of the 19th century, when both A.T. Still and D.D. Palmer were developing their healing techniques. Magnetic healing held the theory that the magnetic healers body was positive and the sickness negative, and that the magnetic healer could detect areas of inflammation and draw the sickness out of the patient by passing their hands over the surface of the patient's body.

Becker (1987) described how biology settled into its "final paradigm" around the turn of the nineteenth century, all functions of living things, from the production of energy to the processing of information in the nervous system, could be reduced to chemical reactions. Stefanatos (1998) mentions that scientists focus on the microscopic, micromolecular mechanisms behind disease causation. Dissatisfied with the prevailing reductionism of Western medicine, many scientists have begun to seek a holistic approach.

Because science and medical technology have developed more sophisticated instrumentation, Stefanatos (1998) feels that the existence of bioelectricity and electromagnetic fields has been scientifically validated. Modern medicine currently uses energetic concepts for diagnostic investigations, such as: electroencephalograms, electromyograms, electrocardiograms, nuclear magnetic resonance studies, and for treatment, such as: pulsed electromagnetic field therapy (PEMF), short wave diathermy (SWD), transcutaneous electrical nerve stimulation (TENS), interferential current (IFC), acupuncture, homeopathy and therapeutic touch. Washnis and Hricak (1993) mentions that the application for diagnostic purposes has convinced the FDA (1989) to declare magnetism in human diagnosis and therapy as "not essentially harmful," leading to further study and trials in medical magnetism without the need of additional toxicity evaluation. The electrochemical processes of the body are extremely complex and incompletely understood, but Livingston (1996: 217) states that the effects of magnetic fields cannot be ruled out.

2.4.2.4 MAGNETIC FIELD THERAPY

Magnets are an everlasting source of an invisible but poorly understood force however, Hudson and Hudson (1998: 275) report that the application of magnets to the body has been used for centuries as a cure for a variety of illnesses and has had a recent resurgence as a safe, and inexpensive method that produces positive results without harmful side effects. Rinker (1997: 23-25) believes the use of an external magnetic source helps the body in the healing process, alleviating the need to deplete its own energy resources.

Gerber (2000: 309) states that to understand the effects of magnetic fields on the multidimensional human beings, we need to observe the human being from a biochemical and bioenergetic perspective. Gerber (2000: 308) proposes that the capacity of magnetic fields to alter nerve cells membrane polarization, as well as changes within the DC bioelectrical current flow control system to produce anaesthesia and decreased pain sensitivity, may provide an important clue as to why magnets can relieve different kinds of pain. Hudson and Hudson (1998: 278) explain that all cellular actions and interactions begin with the organization and behaviour of atoms and molecules. Atoms that take on a negative or positive charge, becoming ionised, and are claimed to be the basis of action in magnetic therapy. Burkhart (2000: 564) hypothesises that the principal site of biophysical interaction leading to cell functional alterations with magnets is most likely the lipid membrane surface, where electromagnetic radiation may affect the ability of ion pump enzymes to move calcium, sodium, and potassium ions across the cell membranes.

Gerber (2000: 316) cite that investigators of magnetobiology, Davis and Rawls, found that positive magnetic fields stimulated biological activity in both plant and animal cells, accelerated growth rate and cause the tissues of the body to become more acidic in nature. Conversely, the negative magnetic field was found to have an inhibitory or relaxing effect upon biological activity and was more alkalizing in nature. Furthermore they found both pain and localized tissue swelling to decrease after negative magnetic field application for thirty to forty minutes once or twice a day.

An Amway Web site (2002) claim magnets and electromagnetic therapy devices are used to eliminate pain, facilitate the healing of broken bones, boost immune systems, relieve diabetes symptoms and counter the effects of stress and depression. Washnis and Hricak (1993: 159) believes temporary pain relief can come about from locally applied, short-term use of static magnets to treat a singular problem, while long-term healing is more likely to come about through the attainment of physiological (pH) balance from full body therapy with magnetic beds or magnetized water.

2.4.2.5 METHODS OF STATIC MAGNETIC THERAPY

The effectiveness of magnets is related not only to the assembly of blood vessels, but quite explicitly to the pole used, gauss strength, penetration depth, and the volume of tissue covered. Magnets are available in numerous sizes, shapes, strengths, and polarity arrangements. The most appropriate magnet for the particular illness should be used; on the other hand, almost any gauss strength utilizing negative polarity can be applied without fear of harm. Dr. Philpott (1990) feels that some trial-and-error is necessary as it is difficult to predict precisely when symptom relief might take place. Washnis and Hricak (1993: 201) believe it depends on the patient's individual constitution, overall state of health, and the type and extent of illness.

2.4.2.5.i Appropriate Pole: negative, positive or both

To demonstrate that increased negative magnetic fields are relayed to the site of injury, Washnis and Hricak (1993: 192) cite a study by Dr. Dean Bonlie. The palm of a subject's hand and wrist was measured with a magnetometer, indicating a negative field of 210 milligauss. He then pinched the palm with a toothed clamp that immediately changed the field to 40.00 milligauss at the point of injury. After 20 minutes, the clamp was removed and the wrist was found to have increased its negative field from 210 to 400 milligauss, which would indicate a biofeedback effect from the brain sending increased negative field currents toward the injured site. After approximately one hour the point of injury had returned to a normal magnetic field reading again. Dr. Bonlie repeated this procedure using a 1-inch diameter x ¼ inch thick neodymium disc placed in the palm with the positive side to the skin to stimulate injury. When the magnet was removed after at least 20 minutes, there was a 52% (150 millgauss) increase in the negative magnetic field at the wrist, which gradually declines over a period of three hours.

Washnis and Hricak (1993: 181) explain how Becker (1961) demonstrated, by use of a magnetometer that a broken bone initially registers electrically positive for about three hours, then becomes electrically negative. He then found that weak electrical currents promoted the healing of broken bones and concluded that the neuroepidermal junction was the source of the negative DC current that stimulated regeneration.

Washnis and Hricak (1993: 181-2) agree with Dr. Philpott (1990) that the negative polarity is a more appropriate field to use as it mimics the action of the brain when it feeds negative energy to the site of injury. Washnis and Hricak (1993: 180) report that most practitioners' claim that the negative polarity helps to normalize metabolic function, has an alkalising and oxidizing effect and, is generally calming. In contrast, the positive pole encourages strength and life in all living systems, including microorganisms, has a stress effect, and with prolonged exposure interferes with metabolic functioning, produces acidity and, reduces cellular oxygen supply. They concluded that the positive pole should therefore be used with caution. Dr. Philpott (1990) believes that the short use of a positive polarity followed with a longer negative application will prevent abnormal cell stress and achieve a balance however he also states that it is sometimes unnecessary to use both poles, and that the negative pole is sufficient and preferred. Philpott (1990: 6) and Norris (1995: 18) provide a compendium of the effects the negative and positive fields of the magnet have on the body (refer to APPENDIX M)

According to Dr. Philpott (1990: 26), when bipolar magnetic fields are used simultaneously and are overwhelmingly high gauss positive, therapy is acidifying to the tissue, and less oxygen is carried in the blood. He claims the use of the negative polarity alone would be effective as it is alkalising – normalizing the pH of the blood and tissues and allows immediate therapy on both swollen and bleeding parts. Philpott believes that negative magnetic fields aid in reducing fat and calcium deposits in the circulatory system by normalizing the acid-base balance (pH) of undesirable cholesterol and triglycerides that adhere and build inside artery walls.

Washnis and Hricak (1993: 191) say that for certain types of ailments some initial stimulation with the positive polarity may be necessary in order to "turn on" the system or hasten results. The positive field, as reported by Davis and Rawls, when used under proper time limitations is beneficial for: biofeedback central nervous system response testing; stimulating wakefulness;

stimulation of specific organs and glands to evoke production of hormones or enzymes and evoking production of endorphins.

In treating LBP, Fred Rinker (1997: 60) recommends using a North/negative pole magnet for pain control on any new injury and believes a chronic injury responds to South/positive pole stimulation once healing has begun. Alternative pole magnetic pads are recommended if the muscles are affected.

Washnis and Hricak (1993: 190) claim bipolar and single pole magnets can be used safely and effectively when applied locally with the proper gauss strength but for long-term application, higher gauss strength can be used safely with the negative polarity. If results are not forthcoming, stronger or heavier magnets, or an extended period of use may be in order. Stress may occur with the positive field but is limited since the body acts in a counter-irritant function by signaling the brain to send negative magnetic energy to the injured site to relieve symptoms. Importantly, the body is limited as to how long it can keep up this reflex response, usually for about eight weeks when the counter-irritant effect wears off and symptoms return. The subject is advised to go off the therapy to rest the body.

Dr. Zimmerman, (Amway web site 2002) states that no scientifically designed, double blind, placebo-controlled studies have been done to substantiate the claims of there being different effects between positive and negative magnetic poles.

2.4.2.5.ii Configuration and Placement

Washnis and Hricak (1993: 189) state that magnets mathematically configured so that lines of force are at right angles to blood vessels logically affect more blood vessels, and have been hypothesized to be more effective. Alternating north/south polarities in either bipolar, concentric rings or checkerboard type patterns in a single magnet were designed mainly to influence ionic currents in blood vessels when crossing from one magnetic pole to another. They also believe alternating polarities are not as powerful as simple north or south bar magnets as one field cancels the other and leads to an overall reduced magnetic field.

When using one polarity, Rinker (1997: 42) describes the *opposite pole feed* as the natural effect of the opposite magnetic field appearing between multiple magnets. To obtain a uniform field, Null (1998: 18) explains that the space between the individual magnets, and the magnet and person need to be a certain distance apart and, that the pad should be larger than the area being treated.

Magnetic treatment is a non-invasive external treatment usually localized at the point of the ailment. Hudson and Hudson (1998: 288) mention the use of magnets in conjunction with acupuncture points, in which the magnet becomes the focal point for extended stimulation. He describes use of disk magnets less than 1 cm in diameter applied to the point with sticking plaster. For extended application, the most common dosage is 500 to 1500 gauss to treat either *ah shi* points or traditional acupuncture points. Magnets are typically placed as close to the injured tissue as possible and attached with Velcro straps or plaster.

Hudson and Hudson (1998: 288) state that when static magnets are worn for days or weeks, at some point, the magnet ceases to assist in the healing process. To obviate the concern about adaptation, some practitioners recommend applying the magnet for 10-20 minute periods at daily intervals until the ache or swelling disappears. Philpott (1990) reports that pain relief will last progressively longer as treatments, lasting 15 to 30 minutes, continues. However, Collacot et al. (2000: 1323) state that the length of time the magnets must be worn has not been established although it was cited that Vallbona et al. (1997) reported pain relief from a 45-minute application when treating postpolio muscle pain, while Weintraub (1999) suggested continuous treatment when treating diabetic polyneuropathy.

2.4.2.5.iii Strength of the magnet

Stefanatos (1998) found in his review of literature that for healing purposes 800 to 1,000 gauss is usually sufficient although Washnis and Hricak (1993: 200) found that therapists generally agreed that 1000 to 3000 surface gauss strength could be applied to large muscles or severe, chronic ailments. A 500 gauss is more appropriate for delicate parts like the eyes, ears, nose, throat, etc., although relief from aching large muscles comes at lower power levels, as well. Washnis and Hricak (1993: 177) report that the Japanese Ministry of Health and Welfare set a standard of 500 gauss minimum in the use of magnetic devices, which they believe is necessary to reach reasonable relief of pain and healing.

In a study on the effectiveness of bipolar permanent magnets for chronic LBP, Dr Collacott and colleagues (2000) used magnets with a manufacture's reported gauss strength of 450 gauss +/- 50 gauss. An average of multiple measurements at different points on the cloth side of the magnets was 300 gauss.

Washnis and Hricak (1993: 191) state that the field strength (or the manufacturer's surface gauss value) decreases by one third when measured away from the surface of the magnet. Washnis and Hricak (1993: 200) also point out that the depth of penetration is in direct relationship to the physical size (mass) of the magnet as well as gauss power – the larger the size, the deeper the penetration. For example, a small round neodymium magnet, even though

12 300 gauss, penetrates only two to three inches into the body; whereas, a 4x 6x 0.5 inch magnet of 1 000 gauss penetrates completely through the body or about 17 inches. Hudson and Hudson (1998: 276) indicate that this is important when considering the depth of penetration of a magnetic field into tissue.

Washnis and Hricak (1993: 188) indicate that deeper disorders may require a heavier and stronger magnet. A steel backing can provide increased strength and penetration by reflecting the magnetic field. However, penetration is primarily related to weight. The larger and heavier the magnet, the deeper the magnetic field penetrates into the tissue. A thin magnet of extra-high gauss strength will not penetrate as deeply as a thick, lower strength magnet, although the thin bipolar magnet will most likely turn on the biofeedback effect more quickly because the body is dealing with a smaller irritant factor (less tissue volume). In a thin bipolar magnet, lines of flux are drawn horizontally to each other across the face of the magnet rather than inward toward the body tissue, resulting in diminished penetration.

2.4.2.6 EFFECTIVENESS

Null (1998) estimates 85 to 90% of the scientific literature is on pulsed bioelectro-magnetic therapy and Hudson and Hudson (1998: 286) noted that pulsing magnetic fields had received more interest and attention by researchers that included both in vivo and in vitro research. Although static magnets are widely used by millions of people, no double blind studies demonstrate the effectiveness of magnets in the treatment of injury or illness and only a handful of studies demonstrate that magnets produce biological effects. Null (1998: 1) points out that since a positive result from pulsed bioelectric magnets cannot be automatically translated to a positive result from a fixed magnet, there is a need for more studies in the area of fixed magnets. There are different schools of thought on the essential mechanisms of magnetic therapy, centered on the question of polarity and strength of field. A large double blind study using magnets is unlikely to be funded without a commercial interest however, a handful of studies demonstrate that magnets do produce biological effects.

Research continues to elucidate the mechanism of action and the effects of dosimetry however monitored physiological results are valuable to the growth of knowledge. Studies on PEMF demonstrating their effectiveness are useful as they contain summaries of the work that has already been done and they provide a basis for further research. Collacot et al. (2000) point out however that the magnetic field from permanent magnets is a static field and is not the same as electromagnetic radiation.

Physicist and psychologist, Dr. Buryl Payne cites documented changes to the body that includes electricity generated in the blood vessels, increased ionizing of particles in the blood, excitation of autonomic nerves, and improved circulation. The effect magnetic fields have on living organisms are summarized as follows:

1. increased blood flow with resultant increased oxygen-caring capacity, both of which are basic to helping the body heal itself.
2. changes in migration of calcium ions which can either bring calcium ions to heal a broken bone in half the usual time, or can help move calcium away from painful arthritic joints.
3. altering the pH balance of various body fluids which are often out of balance in conjunction with illness or abnormal condition.
4. increases or decreased hormone production from the endocrine glands.

   (Washnis and Hricak 1993: 94).

2.4.2.6.i Circulation

Hudson and Hudson (1998: 284) describe Warnke's (1980) investigation on physiologic effects of PEMFs having a specific pulse form, frequency, and amplitude on humans. He experimented with 50 Hz at a magnetic field range of 6 to 30 gauss. Results were measured via thermography and showed dilation of large and small blood vessels, even when the magnetic field was applied only to the back of the head, with a measurable increase taking place within 3 minutes. About 30% of his subjects showed no thermographic effect from PEMF.

Hudson and Hudson (1998: 285) further noted that besides stimulating local circulation, Warnke documented increased oxygen partial pressures in tissue. The highest measured and reproducible increase in oxygen value found for a given subject (a 25 year old athlete in good health) after 10-minute exposure to the PEMF was more than 1000%. Using the Clark electrode, which measures through the skin of the subject, the average value increase for 58 experiments was about 200% and the effect remained for an individually specific time after the field was turned off. No effect was found in 20% of the subjects. The most effective pulse rate found for increases in oxygen was 21 Hz. These results were confirmed by experiments by Dr. Benjamin Lau (no date) who demonstrated a 1 to 4 fold increase in oxygen partial pressure in 90% of subjects when stimulated with a 12 to 20 Hz PEMF, with no statistically significant increase in heart rate or blood pressure. It was implied that the increase in blood flow was associated with decreased peripheral vascular resistance secondary to dilation of the blood vessel.

2.4.2.6.ii Analgesia

Coghill (1999: 26) states that in 1998, at the bioelectromagnetics annual meeting at St Pete Beach, Florida, Holcomb and McClean reported a study whereby a pepper-based substance was injected into the subjects' skin and then exposed to magnets. Those given the benefit of the magnetic fields were able to withstand the intense irritation far better than the controls.

Hudson and Hudson (1998: 285) cite that Warnke (1980) studied 21 patients with diabetic neuropathy, including results of nerve conduction studied at the end of treatment and 2 months later. Patients rated their symptoms before and after the treatment series and at the follow-up session 2 months later. The study showed significant changes of all symptoms in patients receiving magnetic field treatment, whereas the control group that did not receive the treatment reported no significant changes in pain. Two studies conducted in 1998 and 1999 by Weintaub (2000: 565) using multipolar magnetic footpads (475 gauss) with placebo control for a total of 12 weeks, found a statistically significant reduction of neuropathic pain in 75% to 90% of individuals with severe diabetic polyneuropathy.

Coghill (1999: 26) mentions that Cavapol et al. (1995), of Vanderbilt University working in collaboration with Holcombe Technologies Inc., Nashville, reported that the size of the sensory neuron blocking action depended on the gradient created by arrays of magnets (for example, four centre-charged neodymiums). In their cell culture study two sets of arrays with different field strengths but a common gradient value (about 1mT per mm) had equally effective blocking capability: about 70% of the action potential firings were thereby blocked. The higher the gradient the greater this blocking effect.

Washnis and Hricak (1993: 184) documents Dr. Gerhard Kletter (1990) at The Oberarzt of the Neurosurgical Clinic, Vienna, Austria, conducting a blind test on 40 patients with similar complaints of severe lumbago three months after a disc operation without surgical complications. Twenty patients were treated with bipolar magnetic foils and twenty with non-magnetized foils. Conclusions reached were that magnetic foil had a strong effect on pain, especially in the first weeks of use. After four weeks, four patients who did not receive magnetic therapy were free from complaints while 13 patients treated with the bipolar magnetic foil were free from pain – this is more than three times as many as the control. The study demonstrated that in the case of long-term pain, effects – from substantial improvement of pain symptoms to practically complete freedom of pain – could be observed in about two-thirds of all patients investigated.

2.4.2.6.iii Myotendofasciopathies

Martin and Laser (1992) conducted a double blind comparison of localized, alternating polarity magnetized and non-magnetized foil on 100 patients with secondary myotendofasciopathies. The test population was divided into three groups, namely: vertebral local lumbar pain syndrome, cervical pain syndrome, and periarthritis humeroscapularis. Permanent use of the foil was required for 14 days at which time 43 patients demonstrated unchanged subjective pain sensation, 48 reported reduced pain, and 9 reported increase pain. The study also reported improvement in restricted movement and reduced use of medicines. The best results in reducing subjective pain was with the cervical pain syndrome where 80 % reported pain relief and 60% achieved improvement in movement restriction. Drug consumption was reduced 60% for cervical pain syndrome and for periarthropathy humaroscapularis, and 44 % for lumbar pain syndrome.

Vallbona et al. (1997) used a randomised double-blind, placebo-controlled trial on 50 post-polio patients who were experiencing arthritic joint pain or had identifiable points of pain in their muscles. Patients ranked the severity of pain in the "trigger point" between one and ten before and after a single 45-minute application of low intensity magnets, less than a half-inch thick. A statistically significant improvement in pain was reported with the active magnets.

2.4.2.6.iv Low Back Pain

In a randomised, double-blind, placebo-controlled, crossover pilot study of 20 subjects suffering from chronic LBP, Dr Collacott et al. (2000) found no significant difference in the outcome measures (visual analog scale, Pain Rating Index of the McGill Pain Questionnaire and range of motion of the lumbosacral spine) comparing magnetic with placebo treatments. For each patient, real or sham bipolar permanent magnets were applied, on alternate weeks, for 6 hours per day, 3 days per week for 1 week, with a 1-week washout period between the 2 treatment weeks. The setting was at an ambulatory care physical medicine and rehabilitation clinic at a Veterans Affairs hospital

In reviewing the study, Weintraub (2000: 565) noticed that the study was bias in gender and selection of patients; 19 of 20 subjects (95%) were men, 11 of 20 (55%) were disabled, and 6 of 20 (30%) were retired. Collacot et al. however, did make an effort to exclude individuals who were actively seeking disability payments or involved in litigation. Weintraub (2000: 565) further felt that it was inappropriate to include a diagnosis of fibromyalgia, which is controversial and not accepted by the majority of US physicians. The statement implying that pain was caused by spondylosis is not scientifically accepted because all patients at mean age of 60 years display degenerative bone disease, which is generally asymptomatic. However, Collacot et äl. felt that the pain from spondylosis was well accepted and more so than "failed back syndrome". Weintraub (2000: 565) states that the intervention was weak in influencing 19 years of LBP. Abdominal binders apparently held the device in place, raising issues of slippage of the magnet. The Barium ferrite magnets used by Collacott et al. (2000) had a weak flux density of 300 gauss, which Blechman (2000: 565) highlights as having very low energy products. He states that although Collacot et al. report a single positive gauss value; such magnets generate non-uniform positive and negative gauss readings on the same pole face surface. Furthermore, the opposing polarities curve the field flux lines, reducing the subdermal penetration of magnetic fields beyond the magnetic surface.

2.5.2.7 COST EFFECTIVENESS

Meeker (2000: 123) states that the public uses of complementary and alternative medicine (CAM) grew 25% between 1990 and 1997 from 3.8% to 42.1%. Attitudes towards CAM are changing as reflected by the increased demand and have significant economic implications as the majority of the cost is out of pocket and not covered by medical aid. Lack of usage data, research on efficacy, economic considerations/cost, and insurance reimbursement for CAM are obstacles for integration of magnets into mainstream health care delivery systems.

2.6.2.7 SAFETY

Washnis and Hricak (1993: 142) state that in 1978, the FDA (Food and Drug Administration) formally approved a number of electromagnetic instruments for healing purposes. This legitimacy of magnetic treatment was primarily sanctioned for healing of non-union bone fractures and is a prime reason why this therapy has gained in general acceptance.

The ChiroACCESS (2001) web site reports that, in the 1997 Science Forum Abstract, No.J-4, the FDA recommended specific magnetic field strengths as unsafe. Research studies have demonstrated that high-level magnetic fields (50mT) exposed for an hour will stimulate growth in some cancer cells. There have been other potential risks associated with magnetic fields. The gauss rating considered safe in Europe is 300 (or 30mT). In the U.S. the maximum safe gauss rating for magnet therapy is 500. It is further mentioned that the FDA's position is that magnets prescribed to patients for the purpose of affecting their function or to treat a health problem are "medical devices". As there is no scientific basis for claims made, the FDA is enforcing the unsubstantiated promotion and use of magnets and has not approved magnets to be use as medical devices.

Washnis and Hricak (1993: 113) report that in 1991, the OTA (Office of Technology Assessment) stated that "there is now a very large volume of scientific findings based on experiments at the cellular level and from studies with animals and people which clearly establish that low frequency magnetic fields can interact with, and produce changes in, biological systems." This report states that developing nervous systems may by particularly susceptible and effects may be latent, manifested only in specific situations later in time. They acknowledge that ELF (extremely low frequency) fields may have an affect on tumour growth to the extent of altering protein synthesis, immunological and hormone status, and metabolic competence via circadian shifts. These fields also depress pineal melatonin associated with cancer growth, and show a weak association to nervous system cancer and leukemia.

Dr. Shimodaira (1990) studied the therapeutic and physiological effects of the *Magnetized Health Mattress* (Nippon Athletic Industry Co., Ltd) conducted on 431 people seen in three Japanese hospitals in a double-blind test, with 375 using magnetized mattresses and 56 with non-magnetized mattresses. The magnetized mattresses used 104 magnets each of 750-950 gauss surface strength (which translated into approximately 10-20 gauss within the body).

The conclusion was that the magnetized mattress proved to be effective in high percentage of cases and with no adverse side effects, as measured by blood and urine tests, within the testing period ranging from 2 to 6 weeks. As there is no potential for thermal, chemical or electrical injury when using permanent magnets, they are safe to use whilst sleeping.

Coghill (1998) says that the UK's National Radiation Protection Board found that there did not appear to be any health risk below 2 Tesla, but to be on the safe side they recommended an exposure limit of one tenth of this value, namely 200 milliTesla (2000 gauss) averaged during any 24 hour period. Application of a 400-milliTesla-neodymium magnet for eight hours nightly would therefore fall below their recommended limits. He also mentions that in the literature searched, no adverse effects were reported from exposure to static magnetic fields. The appropriate size magnet for the particular ailment, the proper polarity and, time frame should be observed.

2.5.2.8 CONTRAINDICATIONS

Philpott (1990:27) reports that no adverse side effects have been observed with negative magnetic energy. However, since negative magnetic energy pulls additional fluid into an enclosed area, such as a joint or other encapsulated area (knee cap, sinuses, eyeball, etc.), pain can increase if direct application is made to an area already full of fluid with no drainage capacity. He recommends moving the magnet two to three inches to pull fluid away from the affected area.

Philpott (1990: 27) cautions against the use of magnets on: the abdomen during pregnancy or near a pacemaker or defibrillator. A magnetic bed must not be used daily for 24 hours if ill as the adrenal function may be suppressed causing slow energy recovery. A magnet must not be used on the abdomen 60 to 90 minutes following meals in order to allow peristalsis to take place. The positive field should only be used under medical supervision because it can over stimulate brain activity, producing seizures, insomnia, addiction, hyperactivity, and hallucinations.

Null (1998: 14) warns that the use of the positive pole, bipolar magnets and positive PEMF on cancerous growths, acute viral and bacterial infections is contraindicated. There are still concerns that since improved blood flow is a consequence of exposure, the use of magnetic products is contraindicated in open injuries, pregnant women, by hemophiliacs, or by those undergoing invasive surgery. The common practice of using RICE (rest, ice, compression and elevation) still applies to acute injuries and medical consultation is advised for chronic ailments.

Precaution must be taken with magnets near video and camera film, cassette tapes, computer discs and bank cards as the field will damage them.

CHAPTER THREE

3. MATERIALS AND METHODS USED

3.1 THE OBJECTIVE

The purposes of this study was to objectively and subjectively evaluate the relative effectiveness of static magnetic therapy versus a placebo, as an adjunct to Spinal Manipulative Therapy (SMT) in the management of mechanical Low Back Pain (LBP).

3.2 THE PATIENTS

The study was limited to 60 patients, aged between 18 and 60 years, who resided in the province of KwaZulu Natal. Patients were recruited by advertisements, requesting participation in the free clinical trial of low back pain treatment at the Natal Technikon Chiropractic Clinic. Notices were placed in local newspapers, on pamphlets and notice boards at sports centers, technikons and universities. Patients presenting to the Chiropractic Day Clinic with mechanical LBP were also considered. Potential patients were screened to determine if they were eligible for the study and were suffering with mechanical LBP.

Potential candidates were assessed at the initial consultation by means of a case history (Appendix A), the relevant physical examination (Appendix B), and a regional low back and pelvis examination (Appendix C) as according to the protocol of the Natal Technikon Chiropractic Clinic. Patients, who complied with the inclusion criteria for the study, were accepted into the research program. Patients who displayed any of the exclusion criteria were not accepted into the research program. Subjects found eligible for inclusion in the study had the procedure explained and a covering letter (Appendix E) was given to them. Informed consent (Appendix D) was obtained from all patients before inclusion into the study.

The inclusion criteria for the study were:

- Patients having uncomplicated mechanical LBP if they had pain located in the lumbar spine or pelvis area with possible radiations and, no pathological or organic disease and no neurological deficiencies (Walsh 1998: 232).
- Patients suffering from mechanical LBP including Lumbar Facet Syndrome, Sacroiliac Syndrome and Myofascial Pain Dysfunction Syndrome in the lumbar-sacral region (Kirkaldy-Willis and Burton 1992: 291).
- Patients were between the ages of 18 and 60 years. Magna et al. (1993b: 222) states that LBP is most common between the ages of 25 and 55, while the average age for filing a workers' compensation claim fell between 33 and 35 in both Canada and the United States.
- Patients receiving treatment or medication for their current LBP had to undergo a 48-hour wash out period before entering the study.

The exclusion criteria for the study were:

- Patients were excluded from the study according to the following contraindications to SMT (Kirkaldy-Willis and Burton 1992: 291):
  - Osteopenia
  - Spondyloarthropathies
  - Patients on anticoagulant medication
  - Bleeding disorders
  - Perceptible psychological overlay
  - Destructive lesions of the spine, ribs and pelvis
  - Healing fractures or dislocation
  - Gross instability

- Cauda equina syndrome
- Large abdominal aneurysms
- Visceral referred pain

- Patients presenting with hard neurological signs such as loss of sensation, muscle weakness or wasting and loss of reflexes.
- Patients suffering from systemic diseases potentially affecting the musculoskeletal system.
- Patients who had an operation in the treatment region during a six months period preceding the study.
- Patients who had any metallic objects in the lumbar-sacral region (e.g.: prosthesis, intra uterine device).
- Patients who use a pacemaker or defibrillator.
- Patients who were pregnant or fell pregnant during the study period.

Patients presenting with Lumbar Facet Syndrome, Sacroiliac Syndrome and Myofascial Pain Syndrome were accepted. Symptomatic joints were identified by motion palpation (Schafer and Faye 1989: 211-216, 256-259) and orthopaedic tests. Trigger points in the lumbar-sacral region (Travell and Simons 1983b: 23-186) were located according to Travell and Simons (1983a: 59-63). Radiographic examination was performed only when indicated by the history and examination findings, to exclude pathology of the lumbar spine and pelvis. Views included anterior, lateral and anterior oblique lumbar spine, lumbar sacral joint and pelvis views.

3.3 PATIENT ALLOCATION

The population size was limited to sixty patients presenting with mechanical LBP who were randomly assigned to either group A, the SMT and Placebo Belt group; or to group B, the SMT and Magnetic Belt group. Each group consisted of thirty patients with five additional patients per group included, to make up for a percentage drop out or non-compliance.

Simple consecutive random allocation of patients was achieved by drawing a number between 1-60 from a hat as they were accepted into the study. Even numbers were designated to the placebo belt group A and odd numbers were designated to the magnetic belt group B. The number chosen by the patient was discarded and the process was repeated until the final patient was allocated the final number. The next person entering the study replaced any patient that dropped out. After the first treatment the corresponding belt was handed to the patient with instructions how it should be worn. The patients were not aware of which treatment group they were placed into.

3.4 TREATMENT INTERVENTIONS

Each patient was treated with SMT a maximum of five times within a two to three week period, with subjective and objective tests being performed before commencing the treatment on the first, fourth and sixth consultation. If patients became asymptomatic and were subluxation free prior to the sixth consultation, they were only required to return for the fourth and sixth consultation for assessment. Belts were given to the patient after the initial consultation to wear at night and they returned them on completion of the study. Patients were requested not to receive any other treatment or undergo any lifestyle changes for the duration of the study.

3.4.1 SPINAL MANIPULATIVE THERAPY

Manipulation was based on motion palpation findings of restricted and/or abnormal motion in lumbar and sacroiliac joint segments. Joint fixations were determined by using the techniques described by Gatterman (1982: 58) whereby palpation of end feel to evaluate joint play and monitoring of separation and closing between contiguous vertebra were found to be both effective. Motion palpation was also used to identify in which plane an adjustive technique should be given to restore maximum joint play to their spine (Shafer and Faye 1989: 211-216, 256-259).

Subluxations were manipulated using the diversified adjusting technique, as described by Szaraz (1990: 137-160). A typical side posture chiropractic adjustment, viz. low amplitude, high velocity thrust, delivered at the point of restriction, in the direction of lost motion. The patient was positioned in a lateral recumbent posture with the fixation side up and the doctor in a square stance facing the patient. The lower limb on the uninvolved side was kept straight as the involved side limb was flexed until resistance was felt. A pisiform or index contact was then taken up on the involved segment, i.e. either on the zygapophyseal joint, spinous process or sacroiliac joint, as the patient's flexed hip and knee was adducted. A fencer's stance was initiated at this point to hold the adducted limb in position. The thrust was then delivered into the direction of lost motion, i.e. either into extension, rotation (contacting the facet joint), or into flexion (inferior aspect of the spinous process), or lateral flexion (lateral aspect of the spinous process) (Schafer and Faye 1990: 222).

The following techniques were used depending on which suited each individual patient best:

- lumbar roll (pisiform-mamillary) (Szaraz 1990: 9.1)
- spinous push/hook (Szaraz 1990: 9.11, 9.12)
- seated lumbar (Szaraz 1990: 9.4)

- upper sacro-iliac joint (flexed innominate) (Szaraz 1990: 9.2)
- lower sacro-iliac joint (extended innominate) (Szaraz 1990: 9.3)

3.4.2 LUMBO-SACRAL BELTS

Thirty placebo and thirty magnetic studies were completed on the patients presenting to the Natal Technikon Chiropractic Clinic. Belts were designed so that there would be maximum magnetic contact over a broad area but minimal support given to the lumbar sacral region. Waddell (2000: 271) suggests that there is no evidence that lumbar corsets or support belts are effective for treating patients with acute LBP and it is therefore assumed that there was no contribution to the results from these belts used in this study. The shape was of a small apron, 26cm by 33cm, worn back-to-front with the front secured by Velcro to suit various sized patients. They were made of light cotton fleece, fifteen with magnets and fifteen with placebo discs sewn between two layers of material. The placebo belts were marked with an A and the magnetic belts with a B. Patients were not told which belt they had received and it was assumed that they would not check for magnetism.

The treatment belts each contained forty ceramic magnets, (15mm diameter x 3mm height) with strength of approximately 550 surface gauss measurements as measured by a gaussmeter obtained from the University of Natal (Bell 1997). The negative pole of the magnet (North Pole) was placed facing the body. The placebo belt contained forty non-magnetizeable metallic discs of the same size as the magnetic discs. The magnets and discs were spaced 25mm apart so that the fields were not repelling each other.

Both groups were instructed to wear the belts for eight hours at night whilst sleeping. The posterior flap was to be flush with the skin so that the negative field was projected to the lumbosacral region. Following the study, the patients returned the belt so that they could be washed and reused for another patient.

3.5 THE DATA

3.5.1 THE OBJECTIVE MEASUREMENTS

The following objective measurements were taken on the first, fourth and sixth consultation:

- An Orthopaedic Rating Scale (Appendix F) to obtain a specific diagnosis and evaluation of the three syndromes involved namely: Lumbar Facet Syndrome, Sacroiliac Syndrome and Myofascial Pain Syndromes (Kirkaldy-Willis and Burton 1992:121-129).
- Algometer measurements to determine the patient's pain sensitivity (Appendix G) (Fischer 1987: 213).

3.5.1.1 The Orthopaedic Rating Scale (Appendix F)

During the orthopaedic low back and pelvis regional examination, the following specific tests were performed and scored similar to Logan (2001: 48) when positive to get a score out of 10 for each syndrome.

Lumbar Facet Syndrome was diagnosed with positive:

- Kemp's test and scored 4 points.

  Kemp's test, as described by Giles and Singer (1997: 346), includes a combination of extension and lateral bending over the facet joints. The examiner reaches around the patient's shoulders from behind and axially compresses the seated patient when in maximal rotation and extension to the right then the left. Gatterman (1990: 141) states that pain in the lumbar region is indicative of a positive test.
- Lumbar facet challenge and scored 4 points.

Lumbar facet joint challenge is performed with the patient prone. The examiner places a thumb on the spinous process tip and pushes medially, varying the force while the spinous process above or below is stabilized. If there is no pain response to gentle pressure the examiner might bounce the joint with a little more force. "Springiness" or joint-play is palpated for to discern the status of the facet joints (Gatterman 1990:49). Dishman (1988: 99) states that a characteristic of loss of joint play is that stressing such a joint causes pain on challenge.

- Prone hyperextension test and scored 2 points.

  Gatterman (1990: 162) describes that lumber facet syndrome pain increases in spine hyperextension. In a prone position, the patient pushes their torso up, keeping the pelvis on the table, and hyper extends the lumbar spine.

Positive Sacroiliac Syndrome was diagnosed with positive:

- Posterior shear test and scored 4 points.

  Posterior Shear Test was applied with the patient supine, the hip and knee flexed and adducted while the examiner applied a force by pushing posteriorly along the line of the femur, thus stressing the sacroiliac joint. Laslett and Williams (1994) describe the test as positive when there is an increase in pain over the sacroiliac joint or a reproduction of the patient's symptoms.

- Gaenslen's test (Magee 1992: 319) and scored 2 points.

  Magee (1997: 446) describes Gaenslen's test with the patient lying supine position with the test hip extended beyond the edge of the table. The patient draws both legs up onto the chest and then slowly lowers the test leg into extension. The other leg is tested in a similar fashion for comparison. Pain in the sacroiliac joints is indicative of a positive test.

- Patric Faber test (Magee 1992: 343) and scored 2 points.

  Magee (1997: 473) describes the Patrick Faber test with the patient lying supine. The examiner places the patient's test leg so that the foot of the test leg is on top of the knee of the opposite straight leg. The examiner then slowly lowers the test leg in abduction toward the examining table, while the opposite hand stabilizes the pelvis at the Anterior Superior Iliac Spine. A negative test is indicated by the test leg falling to the table or at least being parallel with the opposite leg. A true positive test results in the leg remaining above the opposite straight leg. If positive, pain is located over the sacroiliac joint thus indicating Sacroiliac Syndrome.

- Erickson's test - scored 2 points.

  Kirkaldy-Willis and Burton (1992: 125) describes the Erickson's test as being the most specific and reliable test for Sacroiliac Syndrome. With the patient in the prone position, the examiner places one hand under the thigh above the knee on the affected side, whilst the other hand presses down over the crest of the ilium to stress the sacroiliac joint by extending the hip and rotating the ilium. Pain is elicited in the sacroiliac joint when the test is positive.

Active trigger points (TP) in the lumbar-sacral region were identified with:

- Referral of pain and scored 4 points.

  According to Travell and Simons (1983a: 18-21), referral of pain was the most important indicator of this syndrome and can be elicited, or increased on digital pressure on the TP. Travell and Simons (1983a: 13) state that the more hypersensitive the TP, the more intense and constant is the referred pain, and the more extensive is its distribution.

- Local twitch response and scored 2 points.

Travell and Simons (1983a: 16) indicate that snapping palpation of the TP frequently evokes a local twitch response.

- Taut palpable band and scored 2 points.

  Travell and Simons (1983a: 16) state that the TP is found in a palpable band as a sharply circumscribed spot of exquisite tenderness.

- Exquisite focal tenderness and scored 2 points.

  Travell and Simons (1983a: 16) point out that moderate sustained pressure on a sufficiently irritable trigger point causes or intensifies pain in the reference zone of that TP.

To be accepted into the study a minimum score of 6 out of 10 had to be achieved in one syndrome. For a diagnosis of two syndromes, a minimum of 12 out of 20 and three syndromes, 18 out of 30 had to be achieved. The total score for each syndrome was recorded and converted to a percentage on the first, forth and sixth consultation. A change in score gave an indication as to whether there was a change in the patient's condition. The Orthopaedic Rating Scale was statistically analysed as a percentage of mechanical LBP for each patient. This allowed for all 60 patients to be analysed

3.5.1.2 The Algometer Pain Tolerance Readings (Appendix G)

Pain tolerance was quantified as the minimum amount of pressure that induced pain or discomfort on application of the force dial Algometer. The measurements were taken bilaterally on the first lumbar facets and the lumbar-sacral angles (or the fifth lumbar facet) with the patient lying in the prone position. The procedure was explained to the patients who were instructed to indicate when the pressure started becoming painful or unbearable. Perpendicular pressure, applied at a rate of 1kg/sec, was stopped when the level of tolerance was indicated. The force readings were recorded in kilograms per square centimetre (kg/cm^2). Fischer (1987: 213) stated that increases in results are interpreted as positive responses to the treatment intervention.

Fischer (1987: 213) reported on the reliability and the widespread use of the Algometer to assess general sensitivity to pain in normal tissue and quantify tenderness in hypersensitive spots originating from ligaments, tendons, muscles, joint capsules and periosteum. He states that the Algometer has excellent reproducibility and validity to measure pressure sensitivity and to identify aberrant tender areas provides a means of quantifying treatment, so as to identify improvement.

In this study, L1 and L5 were used so as to get a general indication of pain sensitivity over the lumbar region. The exact spot of maximal tenderness were not measured and this could possibly have lead to false readings with several kg/cm^2 differences.

3.5.2 THE SUBJECTIVE MEASUREMENTS

The following subjective measurements were taken on the first, fourth and sixth consultations:

- The Revised Oswestry Low Back Disability Index (Appendix H) to determine the patient's disability (Fairbank et al. 1980).
- The Total Numerical Pain Rating Scale-101 (Appendix I) to determine the patient's pain intensity (Jensen et al. 1986).
- The Short-form McGill Pain Questionnaire (Appendix J) to determine the patient's pain perception (Melzack 1987).
- The 11-point Box Scale (Appendix K) (Jensen et al. 1986).

- A symptom diagram (Appendix L) diagrammatically indicating change in distribution and quality of pain before and after treatment (Gatterman 1990).

3.5.2.1 The Revised Oswestry Back Disability Questionnaire (Appendix H)

Enebo (1998: 30) found the Revised Oswestry was appropriate for mild to moderate chronic low back pain with minor disabilities due to a new section asking for the patient's perception of their changing pain pattern and therefore making it more sensitive to small changes in patient function. With the ease of administration and scoring, both the original and the Revised Oswestry questionnaires have been reported to be equally reliable, consistent and valid by Beurskens et al. (1995: 1019). Judging the predictive values to differentiate broad categories of low back pain and reach a specific diagnosis, Haas and Nyiendo (1992) found that only the combined use of the McGill (subjective pain) and Oswestry Disability Questionnaire (disability) models gave acceptable predictive power value. Haas and Nyiendo (1992: 97) state that this questionnaire may help distinguish patients who may be treated conservatively from those who should be referred for surgical evaluation and, has led to increased use of the instrument in research with LBP patients.

This questionnaire consists of ten sections of six questions each. For each section, the total possible score is five points, with the point distribution ranging from zero (if the first statement of the respective section was marked) to five (if the sixth statement was chosen). Upon completion of the questionnaire, the points for each section were added, with the maximum possible score being 50. The final score was then converted to a percentage for each patient, for that particular consultation. In the event that one section was not completed, the final score is adjusted by dividing by the number of sections answered to obtain a percentage. Fairbank et al. (1980) reports that the questionnaire is a valid indicator of disability if its score closely reflects the patient's observed disability and symptoms. Improvement in disability, as measured by the scores of the Oswestry Back Disability Index, was indicated as an increase in numerical mean values percentage over the first, fourth and sixth consultations.

3.5.2.2 The Total Numerical Pain Rating Scale-101 (Appendix I)

Jensen et al. (1986: 125) suggest that the NRS-101 is a reliable method of measurement and should be used as the questionnaire of choice when assessing pain intensity in chronic pain patients at different points in their lives. Furthermore Jensen et al. (1986) found this method to be the most practical index when compared to six other methods of measuring clinical pain in its ease of administering and scoring and, can be administered either in written or verbal form.

The subjects were required to rate their perceived pain intensity on a numerical scale from 0 to 100, when it was at its worst and when it was at its least on the appropriate lines. A numerical scale from zero, to indicate "no pain at all", to one hundred, indicated "pain as bad as it could be" was used. An accurate assessment of the pain intensity was then obtained by taking the average of the two scores (Jensen et al. 1986).

3.5.2.3 The Short-form McGill Pain Questionnaire (Appendix J)

According to Melzack (1987) this questionnaire is a reliable, consistent and valid measuring tool to quantify the sensory dimension of the pain experienced, in a limited time. This questionnaire is designed to assess the multi-dimensional nature of pain experienced by patients. It was derived from the McGill Long-form Questionnaire and contains 15 representative words or descriptors (11 sensory and 4 affective). These descriptors were selected based on the frequency of their use by patients. Melzack (1987) ranked each one on an intensity scale of: 0 = none; 1 = mild; 2 = moderate; 3 = severe. The scores were added together and recorded out of a maximum score of 45.

3.5.2.4 The 11-point Box Scale (Appendix K)

Patients rated their present level of pain intensity, using the 11-point Box Scale (BS-11) (Jensen et al. 1986:119) at the first, fourth and sixth consultations. The patient was asked to place a mark on a scale of 0 to 10, the number representing the level of pain, where 0 represented the least pain and 10 the worst pain experienced. Jensen et al. (1986) found this scale to yield similar results compared to other intensity scales, in terms of the number of subjects who respond correctly to them and their predictive validity.

3.5.2.5 The Symptom diagram (Appendix L)

Gatterman (1990: 72) describes the pain diagram as a useful tool that gives valuable information about both physical and psychological problems. Waddell (2000: 158) states that patients regard it as a simple question about the physical pattern of their pain however, the way in which they describe their pain also give information about how they are reacting and about how the pain is affecting them. The simplest signal of psychological involvement is the sheer quantity of drawing – how large an area and how densely they fill it in.

In an attempt to demonstrate changes in the magnitude and description of the quality of pain experienced, this visual representation of pain experience was used to compare the distribution of pain before and after the study. On the first and sixth consultation, six types of pain and sensations, represented by symbols, were provided and patients were instructed to mark the areas on the body outline diagram that they felt best represented what they were experiencing.

The distribution was analysed according to the description used by Walsh (1998: 234) who categorized LBP as L (diffuse lumbar) if pain was spread over the lumbar region, UL (upper lumbar) if located in the L1 to L3 area, L4 if in fourth lumbar region, L5 if in the fifth lumbar region and S1 if located over one or both sacroiliac joints. The author of this study included pain that radiated into the anterior and posterior thigh, calf and foot. One point was given for each area marked and a point for each type of the symbol used. The points were added and scored for each group.

3.6 THE TREATMENT OF THE DATA

3.6.1 OBJECTIVE DATA

The objective data was treated as follows:

- The results of the Orthopaedic tests were recorded separately for each group in the separate categories of diagnosis.
- The Algometer readings at bilateral L1 and L5 were recorded separately for each group.
- These results were recorded in a spreadsheet format.

3.6.2 SUBJECTIVE DATA

The subjective data was treated as follows:

- Questionnaires that each patient completed were screened to ensure they had been completed correctly during the consultation.
- Raw data from the 15 questionnaires was converted into percentages and recorded separately for each group in a spreadsheet format.

3.6.3 DEMOGRAPHIC DATA

Demographics of the two groups include the following information: average age; the ratio of males to females; race; occupation and duration of pain were recorded in a spreadsheet format.

3.7 THE STATISTICAL PROCEDURE

The data was analyzed using the version 9.0 SPSS statistical package and presented in the form of tables and bar graphs. Due to the sample size ($n_1 = 30$ and $n_2 = 30$), both parametric and non-parametric tests were used to analyze the data. Continuous variables were analyzed using the parametric Unpaired t-test and the Paired t-test tests. Categorical variables were analyzed using the non-parametric Mann-Whitney U-test and the Friedman's T-test tests along with the Dunn Procedure.

3.7.1 PROCEDURE 1: Unpaired t-test (Inter-group)

Unpaired t-test (two sample analysis) was used at the 5% level of significance. It was used to determine whether there was any difference between the two groups at the time of the first, fourth and sixth consultations for the Orthopaedic Rating Scale, Algometer readings, Revised Oswestry Low Back Disability Questionnaire and the Numerical Rating Scale-101. This parametric test was used, as the sample size was greater than or equal to 30 ($n = 30$).

The null hypothesis (H_O) stated that there was no difference between the two groups. Therefore the null hypothesis is either rejected or accepted depending on the *p*-value being less than or greater than or equal to α. The alternative hypothesis (H_a) stated that there was a difference between the two groups (Fisher and Van Belle 1993: 315-319).

H_0: There is no difference between the two groups.

H_a: There is a difference between the two groups.

α = **0,05**

Decision rule:

If $p < \alpha$, reject H_0

If $p \geq \alpha$, accept H_0

(Where p is the observed significance level.)

3.7.2 PROCEDURE 2: Mann-Whitney U-test (Inter-group)

The Mann-Whitney U-test was used to determine whether any significant difference existed between group A and group B at the time of the first, fourth and sixth consultations using the Revised Oswestry Low Back Disability Questionnaire, Short-Form McGill Questionnaire and the 11-point Box Scale, at the 5% level of significance.

The null hypothesis (H_0) stated that there would be no significant difference between each group. Therefore the null hypothesis is either rejected or accepted depending on the p-value being less than or greater than or equal to α. The alternative hypothesis (H_a) stated that there was a difference between each group (Fischer and Van Belle 1993: 315-319).

H_0: There is no difference between the two groups.

H_a: There is a difference between the two groups.

α = **0,05**

Decision rule:

If $p < \alpha$, reject H_0

If $p \geq \alpha$, accept H_0

3.7.3 PROCEDURE 3: Paired t-test (Intra-group)

The Paired t-test (one sample analysis) was used to determine whether any improvement occurred within group A and group B by comparing the results from the first and sixth consultation's Symptom Diagram, at the 5% level of significance. This parametric test was used, as the sample size was greater than or equal to 30 (n = 30).

The null hypothesis (H_0) stated that there was no difference between each of these consultations. Therefore the null hypothesis is either rejected or accepted, depending on whether the *p*-value was less than or greater than or equal to α. The alternative hypothesis (H_a) stated that there was an improvement between consultations (Fisher and Van Belle 1993: 315-319). (The reported *p*-value is the SPSS print out value of *p*.)

H_0: There is no improvement between the consultations.

H_a: There is an improvement between the consultations.

$\alpha = \mathbf{0.05}$

Decision rule:

For a one-tailed test

If $p < \alpha$, reject H_0

If $p \geq \alpha$, accept H_0

i) $p = \dfrac{\text{reported p-value}}{2}$ If H_a is of form > and z is positive
If H_a is of form < and z is negative

ii) $p = 1 - \dfrac{(\text{reported p-value})}{2}$ If H_a is of form > and z is negative
If H_a is of form < and z is positive

3.7.4 PROCEDURE 4: Friedman's T-test (Intra-group)

The non-parametric Friedman's T-test compares three or more paired groups (Instat 2001). If the *P*-value was small, one can conclude that at least one of the treatments differs from the rest, and it was therefore necessary to look at post-hoc tests to determine which group differed from which group (Instat 2001). In this study the post-hoc test used was a multiple comparison procedure called the Dunn Procedure (Daniel 1978: 231). The Friedman T-test was used within the magnetic and placebo group to determine if there was any significant difference for categorical variables from the Orthopaedic Rating Scale, Algometer reading, Revised Oswestry Low Back Disability Questionnaire, Total Numerical Rating Scale-101, Short-Form McGill Questionnaire, and the 11-point Box Scale between the first, fourth and the sixth consultations.

The null hypothesis H_0 stated that there was no difference between consultations with regards to the variable of interest. The alternative hypothesis H_a stated that there was a difference between consultations with regards to the variable of interest.

H_0: The three treatments yield identical results.

H_a: At least one treatment tends to yield larger values than at least one other treatment.

α = **0.05**

Decision Rule:

For a two-tailed test:

If $p < \alpha$, reject H_0

If $p \geq \alpha$, accept H_0

The Dunn Procedure

If the null hypothesis H_0 is rejected for the Friedman's test, then this multiple comparison procedure will be applied to determine which of the treatments are significantly different (Daniel 1978).

Let R_j *and* R_j' be the jth and j'th treatment rank totals.

If $|R_j - R_j'| \geq z$, then R_j and R_j' was declared significant

In the above formula:

b = the number of blocks

k = the number of treatments

z = value in the inverse normal distribution corresponding to $(1 - [\Upsilon/k(k-1)])$

To compute the treatment rank total; the values were ranked in each block and the sum of the ranks then computed for each treatment.

When $k = 3$, $\alpha = 0.10$, $z = 2.12$

3.8 THE SPECIFIC TREATMENT OF EACH OBJECTIVE

3.8.1 OBJECTIVE ONE

The first objective was to evaluate the relative effectiveness of SMT and a Placebo Belt, compared to SMT and a Magnetic Belt in terms of subjective clinical findings, in the management of mechanical LBP.

The data required for the first objective was the response of the patients in both the groups to the Revised Oswestry Low Back Disability Questionnaire (Appendix H), the Numerical Pain

Rating Sacle-101 (Appendix I), the Short-form McGill Pain Questionnaire (Appendix J), the 11-point Box Scale (Appendix K), and the Symptom Diagram (Appendix L).

All data was collected from the participating patients treated at the Natal Technikon Chiropractic Day Clinic. This data was recorded in each patient's file at the aforementioned times of data collection. All questionnaires were completed at the appointed consultations under the researcher's supervision, as explained in the methodology.

3.8.2 OBJECTIVE TWO

The second objective was to evaluate the relative effectiveness of SMT and a Placebo Belt, compared to SMT and a Magnetic Belt in terms of objective clinical findings, in the management of mechanical LBP.

The data required for the second objective were the findings collected from the patients in both groups using the Orthopaedic Rating Scale (Appendix F) and the Algometer (Appendix G).

All data was collected from the participating patients treated at the Natal Technikon Chiropractic Day Clinic. This data was recorded in each patient's file at the aforementioned times of data collection. The objective clinical findings and readings were observed and noted by the researcher at the appointed consultation in the relevant documents.

3.8.3 OBJECTIVE THREE

The third objective was to integrate the results of objective one and objective two in order to determine whether either of the treatments was more effective in the management of mechanical LBP, in terms of subjective and objective clinical findings.

The data required for the third objective was the response of the patients in both groups to the Orthopaedic Rating Scale (Appendix F), the Algometer readings (Appendix G), the Revised Oswestry Low Back Disability Questionnaire (Appendix H), the Numerical Rating Scale-101 (Appendix I), the Short Form McGill Pain Questionnaire (Appendix J), the 11-point Box Scale (Appendix K), and the Symptom Diagram (Appendix L).

The data required was recorded in the files of all participating patients during the process of securing data for objective one and two.

CHAPTER FOUR

4. THE RESULTS

4.1 INTRODUCTION

Results, obtained from the statistical analysis of measurement criteria as discussed in chapter 3, will be presented in table form with comments and interpretations to accept or reject the null hypothesis. Group A consists of the SMT and placebo belt group. Group B consists of the SMT and magnetic belt group.

4.2 DEMOGRAPHIC DATA

4.2.1 AGE DISTRIBUTION

Table 4.1: Age distributions of Patients (n=60).

AGE	GROUP A (PLACEBO)	%	GROUP B (MAGNETIC)	%	TOTAL SUBJECTS	%
RANGE:	18-59 YRS		22-55 YRS		18-59 YRS	
18-20 YRS	3	**10.00%**	0	**0.00%**	3	**10.00%**
21-30 YRS	10	**33.33%**	10	**33.33%**	20	**33.33%**
31-40 YRS	8	**26.67%**	12	**40.00%**	20	**33.33%**
41-50 YRS	6	**20.00%**	4	**13.33%**	10	**16.67%**
51-60 YRS	3	**10.00%**	4	**13.33%**	7	**11.67%**
TOTAL	30	**100.00%**	30	**100.00%**	60	**100.00%**
AVERAGE AGE	34.5 YRS		36.5 YRS		35.6 YRS	

4.2.2 GENDER DISTRIBUTION

Table 4.2: Gender Distributions of Patients (n = 60).

GENDER	GROUP A (PLACEBO)	%	GROUP B (MAGNETIC)	%	TOTAL	%
MALE	22	**73.33%**	20	**66.67%**	42	**70.00%**
FEMALE	8	**26.67%**	10	**33.33%**	18	**30.00%**
TOTAL	30	**100.00%**	30	**100.00%**	60	**100.00%**

4.2.3 RACE DISTRIBUTION

Table 4.3: Race Distributions of Patients (n = 60).

RACE	GROUP A (PLACEBO)	%	GROUP B (MAGNETIC)	%	TOTAL	%
WHITE	20	66.67%	20	66.67%	40	66.67%
ASIAN	7	23.33%	8	26.67%	15	25.00%
BLACK	3	10.00%	2	6.67%	5	8.33%
TOTAL	30	100.00%	30	100.00%	60	100.00%

4.2.4 OCCUPATION DISTRIBUTION

The following classification of occupation was used according to Walsh (1998: 234):

- Non-manual (e.g. clerical, sales, managerial, professional, technical, administrative, retired, unemployed)
- Light-manual (e.g. craftsman, skilled, domestic, student)
- Heavy-manual (e.g. labor, nursing).

Table 4.4: Occupation Distributions of Patients (n = 60).

OCCUPATION	GROUP A (PLACEBO)	%	GROUP B (MAGNETIC)	%	TOTAL	%
NON-MANUAL	15	50.00%	18	60.00%	33	55.00%
LIGHT-MANUAL	12	40.00%	10	33.33%	22	36.67%
HEAVY-MANUAL	3	10.00%	2	6.67%	5	8.33%
TOTAL	30	100.00%	30	100.00%	60	100.00%

4.2.5 DURATION OF PAIN

The traditional clinical classification of back pain according to Waddell (2000: 73) is: acute – current attack of less than 3 months; recurrent – current attack of less than 3 months, but experienced previous attacks; and chronic – current attack of more than 3 months.

Table 4.5: Duration of Pain in Patients (n = 60).

PAIN DURATION	GROUP A (PLACEBO)	%	GROUP B (MAGNETIC)	%	TOTAL	%
ACUTE	4	13.33%	5	16.66%	9	15%
RECURRENT	19	63.33%	13	43.33%	32	53.33%
CHRONIC	7	23.33%	12	40%	19	31.66%
TOTAL	30	100.00%	30	100.00%	60	100.00%

4.2.6 SYMPTOMATIC PRESENTATION

Table 4.6: Distributions of Symptoms in Patients (n = 60).

GROUP	GROUP A (PLACEBO)				GROUP B (MAGNETIC)			
AREA	BEFORE	%	AFTER	%	BEFORE	%	AFTER	%
UPPER LUMBAR (L1-L3)	9	30%	6	20%	16	53.33%	10	33.33%
LOWER LUMBAR (L4-S1)	21	70%	18	60%	22	73.33%	17	56.66%
SACROILIAC	15	50%	9	30%	10	33.33%	6	20%
BUTTOCK	5	16.67%	3	10%	7	23.33%	5	16.67%
POSTERIOR THIGH	3	10%	3	10%	7	23.33%	2	16.67%
ANTERIOR THIGH	1	3.33%	1	3.33%	5	16.67%	1	3.33%
CALF	2	6.66%	0	0%	3	10%	2	6.67%
FOOT	0	0%	0	0%	3	10%	1	3.33%

4.3 HYPOTHESIS TESTING

4.3.1 DECISION RULES

Two-tailed Tests:

If $p < Y$, reject the null hypothesis H_0.

If $p \geq Y$, do not reject the null hypothesis H_0.

p is the reported p–value.

One-tailed Test:

For one-tailed tests, p-values are obtained as follows:

$p = \dfrac{\text{reported } p\text{-value}}{2}$ If H_a is of form > and z is positive
If H_a is of form < and z is negative

$p = 1 - \dfrac{(\text{reported } p\text{-value})}{2}$ If H_a is of form > and z is negative
If H_a is of form < and z is positive

4.3.2 *P*-VALUES

For Two-tailed Test:

If $p < 0.05$ reject H_0

If $p \geq 0.05$ accept H_0

For One-tailed Test:

$$p = \frac{\text{reported } p\text{-value}}{2}$$

If $p < Y$, reject H_0

If $p \geq Y$, accept H_0

Note:

- Data was analyzed at $Y = 0.05$ level of significance.
- The reported p-value means SPSS computed p-value.

4.3 ANALYSIS OF THE DATA

4.4.1 PARAMETRIC TESTS: INTER-GROUP COMPARISON WITH RESPECT TO CONTINUOUS VARIABLES

Table 4.7: Inter-group analysis at the first consultation: a test for the equality of means for continuous variables, using the Unpaired t-test.

	TREATMENT GROUP 1 (PLACEBO) INITIAL CONSULTATION				TREATMENT GROUP 2 (MAGNETIC) INITIAL CONSULTATION		
	Me.	S.D	S.E.	P-VALUE	Me.	S.D.	S.E.
ORS – FACET SYNDROME	94.000	19.046	3.477	**0.256**	86.667	29.400	5.368
ORS – SACROILIAC SYNDROME	32.000	39.510	7.210	**0.785**	34.670	35.600	6.500
ORS – MYOFASCIAL SYNDROME	67.330	29.930	5.470	**0.745**	64.670	33.090	6.040
L1 ALGOMETER READING	12.200	18.513	3.380	**0.239**	8.155	1.893	0.346
L5 ALGOMETER READING	8.545	1.679	0.307	**0.216**	7.963	1.913	0.349
TOTAL NRS-101	44.083	13.285	2.456	**0.407**	47.100	14.639	2.673

The null hypothesis is accepted for the Orthopaedic Rating Scale, the L1 and L5 Algometer reading and the Total NRS-101, indicating that no difference existed between group A and group B at the first consultation. This suggests that each group was similarly matched in terms of positive orthopaedic findings, tenderness and the severity of their LBP at the onset of the study.

Table 4.8: Inter-group analysis at the fourth consultation: a test for the equality of means for continuous variables, using the Unpaired t-test.

	TREATMENT GROUP 1 (PLACEBO) FOURTH CONSULTATION				TREATMENT GROUP 2 (MAGNETIC) FOURTH CONSULTATION		
	Me.	**S.D**	**S.E.**	**P-VALUE**	**Me.**	**S.D.**	**S.E.**
ORS – FACET SYNDROME	92.667	19.286	3.521	**0.016**	77.333	27.660	5.050
ORS – SACROILIAC SYNDROME	22.000	27.966	5.106	**0.862**	20.667	31.287	5.712
ORS – MYOFASCIAL SYNDROME	49.333	37.410	6.830	**0.711**	52.667	31.724	5.792
L1 ALGOMETER READING	8.747	1.158	0.211	**0.143**	8.155	1.848	0.338
L5 ALGOMETER READING	8.785	1.223	0.223	**0.266**	8.317	1.929	0.352
TOTAL NRS-101	29.250	16.003	2.922	**0.704**	30.717	13.616	2.486

The null hypothesis is accepted for the Orthopaedic Rating Scale, the L1 and L5 Algometer reading, and the Total NRS-101, indicating that no difference existed between group A and group B at the fourth consultation. Only the Orthopaedic Rating for Facet syndrome was found to have a statistically significant difference between group A and group B and the null hypothesis was rejected, indicating there were fewer positive orthopaedic tests at the fourth consultation.

Table 4.9: Inter-group analysis at the sixth consultation: a test for the equality of means for continuous variables, using the Unpaired t-test.

	TREATMENT GROUP 1 (PLACEBO) SIXTH CONSULTATION				TREATMENT GROUP 2 (MAGNETIC) SIXTH CONSULTATION		
	Me.	**S.D**	**S.E.**	**P-VALUE**	**Me.**	**S.D.**	**S.E.**
ORS – FACET SYNDROME	73.00	31.856	5.816	**0.142**	60.000	35.623	6.504
ORS – SACROILIAC SYNDROME	17.333	28.154	5.140	**0.402**	12.000	20.069	3.664
ORS – MYOFASCIAL SYNDROME	39.667	33.475	6.112	**0.600**	24.667	26.618	4.860
L1 ALGOMETER READING	8.508	1.507	0.275	**0.792**	8.620	1.743	0.318
L5 ALGOMETER READING	8.455	1.617	0.295	**0.709**	8.622	1.819	0.332
TOTAL NRS-101	26.533	22.401	4.090	**0.419**	22.450	15.907	2.905

The null hypothesis is accepted for the Orthopaedic Rating Scale, the L1 and L5 Algometer reading, and the Total NRS-101, indicating that no difference existed between group A and group B at the sixth consultation.

FIGURE 1.1: Parametric mean values of the ORTHOPAEDIC RATING SCALE at the initial, fourth and sixth consultations comparing the SMT and placebo and SMT and magnetic belts

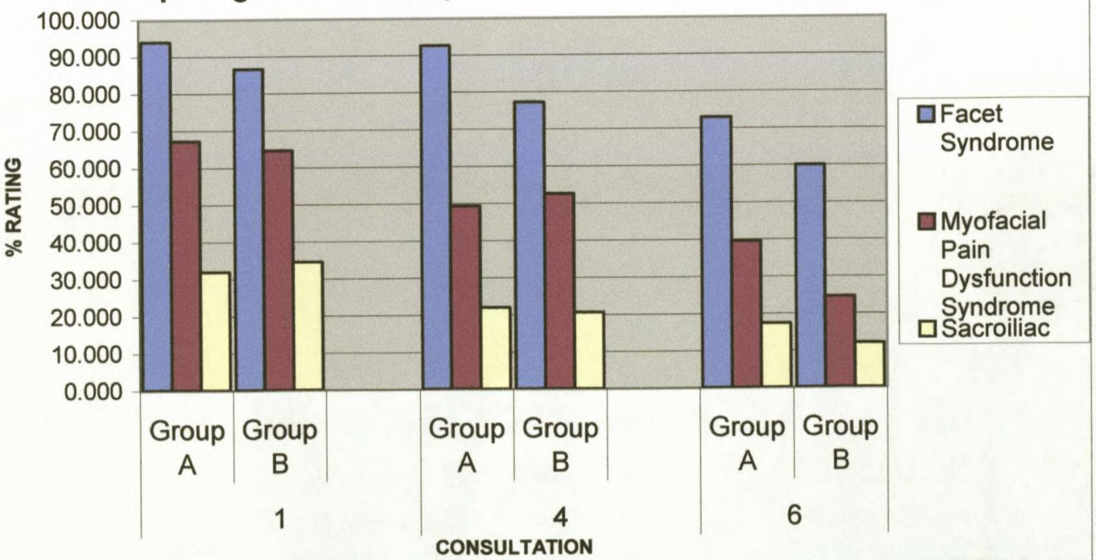


FIGURE 1.2: Parametric mean values of the L1 ALGOMETER READING at the initial, fourth and sixth consultations comparing the SMT and placebo with SMT and magnetic belts

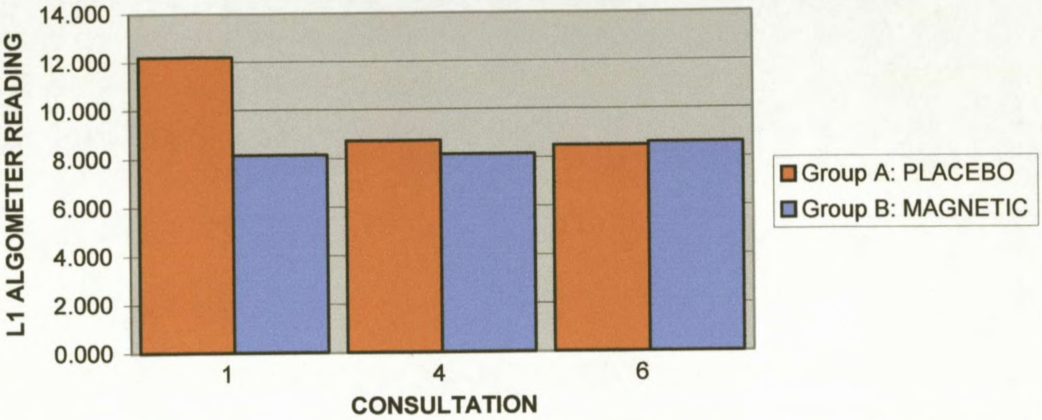


FIGURE 1.3: Parametric mean values of the L5 ALGOMETER READING at the initial, fourth and sixth consultations comparing the SMT and placebo with SMT and magnetic belts

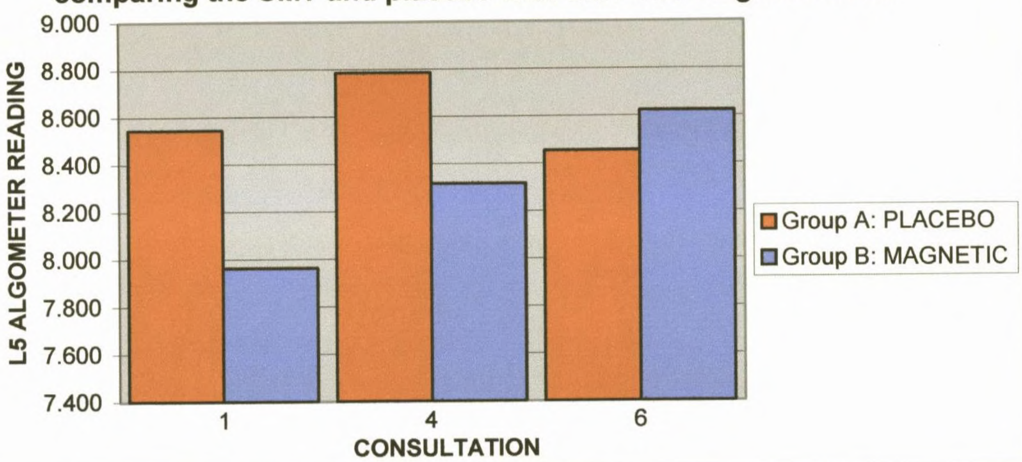
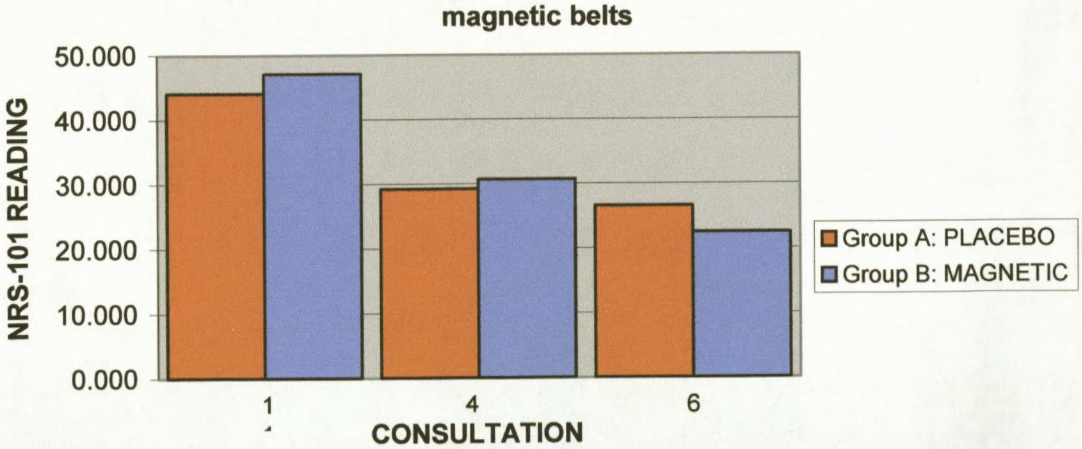


FIGURE 1.4: Parametric mean values of the TOTAL NUMERICAL PAIN RATING SCALE-101at the initial, fourth and sixth consultations comparing the SMT and placebo with SMT and magnetic belts



4.4.2 NON-PARAMETRIC TESTS: INTER-GROUP COMPARISON WITH RESPECT TO CATEGORICAL VARIABLES

Table 4.10: Inter-group analysis at the first consultation: a comparison of medians for ordinal data, using the Mann-Whitney U-test.

	TREATMENT GROUP 1 (PLACEBO) INITIAL CONSULTATION				TREATMENT GROUP 2 (MAGNETIC) INITIAL CONSULTATION		
	Me.	S.D	S.E.	P-VALUE	Me.	S.D.	S.E.
REVISED OSWESTRY	32.400	13.890	2.536	**0.415**	34.467	10.474	1.912
SHORT-FORM MCGILL	8.233	5.237	0.956	**0.894**	9.067	7.593	1.386
11-POINT BOX SCALE	5.333	2.139	0.391	**0.459**	4.767	2.112	0.386

The null hypothesis is accepted for the Revised Oswestry questionnaire, the Short-form McGill questionnaire and the 11-point Box Scale, indicating that no difference existed between group A and group B, in terms of the disability and pain severity at the onset of the study.

Table 4.11: Inter-group analysis at the fourth consultation: a comparison of medians for ordinal data, using the Mann-Whitney U-test.

	TREATMENT GROUP 1 (PLACEBO) FOURTH CONSULTATION				TREATMENT GROUP 2 (MAGNETIC) FOURTH CONSULTATION		
	Me.	S.D	S.E.	P-VALUE	Me.	S.D.	S.E.
REVISED OSWESTRY	21.600	17.272	3.153	**0.394**	22.533	9.157	1.672
SHORT-FORM MCGILL	4.233	4.256	0.777	**0.263**	4.833	3.270	0.597
11-POINT BOX SCALE	2.967	1.938	0.354	**0.792**	3.200	1.883	0.344

The null hypothesis is accepted for the Revised Oswestry questionnaire, the Short-form McGill questionnaire and the 11-point Box Scale, indicating that no difference existed between group A and group B, in terms of the disability and pain severity at the fourth consultation.

Table 4.12: Inter-group analysis at the sixth consultation: a comparison of medians for ordinal data, using the Mann-Whitney U-test.

	TREATMENT GROUP 1 (PLACEBO) SIXTH CONSULTATION				TREATMENT GROUP 2 (MAGNETIC) SIXTH CONSULTATION		
	Me.	**S.D**	**S.E.**	**P-VALUE**	**Me.**	**S.D.**	**S.E.**
REVISED OSWESTRY	18.067	21.748	3.971	**0.533**	14.967	8.759	1.599
SHORT-FORM MCGILL	3.233	2.417	0.441	**0.292**	2.700	2.588	0.477
11-POINT BOX SCALE	2.400	2.027	0.370	**0.527**	2.133	1.697	0.310

The null hypothesis is accepted for the Revised Oswestry questionnaire, the Short-form McGill questionnaire and the11-point Box Scale, indicating that no difference existed between group A and group B, in terms of the disability and pain severity at the sixth consultation.

FIGURE 1.5: Non-parametric mean values of the REVISED OSWESTRY QUESTIONNAIRE at the initial, fourth and sixth consultations comparing the SMT and placebo with SMT and magnetic belts

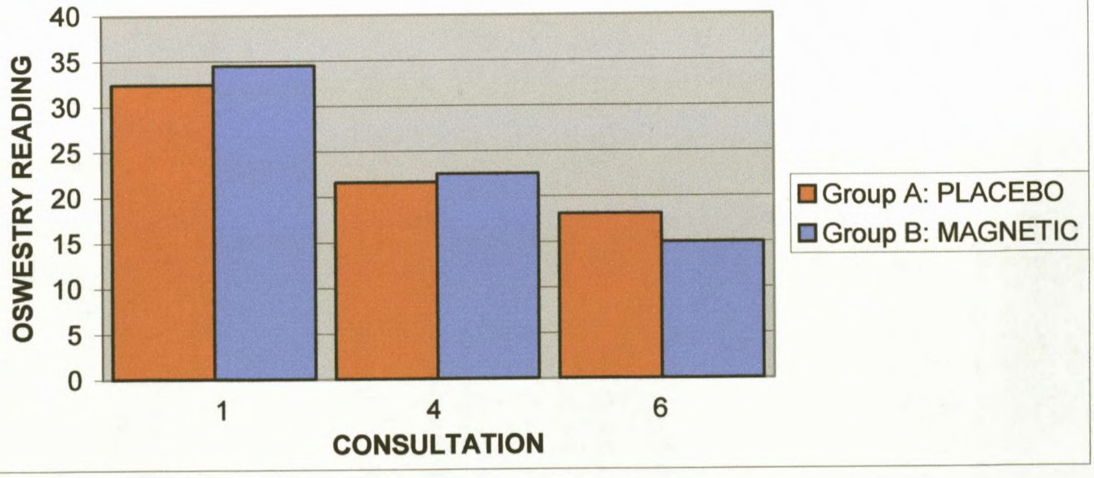


FIGURE 1.6 Non-parametric mean values for the SHORT FORM McGILL PAIN QUESTIONNAIRE at the initial, fourth and sixth consultations comparing the SMT and placebo and SMT and magnetic belts

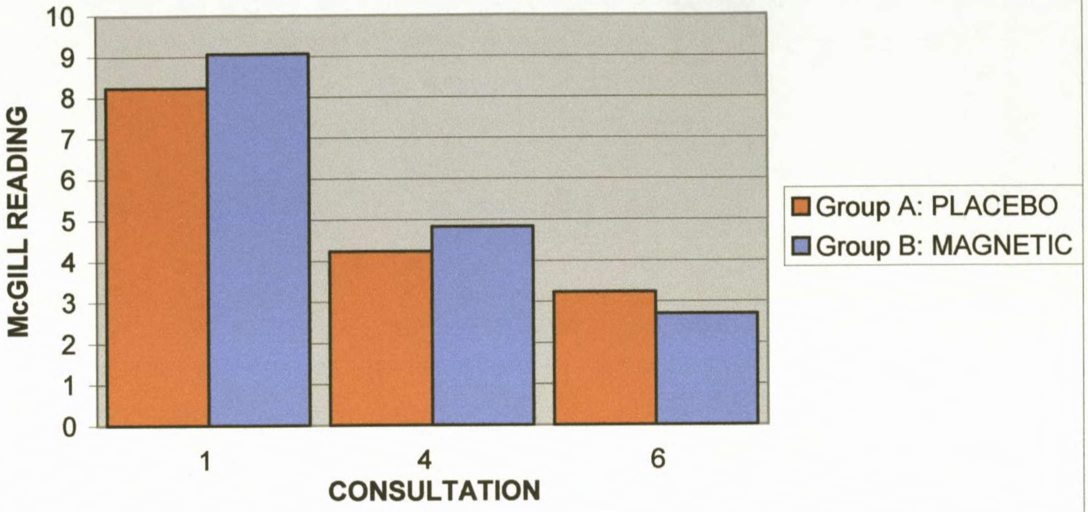
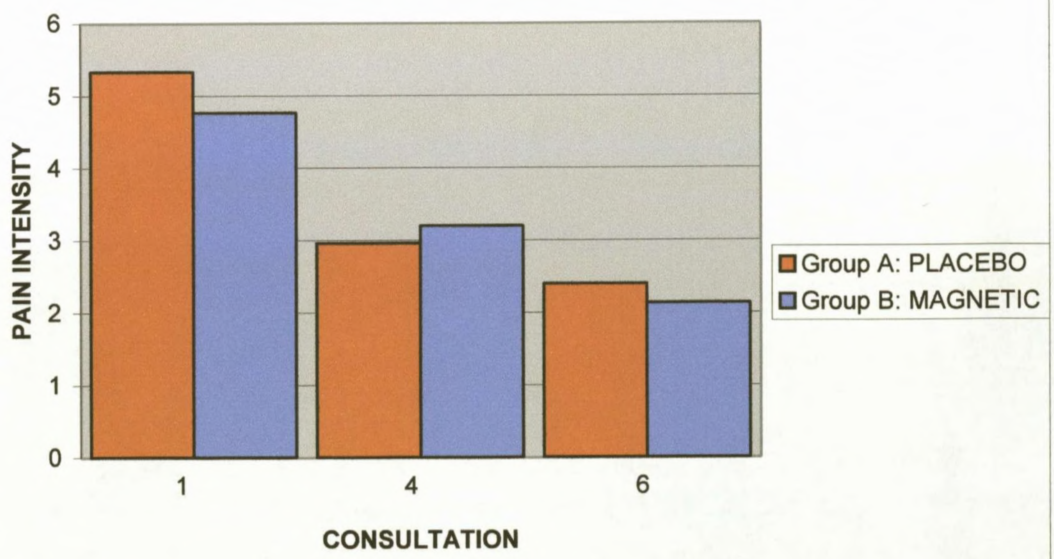


FIGURE 1.7: Non-parametric mean values for the 11-POINT BOX SCALE at the initial, fourth and sixth consultations comparing the SMT and placebo and SMT and magnetic belts



4.4.3 INTRA-GROUP A COMPARISON WITH REPECT TO CONTINUOUS VARIABLES

Table 4.13: Intra-group A analysis between the first and sixth consultation symptom diagram: a test for the mean of the differences, using the Paired t-test.

	TREATMENT GROUP A (PLACEBO) FIRST CONSULTATION				TREATMENT GROUP A (PLACEBO) SIXTH CONSULTATION		
	Me.	**S.D**	**S.E.**	**P-VALUE**	**Me.**	**S.D.**	**S.E.**
AREA OF PAIN	22.917	9.894	1.806	**0.001**	15.417	7.826	1.429
TYPE OF PAIN	30.551	12.446	2.272	**0.0005**	22.218	13.373	2.442

The null hypothesis is rejected for the area and the type of pain found on the Symptom Diagram, indicating that a statistically significant improvement took place between the initial and final consultation within group A.

4.4.4 INTRA-GROUP B COMPARISON WITH REPECT TO CONTINUOUS VARIABLES

Table 4.14: Intra-group B analysis between the first and sixth consultation symptom diagram: a test for the mean of the differences, using the Paired t-test.

	TREATMENT GROUP B (MAGNETIC) FIRST CONSULTATION				TREATMENT GROUP B (MAGNETIC) SIXTH CONSULTATION		
	Me.	**S.D**	**S.E.**	**P-VALUE**	**Me.**	**S.D.**	**S.E.**
AREA OF PAIN	29.167	17.162	3.133	**0.000**	17.917	10.215	1.865
TYPE OF PAIN	34.440	19.543	3.568	**0.0205**	26.107	14.308	2.612

The null hypothesis is rejected for the area and the type of pain found on the Symptom Diagram, indicating that a statistically significant improvement took place between the initial and final consultation within group B.

FIGURE 1.8: Mean values for the AREA OF PAIN at the initial and sixth consultations comparing the SMT and placebo and SMT and magnetic belts

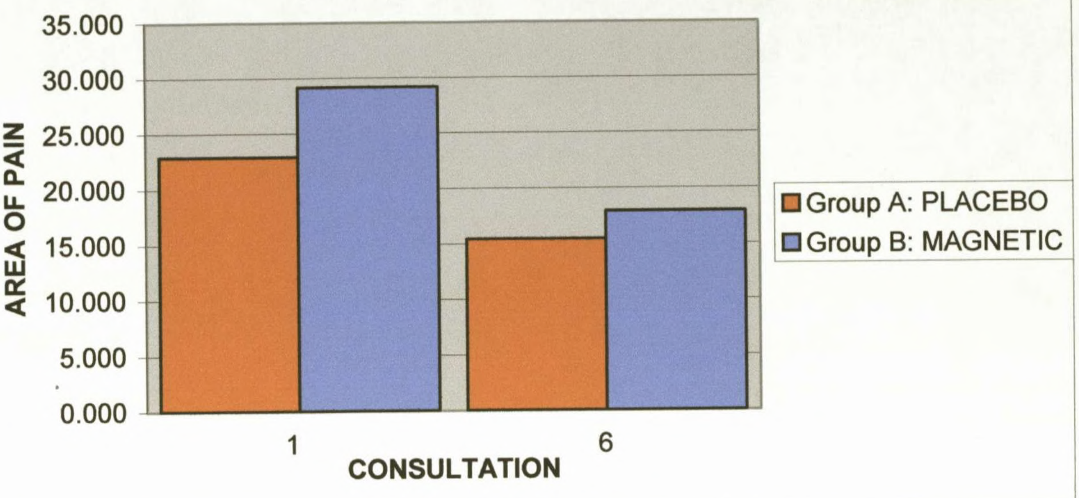
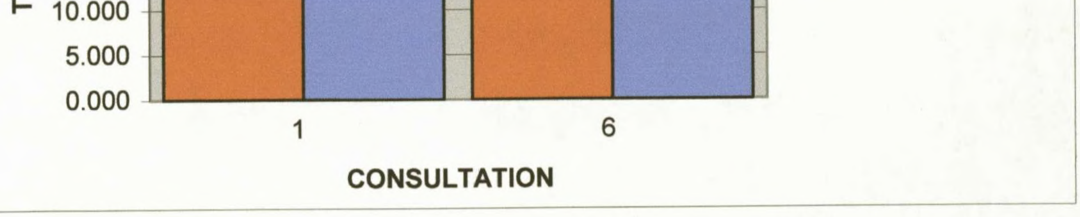


FIGURE 1.9: Mean values for the TYPE OF PAIN at the initial and sixth consultations comparing the SMT and placebo and SMT and magnetic belts



4.4.5 NON-PARAMETRIC TESTS: INTRA-GROUP A COMPARISON FOR CATEGORICAL VARIABLES

Table 4.15: Intra-group A analysis between the first, fourth and the sixth consultation: a comparison of medians for ordinal data, using the Friedman's t-test.

	TREATMENT GROUP A (PLACEBO) FIRST CONSULTATION		TREATMENT GROUP A (PLACEBO) FOURTH CONSULTATION		TREATMENT GROUP A (PLACEBO) SIXTH CONSULTATION		
	Me.	**S.D**	**Me.**	**S.D**	**Me.**	**S.D**	**P-VALUE**
ORS-FACET SYNDROME	94.000	19.047	92.667	19.286	73.000	31.856	**0.000**
ORS-SACROILIAC SYNDROME	32.000	39.510	22.000	27.965	17.333	28.154	**0.007**
ORS-MYOFASCIAL SYNDROME	67.330	29.930	49.333	37.410	39.667	33.475	**0.000**
ALGOMETER READINGS – L1	8.867	1.260	8.747	1.158	8.508	1.507	**0.292**
ALGOMETER READINGS – L5	8.545	1.679	8.785	1.223	8.455	1.617	**0.293**
REVISED OSWESTRY	32.400	13.890	21.600	17.272	18.067	21.748	**0.000**
TOTAL NRS-101	44.083	13.285	29250	16.003	26.533	22.401	**0.000**
SHORT-FORM MCGILL	8.233	5.237	4.233	4.256	3.233	2.417	**0.000**
11-POINT BOX SCALE	5.333	2.139	2.967	1.938	2.400	2.027	**0.000**

The null hypothesis was rejected for the Orthopaedic Rating Scale, the Revised Oswestry questionnaire, the Total NRS-101, the Short-form McGill Pain questionnaire and the 11-point Box Scale. This indicates that there was a statistically significant difference between consultations for group A. The null hypothesis was accepted for the L1 and L5 Algometer reading, indicating that there was no difference between consultations for group A.

THE DUNN PROCEDURE:

Significant if $| R_j - R_j' | \geq z$

≥ 2.12

≥ 2.12

$\geq 2.12 \times 7.75$

≥ 16.42

Table 4.16: Results from Dunn Procedure for Group A (Placebo).

DUNN PROCEDURE FOR GROUP A (PLACEBO) SIGNIFICANT IF ≥ 16.42			
	| R1 – R4 |	**| R4 – R6 |**	**| R1 – R6 |**
ORS-FACET SYNDROME	1.5	**19.5**	**21**
ORS-SACROILIAC SYNDROME	7	5.5	12.5
ORS-MYOFASCIAL SYNDROME	**18.5**	12.5	**31**
REVISED OSWESTRY	**27.5**	11	**38.5**
TOTAL NRS-101	**25.2**	5.4	**30.6**
SHORT-FORM MCGILL	**28**	11.5	**39.5**
11-POINT BOX SCALE	**30.6**	8.1	**38.7**

In group A, there were statistically significant differences in the Orthopaedic Rating Scale for Facet syndrome between the fourth and sixth consultations and the first and sixth consultations. No difference was found in the Orthopaedic Rating Scale for Sacroiliac syndrome. A statistically significant difference was found between the first and fourth consultations and the first and sixth consultations in the Orthopaedic Rating Scale for Myofascial syndrome, the Revised Oswestry questionnaire, the Total NRS-101, the Short-form McGill questionnaire, and the 11-point Box Scale.

4.4.6 NON-PARAMETRIC TESTS: INTRA-GROUP B COMPARISON FOR CATEGORICAL VARIABLES

Table 4.17: Intra-group B analysis between the first, fourth and the sixth consultation: a comparison of medians for ordinal data, using the Friedman's t-test.

	TREATMENT GROUP B (MAGNETIC) FIRST CONSULTATION		TREATMENT GROUP B (MAGNETIC) FOURTH CONSULTATION		TREATMENT GROUP B (MAGNETIC) SIXTH CONSULTATION		
	Me.	**S.D**	**Me.**	**S.D**	**Me.**	**S.D**	**P-VALUE**
ORS-FACET SYNDROME	86.667	29.400	77.333	27.660	60.000	35.622	**0.005**
ORS-SACROILIAC SYNDROME	34.667	35.597	20.667	31.287	12.000	20.069	**0.010**
ORS-MYOFASCIAL SYNDROME	64.667	33.086	52.667	31.724	24.667	26.618	**0.000**
ALGOMETER READINGS – L1	8.155	1.893	8.155	1.848	8.620	1.743	**0.105**
ALGOMETER READINGS – L5	7.963	1.913	8.317	1.929	8.622	1.819	**0.005**
REVISED OSWESTRY	34.467	10.474	22.533	9.157	14.967	8.759	**0.000**
TOTAL NRS-101	47.100	14.639	30.717	13.616	22.450	15.909	**0.000**
SHORT-FORM MCGILL	9.067	7.593	4.833	3.270	2.700	2.588	**0.000**
11-POINT BOX SCALE	4.767	2.112	3.200	1.883	2.133	1.697	**0.000**

The null hypothesis was rejected for the Orthopaedic Rating Scale, and L5 Algometer the Revised Oswestry questionnaire, the Total NRS-101, the Short-form McGill Pain questionnaire and the 11-point Box Scale. This indicates that there was a statistically significant difference between consultations for group B. The null hypothesis was accepted for the L1 Algometer reading, indicating that there was no difference between consultations for group B.

Table 4.18: Results from Dunn Procedure for Group B (Magnetic).

DUNN PROCEDURE FOR GROUP B (MAGNETIC) SIGNIFICANT IF ≥ 16.42 (As per §4.4.5)			
	| R1 – R4 |	**| R4 – R6 |**	**| R1 – R6 |**
ORS-FACET SYNDROME	13	7	**20**
ORS-SACROILIAC SYNDROME	10	8.5	**18.5**
ORS-MYOFASCIAL SYNDROME	15.5	**21.5**	**37**
ALGOMETER READINGS – L5	13.5	9	**22.5**
REVISED OSWESTRY	**22**	**26.5**	**48.5**
TOTAL NRS-101	15.6	**22.8**	**38.4**
SHORT-FORM MCGILL	**20**	**24.5**	**44.5**
11-POINT BOX SCALE	**17.4**	**17.4**	**34.9**

In group B, there were statistically significant differences between the first and sixth consultations in the Orthopaedic Rating Scale for Facet syndrome, Sacroiliac syndrome and L5 Algometer Readings. The Orthopaedic Rating Scale for Myofascial syndrome and the Total NRS-101 had significant differences between the fourth and sixth and the first and sixth consultations. The Revised Oswestry questionnaire, the Short-form McGill questionnaire and the 11-point Box Scale were found to have statistically significant differences between the first and fourth, fourth and sixth, and the first and sixth consultations.

CHAPTER FIVE

5. DISCUSSION OF RESULTS

5.1 DEFINING THE STUDY OBJECTIVES

The aim of this study was to determine whether magnetic therapy was more effective that a placebo treatment as an adjunct to SMT in the management of mechanical LBP in the terms of subjective and objective clinical findings. The results of objective and subjective data presented in chapter 4 will be discussed below.

5.2 DEMOGRAPHIC DATA

The average age (Table 4.1) of patients for Group A was 34.5 years, Group B was 36.5 years and the combination of both groups was 35.6 years which fell into the common age interval of LBP suffers of 25 and 55 years as described by Magna et al. (1993a: 17). Findings were consistent with Waddell's (2000: 89) conclusion that the prevalence of back pain increases from adolescence to late 40s or early 50s, and fell slightly above the age of 60 years.

According to Waddell (2000: 87) LBP is not gender specific however, surveys in the UK showed a higher prevalence in women than in men. In this study, 70% of the patients were men, (Table 4.2) indicating a higher prevalence, although there may have been a gender bias as pregnant women were excluded from the study.

An average of 66.67% of patients were from the White population, 25% were from the Asian population and 8.33% from the Black population group (Table 4.3). This demographic seems to indicate the prevalence of LBP among racial subgroups but these figures may have been biases by the method of advertising, the location of the Chiropractic day clinic and the lack of awareness of the role of chiropractic in the management of LBP in South Africa.

An average of 55% of patients were involved in non-manual occupations, 36.67% were involved in light-manual work and, 8.33% were involved in heavy manual work (Table 4.4). Walsh (1998: 234) found highest positive orthopaedic test rates in the straight and double leg raise tests in the heavy manual occupations and their lowest positive rates for those not employed.

An average of 15% patients had acute LBP, while 53.33% had recurrent LBP and 31.66% had chronic LBP (Table 4.5). These figures support the statement by Waddell (2000: 73) that although most acute attacks of LBP settle rapidly, residual symptoms and recurrences are common.

The most common area involved (Table 4.6) was the lower lumbar region from L4 to S1. For Group A the sacroiliac region was the second most commonly involved and the upper lumbar region from L1 to L3, third most commonly involved. For Group B the upper lumbar area from L1 to L3 was the second most commonly involved and the sacroiliac joints, third most commonly involved. Group B had a higher symptomatic presentation and distribution of pain but also showed a greater reduction at the final consultation. Although the symptomatic diagrams have not been used in research studies, as it is subjective to the patient's perception of local and referred pain and, their understanding of anatomical landmarks. This was a preliminary attempt to diagrammatically quantify the distribution and quality of pain by allocating one point to each area marked and for each symbol used. Besides being valuable in clinical evaluation, this questionnaire could possibly be of value in research if quantification of the symptoms were refined.

5.3 PARAMETRIC TESTS: INTER-GROUP COMPARISON WITH RESPECT TO CONTINUOUS VARIABLES

When the results of the Orthopaedic Rating Scale, L1 and L5 Algometer readings, and Total NRS-101 (Table 4.7) were compared using the Unpaired t-test, no difference was found between the two groups at the initial consultation, suggesting that each group was similarly matched in terms of positive orthopaedic findings, tenderness, and the severity at the onset of the study.

At the fourth consultation, no difference was found in the Orthopaedic Rating Scale for Sacroiliac and Myofascial syndrome, L1 and L5 Algometer readings, and Total NRS-101 (Table 4.8). Only Facet syndrome showed a statistically significant difference between group A and Group B in the Orthopaedic Rating Scale, indicating an improvement in patient's signs.

The Orthopaedic Rating Scale, L1 and L5 Algometer readings, and Total NRS-101 (Table 4.9) showed no difference at the sixth consultation indicating both forms of treatment were equally effective in reducing the severity of mechanical LBP.

Total NRS-101, Short-form McGill Pain questionnaire and 11-point Box Scale. No difference was found between consultations for L1 and L5 Algometer reading.

Using the Dunn procedure (Table 4.16) to find when the differences occurred, there were statistically significant differences in the Orthopaedic Rating Scale for Facet syndrome between the fourth and sixth consultations and the first and sixth consultations. A statistically significant difference was found between the first and fourth consultations and the first and sixth consultations in the Orthopaedic Rating Scale for Myofascial syndrome, Revised Oswestry questionnaire, Total NRS-101, Short-form McGill questionnaire, and 11-point Box Scale. No difference was found in the Orthopaedic Rating Scale for Sacroiliac syndrome.

5.8 NON-PARAMETRIC TESTS: INTRA-GROUP B COMPARISON FOR CATEGORICAL VARIABLES

When comparing the medians between the first, fourth and sixth consultations using the Friedman's t-test for ordinal data in group B (Table 4.17), a statistically significant difference was found for the Orthopaedic Rating Scale, L5 Algometer, Revised Oswestry questionnaire, Total NRS-101, Short-form McGill Pain questionnaire and 11-point Box Scale. No difference was found between consultations for L1 Algometer reading.

Using the Dunn procedure (Table 4.16) to find when the differences occurred, statistically significant differences were found between the first and sixth consultations in the Orthopaedic Rating Scale for Facet syndrome, Sacroiliac syndrome and, L5 Algometer Reading. The Orthopaedic Rating Scale for Myofascial syndrome and the Total NRS-101 had significant differences between the fourth and sixth and the first and sixth

5.4 NON-PARAMETRIC TESTS: INTER-GROUP COMPARISON WITH RESPECT TO CATEGORICAL VARIABLES

The results from the Revised Oswestry questionnaire, Short-form McGill questionnaire and 11-point Box Scale were compared using the Mann-Whitney U-test at the initial (Table 4.10), fourth (Table 4.11) and sixth (Table 4.12) consultations. This indicates that no difference existed between group A and B in terms of the functional disability and pain severity.

5.5 INTRA-GROUP A COMPARISON WITH REPECT TO CONTINUOUS VARIABLES

Using the Paired t-test to find the mean of the difference within group A for the area and type of pain found on the Symptom diagram (Table 4.13), an improvement was found between the initial and final consultation.

5.6 INTRA-GROUP B COMPARISON WITH REPECT TO CONTINUOUS VARIABLES

Using the Paired t-test to find the mean of the difference within group B for the area and type of pain found on the Symptom diagram (Table 4.14), an improvement was found between the initial and final consultation.

5.7 NON-PARAMETRIC TESTS: INTRA-GROUP A COMPARISON FOR CATEGORICAL VARIABLES

When comparing the medians between the first, fourth and sixth consultations using the Friedman's t-test for ordinal data in group A (Table 4.15), a statistical significant difference was found for the Orthopaedic Rating Scale, Revised Oswestry questionnaire, consultations. The Revised Oswestry questionnaire, Short-form McGill questionnaire and 11-point Box Scale were found to have statistically significant differences between the first and fourth, fourth and sixth, and the first and sixth consultations.

5.9 CONCLUSIONS

5.9.1 THE FIRST OBJECTIVE

It can be concluded that SMT and a Placebo belt, does not show any relative effectiveness compared to SMT and a Magnetic belt in the management of mechanical LBP, in terms of subjective clinical findings. The Symptom diagram showed an improvement in both group A and B.

5.9.2 THE SECOND OBJECTIVE

It can be concluded that SMT and a Placebo belt, does not show any relative effectiveness compared to SMT and a Magnetic belt in the management of mechanical LBP, in terms of objective clinical findings.

5.9.3 THE THIRD OBJECTIVE

It can be concluded that SMT and a Placebo belt, does not show any relative effectiveness compared to SMT and a Magnetic belt in the management of mechanical LBP, in terms of subjective and objective clinical findings.

CHAPTER SIX

6. RECOMMENDATIONS AND CONCLUSIONS

6.1 RECOMMENDATIONS

Three major diagnosis of mechanical LBP: Lumbar Facet, Sacroiliac, and Myofascial Pain Syndromes, were included in this study. This resulted in smaller in sample sizes, as variations in the number of individual syndromes or combination of syndromes occurred. Statistical evaluation of these smaller subgroups was subjected to subtle changes in the subjective and objective data, leading to a misrepresentation of the entire group. To achieve a statistically significant difference, the evaluation of large sample sizes of individual syndromes or combination of syndromes is recommended to minimize the chance of Type II error.

To ensure homogeneity within the two groups, further stratification of inclusion and exclusion criteria according to the patient's age, gender, race, occupation, acute and chronic nature of the problem, extent of pain and disability is recommended. This will enhance the interpretation of statistical variations as allows for a uniformity of patient baseline characteristics.

Blinding the examiner collecting and collating the data as to which group the patient fell into could eliminate observer bias. Patients should be blinded as to what form of treatment they were receiving, however magnets are easily testable for magnetism. The chance of patients manipulating the belts therefore needs to be overcome. Honesty was assumed and patient compliance was not examined in this study. Patient compliance could be improved by improving the belt design, for example, a supportive brace with magnets inserted could provide stability and treatment at the same time. Ethically however, patients should be informed that they could be receiving magnetic therapy.

More standard assessment instruments, that develop consistent outcome measures and are responsive to clinically meaningful changes in the patient's health status, are needed to obtain comparative research data. It is recommended that more advanced technology, that is more sensitive and accurate, such as a digital algometer, thermographs, hematological or urine analysis, physiological function tests, and improved questionnaires regarding the patients health status (quality of life, level of function or disability), are used to gauge the therapeutic intervention and will reduce observer bias or human error.

Introduction of a non-treatment, placebo or control group would assess whether spontaneous recovery provided any of the results. Magnetic therapy versus a placebo or manipulation versus magnetic therapy will provide more accurate evaluation of treatment effectiveness. An internationally recognized standardized set of clinical outcomes would facilitate comparative results to similar studies. Intermediate and long-term follow-up assessments would provide an indication of the effectiveness of the interventions, the cost effectiveness.

More studies have been conducted on PEMF and have had some success. Although proof of this does not automatically apply to static magnets and should be further investigated. LBP is a complicated dysfunction, experimentation on less complicated syndromes will help evaluate the effectiveness of magnets. This was a pilot study and it is suggested that more controlled studies are performed for LBP and other conditions. It is important that the treatment protocol and the treatment modalities are clearly defined so that tests can be reproduced. The target tissue and the strength of the magnetic field to penetrate to the target tissue site need to be determined. Either using a higher gauss rating or different types of magnets to increase the depth of magnetic field is recommended. Various configurations of polarity, the use on acupuncture points, PEMF compared to static magnets and, local versus general treatment could be evaluated. The duration of use may be varied and a longer period of evaluation is suggested. Muscle strength testing (kinesiology), if and when scientifically validated, could be useful to find out which placement and pole might be appropriate for the patient's illness.

6.2 CONCLUSIONS

The purpose of this study was to evaluate the relative effectiveness of SMT combined with magnetic therapy or, SMT and a placebo in the management of mechanical LBP, in terms of subjective and objective clinical findings. Although both forms of treatment were effective in relieving the symptoms and signs associated with mechanical LBP, there was no significantly conclusive proof that SMT, when combined with magnetic therapy was more effective than the SMT and placebo. Evaluation of the symptom diagram did indicate that the magnetic belt group had a greater reduction in the type and area of pain, although the method of quantification of this diagram has not yet been validated.

To limit high costs of treatment, which are often compromised by side effects, LBP treatment could benefit from additional a safe, non-invasive, convenient and effective complementary therapy to spinal manipulative therapy (SMT). Clinical guidelines have recommended SMT as an effective treatment, especially for pain of less than 6 weeks duration and the reassuring knowledge is that most simple backache resolves spontaneously. However, a high rate of reoccurrences eventually leads to a history a chronic LBP. This was a pilot study in the use magnetic therapy, as an adjunct to SMT, conducted to question the validity of using this technique as an adjunct to SMT.

In this pilot study, the use of the north/negative field as an adjunct to SMT to treat mechanical LBP was exploratory. It is the author's recommendation that stronger magnets and an improvement in their application is warranted to fully appreciate the therapeutic role of static and electromagnetic fields in the healing arts as a whole.

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APPENDIX A

CASE HISTORY

TECHNIKON NATAL CHIROPRACTIC DAY CLINIC
CASE HISTORY

Patient:______________________________ Date: ________________
file #:_______ X-Ray#:_______________
Age:_______ Sex:_______ Occupation:________________
Intern:_________________________ Signature:________________

FOR CLINICIAN'S USE ONLY
Initial visit clinician:_________________Signature:__________________

Case History:

Examination:
Previous: Current:

X-Ray Studies:
Previous: Current:

Clinical Path. lab:
Previous: Current:

Case Status:

PTT: Conditional: Signed Off: Final Sign out:

Recommendations:

Intern's Case History

1. Source of History:

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

3. Present Illness:

- Location
- Onset
- Duration
- Frequency
- Pain (Character)
- Progression
- Aggravating Factors
- Relieving Factors
- Associated S & S
- Previous Occurrences
- Past Treatment and 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
- Environmental Hazards (Home, School, Work)
- Safety Measures (seat belts, condoms)
- Exercise and Leisure
- Sleep Patterns
- Diet
- Current Medication
- 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 B

PHYSICAL EXAMINATION

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 C

LOW BACK AND PELVIS REGIONAL EXAMINATION

TECHNIKON NATAL CHIROPRACTIC DAY CLINIC

REGIONAL EXAMINATION - *LUMBAR SPINE AND PELVIS*.

PATIENT: ______________________________

FILE #: ____________________ DATE: ______________

INTERN/RESIDENT: ______________________________

SUPERVISING CLINICIAN: ______________________________

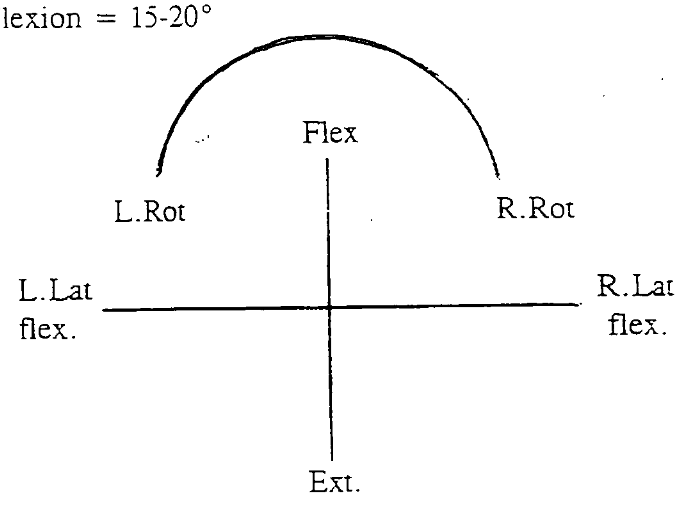
STANDING:

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 D

PATIENT INFORMED CONSENT FORM

INFORMED CONSENT FORM

(To be completed by patient / subject)

ate :

---

itle of research project : **The efficacy of Static Magnetic Therapy as an adjunct to Chiropractic Manipulation for the treatment of Mechanical Low Back Pain**

Name of supervisor : **Dr H. White**

Name of research student : **Lyn Terry**

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? a) at any time b) without having to give any a reason for withdrawing, and c) without affecting your future health care.	Yes	No
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 necessary information before signing

Please Print in block letters:

Patient /Subject Name:______________________ Signature:______________________

Parent/ Guardian:______________________ Signature:______________________

Witness Name:______________________ Signature:______________________

Research Student Name:______________________ Signature:______________________

APPENDIX E

PATIENT INTRODUCTORY LETTER

Chiropractic Clinic: 204-2205
204-2512
Cell phone: 083-470 4474

Dear Participant,

Welcome to this exciting research study. You are one of sixty people who have been selected to participate in a clinical trial which will help chiropractors find a more effective treatment for low back pain. This is a common cause of disability and lost working days and is only second to heart disease in its prevalence.

You will be placed into one of two treatment groups, each receiving similar treatments and assessments. You will be asked to fill in questionnaires as honestly as possible to assess changes in your back pain and to draw conclusions form this. Six treatments over a two week period will be given where your spine will be manipulated under the supervision of a qualified chiropractor.

On your first consultation you will recieve a belt containing magnetic or non-magnetic discs. You are required to wear this at night for eight hours prior to waking in the morning during the two weeks of treatment. The tan, fluffy side is to be placed facing the skin and firmly secured around your waist so that the discs are overlying the lumbar sacral region.

Continue in your normal daily habits but refrain from doing any new or unaccustomed activities. Avoid any other therapy during the study as it can affect the outcome of this treatment regimen. Please refrain from taking medication (including homeopathic remedies). Avoid placing the belt anywhere near bank cards, video tape or any magnetically sensitive devices as it can damage them. There are no known side effects of weak magnetic field, however, the effect on pregnant women is still undetermined so please inform me if you do fall pregnant.

The treatments are free of charge however, the belts will be reused in this trial. If you do wish to discontinue the trial, please first consult me and return the belts as only a limited number are available for this study. If you cannot attend your treatment at the appointed time, please reschedule as soon as possible.

Your assistance is greatly appreciated. Sincerely yours,

Lyn Terry
6th year Chiropractic Resident

APPENDIX F

ORTHOPAEDIC ASSESSMENT RATING

ORTHOPAEDIC ASSESSMENT RATING

Patient's Name	Date:
File No.	Treatment No.
Group No.	

LUMBAR FACET SYNDROME		SACROILIAC SYNDROME		MYOFASCIAL DYSFUNCTION SYNDROME	
KEMPS TEST [4]		POSTERIOR SHEAR TEST [4]		REFERAL OF PAIN [4]	
LUMAR FACET CHALLENGE [4]		GAENLENS TEST [2]		LOCAL TWITCH RESPONSE [2]	
PRONE HYPER-EXTENSION TEST [2]		PATRICK FABER TEST [2]		TAUT PALPABLE BAND [2]	
		ERICHSONS TEST [2]		EXQUISITE FOCAL TENDERNESS [2]	
TOTAL OUT OF 10 PER SYNDROME					
MEAN RATING:					

APPENDIX G

ALGOMETER READINGS

ALGOMETER READINGS

Patient's Name:

Date:

File No:

Group No:

Site Description	Site	Treatment		
		First	Third	Sixth
L1 - LEFT	A			
L1 - RIGHT	B			
L5 - LEFT	C			
L5 - RIGHT	D			

APPENDIX H

OSWESTRY LOW BACK DISABILITY QUESTIONNAIRE

Low back pain and Disability Questionaire (Revised Oswestry)

tient Name:________________________________ File no:______________Date____________

is questionnaire has been designed to give the doctor information as to how your back pain has affected your ability to manage everyday life. Please s ery 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 ction .elate 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.

APPENDIX I

NUMERICAL PAIN RATING SCALE-101

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 **<u>when it is at its worst</u>**. 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 **<u>when it is at its least</u>**. 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 J

SHORT-FORM McGILL PAIN QUESTIONNAIRE

Short-form McGill Pain Questionnaire (SF-MPQ)

Ronald Melzack (1984)

Date:_______________ File no.:_______________ Visit no:____

Patient name:____

	NONE 0	MILD 1	MODERATE 2	SEVERE 3
THROBBING				
SHOOTING				
STABBING				
SHARP				
CRAMPING				
GNAWING				
HOT-BURNING				
ACHING				
HEAVY				
TENDER				
SPLITTING				
TIRING-EXHAUSTING				
SICKENING				
FEARFUL				
PUNISHING-CRUEL				

APPENDIX K

11-POINT BOX SCALE

11-POINT BOX SCALE

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

0	1	2	3	4	5	6	7	8	9	10
No pain										Excruciating pain

APPENDIX L

SYMPTOM DIAGRAM

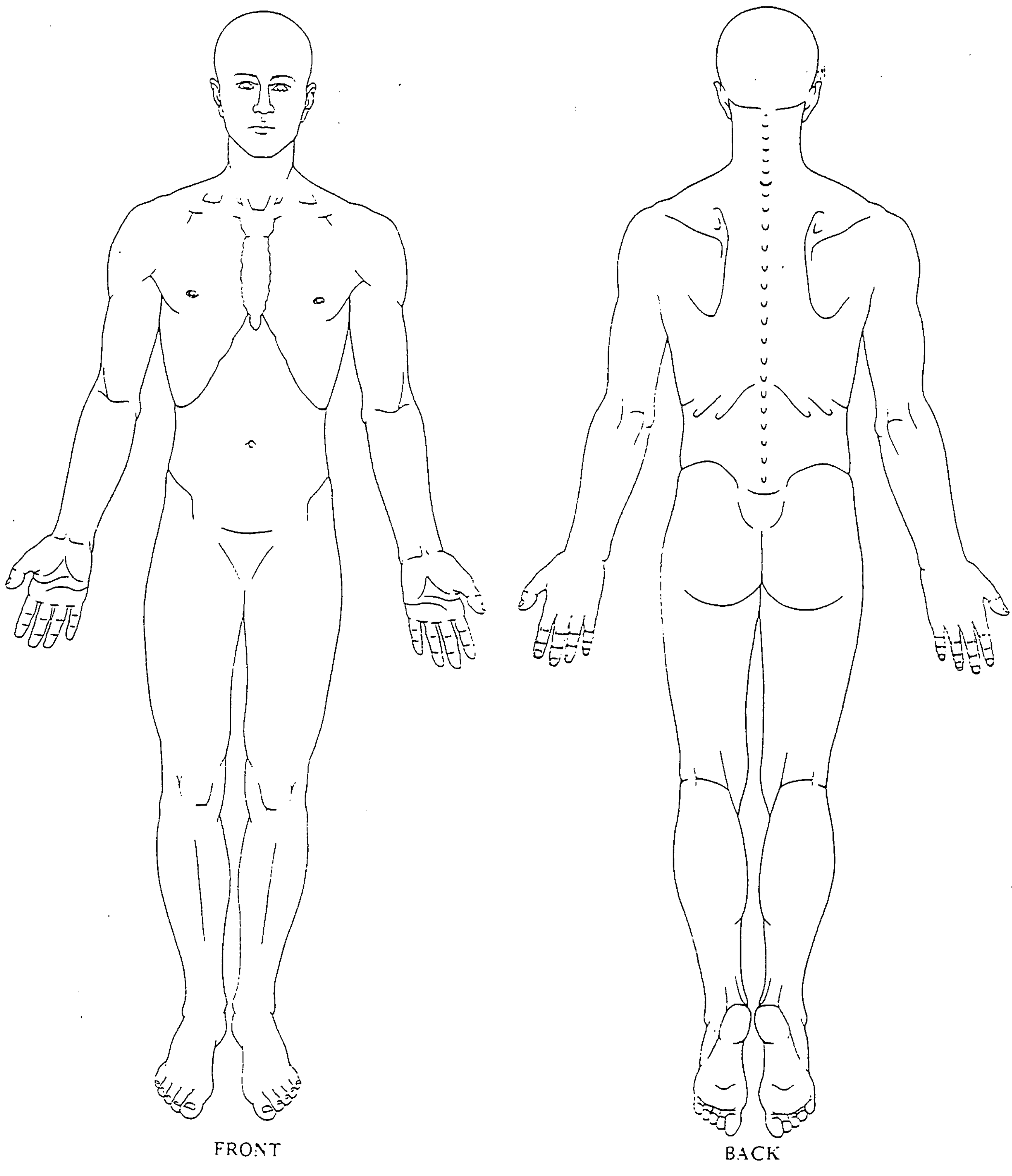
SYMPTOM DIAGRAM

PATIENT NAME:.. FILE NO:................ DATE:...............

In the diagram provided below, please mark the areas on your body which you feel best represents the pain (s) or sensations (s) you are experiencing. Please include all areas. Use the symbols provided below.

SYMBOLS:

NUMBNESS	= = = =	PINS AND NEEDLES	....
BURNING	XXXX	STABBING AND SHARP	////////
DULL AND ACHING	+++—	STIFF AND TIGHT	ZZZZ



APPENDIX M

DIFFERENCE IN POLES

APPENDIX M

The proposed reactions by Philpott 1990, compiled from other's research and clinical observations of this medical author:

NORTH POLE	SOUTH POLE
Negative magnetic field energy	Positive magnetic field energy
Increases cellular oxygen*	Decreases cellular oxygen*
Pulls fluids and gasses	Pushes fluids and gasses
Reduces fluid retention	Increases intracellular edema
Encourages deep restorative sleep	Stimulates wakefulness
Fights infection	Accelerates microorganism growth
Supports biological healing	Inhibits biological healing
Reduces inflammation	Can increase inflammation
Normalizes acid base balance	Acidic metabolic response
Relieves/stops pain	Increases pain
Relieves withdrawal symptoms by reducing inflammation (nonaddicting)	Relieves withdrawal be endorphin production (addicting)
Can reduce/stop symptoms	Can intensify symptoms
Promotes mental acuity & reasonableness	Promotes mental over activity & unreasonableness
Reduces/dissolves fatty deposits	Encourages fatty depositing

*Indirect evidence

The action of Negative (South seeking) and Positive (North seeking) fields according to Norris (1995: 18):

NEGATIVE FIELD	POSITIVE FIELD
Increases negative ions	Increases positive ions
Increases cellular oxygen	Decreases cellular oxygen
Acts to relieve, inhibit and control pain of chronic ailments	Acts to increase pain of chronic ailments
Acts to relieve stress symptoms by sedating and calming	Acts as a stimulant on the body
Promotes restful sleep	Can result in mental hyper-activity and increase symptoms of stress
Acts to increase alkalinity	Acts to increase acidity
Can disperse acu-site points	Can tonify acu-site points
Can improve hyper conditions of major organs	Can improve hypo conditions of major organs
Fights and counters infection	Promotes bacterial growth (infections)
Acts to relax muscle tissue	Acts to contract muscle tissue
Assists fat burning	Can act to increase fat build up
Encourages healing and repair of tissue	Negative effect on healing and tissue repair
Acts on pineal gland to increase melatonin and growth hormone secretion	Can assist in treatment of bruising or inflammation of soft tissue not associated with infection