A PILOT STUDY TO DETERMINE THE PRELIMINARY EFFECTS OF SPINAL MANIPULATIVE THERAPY ON FUNCTIONAL DYSPEPSIA IN ADULTS

By

Dr Melanie Jill Sweidan

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

I, Melanie Jill Sweidan, do hereby declare that this dissertation is representative of my own work, both in conception and execution (except where acknowledgements indicate to the contrary).

……. ……..

Dr Melanie Sweidan (M.Tech.Hom) Date

Approved for final examination

……. ……..

Dr N de Busser (M.Tech.Chiro,M.Med(Sports Med) Date

For Brannin, Ava and Eli.

Acknowledgements

I wish to express my sincere gratitude to the following people:

My supervisor, Dr Nikki de Busser, thank you for your steadfast guidance and support through this task.

Tonya Esterhuizen for the statistical analysis provided.

Dr Richard Steele for proofreading and editing.

The Chiropractic Department at the Durban University of Technology (DUT).

Clinic staff at the Chiropractic Day Clinic at DUT.

Thank you to all the patients who participated in this study.

Abstract

BACKGROUND

Functional dyspepsia is a chronic pain/discomfort centred in the upper abdomen in the absence of any known structural cause. Epidemiological studies have shown that functional dyspepsia is a common complaint affecting all population groups that over time places considerable financial strain on public and private resources due to frequent doctors' visits and expensive diagnostic procedures. The development of non-surgical and non-pharmaceutical treatments of functional dyspepsia would not only make economic sense but would also provide a means to improve patients' quality of life in the least invasive way possible. Although not traditionally seen to be within the chiropractic scope of practice, anecdotal evidence suggests that chiropractic care and management may have the ability to alleviate visceral symptomatology.

OBJECTIVES

The purpose of this placebo controlled pilot study was to evaluate the preliminary effects of chiropractic manipulation versus inactive laser in the treatment of adult patients suffering from functional dyspepsia. Due to the small sample size, time and budgetary constraints it was hypothesised that the dyspepsia symptoms of participants treated with active chiropractic manipulation would not respond more favourably to the treatment, nor would these patients experience a greater improvement in terms of quality of life, compared to those participants receiving placebo treatment.

METHOD

Thirty participants with pre-diagnosed functional dyspepsia were selected after being screened according to the inclusion and exclusion criteria identified by the researcher. These participants were then divided into two groups using consecutive sampling. Data was collected at the Chiropractic Day Clinic at the Durban University of Technology.

Group A received an active chiropractic manipulation using diversified technique to pre-identified levels in the cervical, thoracic and lumbar spine. Group B received inactive laser to pre-identified levels in the cervical, thoracic and lumbar spine. Both groups received one treatment a week for three weeks. The fourth and final consultation consisted only of data capturing.

At each visit both groups of participants filled in three validated questionnaires:

- The numerical pain rating scale;
- PAGI-SYM physical symptom assessment;
- QOLRAD quality of life assessment.

RESULTS

Results were statistically analysed using IBM SPSS version 20 and a p value ≤ 0.05 was considered to be statistically significant. Repeated measures ANOVA testing was used to assess the effect of each of the treatments separately and to assess the comparative effects of the spinal manipulation vs the placebo.

CONCLUSION AND RECOMMENDATIONS

The gathered results and analysis were statistically insignificant. Clinical improvement in their symptomotology was however noted within both groups over the trial period in terms of treatment received and their perceived quality of life, symptomatology and pain levels. Both groups tended to have reduced pain and discomfort over time, improved: emotional distress, sleep disturbance, food problems, vitality, post-prandial fullness and abdominal pain. This study should be repeated with selected outcome measurements, and perhaps objective outcome measurements, and a larger sample size in order to determine any benefit.

Table of Contents

List of Figures

List of Tables

List of Appendixes

Glossary of Terms

Barium sulphate swallow: A fine white insoluble powder, used as a radiopaque contrast medium when given orally or as an enema for x-ray visualisation of the gastrointestinal tract (Dox, Melloni and Eisner, 1993: 58)

Duodenal ulcers: Ulceration of the mucous lining of the duodenum (Dox, Melloni and Eisner, 1993: 496)

Dyspepsia: Indigestion, there may be abdominal discomfort, flatulence, nausea and sometimes vomiting (Weller and Wells, 1992: 155).

Dysphagia: Difficulty in swallowing (Dox, Melloni and Eisner, 1993:139)

Endoscopy: Inspection of a canal or any air or food passage by means of an endoscope (Dox, Melloni and Eisner, 1993: 149)

Gastric ulcers: A depressed lesion of the mucosa of the stomach, usually occurring in the lesser curvature (Dox, Melloni and Eisner, 1993: 496).

Gastrin: One of the gastrointestinal hormones released during digestion, it is secreted by the mucosa of the pyloric region of the stomach upon contact with food and it increases the secretion of hydrochloric acid and to a lesser degree pepsin (Dox, Melloni and Eisner, 1993: 180)

Gastritis: Inflammation of the stomach (Dox, Melloni and Eisner, 1993: 180).

Haematemesis: Vomiting of blood (Dox, Melloni and Eisner, 1993: 197)

Heartburn: Burning sensation in the lower chest and upper central area of the abdomen, caused by irritation of the esophagus, also called pyrosis (Dox, Melloni and Eisner, 1993: 196)

Helicobacter pylori: Gram negative, S-shaped spiral bacterium found in secreting cells of the antral area of the stomach, responsible for type B chronic gastritis (Dox, Melloni and Eisner, 1993: 196).

High resolution manometry: When food passes from the oesophagus into the stomach, reflux is prevented back into the oesophagus by the lower oesophageal

sphincter. This sphincter has a pressure gradient of between 10 and 30mmHg, however a pressure of only 5 to 10 mmHg is needed to prevent reflux. High resolution manometry is used to measure the pressure activity in the gastrointestinal tract and is used to detect changes within the lower oesophageal sphincter when relaxed (Anderson, 2010: 252)

Non-steroidal anti-inflammatory: Abbreviated NSAID's. A group of drugs having analgesic, antipyretic and anti-inflammatory activity due to their ability to inhibit the synthesis of prostaglandins. It includes aspirin, phenylbutazone, indomethacin, tolmetin and ibuprofen (Weller and Wells, 1992: 334)

CHAPTER ONE: INTRODUCTION

1.1 INTRODUCTION

Functional dyspepsia is a non-life threatening condition which, whilst it has not been shown to be associated with increased mortality, has been shown to have a considerable impact on patients' quality of life and health care resources (Mahadeva and Goh, 2006: 2661). Allescher (2006: 2) noted that advances in medicine and drug therapy over the last 30 years has resulted in several theories being put forward as a possible aetiology for functional dyspepsia. He postulates a multi-causal aetiology leading to altered processing of afferent information from the gastrointestinal tract to the central nervous system. In functional dyspepsia changes in gut motility, chronic inflammation and changes in gut and intestinal secretion could increase neural afferent inputs within the autonomic nervous system. The possibility therefore exists that treatment aimed at altering autonomic reactivity in the area may be of benefit.

The somatovisceral reflex can be defined as: "a reflex in which visceral functions are activated or inhibited by somatic sensory stimulation" (Mosby, 2009: 1730). In a broad context this reflex is under autonomic nervous system control whereby excitatory sympathetic and inhibitory parasympathetic stimuli work in opposition to each other to regulate homoeostasis and function within the body (Masarsky and Todres-Masarsky, 2001: 137). Whilst beyond the scope of this research it should be said that, subtleties exist within this homoeostatic mechanism of the sympathetic and parasympathetic system. This is illustrated by Malliani (1997:158) who says that excitatory positive feedback mechanisms as well as inhibitory negative feedback mechanisms at the level of the spinal nerve pathway, supra-spinal pathway or the brainstem, exists for both the sympathetic and parasympathetic nervous system. These delicate intricacies of the autonomic nervous system has provided rich research for the field of neuroscience and various animal studies have been conducted to attempt an explanation of the somatovisceral reflex phenomenon. These studies have elicited a definite link between somatic stimulation and visceral functioning in relation to adrenal function (Budgell *et al*., 1997: 33), cardiac function (Kimura *et al*., 1996c: 91), splenic sympathetic and natural killer cell activity (Kagitani

et al., 1996b: 109) and bladder function (Hubscher, Ezidin and Kaddumi, 2006: 349).

A review of the literature with regards to chiropractic intervention and gastrointestinal disorders shows a possible link between therapeutic benefit and somatovisceral reflex stimulation. Young, McCarthy and King (2009: 30) identified specific areas along the spine according to their visceral innervations. The researchers performed spinal manipulation using diversified technique (Peterson and Bergmann, 2011: 152) to the mid cervical spine (the origin of the phrenic nerve, C3-C5) and the thoraco-lumbar spine (the origin of the lesser splanchnic nerve and the levels of diaphragmatic insertion, T5-L2), in order to elicit and record any changes in symptomatology and perceived quality of life in subjects.

The research problem in this pilot study was addressed using the following theoretical framework:

- The functioning of the autonomic nervous system.
- A literature review of studies showing positive evidence as to the existence of the somatovisceral reflex.
- Somatovisceral theory within chiropractic.
- Possible effects of chiropractic subluxation on visceral pathology based on the literature reviewed.
- Clinical trial to determine the preliminary effects of spinal manipulative therapy on gastrointestinal symptoms and patients quality of life.

1.2 AIMS AND OBJECTIVES

The primary aim of this pilot study was to determine the preliminary effects of spinal manipulation versus placebo (inactive laser) on functional dyspepsia in adults with regards to patients' perceived quality of life, symptomatology and the need for dyspeptic medication. This aim was achieved by means of:

1. Evaluation of the efficacy of spinal manipulation on functional dyspepsia in terms of:
    - The quality of life in dyspepsia (QOLRAD) questionnaire (Appendix I);
    - The patient assessment of gastrointestinal symptom severity index (PAGI-SYM) questionnaire (Appendix J);

- Numerical pain rating scale (Appendix H).

2. Evaluation of the efficacy of placebo inactive laser on functional dyspepsia in terms of:
    - The QOLRAD questionnaire (Appendix I);
    - The PAGI-SYM questionnaire (Appendix J);
    - Numerical pain rating scale (Appendix H).
3. Comparisons between the results of spinal manipulative therapy versus placebo inactive laser in the treatment of functional dyspepsia in adults.
4. A literature review regarding the role of the autonomic nervous system and the possibility of a somatovisceral reflex in functional dyspepsia in adults.
5. To assess the feasibility of a larger scale study in terms of the recruitment potential, chosen methodology, time and budget needed.

1.3 RATIONALE

Various small studies have been conducted in South Africa on the effect of somato-visceral reflex paths in the chiropractic management of various disorders, although not peer-reviewed, they all suggested the use of chiropractic as an additional treatment modality for such disorders, including: infantile colic (Koonen, 2002), irritable bowel syndrome (Barker, 2005) and chronic idiopathic constipation (Vadachia, 2006). To date no studies on chiropractic manipulation and functional dyspepsia have been conducted in South Africa. In the United Kingdom a pilot study (n = 603) on the chiropractic management of functional dyspepsia conducted by Young, McCarthy and King (2009: 30) showed an improvement in severity and frequency of symptoms over a three month treatment period, with most patients reporting decreased frequency and severity of symptoms with many being able to reduce or eliminate medication usage.

1.4 HYPOTHESES

Given the fact that there are so few studies on the topic, the following null hypotheses were set to address the aims and objectives mentioned above:

1. Spinal manipulative therapy will have no effect on patients' dyspeptic symptoms and their perceived quality of life.

2. Inactive laser (placebo) will have no effect on patients' dyspeptic symptoms and their perceived quality of life.
3. There will be no difference between the two groups.

1.5 ASSUMPTIONS

Manual therapies have been traditionally thought of and used as treatment for musculoskeletal conditions, however the following studies suggest that these modalities can influence the autonomic nervous system in a favourable way to elicit therapeutic results:

- Physiotherapy: the possibility of segmental (type III afferents) and supra-segmental (type II, III and delta afferents) facilitation of the autonomic nervous system following connective tissue manipulation (Holey, 1995: 366).
- Acupuncture: gastrointestinal sphincter modulation (Chiu, 2002: 141), chronic constipation (Tsai and Wang, 2012: 127), gastrointestinal motility disorders (Chen and Yin, 2010: 31).
- Osteopathy: non-cardiac shortness of breath (Berkowitz, 2011: 2).
- Chiropractic: improved non musculoskeletal symptoms reported after spinal manipulative therapy (Lebouf-Yde *et al*., 1999: 559), visceral responses to spinal manipulation (Budgell and Bolton, 2012: 1) and infantile colic (Hipperson, 2004: 180).

Chiropractic manipulation is a form of manual therapy that uses a controlled force directed at a specific joint which produces mechanical, soft tissue, neurologic and psychological effects (Gatterman, 2005: 305). Like any therapeutic modality chiropractic has at its foundation many theories as to its mechanism of action, one is that a vertebral subluxation complex can interfere with the neurophysiologic balance within the body, which could impact on visceral reflex pathways at the level of the spinal joints causing symptoms within the viscera known as the somatovisceral reflex (Leach, 2004: 288). Literature review is still unclear as to the clinical significance and relevance of this principle, and the question is asked, would the application of a manipulation to said vertebral subluxation then relieve the symptoms displayed within the viscera? The paucity of reliable literature does not allow for an answer, but very good animal studies do show this principle to some degree in relation to the gastrointestinal system. Budgell and Suzuki (2000:162) elicited inhibition of gastric

motility by introducing a noxious chemical stimulation to the inter-spinous tissues in a rat. Their results suggested a segmentally organised reflex principally mediated at the spinal level. Their attempt to tackle this neurophysiological mechanism may add impetus to the principle stated above if one equates noxious chemical stimuli to vertebral subluxation.

1.6 LIMITATIONS

- This study was limited to its clinical outcomes and although it broadly discusses somatovisceral phenomena it does not attempt to explain in detail the mechanism whereby spinal manipulation could affect functional dyspepsia in a positive or a negative way.
- Budgetary constraints could not cater for a larger sample group which may or may not have shown statistical significance.

1.7 CONCLUSION

This chapter provided an introduction to the research topic with regards to its problem and context within the field of chiropractic. Objectives with relevant hypotheses were highlighted as well as the limitations to the study. The following chapters will provide further understanding of the research problem arising from the literature review and analysis of the results obtained from this clinical trial.

CHAPTER TWO: LITERATURE REVIEW

2.1 INTRODUCTION

This chapter provides an overview of the available literature regarding functional gastrointestinal disease and functional dyspepsia in particular. Further, it explores the definition, current medical care and potential scope for the chiropractic management of its presenting symptoms. The “science of digestion” according to Fukudo, Kuwano and Miwa (2012: 85) is greatly expanding due to the questioning of traditional views of the gastrointestinal system. No longer are the explanations of digestive diseases limited to that of the gastrointestinal tract; explanations now incorporate the impact other systems may be making on the digestive tract. This is especially true for a common and debilitating condition such as dyspepsia.

Dyspepsia is an umbrella term covering a number of symptoms such as upper abdominal pain, bloating and heartburn (Elliot, 2013: 481). More money is spent on the medication used for dyspepsia than any other treatment for a symptom group within gastrooesophageal reflux diseases. Elliot (2013: 481) further says that “universal investigation for this group of symptoms is neither desirable nor affordable: however 40% for those referred to endoscopy are found to have functional dyspepsia.” The question is then asked: if there is no known organic reason for the presenting symptoms, what treatment options with measurable outcomes are available to the patient? The treatment of functional dyspepsia is not common practice within the chiropractic profession, however numerous studies, highlighted below, do indicate a favourable response to visceral pathology following chiropractic intervention.

2.2 ANATOMY OF THE UPPER GASTROINTESTINAL TRACT

2.2.1 General anatomy and histology

As can be seen in Figure 2.1, the upper gastrointestinal system consists of the oesophagus which is a muscular tube that propels food toward the cardiac orifice of the stomach (the arrows show the direction of passage of ingested food). Entry into

the stomach is controlled by the lower oesophageal sphincter below the level of the diaphragm.

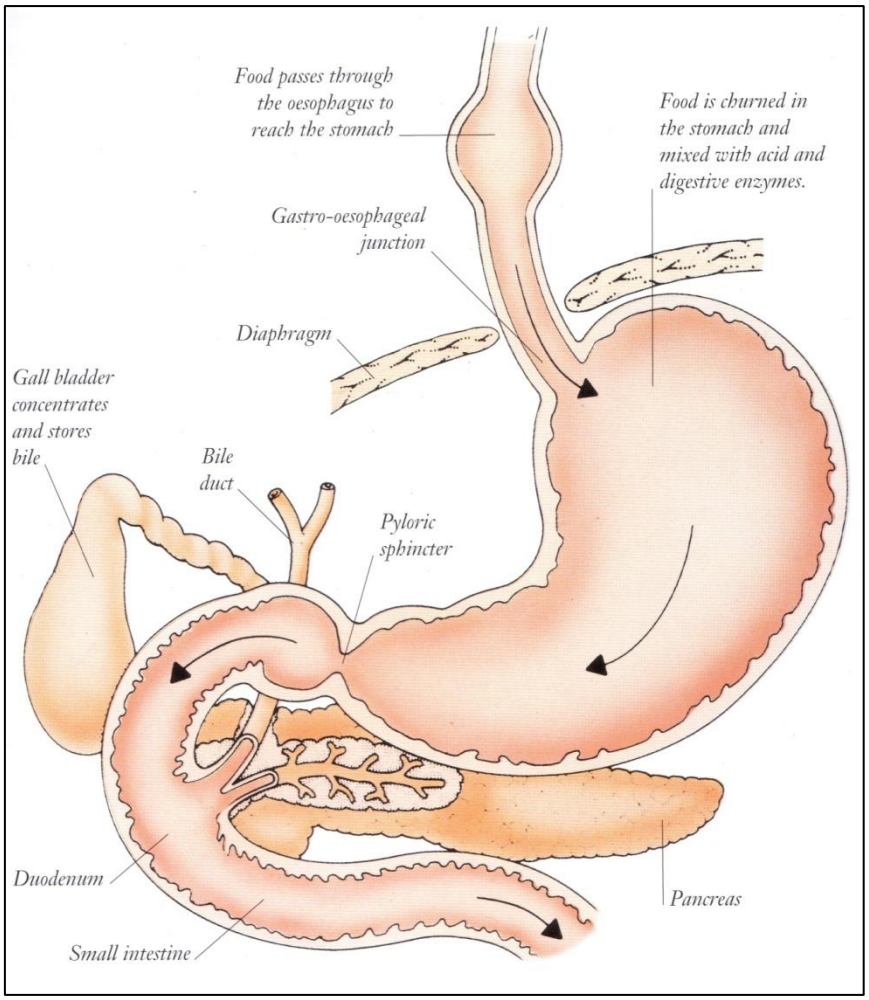


Figure 2.1 Gross anatomy of the upper gastrointestinal tract (Hawkey and Wight, 2000: 11)

The oesophagus consists of stratified squamous epithelium and the stomach mucosa consists of simple or branched tubular glands (Young, McCarthy and King 2000: 251). Haslett *et al.* (2002: 750) highlights the histological tissues that govern the main function of the stomach:

- Gastric secretion: The parietal cells in the stomach secrete hydrogen and chloride ions in response to hydrogen potassium ATPase, forming stomach acid as well as glycoprotein intrinsic factor. This acid sterilises the

gastrointestinal tract and converts pepsinogen into pepsin and the glycoprotein facilitates vitamin B12 absorption.

- Gastrin and somatostatin: The G cells and the D cells secrete the hormones gastrin and somatostatin respectively. Gastrin stimulates and somatostatin suppresses stomach acid secretion.
- Protective factors: Bicarbonate ions and mucous protect the stomach lining from the ulcerative effects of the acid and the pepsin.

A clue to the dynamic nature of the epithelial cells within the gastrointestinal tract is highlighted within the field of stem cell research and cancer therapy by Clevers *et al.* (2010: 25). Their focus on epithelial renewal, inflammation and cancer showed that each surface cell differentiates from the basal layer of stem cells at varied rates ranging from 1 to 160 days. They state that it is therefore beneficial to target stem cells in a treatment regime. Within the parameters of homeostasis stem cells have a cellular turnover rate of 7-10 days, and are responsible for maintaining a steady flow of clonal daughter cells for further differentiation.

2.2.2 Nervous innervations

Furness (2006:2) states, “The autonomic nervous system functions are all related to adjusting the activities of tissues and organs so that they operate at levels that are most favourable to the state of the body and to its interaction with the environment”. This state of homoeostasis is a complex one and is beyond the scope of this research, therefore for the sake of understanding, key concepts of the neurological innervation of the gastrointestinal tract will be elucidated, however it by no means encompasses the subtleties that exist between definitions. Figure 2.2 represents the neurological innervations of the gastrointestinal tract. In the light of the relevance to this study, observe the anterior and posterior vagal trunks, as well as the greater splanchnic nerve.

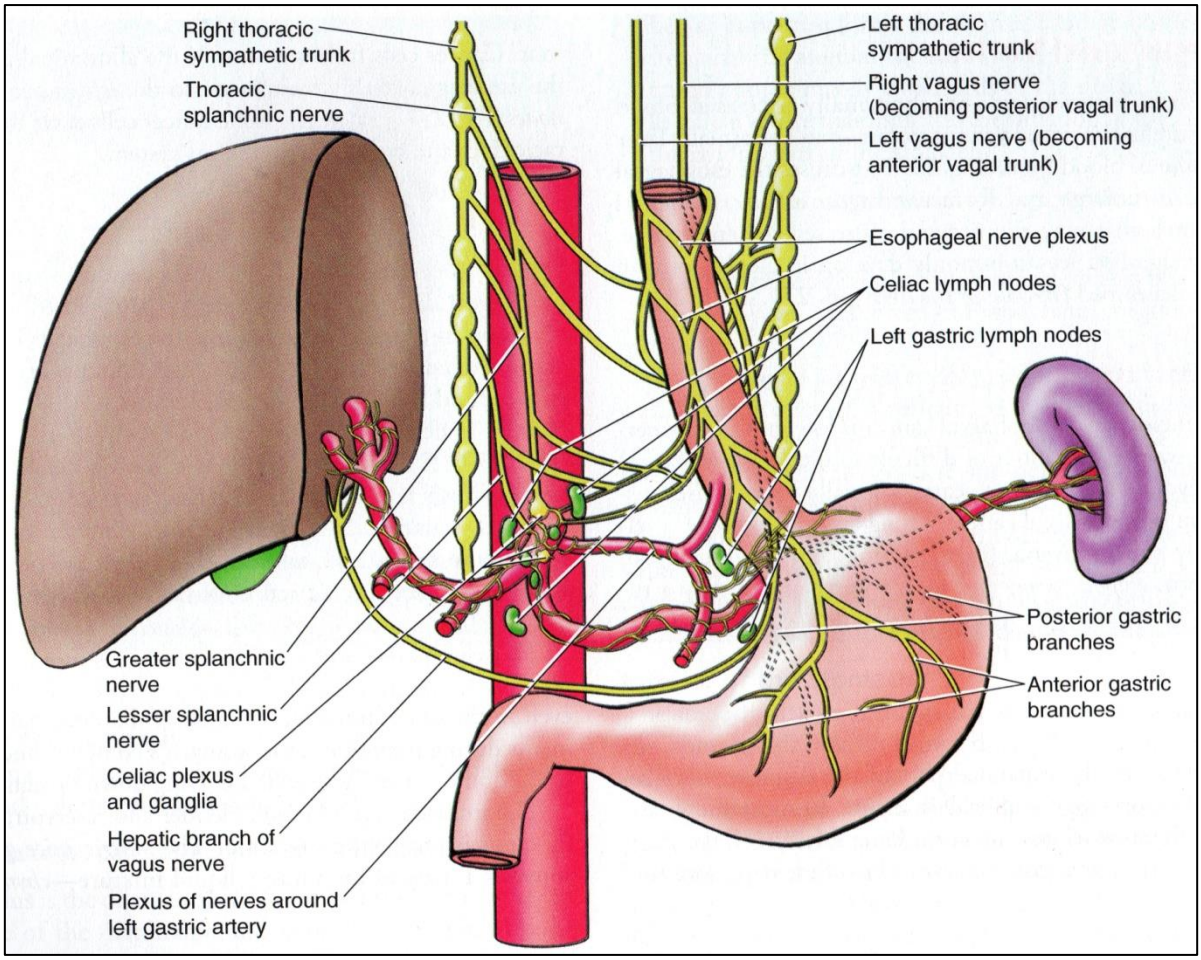


Figure 2.2 Nerves of the stomach (Moore and Dalley, 1999: 225)

The gastrointestinal tract is under autonomic control, which comprises parasympathetic, sympathetic and enteric supply. Interestingly the gastrointestinal tract receives connections from the central nervous system, as well as connections that bypass the central nervous system such as: control circuits within the gut wall and connections between organs such as the stomach and intestines (Furness, 2006:4).

2.2.2.1 Parasympathetic supply

The parasympathetic nervous system arises from the cell bodies of the motor nuclei of cranial nerves III, VII, IX, X and XI in the brainstem, as well as the second, third and fourth sacral segments of the spinal cord. Parasympathetic innervations to the lower two thirds of the oesophagus and the stomach is provided by the vagus nerve (Welch and Boone, 2007:87). More specifically extrinsic motor neuron control as

described by Furness (2000:89) is supplied by vagal motor neurons to the striated muscles of the oesophagus.

2.2.2.2 Sympathetic supply

As can be seen in Figure 2.3, cell bodies of the sympathetic fibres are found in the lateral horns of the spinal segments of T1-L2, more specifically, the sympathetic innervations to the oesophagus and the stomach originate from T5-T9 spinal level, forming the greater splanchnic nerve which synapses at the celiac ganglion (Welch and Boone, 2007:87). Extrinsic motor control of the gastrointestinal tract is supplied by norandrenergic/sympathetic neurons that innervate the sphincters and norandrenergic vasoconstrictor neurons that innervate arteries within the gut wall (Furness, 2000:89).

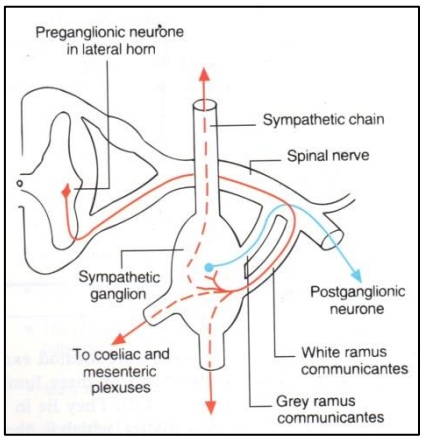


Figure 2.3 Relationships between a typical thoracic spinal nerve and the sympathetic chain (Crossman and Neary, 2000: 46)

Expanding on Figure 2.3 the diagram in Figure 2.4 shows the origin of the sympathetic and parasympathetic fibres at the level of the spinal cord. The left portion of the diagram shows the visceral afferent pathways to the spinal cord through both the prevertebral and paravertebral ganglia. The right portion of the diagram shows afferent vagal and pelvic nerve input through dorsal root and nodose ganglia. It can be seen that the innervations to the viscera overlap with spinal input to specific spinal segments. The innervations to the stomach and oesophagus via

the greater splanchnic nerve are represented in the thoracolumbar spinal segments (Blackshaw and Gebhart, 2002: 644).

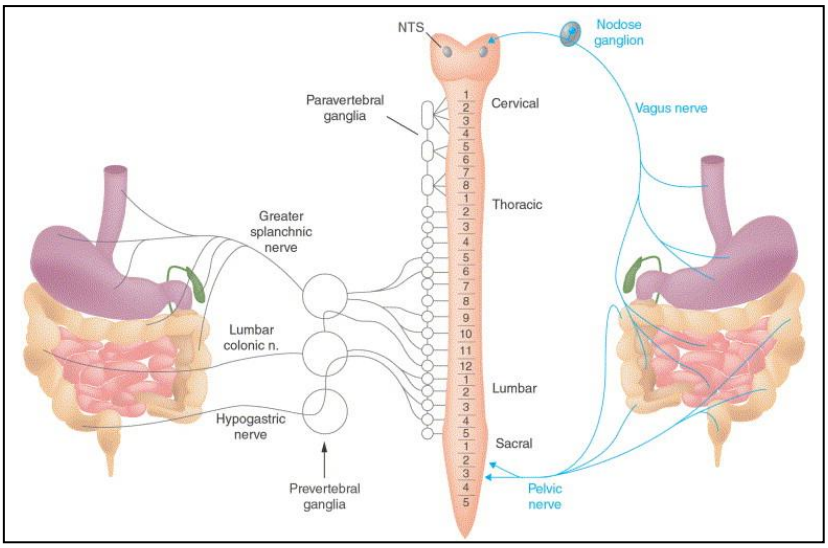


Figure 2.4 Representation of the sensory innervations of the gastrointestinal tract (Blackshaw and Gebhart, 2002: 644)

It has been believed that an increased parasympathetic activity, results in increased stomach acid secretion and the rate of gut peristalsis. On the other hand an increased sympathetic outflow to the gastrointestinal tract increases the vascular tone leading to decreased oxygen and nutrient perfusion to the tissues, as well as decreased peristaltic activity (Branyon, 2008:30). This simplistic classification system has proved challenging especially in defining classification systems within neurophysiology. Malliani's (1997:158) views depict a more complex and interrelated system in that sympathetic and parasympathetic divisions have both excitatory and inhibitory components, and therefore the sympathetic cannot be seen as exclusively excitatory, and the parasympathetic exclusively inhibitory.

2.2.2.3 Enteric supply

The nervous control of the gastrointestinal tract is known as the enteric nervous system. This is an intrinsic system unique to the gut and is classified as a part of the peripheral nervous system and more specifically a division of the autonomic nervous system. This system is both a highly integrated complex of afferent and efferent connections with the central nervous system as well as an autonomously functioning

system separate from central nervous system control (Furness, 2006:4). The current understanding is that functional gastrointestinal disorders result from dysregulation of the bidirectional communication between the gut and the brain (i.e. the brain-gut axis), modulated by various psychosocial and environmental factors (i.e. the bio-psychosocial model). This concept has led to a growing interest in the research of brain function in relation to gut motor and sensory function (Ringel, 2002: 23).

The enteric nervous system is embedded in the walls of the digestive tract as can be seen in Figure 2.5, and extends the entire length of the digestive tract from oesophagus to anus. The ganglia of the enteric nervous system can be found in one of two plexuses (Pachnis and Laranjeira, 2009:61):

- The myenteric/Auerbach plexus

Ganglia are found deep within the external muscle layers (circular and longitudinal) and are primarily concerned with digestive tract motility. Stimulation of these ganglia results in: increased gut wall tone, rhythmical contractions of the gut as well as inhibition to muscles that could impede the movement of food between segments of the gastrointestinal tract.

- The submucosal/Meissner's plexus

Ganglia are found within the submucosa and are primarily responsible for: the control of intestinal secretion, absorption and the contraction of the submucosal muscle.

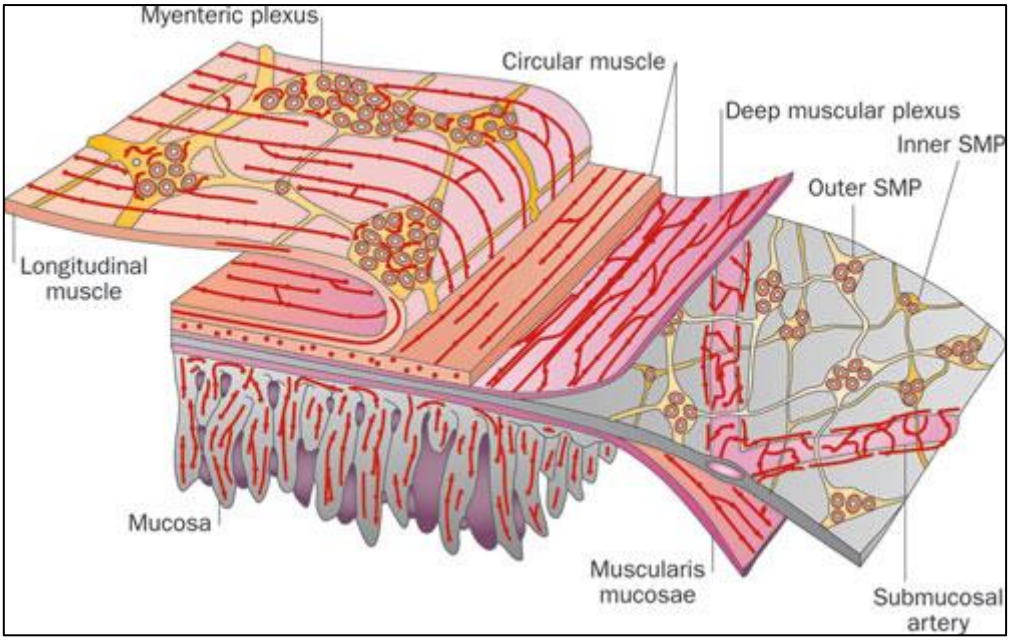


Figure 2.5 The ganglionated plexuses of the enteric nervous system (Furness, 2012)

There are numerous different types of neurons found within the plexuses can be broadly divided into three main classes (Pachnis and Laranjeira, 2009:62):

- Intrinsic primary afferent neurons/sensory neurons (IPANs)

IPANs detect the physical and chemical state of the gastrointestinal organs via specific sensory neurons such as: mucosal chemosensors, mucosal mechanoreceptors and stretch responsive neurons (Furness, 2000:92).

- Intrinsic excitatory and inhibitory motor neurons

This group of neurons directly influence the smooth muscle and endocrine cells found within the enteric nervous system, and collectively function to control gastrointestinal motility, secretion and absorption. They comprise of: excitatory and inhibitory neurons to the gut muscles, secretomotor neurons, vasodilator neurons and neurons that innervate entero-endocrine cells such as gastrin secreting cells (Furness, 2000:89).

- Ascending and descending interneurons

Orally directed ascending cholinergic neurons and anally directed descending neurons act as intermediaries between signals of the IPANs and motor neurons as

well as other interneurons within the different ganglia of the enteric nervous system (Furness, 2009:91).

2.2.3 Diaphragmatic innervations

The phrenic nerve is the main nerve supply to the diaphragm, due to their common embryonic association. As can be seen in Figure 2.6 the phrenic nerve, from both sides of the body, originates from the ventral rami of the third to the fifth cervical nerves, and contributes mainly to the motor fibres of the hemi diaphragm. Sensory fibres of the phrenic nerve, which supply the peripheral attachments of the muscle, refer pain to the C4 dermatome. The relevance of the phrenic nerve to this study is its association to the diaphragm and the subsequent presence of a hiatus hernia. According to Haslett *et al.* (2002: 775) hernias develop when parts of the stomach pass through the diaphragm into the thoracic cavity. The pressure gradient is lost between the abdomen and thorax which normally pinches across the lower oesophageal sphincter and physically contributes to its overall tone. Hernias have been shown to contribute to the pathogenesis and subsequent dyspeptic symptoms seen in gastroesophageal diseases.

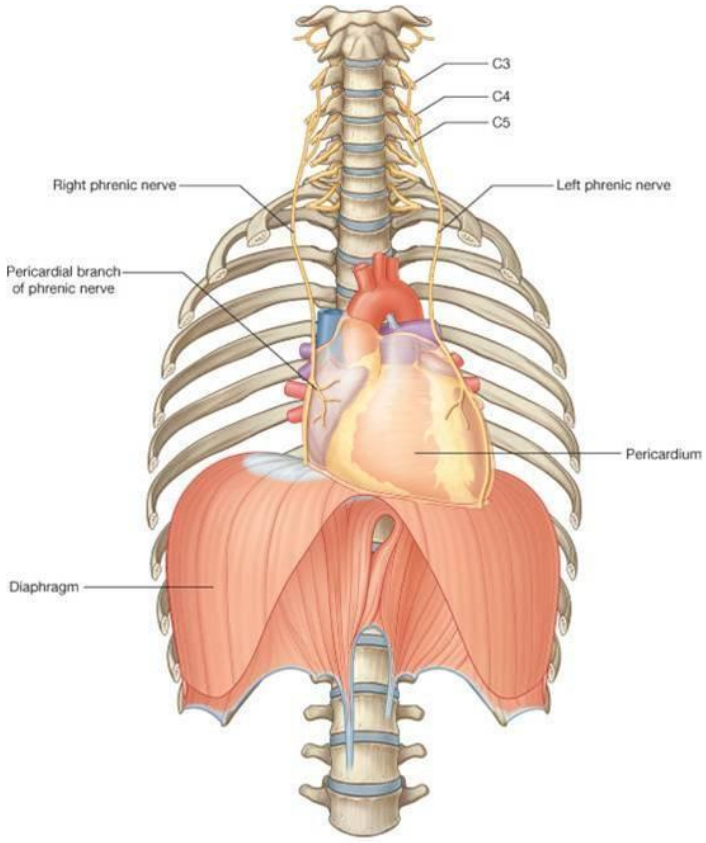


Figure 2.6 Location of the phrenic nerve (www.studyblue.com)

2.3 FUNCTIONAL GASTROINTESTINAL PATHOLOGY

Functional gastrointestinal disorders represent any condition where a combination of chronic or recurrent symptoms exists that is not explained by structural or biochemical abnormalities. This results in 'functional' pathology, such as functional dyspepsia and irritable bowel syndrome, where patients experience symptoms but in the absence of organic verifiable causes. With the absence of any objective marker, the identification and classification of functional gastrointestinal disorders (FGIDs) are therefore largely based on symptoms (Corazziari, 2004: 613). The most widely accepted symptom classification is based on the 'Rome III diagnostic criteria,' which have classified 24 FGIDs into oesophageal, gastroduodenal, bowel, biliary, anorectal and abdominal pain subcategories. This classification has been useful in attempting to ascertain the epidemiological impact of these types of disorders (Corazziari, 2004: 613). According to Young, McCarthy and King (2009: 28) this epidemiological impact is demonstrated by the fact that dyspepsia has a prevalence in Western populations of about 7% in adults who suffer daily and up to 45% monthly, they state however

that this may be an under representation of the degree of suffering as only 5-17% of those with dyspeptic symptoms actually seek medical attention. The successful management of FGIDs according to Smith (2005: 548) remains an “elusive goal” for gastroenterologists, and what were thought to be appropriately targeted pharmaceutical agents such as prokinetic drugs and anti-depressants have proven disappointing.

2.3.1 Quality of life

The aspect of a patient’s quality of life is a subjective entity that broadly refers to those factors that make life worth living for the individual patient with a disease (Talley, 1996: 21). Quality of life assessments, usually in the form of verified questionnaires, are necessary to measure the ‘functional status’ of patients. According to Talley (1996: 21) this functional status encompasses concepts such as the patient’s health perception, physical, emotional and social wellbeing, which have been identified as key factors in the assessment of patients with conditions such as functional gastrointestinal disorders. Chang (2004: 31) reports that quality of life is “significantly impacted in patients with FGIDs” especially when compared with the general healthy population as well as to patients with other chronic disease such as gastroesophageal reflux disease and asthma.

2.3.2 Functional pathology and models of disease

In a paper published in the *British Medical Journal* authors Wade and Halligan (2004: 1398) question whether “biomedical models of illness make for good healthcare systems”. In light of the prevalence of functional gastrointestinal pathology as referred to above, this question cannot be more pertinent to the analysis of functional disease. The use of models in healthcare has been widely accepted as a blueprint for focus driven assessment and treatment of a diseased individual. They provide a framework to aid in the diagnosis and treatment of a particular pathology (Wade and Halligan, 2004: 1398). Until recent times the traditional biomedical model has been used as the mainstay for the explanation of diseases and subsequent healthcare delivery. The biomedical model is based on reductionist reasoning which centres on certain core beliefs and assumptions:

- All diseases arise from an underlying abnormality within the body (usually in the functioning or structure of specific organs).

- All diseases give rise to symptoms and health is the absence of disease.
- Mental phenomena, such as emotional disturbance are separate from and unrelated to disturbances of bodily function.
- The patient is a victim of circumstance with little responsibility for the presence or cause of the illness.
- The patient is a passive co-operative recipient of treatment.

Wade and Halligan (2004: 1399) state that whilst the biomedical model has been associated with huge improvements in medical care it still falls short in explaining functional somatic syndromes and illnesses without discernible disease. This thinking is not new and psychiatrist G.J. Engel as early as 1977 first highlighted a new model termed the 'bio-psychosocial model'. He states "the dominant model of disease today is biomedical, and it leaves no room within its framework for the social, psychological, and behavioural dimensions of illness. A bio-psychosocial model is proposed that provides a blueprint for research, a framework for teaching, and a design for action in the real world of health care". Patients often experience anomalous problems which only now are starting to be incorporated into newer models. Wade and Halligan (2004: 1400) show that new models like the bio-psychosocial are needed to take into account psychological and social factors which can strongly influence the presentation of somatic symptoms in terms of patient functioning, disability and health. Disease is seen to be a consequence of a variety of elements which are influenced by contextual factors. The assumptions for these newer models can be summarised as follows:

- Illnesses can occur without discernible pathology
- Functional non-organic illness is no longer medically unexplained and therefore there is greater support for a wider array of treatment options
- The effects of pathology may be due to abnormalities of other parts of the body; therefore therapeutic intervention may be needed at several points, and may not necessarily include removal of the main abnormality
- Objective and subjective symptomatology are analysed within the physical, social and personal context of the patient.

Figure 2.7 illustrates how the bio-psychosocial model highlighted above can be applied to functional gastrointestinal disorders in terms of diagnoses and treatment

(Wu, 2012). According to Wu, “concomitant psychological disorders, notably anxiety and depressive disorders are strongly associated with FGID and these psychological co-morbidities correlate with severity of FGID symptoms.” There is mounting evidence showing that psychological disorders are commonly associated with abnormal central processing of visceral noxious stimuli. Psychotropic agents such as antidepressants and psychological intervention such as cognitive behavioural therapy and meditation have been reported to be effective for alleviation of gastrointestinal symptoms and quality of life in FGID patients. The significance of this then would be the choice of treatment modalities which would never be considered if the biomedical model alone is used in functional disorders.

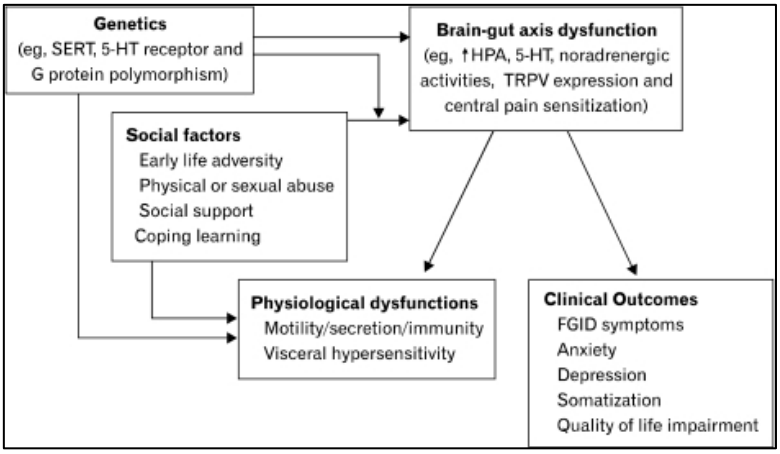


Figure 2.7: Schematic diagram illustrating the pathophysiologic links between functional gastrointestinal disorder and psychiatric disorders (Wu, 2012)

2.4 FUNCTIONAL DYSPEPSIA

Functional dyspepsia falls into a category of gastrointestinal disorders in which symptoms are caused by functional abnormalities rather than by organic means. This chronic disorder is characterised by non-specific upper abdominal symptoms that are compromising and bothersome and result in a lowered quality of life (Allescher, 2006: 2). Patients display common dyspeptic symptoms such as epigastralgia, heartburn, nausea, belching and post-prandial fullness (Tack *et al.*, 2006: 1466) but do not show evidence of organic disease in the upper gastrointestinal tract when examined by endoscopy and computed tomography (Miwa, 2012: 862b). Functional dyspepsia is a non-life threatening condition which,

whilst it has not been shown to be associated with increased mortality, has been shown to have a considerable impact on a patient's quality of life and health care resources (Mahadeva and Goh, 2006: 2661).

2.4.1 Definition

The formulation of a formal definition of functional dyspepsia according to Yarandi and Christie (2013: 1) has been a challenge due to the fact that the "diagnosis as well as the management of the condition remains a clinical dilemma for physicians". Nevertheless a few definitions have been put forward. According to Tack *et al*. (2006: 1466) functional dyspepsia can be defined as: "the chronic or recurrent pain/discomfort centred in the upper abdomen in the absence of any known structural cause and without any features of irritable bowel disease". According to Rome III criteria (Yarandi and Christie, 2013: 1), it is defined as "the presence of postprandial fullness, early satiation, epigastric pain, or burning in the absence of organic disease to explain the patients symptoms." Rome III criteria further subdivide functional dyspepsia into postprandial distress syndrome and epigastric pain syndrome.

2.4.2 Prevalence

Epidemiological studies show that functional dyspepsia is a common complaint affecting all population groups. Young, McCarthy and King (2009: 28) report that 7% of adults in Western populations are affected daily and up to 45% monthly. Dyspepsia in general whether organic or functional is one of the most common disorders in medicine (Miwa, 2012b: 464) with up to 40% of the population suffering from it annually (Panchmatia, 2010: 439). Despite dyspeptic patients being seen on a daily basis not only by gastroenterologists but also by physicians in a variety of other fields, patients seeking medical intervention are said to be only around 5% of the total dyspeptic population (Panchmatia, 2010: 439), which could imply that patients self-medicate. With the lack of organic pathology, in order to diagnose functional dyspepsia frequent doctors' visits and expensive diagnostic procedures are necessary, which unfortunately places financial strain on all healthcare sectors (Richter and Talley, 2007: 1489). Studies have shown that functional dyspepsia results in serious long term suffering in patients and subsequently their quality of life

is known to be markedly decreased (Hango *et al.*, 2012: 62), with resultant poor labour productivity and a negative financial impact on the economy.

2.4.3 Aetiology and pathophysiology

Due to the apparent lack of organic disease, the mechanism of symptom production may rest on why the symptoms occur in the first place. Studies focused on this are challenging (Miwa, 2012a: 863), for the following reasons:

- Functional dyspepsia has the characteristics of a syndrome and therefore does not have a single pathogenesis.
- The study of symptoms requires human subjects.
- Functional dyspeptic patients are not always symptomatic – their symptoms can be greatly influenced by psychological and physical states and these symptoms may not always be reproducible at the time of formal testing.
- The indices used for the measurement of symptoms are largely subjective as symptoms cannot be verified by objective testing.
- The definitions of functional dyspepsia change every few years therefore the results of new tests cannot be directly applied to previous results and study interpretations.

Despite the above challenges Miwa (2012a: 866) hypothesises that the basis of functional dyspepsia is excessive responsiveness of gastrointestinal functions to stress and stimuli. This excessive responsiveness can be either direct or indirect in its presentation:

1. Direct: caused by physiological abnormalities, namely, abnormal gastric motility and visceral hypersensitivity caused by emotional and physical stress, genetics and post infection inflammation.
2. Indirect: caused by factors that modify the physiological abnormalities such as psychological factors, abnormal secretion of gastric acid, *helicobacter pylori* infection, diet and lifestyle.

Yarandi and Christie (2013: 2) concur with the above explanation; however they state that “despite years of research, evidence regarding the role of these factors remains controversial, and it has been difficult to prove a causal relationship between any of these factors and the symptoms of functional dyspepsia”. They suggest that there is a lack of a consistent relationship between symptoms and

suggested abnormalities such as delayed gastric emptying and propose therefore that research should shift towards “the identification of alterations in visceral sensory perception as a necessary component for any unifying pathophysiological model.”

2.4.3.1 Neuropathophysiology

In light of the previous subsection (2.4.3), it is worthwhile looking specifically at the neuropathology associated with functional dyspepsia. Miwa (2012a: 866) emphasises the need for further study of the relationship between the digestive tract and the central nervous system. Lee, Kindt, and Tack (2004: 713) have elucidated on this aspect and called for further study in autonomic and central nervous system dysfunction as a possible reason for symptom production. They postulate that efferent vagal dysfunction could be the mechanism behind impaired gastric accommodation to a meal and hypo-motility. They also point to low level vagal stimulation caused by psychological stress and emotions which could give rise to functional dyspeptic symptoms. Allescher (2006: 2) states that “there is increasing evidence to suggest that functional dyspepsia is a multi-causal disorder, which leads to altered processing of afferent information from the gastrointestinal tract to the central nervous system. Autonomic hypersensitivity and altered central processing could be a common phenomenon whereas motility changes, inflammation or altered secretion could increase neural afferent inputs.” Research into these autonomic phenomena still continues as can be seen in a study by Fukudo, Kuwano and Miwa (2012: 88) who state that “autonomic abnormalities affecting the cephalic phase of vagal activity may be important in the pathogenesis of functional dyspepsia.”

2.4.4 Diagnosis

Generally the diagnosis and treatment of a particular disease state within a patient follows a more traditional biomedical model where there are set norms and parameters to analyse symptoms effectively and treat effectively. In gastrointestinal disease, especially those of a more functional nature, those diagnostic and treatment lines become blurred and obscured when psychological and social inputs come into play and disease outcome measures become unpredictable and obsolete (Wu, 2012). Unfortunately no diagnostic gold standard exists when faced with functional dyspepsia in medical practice. Gastro-oesophageal reflux disease in itself is often

complicated and expensive to diagnose and treat (Anderson, 2010: 256), even more so when an organic cause cannot be found, as in functional dyspepsia.

2.4.4.1 Clinical features

According to Smith (2005: 547) functional dyspepsia is more common in general practice than dyspepsia caused by organic causes, and in terms of routine clinical practice, a diagnosis of functional dyspepsia is given if the symptoms of nausea, vomiting, fullness, belching, heartburn and upper abdominal pain are present in the absence of organic causes seen on endoscopy and abdominal ultrasound. Tack *et al.* (2006: 1466) state that the diagnostic criteria for functional dyspepsia must include no evidence of structural disease and one or more of the following:

- Post prandial fullness;
- Early satiety;
- Epigastric pain;
- Epigastric burning.

The Rome III criteria outlined by Yarandi and Christie (2013: 2) further expands on the clinical features outlined by Smith (2005: 547) and Tack *et al,* (2006: 1466) in that symptoms need to be present for longer than 12 weeks and greater emphasis needs to be applied to the subtypes of functional dyspepsia in terms of typical features and location of symptoms. These subtypes as first mentioned in 2.4.1 have the following characteristics:

1. <u>Post prandial distress syndrome (PDS):</u>
    - Post prandial fullness;
    - Early satiation with an inability to finish meals.
2. <u>Epigastric pain syndrome (EPS):</u>
    - Pain and or burning in epigastrium;
    - Pain that is moderate to severe;
    - Pain is intermittent and not relieved by defecation;
    - Pain not caused by gallbladder and sphincter of Oddi dysfunction.

2.4.4.2 Diagnostic procedures

2.4.4.2.1 History, examination and blood tests

Aside from a full case history and physical examination, in order to rule out an organic cause for patient symptoms physicians may request certain blood tests. If the following is found it is less likely to be functional dyspepsia and would warrant further investigation (Surjoodeen, 2007: 15):

- Decreased haemoglobin on full blood count;
- Increased platelet levels;
- Raised eosinphilic sedimentation rate (ESR);
- Increased liver function enzymes;
- Raised tumour markers.

According to Allescher (2006: 4) the following tests may also be performed before more invasive tests are called for:

- Exocrine pancreatic function tests for adequate digestive enzymes;
- Glucose breath test for bacterial overgrowth;
- Lactose breath test for lactose malabsorption;
- Stool tests for parasites.

2.4.4.2.2 Invasive diagnostic procedures

If patients are still symptomatic despite first line therapy outlined in the next section then more invasive clinical testing such as endoscopy, barium X-ray, oesophageal biopsy and high resolution manometry may be necessary to rule out sinister pathology such as ulcers, Barrett's oesophagus and malignancy. Elliot (2013: 481) highlights the difficulties in diagnosis and states that "universal investigation for this group of symptoms is neither desirable nor affordable, however 40% of those referred to endoscopy are found to have functional dyspepsia, 40% have gastro-oesophageal reflux disease and 13% have peptic ulcers. A further 3% of all referrals for endoscopy will be diagnosed with gastric cancer. Other findings at endoscopy include Barrett's oesophagus and motility disorders."

2.4.4.2.3 Other diagnostic procedures

According to Ringel (2002: 23) brain research in functional gastrointestinal disorders is a growing field. Brain research on the mechanisms that are involved in the

generation of gastrointestinal symptoms include studies of the gut response to brain stimulation with techniques such as:

- Transcranial magnetic stimulation;
- Brain response to gut stimulation by cortical evoked potentials;
- Positron emission tomography;
- Functional magnetic resonance imaging.

Ringel (2002: 23) points out that studies using these techniques have shown that visceral/gut sensation involves activation of several brain regions that are associated with various brain functions, including sensation, cognition, and affect. He does note, however, that “the complexity of the brain response to visceral stimulation and the multi-determined nature of functional gastrointestinal disease make studies of brain function in functional gastrointestinal disease patients difficult and demands great caution in interpreting their results”. Nevertheless these studies highlight the role the central nervous system plays in conducting and processing visceral signals and suggestion is also made that any alteration in the brain processing of perception and affective responses may be factors in the pathogenesis of functional gastrointestinal symptoms.

2.4.5 Current medical treatment

Yarandi and Christie (2013: 5) say that in order to formulate the appropriate medical management of a patient with functional pathology it is important to ascertain the cardinal symptom of the patient and then classify according to the subtypes outlined in 2.4.4.1 above, for example burning in the epigastric area may respond to acid regulators whilst pain may require opiate therapy. A therapeutic intervention will often involve Phase 1 treatment options as outlined later with some Phase 2 crossovers such as a temporary proton pump inhibitor use. The treatment intervention in particular with suppressive type agents can be a way of confirming that it is functional in nature or that a true organic cause exists which would warrant further investigation. Surjoodeen (2007: 13) outlined this as the basis of a ‘therapeutic trial’ and is often seen in orthodox medical treatment. The rationale for this trial is twofold as it can either confirm or deny the diagnosis and it can prevent unnecessary costs of referral and expensive diagnostic testing. The Phase 1 and Phase 2 treatments are modelled on the modification of known factors associated

with the development of symptomatic gastroesophageal reflux disease, as shown in Figure 2.8.

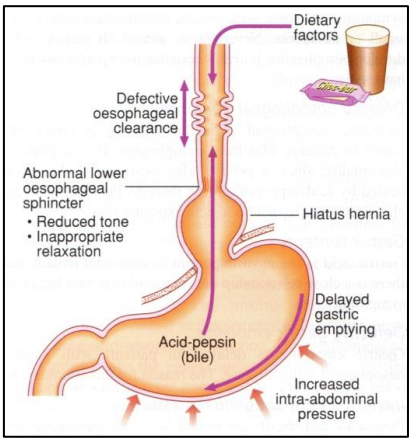


Figure 2.8 Factors associated with the development of gastroesophageal reflux disease (Haslett et al., 2002: 775)

2.4.5.1 Phase 1 therapy

Patients with mild to moderate symptoms are treated using Phase 1 type therapies discussed below.

2.4.5.1.1 Lifestyle modification

Lifestyle modification is a first line therapy which currently prescribes the use of healthy food choices, certain food avoidance, weight loss and smoking cessation. Lifestyle modification also includes the promotion of self-management and control for the individual (Elliot, 2013: 183). This is brought about by giving the individual an opportunity to discuss and explore their symptoms with the goal of understanding the condition involved. This is particularly important when there is no medical explanation as to why they are ill in the first place. No clear evidence exists to show that lifestyle changes impact functional dyspeptic symptoms in any way (Elliot, 2013: 183), however, there is anecdotal evidence to suggest that simple lifestyle changes can be efficacious and cost effective when embarking on a treatment regime with patients (Surjoodeen, 2007: 17).

2.4.5.1.2 Antacids and alginates

Figure 2.9 diagrammatically illustrates the mechanism of action when medicating with an antacid formulation and an alginate formulation. These combinations are more commonly used in mild dyspeptic states and are available without prescription.

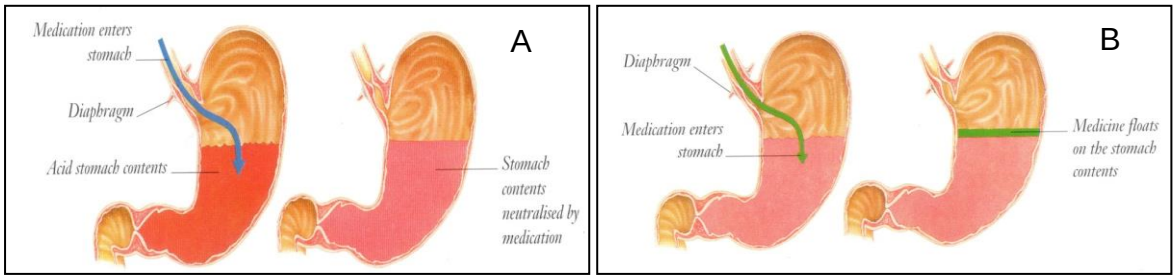


Figure 2.9 A: Neutralised stomach acid following ingestion of an antacid. B: Protective lining formation following alginate administration (Hawkey and Wight, 2000: 20 and 21)

According to Surjoodeen (2007: 17) an estimated one in every two adults in the United States uses antacids on a regular basis, with one in four adults taking them at least twice per month. Antacids neutralise stomach acid which reduces the irritation effect of the refluxed gastric acid on the mucosa of the oesophagus. Alginates work as a physical block to the stomach acids regurgitating into the oesophagus by forming a gel like layer that floats on top of the stomach contents. The side effects of antacids are numerous and include diarrhoea, constipation and stomach cramps, and continuous uncontrolled use may cause ‘acid rebound’, which is a sudden increase in the production of stomach acid above the norm when antacid use is discontinued (Surjoodeen, 2006: 17).

2.4.5.2 Phase 2 therapy

Patients with moderate to severe symptoms that are unresponsive to first line therapy are often prescribed singularly or in combination certain prescription drugs, the most common being proton pump inhibitors (PPIs), histamine 2 receptor antagonists, prokinetics and anti-depressants. Allescher (2006: 6) found that most pharmaceutical treatment is only 10-20% more effective than placebo treatment, which has a rate of around 40%. Therefore the estimated combined effect of the placebo plus pharmaceutical intervention would not effectively provide relief. He

concludes that “currently there is no standard medication for the treatment of functional dyspepsia which will eliminate the symptoms with high likelihood and high effectiveness.”

2.4.5.2.1 Proton pump inhibitors

This category of drugs constitutes the most commonly prescribed medication for dyspepsia. As shown in Figure 2.10 these drugs reduce gastric acid secretion within the gastric parietal cells by up to 90% by inhibiting the hydrogen/potassium adenosine triphosphatase enzyme, known as the cells ‘proton pump’ (Panchmatia, 2010: 441). PPIs are used for mild to severe dyspeptic symptoms, with the typical initial period of treatment lasting between four to six weeks. After this there is a reduction in dose to find the optimum dosage required to manage the dyspeptic symptoms over a long term. Gray, Lacroix and Larson, (2010: 768) highlight some safety concerns with long term PPI use such as nausea, vomiting, constipation and as well as the increased risk of fractures in post-menopausal women. Omeprazole, lansoprazole, pantoprazole and rabeprazole are the most commonly prescribed PPIs (Hawkey and Wight, 2000: 20).

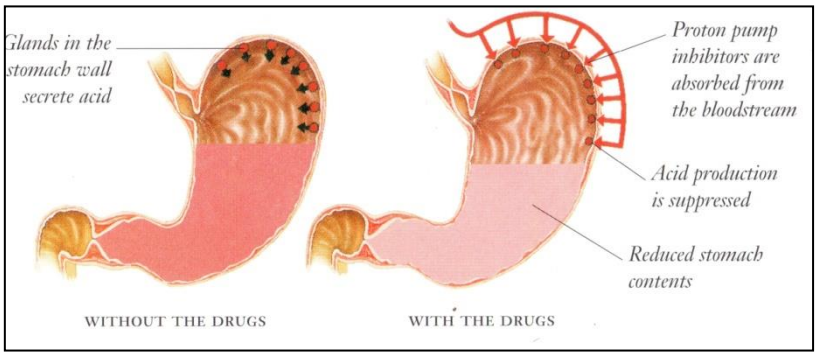


Figure 2.10 Illustration showing the effect of a proton pump inhibitor (Hawkey and Wight, 2000: 48).

2.4.5.2.2 H2 receptor antagonists (H2RA)

This category of drug is considered to be a second line drug to PPIs, however they are often prescribed in conjunction with PPI therapy, especially in those patients who suffer from night time exacerbations. These drugs work by competitively blocking the histamine receptors of the gastric parietal cells, which leads to a 60% reduction in

acid production (Panchmatia, 2010: 442). Adverse reactions to this class of drug are common and symptoms include headaches, dizziness, skin rashes, fatigue, diarrhoea and muscle pain. Care should also be taken with drugs that are metabolised by the liver. As an example H2RAs bind to liver microsomal CYP450 which is the enzyme system that breaks down drugs used in anti-coagulant therapy. Therefore a dual prescription could cause increased bleeding and lowered clotting time. Cimetidine, famotide, nizatidine and ranitidine are the most commonly used H2RAs (Hawkey and Wight, 2000: 22).

2.4.5.2.3 Prokinetic drugs

As can be seen in Figure 2.11, this category of drugs does not alter acidity within the stomach, but rather they force contraction within the muscular layer of the stomach which allows for faster stomach emptying and greater constriction across the gastroesophageal sphincter. Due to their prokinetic ability this class of drug is associated with stomach cramps and diarrhoea, examples of this drug include metoclopramide, domperidone and cisapride (Hawkey and Wight, 2000: 50).

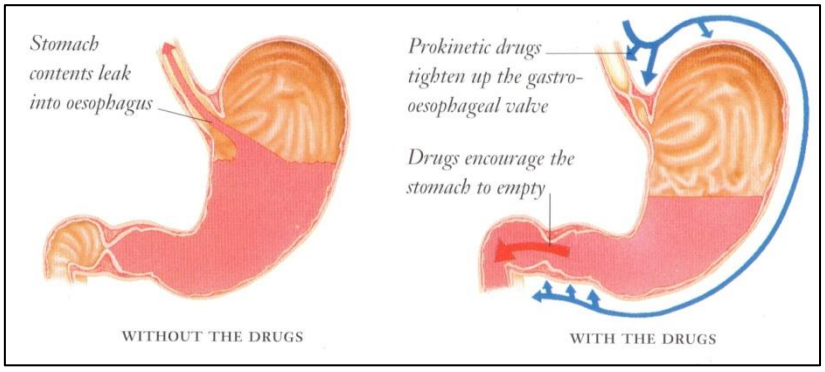


Figure 2.11 Illustration showing the effect of a prokinetic drug (Hawkey and Wight, 2000: 49)

2.4.5.2.4 Anti-depressant therapy

According to Smith (2005: 552) “the mode of action of antidepressant drugs in functional gastrointestinal disorders is unknown.” He postulates, however, that they may act centrally by addressing any co-existing psychological states. They may directly affect the central processing of pain or they may act peripherally by modulating gut hypersensitivity and dysmotility. Low dose anti-depressants have

been suggested as treatment options for those suffering from functional dyspepsia. The most common drugs prescribed include: tricyclic, serotonin and noradrenalin reuptake inhibitors, but Allescher (2006: 7) points out that no studies support their use for this purpose.

2.4.5.3 Possible role of manual therapies

Manual therapies have been traditionally thought of and used as treatment for musculoskeletal conditions. Rome (2010: 13) conducted a literature review of all chiropractic, medical and osteopathic references referring to the possibility of manual therapies potentially influencing visceral pathologies. He estimates that in the chiropractic literature alone there are over 5000 published papers on this topic. These published papers consist of empirical and anecdotal evidence, case reports and laboratory research.

The following selected studies, whilst no means representative of the state of the totality of the literature suggest that manual therapies can influence visceral pathology through the autonomic nervous system:

- Physiotherapy: Connective tissue manipulation and the autonomic nervous system (Holey, 1995: 366).
- Acupuncture: Gastrointestinal sphincter modulation (Chiu, 2002: 141), treating pain and somatovisceral disorders (Dorsher and Fleckenstein, 2008: 6), chronic constipation (Tsai and Wang, 2012: 127), gastrointestinal motility disorders (Chen and Yin, 2010: 31).
- Osteopathy: Cutaneous blood flow in the lower limb (Karason and Drysdale, 2003: 220), gastroesophageal reflux disease (Branyon, 2008: 29), non-cardiac shortness of breath (Berkowitz, 2011: 2), gastrointestinal function in preterm infants (Pizzolorusso *et al.*, 2011: 1).
- Chiropractic: Improved non-musculoskeletal symptoms reported after spinal manipulative therapy (Lebouf-Yde *et al*.,1999: 559), visceral responses to spinal manipulation (Budgell and Bolton 2012: 1), infantile colic (Hipperson, 2004: 180) effect of spinal manipulative therapy on heart rate variability (Budgell and Polus 2006: 603).

2.5. CHIROPRACTIC AND VISCERAL PATHOLOGY

According to Jonasson and Knaap, (2006: 246) “Most of the conditions that present to the doctor of chiropractic are of a biomechanical origin. However in a number of cases, underlying visceral pathology is the source of the complaint.” The researchers go on to say that chiropractors play a primary health care role and it is therefore inevitable that they will be confronted with non-biomechanical complaints within their career in that “the great amount of biomechanical problems must not overshadow signs and symptoms in the history and physical examination that point towards an underlying organic cause of the complaint. In cases where the expected outcome of the treatment fails to take place, the necessary measures should be taken to find further information.”

According to Welch and Boone (2007: 86) there have been numerous reports of positive effects on visceral pathology following chiropractic adjustments. Plaughter (1993: 356) says that research with regard to the effects of chiropractic manipulative therapy on the autonomic nervous system should be a high priority for the growing chiropractic profession, as more experimental data is needed to understand the complexities of the autonomic reflexes in response to vertebral joint stimulation. Biomechanical studies generally make up the bulk of chiropractic studies however there are a selection of chiropractic studies that have focused on the principle that a vertebral subluxation complex can interfere with the neurophysiologic balance within the body, which could impact on visceral reflex pathways at the level of the spinal joints causing symptoms within the viscera (Leach, 2004: 288). Branyon (2008: 29) highlights the interrelationship that structure and function play in the relationship between somatic and visceral structures saying that “proprioceptor input from somatic dysfunction may facilitate a cord segment. If that cord segment is also the site of the cell bodies for sympathetic outflow to a visceral structure, that particular visceral structure’s function may be affected by excessive sympathetic tone”. With this interrelationship in mind Rome (2010: 14) says that vertebral manipulation can be a powerful source of controlled neurological stimulus to the nervous system.

2.5.1 Anatomy at the level of the spine

Whilst it is not the scope of this literature review to highlight every complex anatomical aspect of the cervical, thoracic and lumbar spine, certain structures will

be highlighted to reinforce section 2.5.2 as well as link up with the neuroanatomy of the gastrointestinal tract highlighted in section 2.2. Spinal motion segments are made up of two vertebral bodies, their associated intervertebral disc and ligaments. Figure 2.12 shows the anatomy of a typical thoracic vertebra with two vertebra, one intervertebral disc and ligaments.

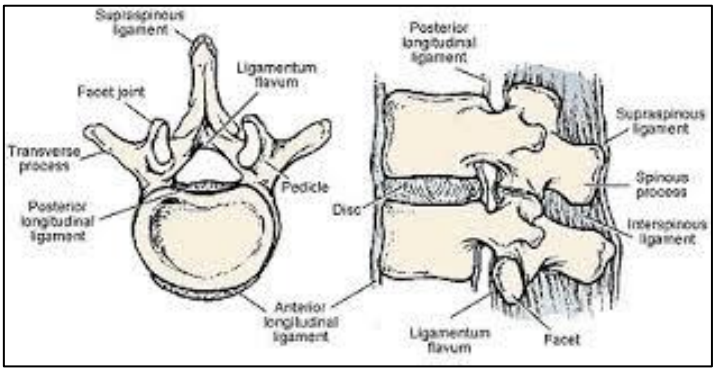


Figure 2.12 Anatomy of a spinal motion segment (www.med.nyu.edu)

Figure 2.13 illustrates this by showing the vertebral bodies with their zygopophyseal joints and their close association to the spinal nerves and ganglia exiting at the level of the intervertebral foramina. The dorsal primary ramus which arises from the spinal nerve outside of the vertebral foramen divides into a medial and lateral branch which supplies the zygopophyseal joints (Moore and Dalley, 1999: 456)

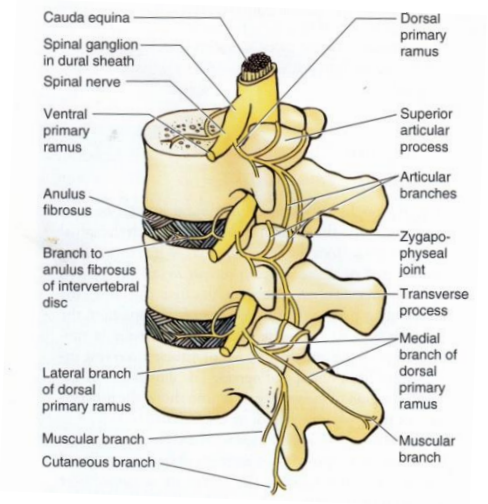


Figure 2.13 Left posterolateral view showing spinal nerves (Moore and Dalley, 1999: 456).

Figure 2.14 shows the branching of a typical spinal nerve and the exiting of that nerve from the spinal cord. Of importance to this study is the close association between the vertebra and the exiting spinal nerve. Note the anterior primary rami which join to form the cervical, brachial and lumbosacral plexuses. Peripheral sensory overlap occurs between the anterior primary ramus as well as the posterior primary ramus as afferent and efferent information travels to and from the spinal cord (Clemente, 1997: 405)

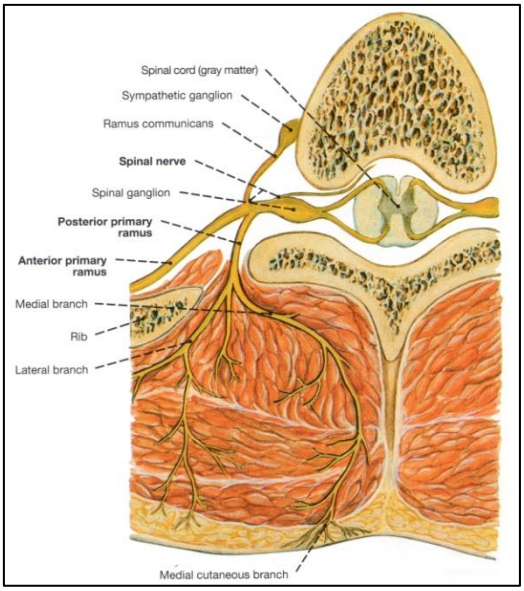


Figure 2.14 Branching of a typical spinal nerve (Clemente, 1997: 405)

Figure 2.15 shows the ganglionated sympathetic chain within the thoracic region which receives and gives communicating rami arising from the spinal nerves. The diagram also shows the formation of the greater splanchnic nerve and its descent prevertebrally into the abdomen.

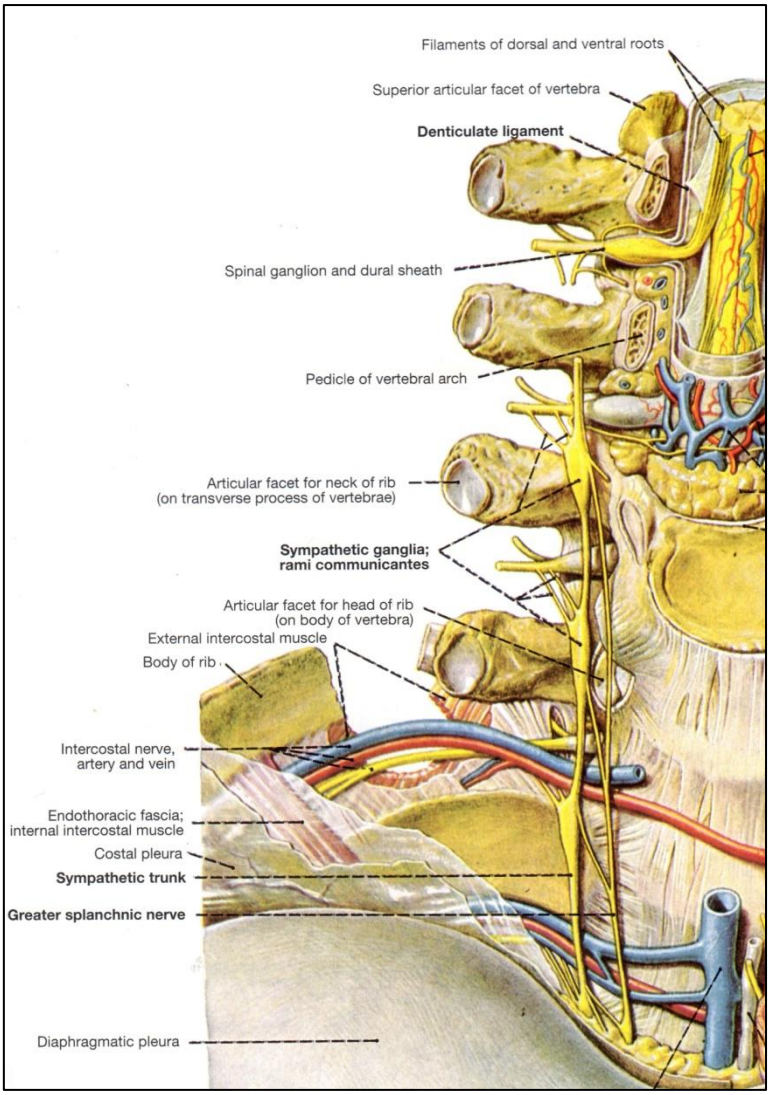


Figure 2.15 Anterior dissection of vertebral column, spinal cord and prevertebral structures at a lower thoracic level (Clemente, 1997: 434)

2.5.2 Spinal manipulation and its effects

According to Gatterman (2005: 305), chiropractic manipulation is a form of manual therapy that uses a controlled force, leverage, direction, amplitude and velocity directed at a specific joint which produces mechanical, soft tissue, neurologic and psychological effects. She further elucidates on the general changes brought about by manual therapy, which are as follows:

- Mechanical changes such as the normalisation of: joint alignment, motion dysfunction, altered spinal curvature dynamics and entrapment;
- Soft tissue changes such as the normalisation of: muscle tone, strength and the dynamics of supportive capsuloligamentous tissue;

- Neurological changes such as: reduction in pain, alteration in motor sensory function and the regulation of the autonomic nervous system;
- Psychological changes, such as: the effect of laying on of hands, placebo factor and patient satisfaction.

Of particular importance to this study are the last two points.

2.5.2.1 Somatovisceral reflexes and spinal manipulation

The somatovisceral reflex can be defined as: “a reflex in which visceral functions are activated or inhibited by somatic sensory stimulation” (Mosby, 2009: 1730). The autonomic nervous system has provided rich research for the field of neuroscience. Pickar (2002: 357) in *The Spine Journal* highlighted various animal studies where visceral effects were noted within seconds after only one stimulation to various spinal levels. Sato and other prominent researchers have performed experiments with rats and cats, and were able to show that somatic nerve stimulation (at a specific spinal level and strength) can affect visceral function. These studies which elicited a definite link between somatic stimulation and visceral functioning included amongst others: adrenal function (Budgell and Sato *et al*., 1997: 33), cardiac function (Kimura and Sato *et al*., 1996: 91) splenic sympathetic and natural killer cell activity (Kagitani and Sato *et al*., 1996: 109) and gastric motility (Budgell and Suzuki, 2000:162). After the completion of his research Sato is quoted as saying: “the functions of various visceral organs can be influenced by a proper cutaneous stimulation as a result of the somatosympathetic or the somatoparasympathetic reflexes. I hope this knowledge is used to carry out similar experimentation in other mammals and that finally this knowledge will be clinically useful in altering the visceral function of humans” (Branyon, 2008: 30). Sato’s work has been further reinforced by other animal studies, such as the study on somatic stimulation and bladder functioning by Hubscher, Ezidin and Kaddumi (2006: 349).

Numerous studies have been conducted in South Africa on the effect of somato-visceral reflex paths in the chiropractic management of various disorders with favourable results, supporting the use of chiropractic as an effective treatment modality for disorders such as infantile colic (Koonen, 2002), irritable bowel syndrome (Barker, 2005) and chronic idiopathic constipation (Vadachia, 2006).

Various theories have been put forward within the chiropractic profession as to how this somatovisceral reflex actually works. Hein (1999: 59), when investigating a possible relationship between organic structures and the nervous system, highlighted Korr's theory of "segmental neurological facilitation". According to this theory "subluxations were associated with increased somatic afferent activity and caused segmental spinal neurological facilitation, and that the resulting hyper-responsive interneurons lead to sympathetic lateral horn activation, sympatheticonia and ultimately visceral organ dysfunction and disease." Branyon (2008: 29) also highlighted Korr's explanation of the facilitated cord segment, where these segments encourage and support physiological, hormonal and biochemical conditions which either increase or inhibit recovery from disease.

2.6 CHIROPRACTIC AND FUNCTIONAL DYSPEPSIA

In 2003 Love and Bull conducted a survey of 621 Australian chiropractors using a qualitative questionnaire. Their aim was to establish:

- If dyspepsia was commonly encountered by chiropractors.
- What treatment methods were used by chiropractors to treat dyspepsia.
- If they believed their methods were effective.

Eighty one percent of the 66 participants saw patients with dyspepsia at least once a month, with up to 43% of them being treated more than five times per month. Ninety one percent of the respondents reported that manipulation to the thoracic spine was the most common method used to treat dyspepsia. Fifty eight percent of the respondents perceived their management of dyspepsia and their chosen treatments to be very effective.

According to Young, McCarthy and King (2009: 29), "In addition to the costs of long-term treatment, conventional care can be complicated by side effects, rebound and dependency" so emphasis should be given to the development of non-pharmaceutical protocols and interventions. Using that tenet as a foundation, Young, McCarthy and King (2009: 29) conducted a pilot study on the chiropractic management of functional dyspepsia. Eighty three participants with diagnosed functional dyspepsia symptomatic for longer than two years, received manipulations at indicated levels between C3-C5 and T5-L2, as well as sacroiliac joint stabilisation and soft tissue manipulation to correct any psoas muscle dysfunction. Fifty nine out

of the 83 participants reported a reduction in symptom severity ($p < 0.001$) and 69 reported a reduction in symptom frequency ($p < 0.001$). This study not only showed an improvement in severity and frequency of symptoms over a three month treatment period, with an average of 2.3 treatments given, but also that 37 participants were able to reduce or downgrade the class of drug they were using to manage their symptoms. The results are important in that they support previous anecdotal evidence to indicate that chiropractic management can have a positive impact on dyspeptic symptoms. This study is important in that it is the first to demonstrate that manipulation can have a positive impact on dyspeptic symptoms. Unfortunately this study lacked the use of a placebo controlled group, as well as the use of validated questionnaires, which would have further substantiated the results.

2.6.1 Proposed neuropathology and clinical manifestation in chiropractic

Peterson (2012: 305) says that although it is unknown how manual medicine might reduce the symptoms of dyspepsia, it is highly unlikely that manual intervention results in stomach acid regulation or in a more alkaline stomach environment. The researcher says however that it may be possible for manual medicine to modify "somatovisceral reflexes along with viscerosensory and interosensory pathways", which could lead to the alleviation of symptoms. Following from the somatovisceral theories outlined above, Hein (1999: 60) formulated questions in order to contextualise the relevancy of somatovisceral theory in chiropractic practice: "Did somatic dysfunction initiate visceral irritation or was visceral dysfunction a cause of somatic irritation?" and "How are these structures related and how can spinal manipulation influence this relationship?" Using these questions as a starting point Hein (1999: 60) provides the following synopsis regarding the somatovisceral reflex in relation to reflux symptomatology and anatomy as highlighted in the preceding sections:

- Reflux is controlled by the anatomical arrangement of the gastroesophageal junction below the diaphragm and the resting tone of the lower oesophageal sphincter, which is controlled by vagal activation and the hormone gastrin.
- Intra-abdominal pressure increases or oesophageal sphincter tone decreases, which is what happens with alcohol induced reflux.
- Reflux of gastric acid causes irritation and inflammation of the oesophageal mucosa which gives rise to the typical "heartburn" sensation.

- The lower oesophagus and the stomach receive their nerve supply from both divisions of the autonomic nervous system.
- Parasympathetic activation supplied by the oesophageal plexus via the vagus nerve results in relaxation of the lower oesophageal sphincter, increased gastric secretions and enhanced peristalsis.
- Sympathetic activation arising from spinal cord levels T5-T9 distributed through the greater splanchnic nerve inhibits peristalsis and digestion.
- Visceral and somatic afferents converge into wide dynamic range neurons in the dorsal horn of the spinal cord. Due to this common divergence, increased activity of either the somatic or visceral afferents can be distinguished by the central nervous system. Therefore no distinction can be made between the structures (somatic or visceral) with a nerve supply of similar spinal cord origin when it comes to referred pain.
- Activation of somatic afferents such as muscle spasm and ligamentous injury can then result in perceived visceral pain and vice versa.

In light of the above points and the relevance to this pilot study, Hein (1999: 60) says that “it has been hypothesised that chiropractic manipulation can subjectively reduce this referred pain by inhibiting the hyper-excitable wide dynamic range neurons through a co-activation of peripheral anti-nociceptive circuits and a descending analgesic system.”

2.6.2 Identified spinal levels in the treatment of dyspepsia

A survey conducted by Love and Bull (2003: 61) showed that there was a greater prevalence of thoracic and cervical manipulations when treating dyspeptic symptoms. They concluded that this was due to the known autonomic innervations of the stomach as well as knowledge of traditional chiropractic philosophy, such as the somatovisceral theory, amongst chiropractors. Unfortunately there is paucity in scientific literature with regards sympathetic and parasympathetic influences in somatovisceral pathology and the treatment thereof, and what does exist does not confirm nor fully deny its existence. This leaves anyone attempting to research the field at a loss for anything tangible. In the light of this research the hypothesis was that no effect would be elicited in the chiropractic treatment of functional dyspepsia based on the premise of the somatovisceral theory. Budgell (2000:104) on vertebral

subluxation and the autonomic nervous system says with regards to sympathetic mediation, that it is possible to demonstrate the existence of spinal reflex centres and subsequently measure segmental organisation which is not the case with parasympathetic mediation. Few good studies and parasympathetic effect actually exist, however Briggs *et al.,* (1988:181) did show a parasympathetic pupillary constriction specific to a C1 spinal manipulation. Do these mechanisms then exist? and with the lack of literature showing a definite link is the topic worthwhile pursuing. This research as stated above hypothesises that it does not exist but the research topic was chosen as anecdotal evidence gathered since chiropractic inception shows the possibility of the contrary. Therefore with the possibility that it could exist the following studies, in 2.6.2.1 and 2.6.2.2 were highlighted.

2.6.2.1 Thoraco-lumbar sympathetic pathway

The thoracic spine and the upper part of the lumbar spine show a predominance of sympathetic innervations. The following is a list of authors and their conclusions relating to the thoraco-lumbar sympathetic pathway:

- Lewit (1985, as per Love and Bull, 2003: 61) demonstrated that the predominant region for vertebral dysfunction in gastric pathology was between T4 and T7, especially T5 and T6.
- Bryner and Straeker (1996: 316) stated that segments showing the most signs of dysfunction in patients with indigestion were T5 and T6, followed by T4 and T7. They found though that alleviation of dyspeptic symptoms was unrelated to a particular thoracic level, and they suggest that this diffuse effect indicates biomechanical complexities and neurological connections.
- Rome (2000) highlighted anecdotal evidence of the improvement of dyspeptic symptoms following a manipulation to T6. He formulated the hypothesis of a “T6 syndrome” which is associated with dyspepsia (Love and Bull, 2003: 61).
- In a case analysis on reflux oesophagitis (Hein, 1999: 60), T5-T7 was manipulated with favourable result.
- Love and Bull (2003: 61), as a result of their questionnaire based study, found that chiropractors were more likely to manipulate between T5 and T7 because:
    - practitioners expected dysfunction in this area based on their knowledge of the autonomic supply to the stomach;

- it is easier to locate a vertebral dysfunction in this area;
- this area usually shows dysfunction in dyspeptic patients.

The survey also showed that the lowest number of respondents were found to manipulate the lumbar spine, however it was noted that the upper lumbar area was a common treatment area for patients with irritable bowel syndrome, which is a syndrome closely related to functional dyspepsia.

- T8, T10 and T12 was manipulated in a case report on pregnancy related dyspepsia with favourable results (Peterson, 2012: 305).
- Young, McCarthy and King (2009: 30) T5-L2 was manipulated with positive results and a statistically significant decrease in symptom severity, frequency and medication usage.

2.6.2.2 Cervical-parasympathetic pathway

Due to the close proximity of the cervical vertebrae to the brainstem already highlighted in section 2.2, parasympathetic influences are said to dominate at these segmental levels. The following is a list of authors that have mentioned the cervical-parasympathetic pathway in studies:

- Beal (1985, as per Love and Bull, 2003: 62) mentions a possible “vagal reflex at C2” used to locate a viscera-somatic effect.
- Hein (1999; 60) noted segmental restrictions at C6-C7 in dyspeptic patients.
- According to Love and Bull (2003: 62), one respondent to their study specified that manipulations performed between C3 and C5 were aimed to affect the phrenic nerve, with resultant action on the diaphragm. They suggest however that the possible effect of cervical adjustment on vagal outflow from the medulla should be an area of focus for further research, especially due to the fact that tumours within the medulla have been shown to give rise to dyspeptic symptoms.
- Young, McCarthy and King (2009: 30) applied manipulations between C3-C5 due to the known origin of the phrenic nerve.

2.8. CONCLUSION

Due to the neurological innervation of the gastrointestinal system as well as the known association with the innervation of the spine, the theory exists that chiropractic manipulations may effect visceral structures in a favourable way to

restore homeostatic function. Literature does not provide a definite answer and research is still undecided as to the effect spinal manipulation actually has on visceral structures. As seen above spinal manipulation of specified spinal segments may or may not result in coherent patterns of afferent input to the central nervous system. Those practitioners inclined to have an interest in this topic may know from anecdotal evidence that a change does occur clinically in patients suffering from visceral pathology. Patients with functional dyspepsia might well benefit from chiropractic management or they may not. Despite this the impact functional disease has on society and the economic strain that this condition exerts within developed countries is undeniable. Surely it therefore makes sense to pursue studies in this field in the attempt to look for less invasive and more economical and effective ways of managing functional dyspepsia.

CHAPTER THREE: MATERIALS AND METHODS USED

3.1 THE STUDY DESIGN

This study took the form of a controlled clinical trial, whereby 30 participants were consecutively sampled into one of two groups. Each group received one treatment a week for three weeks, their fourth and final visit two weeks later consisting of data capturing only. The research took place between June and September 2013.

3.2 THE OBJECTIVE

The objective of the study was to investigate the effect of spinal manipulation versus an inactive laser device (placebo) on the severity, character and sense of wellbeing of individuals in the management of adult functional dyspepsia. In order to realise this objective the following subjective tools were used:

- The QOLRAD questionnaire published by AstraZeneca (1997) (Appendix I);
- The PAGI-SYM questionnaire published by Johnson and Johnson (2004) (Appendix J);
- The numerical pain rating scale (Appendix H).

3.3 SAMPLE SIZE AND CHARACTERISTICS

Thirty pre-diagnosed participants were accepted into the pilot study. The diagnosis of functional dyspepsia had to be confirmed by a professional qualified to do so, such as a general practitioner and gastroenterologist, either via clinical means or via endoscopes and barium swallows. Participants were recruited through advertising at various doctors' rooms and clinics in the local area. In order to ascertain whether the potential participants were good candidates for the study and still symptomatic despite current treatment, an initial telephonic interview by the researcher had to confirm the willingness to participate in the study as well as to ascertain suitability based on the inclusion and exclusion criteria as outlined below.

3.3.1 Inclusion criteria

All participants had to fulfil the following criteria:

A. Be symptomatic despite current treatment and have had at least four of the following symptoms:
    - Epigastric discomfort/pain;
    - Flatulence;
    - Early satiety;
    - Sensation of fullness;
    - Heart burn;
    - Bloating;
    - Nausea;
    - Vomiting of acid fluids.
B. Measure between four and seven on the numerical pain rating scale.
C. Be between the ages of 18 and 55 years of age.
D. Those on current anti-dyspeptic medication were permitted onto the study provided they had been on it for longer than a month.
E. Those on current unrelated medication were permitted onto the study provided that their medication remained unchanged during the study.
F. Both males and females of any race group could participate in the study.

3.3.2 Exclusion criteria

Participants were excluded from this study if they:

- Were pregnant.
- Had known musculoskeletal hypermobility.
- Participants with red flag symptoms (Meineche-Schmidt, 2002) (Appendix A).
- Regularly took non-steroidal anti-inflammatory drugs.
- Had known gastric pathology, including but not limited to any of the following:
    - Barrett's Oesophagus;
    - Coeliac disease;
    - Crohns disease;
    - Gastric/laryngeal cancer;
    - Peptic ulcer;
    - Scleroderma;

- Zollinger-Ellison syndrome.

3.4 THE INTERVENTION

Willing participants underwent a consultation at the Chiropractic Clinic at the Durban University of Technology. The clinic administration staff consecutively sampled the participants into one of two groups. All subjects were asked to read the information letter and complete an informed consent (Appendix B), complete the QOLRAD questionnaire (Appendix I) and the PAGI-SYM questionnaire (Appendix J) and rate their level of discomfort on the numerical pain rating scale (Appendix H).

The researcher then took a full case history (Appendix C) and performed a general physical examination (Appendix D) as well as cervical (Appendix E), thoracic (Appendix F) and lumbar regional assessments (Appendix G). The regional assessments also included motion palpation to determine the levels of spinal fixation, which were noted at the first three visits.

Both groups received one treatment a week for three weeks and both completed the questionnaires at every treatment as well as at their two week post treatment follow-up, which did not include a treatment. At each visit both groups received motion palpation to determine the levels of the spinal fixation. This also ensured that both groups remained homogenous in their assessments. Both groups were asked not to alter diet, lifestyle and medication over the treatment period.

3.4 1 Group A: Spinal manipulative therapy

Group A underwent spinal manipulation using diversified technique (Peterson and Bergmann, 2002) to the mid cervical spine (the origin of the phrenic nerve, C3-C5), and the thoraco-lumbar spine (the origin of the lesser splanchnic nerve and the levels of diaphragmatic insertion, T5-L2).

3.4.2 Group B: Placebo

Group B received inactive laser to the mid cervical spine (the origin of the phrenic nerve, C3-C5), and the thoraco-lumbar spine (the origin of the lesser splanchnic nerve and the levels of diaphragmatic insertion, T5-L2). The choice of the laser as placebo was to ensure that no skin contact was needed for the treatment to take place. The choice to use placebo in this study was based on the fact that previous

studies on functional dyspepsia were not able to exclude the placebo effect as they did not have a placebo group (Young, McCarthy and King 2009: 30).

3.4.2.1 The role and effect of placebo in clinical trials

Linde, Fassler and Meissner (2011: 1905) give a broad definition of the term placebo used in clinical trials. According to them “a placebo is defined as any therapy or component of therapy used for its nonspecific, psychological, psychophysiological effect or that is used for its presumed specific effect, but is without specific activity for the condition being treated”. If any advancement in medicine is going to take place clinical trials need to be carried out on medical interventions, which usually require the use of a placebo in order to test hypothesis made. The ethical question therefore, according to McQuay and Moore (2005: 159), should only be questioned if a trial design does not aim to answer any research question, but common sense also dictates that the placebo design is not suitable for life threatening conditions such as septicaemia and chemotherapy.

Added to this Linde, Fassler and Meissner (2011: 1905) give instances where placebos as per the definition play an important role, such as:

- Control interventions in experimental studies to determine specific effects and to reduce bias.
- Experimental interventions in placebo research to study placebo effects.
- A tool in clinical practice.

In light of the above, Gupta and Verma (2013: 49) show that placebo, which was previously thought of as being an ‘inert’ intervention, has manifested “genuine psychobiological phenomena”. This then assumes a certain paradoxical state within the very definition of a placebo. Gupta and Verma (2013: 49) state that “a greater understanding of the placebo effect is the recognition that there is not one placebo effect but many.”

3.4.2.1 The effect and mechanism of action of placebo

McQuay and Moore (2005: 156) highlight the difficulty of explaining the mechanism of action of a placebo, in particular when it comes to subjective outcomes such as pain and depression where patients are expected to “feel better” after any intervention, placebo or otherwise. Despite this Gupta and Verma (2013: 49) try to

show how potential mechanisms can be broadly explained via a psychological and neurobiological mechanism.

3.4.2.2 Psychological mechanism

This mechanism encompasses that of expectation, conditioning, learning, memory, motivation, somatic focus, rewards and reduction of anxiety which could contribute to a placebo effect. Mcquay and Moore (2005: 156) give examples as to how the psychological mechanism can come into effect: if the doctor or nurse was nice to them, or appeared authoritative; if the placebo was a big red capsule instead of a small white pill, or was an injection and not a tablet. They go on to say that "whatever we think, proving that any or all of these influences had an effect would be difficult because very large trials would be necessary to show any effect independent of random chance".

3.4.2.3 Neurobiological mechanism

This effect encompasses the mechanism of endogenous opioid production which results in placebo analgesia. Gupta and Verma (2013: 50) highlight studies that have shown how the analgesic placebo effects can be reversed by the opioid antagonist naloxone. This further substantiates their stance that placebo although the gold standard in controlled clinical trials, are by no means 'inert'.

3.4.2.4 Placebo and random chance

McQuay and Moore (2005: 158) state that the response to placebo can vary hugely depending on the factors given in 2.7.1.1 and 2.7.1.2 above, which they attribute to random chance. They go on to say that "if random chance is the most important factor underlying the variability that makes small studies particularly vulnerable, then that minimises the need to look for other explanations, such as kind compared to unkind nurses".

3.5 TIMELINE SUMMARY

Initial telephonic interview

↓

Acceptance into the study and randomly divided into two groups:

- Group A: Treatment group;
- Group B: Placebo group.

↓

First visit:

- Case history, cervical, thoracic and lumbar regional;
- Numerical pain rating scale;
- QOLRAD questionnaire;
- PAGI-SYM questionnaire;
- Intervention: Group A (spinal manipulation), Group B (inactive laser).

↓

One week later – Second Visit:

- Numerical pain rating scale;
- QOLRAD questionnaire;
- PAGI-SYM questionnaire;
- Motion palpation;
- Intervention Group A (spinal manipulation), Group B (inactive laser).

↓

One week later – Third Visit:

- A repeat of visit two.

↓

Two weeks later – Fourth visit:

- Numerical pain rating scale;
- QOLRAD questionnaire;
- PAGI-SYM questionnaire;
- No Intervention.

3.6 THE CLINICAL PROCEDURE

Traditionally the treatment of dyspepsia had not been considered to be part of a chiropractor's scope of practice. Anecdotal evidence suggested though that Chiropractors had noticed changes in visceral pathology following spinal manipulation (Love and Bull, 2003: 57). However a literature review for this study did not reveal a standard protocol for the treatment of somato-visceral conditions, so it was necessary to look at the methodology of similar studies in order to formulate a research methodology for this study.

In a paper published in *Gut* journal, authors Van Zanten *et al.* (1999: 69) provided guidelines for how to design treatment trials for functional gastrointestinal disorders. They made it clear that the trial must incorporate the principles of best and usual clinical practice as much as possible to ensure that the study results are relevant to the real practice situation. Sections 3.6.1 and 3.6.2 describe the rationale for the treatment regimen used.

3.6.1 Rationale for three treatments

Two studies on the chiropractic treatment of functional dyspepsia show that the choice of three treatments was a reasonable regimen:

- Hein (1999: 59), results were positive for two treatments over a three week period.
- Young, McCarthy and King (2006: 28), results were positive for an average of 2.3 treatments over several months.

One can also compare the chiropractic treatment of other visceral pathologies such as:

- Colic: Olafsdottir *et al.* (2001: 138), three treatments were given and a mean of 3.8 treatments by Wiberg and Kerin (1999: 536);
- Constipation: Vadachia (2006: 47), four treatments were given;

3.6.2 Rationale for weekly treatments

The questionnaires chosen, as described in section 3.7.2, provided a tool for the retrospective analysis of the patient's symptoms over a week. Predetermined spinal levels were assessed, however manipulation of any fixations felt within those levels was determined by patient presentation on the day.

Barker *et al.* (2010: 25) highlight the dynamic nature of the epithelial cells within the gastrointestinal tract. Each surface cell differentiates from the basal layer of stem cells at varied rates ranging from 1 to 160 days. They state that it is therefore beneficial to target stem cells in any treatment regime. Within the parameters of homeostasis stem cells have a cellular turnover rate of 7-10 days, and are responsible in maintaining a steady flow of clonal daughter cells for further differentiation. Treatment was therefore needed within the parameters of known stem cell turnover rate in order to enhance a homoeostatic state within the body and better evaluate the effect on patient symptomatology.

3.7 THE DATA

3.7.1 Objective data

There was no method of objective data collection used for this study. Subjective data collection was deemed most applicable since the symptoms of functional dyspepsia are subjective in their presentation (Miwa, 2012a: 862). No known organic causes, such as ulcers, are present to warrant the severity of the condition in terms of typical symptom presentation, and hence objective tools would have only ruled out other more sinister pathology.

3.7.2 The subjective data

The researcher made use of two validated questionnaires (QOLRAD and PAGI-SYM) and a numerical pain rating scale, which were used to track any changes in paticipants' symptomatology as they progressed through the study. The QOLRAD questionnaire, published by Astra-Zeneca (1997), has been tested and used in numerous studies testing the efficacy of pharmaceutical drugs on functional dyspepsia and is often a tool used in conjunction with the PAGI-SYM questionnaire developed by Johnson and Johnson (2004) when conducting large clinical trials. Both questionnaires were only made available to the researcher via a detailed application process through the MAPI trust, who only publish and release validated and tested questionnaires for clinical trials. The role of validated questionnaires in this study was to prevent researcher bias and misinterpretation of results.

3.7.2.1 Numerical pain rating scale (NPRS)

The numerical pain rating scale is considered to be a valid method of obtaining a subjective measurement of the intensity of patients' pain and discomfort level (Jensen, Karoly and Braver, 1986: 117). The NPRS was used in this study to determine the intensity of the participants' pain and discomfort level throughout the study. Also on acceptance into the study participants had to fall between a four and a seven, on the first reading, in order to ensure a more homogenous group. The scale was filled in by the participant at each visit. Participants were asked to rate their pain and discomfort level out of ten, where zero represented no pain at all and ten represented the highest intensity of pain.

3.7.2.2 Quality of life and dyspepsia (QOLRAD) questionnaire

This questionnaire was used to assess the participant's quality of life and dyspepsia. The questionnaire was self-administered and took on average five minutes to complete. Each question was scored from 0 to 6. A score of 6 represented a low quality of life and the lower scores represented better health.

The questionnaire assessed the following parameters:

A. Emotional distress in the following questions:

12. Discouraged or distressed*
14. Frustrated or impatient
15. Anxious or upset
17. Worries or fears
19. Irritable
22. Exact cause is not known

B. Sleep disturbances in the following questions:

8. Night sleep
10. Tired due to lack of sleep
11. Wake up at night
18. Fresh and rested
21. Trouble getting to sleep

C. Food/drink problems in the following questions:

3. Eating or drinking
5. Eat less than usual
9. Unable to eat foods or snacks
13. Food unappealing
16. Not tolerate foods or snacks
20. Avoid certain food/drink

D. Physical/social functioning in the following questions:

2. Avoid bending over
6. Doing things with family
23. Difficulty socializing
24. Unable to carry out daily activities
25. Unable to carry out physical activities

E. Vitality in the following questions:

1. Feeling tired or worn out
4. Generally unwell
7. Lack of energy

*** Question numbers are not in chronological order as they represent the number layout within the questionnaire.**

3.7.2.3 Patient assessment of gastrointestinal symptom severity (PAGI-SYM)

This questionnaire was used to assess the participants' symptom severity. The questionnaire was self-administered and took on average five minutes to complete. It consisted of a six point Likert scale ranging from 0 = "none" to 5 = "very severe". The following parameters were assessed:

- Seven questions assessed symptoms related to heartburn and regurgitation.
- Four questions assessed symptoms related to post-prandial fullness/early satiety.
- Three questions assessed symptoms related to nausea and vomiting.
- Two questions assessed symptoms related to bloating.
- Two questions assessed symptoms related to upper abdominal pain.
- Two questions assessed lower abdominal pain.

3.8 STATISTICAL ANALYSIS

- The raw data was captured using an EXCEL spreadsheet.

- IBM SPSS version 20 was used for analysis.
- A p value ≤ 0.05 was considered to be statistically significant.
- Repeated measures ANOVA testing was used to assess the effect of each of the treatments separately and to assess the comparative effects of the spinal manipulation vs the placebo.
- A significant time*group interaction effect signified a significant treatment effect in the inter-group comparison.
- Profile plots were used to assess the direction and trend of the effect.

CHAPTER FOUR: RESULTS

4.1 INTRODUCTION

This chapter presents the statistical data obtained by the questionnaires as well as the quantitative data of the participants. Demographic information will be highlighted followed by the pertinent comparisons made between the spinal manipulation group versus the placebo group.

4.2 DEMOGRAPHIC PROFILE OF PARTICIPANTS

There were 30 participants in this study, with 15 participants in each group. 34 participants were accepted into the study. Three of those participants dropped out of the study as data collection erroneously started before full clearance was given to secondary changes made to the methodology. One participant fell ill midway through the study and could not continue.

The age range of the study was 18-55 and there was no significant difference in age between the two groups (p = 0.841) as shown in Figure 4.1. The majority of the participants in the overall study fell within the 36-45yr age group (n = 12; 40%). The total number of females in the overall study was 17 (56.7%) and the total number of males was 13 (43.4%). Group A had four male (26.7%) and 11 female (73.3%) participants, whilst Group B had 9 male (60%) and six female (40%) participants. This did not represent a statistically significant difference between the groups (p = 0.065). The majority of the participants in the study were White (n = 17; 56.7%). Eighty percent of participants in Group A were White in comparison to only 40% of participants in Group B, however, despite this, there was not a statistically significant difference between the two groups (p = 0.118) as shown in Figure 4.2.

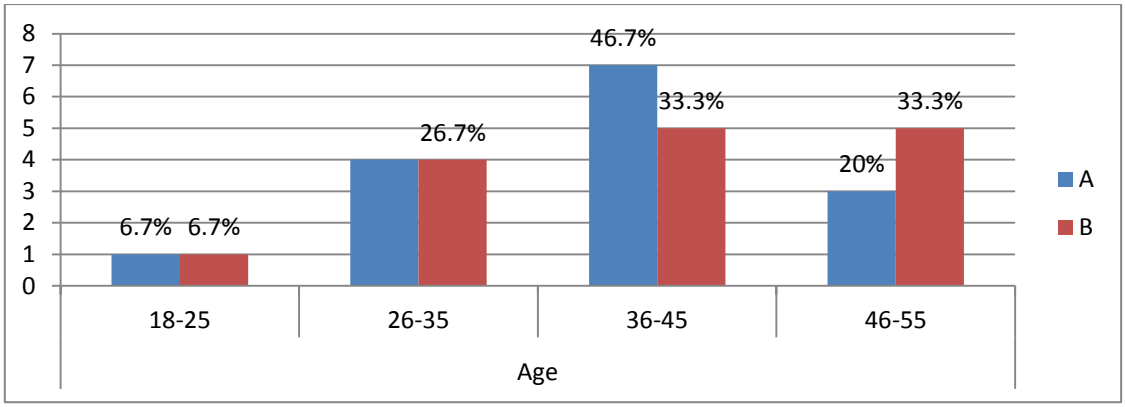


Figure 4.1 Age range of participants in groups A and B (*p* = 0.0841)

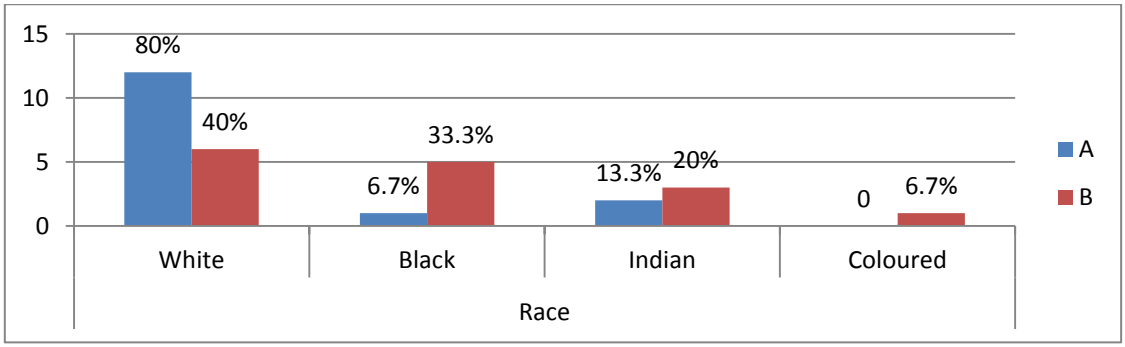


Figure 4.2 Race representation of participants in Group A and B (*p* = 0.118)

4.3 DISEASE CHARACTERISTICS

4.3.1 Confirmation of diagnosis

The diagnosis was confirmed by several health care specialities either clinically or via endoscopic means. Seven participants in Group A (46.7%) and 4 in Group B (26.7%) were diagnosed by a gastroenterologist; one participant in Group A (6.7%) and two in Group B (13.3%) were diagnosed by a specialist physician; seven participants in Group A (46.7%) and seven in Group B (46.7%) were diagnosed by a general practitioner. In the population study the general practitioner diagnosed the condition most often (n = 14; 46.7%). This did not represent a statistically significant difference between the groups (*p*=0.533). Eight participants in Group A (53.3%) and 11 in Group B (73.3%) were diagnosed on clinical symptoms and seven in Group A (46.7%) and 4 in Group B (26.7%) were diagnosed by endoscopic means. Therefore clinical symptoms represented the highest overall confirmation of diagnosis across both groups (n = 19; 63.4%).

4.3.2 Symptom characteristics

4.3.2.1 Disease characteristics

Below is a table illustrating disease characteristics at the outset of the study in terms of onset, duration of an episode as well as the frequency and progression of symptoms. Frequency of symptoms showed a statistically significant difference between Group A and Group B (p = 0.030), the frequency of symptoms in Group B was higher. A total number of 19 participants (63.4%) experienced their symptoms on a daily basis, however a greater percentage of these participants fell into Group B (n = 13; 86.7%).

Table 4.1 Disease characteristics of participants in Group A and Group B

		Group				
		A		B		
		n	%	n	%	
Onset	6-12 months	1	6.7%	1	6.7%	*0.821*
	1-2 years	2	13.3%	4	26.7%	
	2-5 years	3	20.0%	3	20.0%	
	> 5 years	9	60.0%	7	46.7%	
Duration of an episode	< 30 mins	4	26.7%	0	0.0%	*0.085*
	half to 1 hour	5	33.3%	6	40.0%	
	1-2 hours	0	0.0%	2	13.3%	
	2-3 hours	0	0.0%	2	13.3%	
	constant	6	40.0%	5	33.3%	
Frequency	Daily	7	46.7%	13	86.7%	***0.030***
	Every 2nd day	5	33.3%	0	0.0%	
	Twice per week	3	20.0%	2	13.3%	
Progression	Yes	4	26.7%	8	53.3%	*0.136*

4.3.2.2 Causes

Table 4.2 shows a cross tabulation between groups A and B in terms of the participants' awareness of known causes of their symptoms. Whilst the data did not reveal any statistically significant differences between the groups for any of the parameters, most participants highlighted both dietary factors (n = 20; 66.7%) and stress (n = 15; 50%) as the main cause for their disease symptoms.

Table 4.2 Cross tabulation of the causes of functional dyspepsia for Group A and Group B

			Group		
			A	B	
Causes	Dietary	n	12	8	*0.245*
		%	80%	53.3%	
	Lifestyle	n	3	2	*1.00*
		%	20%	13.3%	
	Stress	n	9	6	*0.466*
		%	60%	40.0%	
	Posture	n	0	2	*0.483*
		%	0%	13.3%	
	Unknown	n	2	5	*0.390*
		%	13.3%	33.3%	

4.3.2.3 Location of symptoms

Table 4.3 shows the most prevalent locations of the symptoms. In the total population the most common location was substernal (n = 22; 73.3%) and throat (n = 16; 53.3%). For both Group A and B, substernal was highest (73.3%; n = 11 in both groups) followed by the throat (60%; n = 9 in Group A and 46.7%; n = 7 in Group B).

Table 4.3 Cross tabulation of location of symptoms between Group A and Group B

			Group		
			A	B	
Location	Substernal	n	11	11	*1.00*
		%	73.3%	73.3%	
	Chest	n	3	8	*0.128*
		%	20.0%	53.3%	
	Throat	n	9	7	*0.715*
		%	60.0%	46.7%	
	Hypogastric	n	9	5	*0.272*
		%	60.0%	33.3%	
	Umbilicus	n	2	0	*0.483*
		%	13.3%	0.0%	
	Below Umbilicus	n	1	0	*1.00*
		%	6.7%	0.0%	

4.3.2.4 Character

Table 4.4 shows the participants description as to the character of their discomfort. A total of 25 participants across both groups (83.3%) described burning to be the most prominent characteristic symptom, of this 86.7% (n = 13) of Group A and 80% (n = 12) of Group B experienced the symptom. Both groups were fairly homogenous, with no statistically significant differences in discomfort between the groups.

Table 4.4 Cross tabulation of character of discomfort in Group A and Group B

			Group		
			A	B	
Characteristic of the discomfort	Burning	N	13	12	*1.00*
		%	86.7%	80.0%	
	Tightness	N	1	2	*1.00*
		%	6.7%	13.3%	
	Cutting	N	2	0	*0.483*
		%	13.3%	0.0%	
	Cramping	N	1	3	*0.598*
		%	6.7%	20.0%	
	Sharp	N	1	1	*1.00*
		%	6.7%	6.7%	
	Dull ache	N	1	1	*1.00*
		%	6.7%	6.7%	
	irritation	N	3	2	*1.00*
		%	20.0%	13.3%	

4.3.2.5 Aggravating factors

Table 4.5 shows the aggravating factors highlighted by the participants in Group A and Group B. Dietary factors (group A: n = 14, 93.3% and Group B: n = 11, 73.3%) as well as stress (group A n = 9, 60% and Group B n = 6, 40%) were the predominant factors similar to that seen in Table 4.2 above. Once again the groups were fairly homogenous with no significant difference between the groups. Overall for both groups food aggravation was represented by 25 participants (83.3%) and stress was represented by 15 participants (50%).

Table 4.5 Cross tabulation of aggravating factors for Group A and Group B

			Group		
			A	B	
Aggravating factors	Food	n	14	11	*0.330*
		%	93.3%	73.3%	
	Alcohol	n	2	3	*1.000*
		%	13.3%	20.0%	
	Medication for other health conditions unrelated to dyspepsia	n	0	2	*0.483*
		%	0.0%	13.3%	
	Sugar	n	1	2	*1.000*
		%	6.7%	13.3%	
	Stress	n	9	6	*0.466*
		%	60.0%	40.0%	
	Lying on right side	n	1	1	*1,000*
		%	6.7%	6.7%	
	Lying down	n	3	5	*0.682*
		%	20.0%	33.3%	
	Hunger	n	2	0	*0.483*
		%	13.3%	0.0%	
	Pressure on abdomen	n	1	0	*1.000*
		%	6.7%	0.0%	
	Overweight	n	3	0	*0.224*
		%	20.0%	0.0%	
	Bending over	n	2	1	*1.000*
		%	13.3%	6.7%	

4.3.2.6 Relieving factors

Table 4.6 presents the relieving factors noted by the participants. The highest recorded relieving factor in the study population was prescribed and/or over the counter medication specific to the treatment of dyspepsia (80%; n = 24) with each group representing 12 participants each (80%). Once again no statistically significant differences were noted between the groups.

Table 4.6 Cross tabulation of relieving factors for Group A and Group B

			Group		
			A	B	
Relieving factors	Water	N	4	7	*0.450*
		%	26.7%	46.7%	
	Prescribed/otc meds	N	12	12	*1.000*
		%	80.0%	80.0%	
	Sitting up	N	1	2	*1.000*
		%	6.7%	13.3%	
	Sleeping on left side	N	1	0	*1.000*
		%	6.7%	0.0%	
	Relaxation exercises	N	3	1	*0.598*
		%	20.0%	6.7%	
	Salt	N	0	1	*1.000*
		%	0.0%	6.7%	
	None	N	1	2	*1.000*
		%	6.7%	13.3%	
	Passing stool	N	1	0	*1.000*
		%	6.7%	0.0%	
	Milky products	N	3	3	*1.000*
		%	20.0%	20.0%	
	Standing	N	1	0	*1.000*
		%	6.7%	0.0%	
	Walking	N	1	0	*1.000*
		%	6.7%	0.0%	
	Not eating	N	0	1	*1.000*
		%	0.0%	6.7%	
	Vomiting	N	0	2	*0.483*
		%	0.0%	13.3%	

4.3.2.7 Associated signs and symptoms

Table 4.7 presents the associated signs and symptoms participants noted which may or may not have been related to the dyspepsia. The most prevalent across both groups was the sensation of bloating (n = 8; 26.6%) followed by headaches (n = 6; 20%). No significant difference was noted between them.

Table 4.7 Cross tabulation of associated symptoms between Group A and Group B

			Group		
			A	B	
Associated symptoms	None	N	1	4	*0.330*
		%	6.7%	28.6%	
	Headaches	N	5	1	*0.169*
		%	33.3%	6.7%	
	Flatulence	N	1	1	*1.000*
		%	6.7%	6.7%	
	Blood in stools	N	0	1	*1.000*
		%	0.0%	6.7%	
	Nausea	n	3	0	*0.224*
		%	20.0%	0.0%	
	Water brash	n	1	2	*1.000*
		%	6.7%	14.3%	
	Coughing	n	0	2	*0.483*
		%	0.0%	14.3%	
	Bloating	n	4	4	*1.000*
		%	26.7%	28.6%	
	Belching	n	3	0	*0.224*
		%	20.0%	0.0%	
	Depression	n	1	2	*1.000*
		%	6.7%	14.3%	
	Loose stools	n	0	2	*0.483*
		%	0.0%	14.3%	
	Fevers	n	0	1	*1.000*
		%	0.0%	6.7%	
	Vomiting	n	1	1	*1.000*
		%	6.7%	6.7%	
	Constipation	n	2	1	*1.000*
		%	13.3%	6.7%	
	Shortness of breath	n	1	0	*1.000*
		%	6.7%	0.0%	
	Fatigue	n	1	1	*1.000*
		%	6.7%	6.7%	

4.3.2.8 Current treatment

Table 4.8 presents the current treatment at the time of the study. The most common form of treatment across both groups was the use of over the counter antacids (Group A: n = 12; 80% and Group B: n = 13; 86.7%), which gave a total across both groups of 25 participants (83.3%). The use of prescription proton pump inhibitors was currently being used by 14 participants in the study (46.6%) across both groups, with group A n = 8 (53.3%) and Group B n = 6 (40%). A total number of 13 participants (43.3%) had been on prescription medication in the past for dyspepsia, with 40% in Group A (n = 6) and 46.7% in Group B (n = 7).

Table 4.8 Cross tabulation of current treatment between Group A and Group B

			Group		
			A	B	
Current treatment	Antacids	n	12	13	*1.000*
		%	80.0%	86.7%	
	Proton pump inhibitors	n	8	6	*0.715*
		%	53.3%	40.0%	
	Anti- depressants	n	2	2	*1.000*
		%	13.3%	13.3%	
	Homoeopathic	n	6	0	*0.017*
		%	40.0%	0.0%	
	Unknown	n	0	1	*1.000*
		%	0.0%	6.7%	
	Past prescription medication	n	6	7	*1.000*
		%	40.0%	46.7%	

4.4 SUBJECTIVE MEASUREMENTS FOR GROUP A AND B

4.4 COMPARATIVE RESULTS OF TREATMENT EFFECT BETWEEN GROUP A AND GROUP B

This section graphically highlights the comparative results of Group A and Group B using repeated measures ANOVA over the four time intervals.

4.5.1 Numerical pain rating scale

Figure 4.15 graphically illustrates the comparison made between Group A and Group B with regards to the numerical pain rating scale. There was a statistically significant decrease (p=0.002) in pain scores over the four time points in Group A in comparison to a non-statistically significant decrease in (p=0.061) in pain scores over the study period in Group B. Group B showed an increase in pain rating at the fourth visit although it was still less than the pain at onset. Comparatively the graph shows that there was a non-significant treatment effect for the numerical pain rating scale (p = 0.063) across both groups.

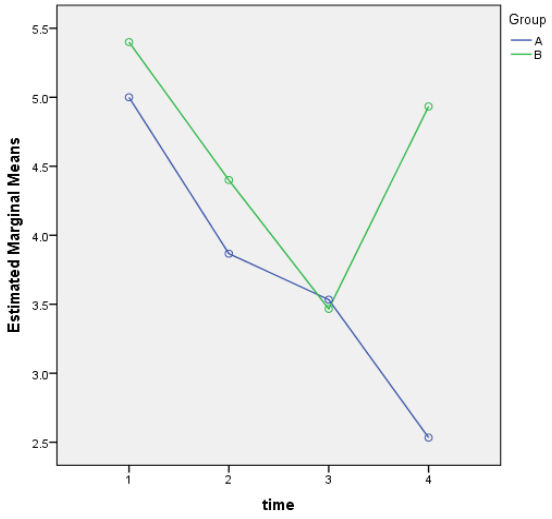


Figure 4.15 Comparative mean treatment effect on numerical pain rating scale by time and group (Wilk's lambda = 0.759)

4.5.2 QOLRAD

Sections 4.5.2.1 to 4.5.2.5 illustrate the comparative results of Group A and Group B with regards to the quality of life of the participants, from the initial consultation to the final follow up visit.

4.5.2.1 Emotional distress

The following graph depicted in Figure 4.16 shows the comparative results between Group A and Group B with regards to the participants' emotional distress over the four time points. There was a non-significant decrease in emotional distress scores (p=0.188) over the four time points in Group A. Group B showed a significant decrease in emotional distress scores (p=0.002) although the score did show a slight

rise at the last visit. The graph shows that comparatively there was no significant difference in treatment effect (p = 0.642) between Group A and Group B.

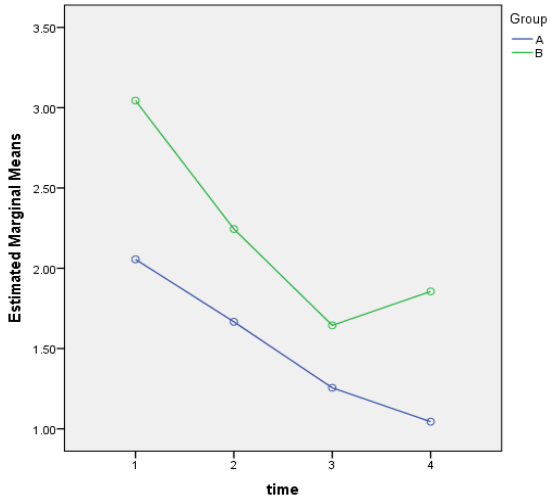


Figure 4.16 Comparative mean emotional distress treatment effect scores by time and group. (Wilk's Lambda = 0.642)

4.5.2.2 Sleep disturbance

Figure 4.17 graphically depicts the comparative difference in treatment effect between Group A and Group B over the four time points. There was a non-significant decrease in sleep disturbance scores (p=0.181) for Group A. Group B showed a significant decrease in sleep disturbance (p= 0.001), however comparatively no significant difference between the groups (p = 0.767) were found.

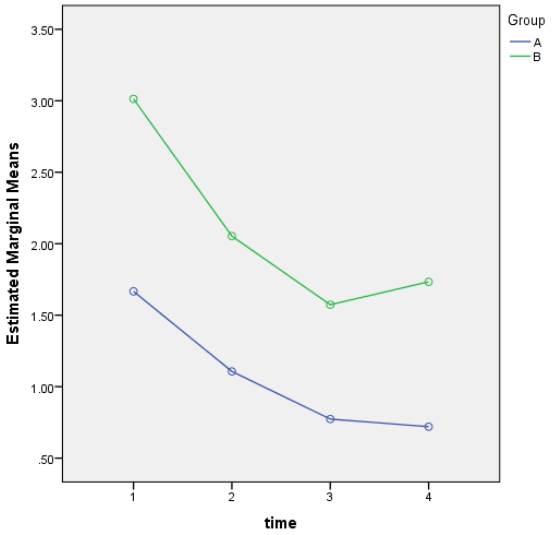


Figure 4.17 Comparative mean sleep disturbance treatment effect scores by time and group. (Wilk's Lambda = 0.958)

4.5.2.3 Food problems

The graph in Figure 4.18 depicts the comparative results obtained for Group A and Group B with regards to food problems over the four time points. Both Group A (p=0.013) and Group B (p=0.001) showed a significant decrease in their food disturbance scores, however comparatively no significant difference in treatment effect between the groups (p = 0.158) was found.

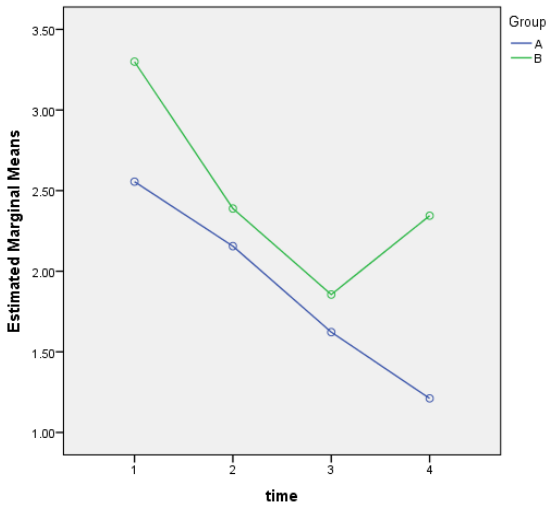


Figure 4.18 Comparative mean food problem treatment effect scores by time and group. (Wilk's Lambda = 0.822)

4.5.2.4 Physical functioning

Figure 4.19 graphically shows the comparative treatment results for Group A and Group B. Group A showed a non-significant decrease (p=0.145) whereas Group B showed a significant decrease in physical functioning (p= 0.021) over the four time points. Comparatively there was no evidence of a difference in treatment effect between the groups in terms of physical functioning (p = 0.982).

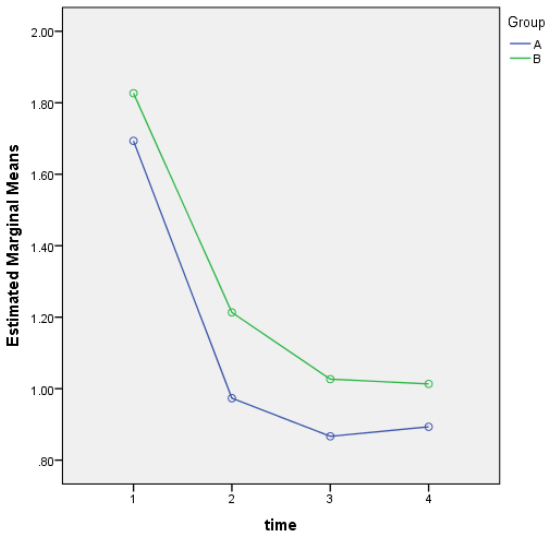


Figure 4.19 Comparative mean physical functioning treatment effect scores by time and group. (Wilk's Lambda = 0.944)

4.5.2.5 Vitality

Figure 4.20 graphically illustrates the comparative treatment results between Group A and Group Both Group A (p=0.028) and Group B (p=0.003) showed a significant improvement in vitality over the four time points, however comparatively there was no difference in treatment effect between the groups for vitality (p = 0.718).

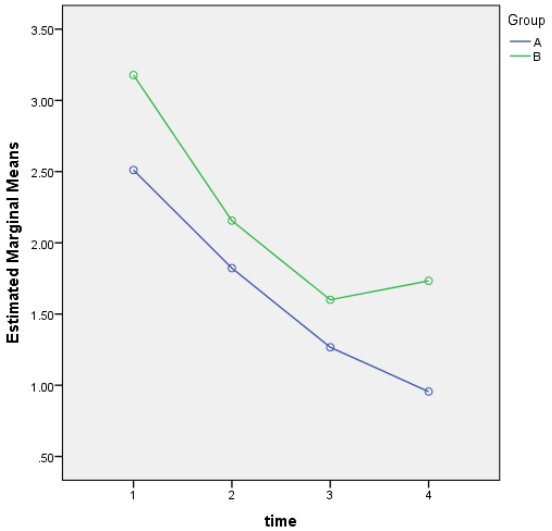


Figure 4.20 Comparative mean vitality treatment effect scores by time and group. (Wilk's Lambda = 0.950)

4.5.3 PAGI-SYM

Sections 4.5.3.1 to 4.5.3.6 illustrate the comparative treatment results between Group A and Group B in terms of participant symptomatology over the four time points.

4.5.3.1 Nausea

Figure 4.21 graphically depicts the difference in treatment effect with regards to participant nausea over the four time points. Both Group A (p= 0.060) and Group B (p= 0.174) showed a non-significant decrease in nausea over the four time points. Comparatively there was no difference in treatment effect between Group A and Group B (p = 0.252).

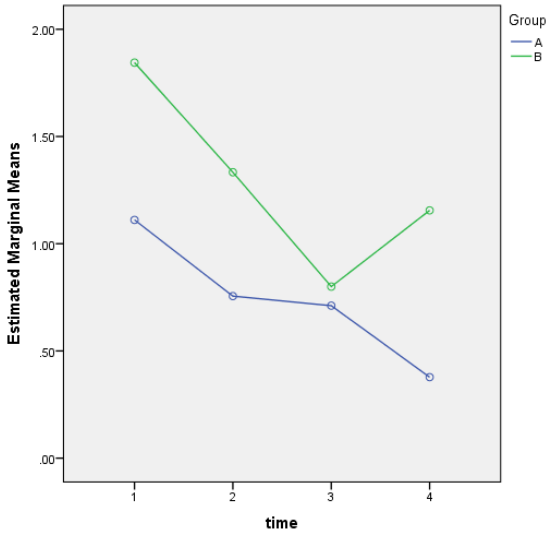


Figure 4.21 Comparative mean nausea treatment effect scores by time and group. (Wilk's Lambda = 0.857)

4.5.3.2 Post-prandial fullness

The graph in Figure 4.22 shows the comparative treatment results for Group A and Group B with regards to post-prandial fullness over the four time points. There was a significant decrease in Group A (p=0.001) whereas Group B showed a non-significant decrease (p=0.176). Comparatively there was no evidence of a difference in treatment effect between the groups (p = 0.064).

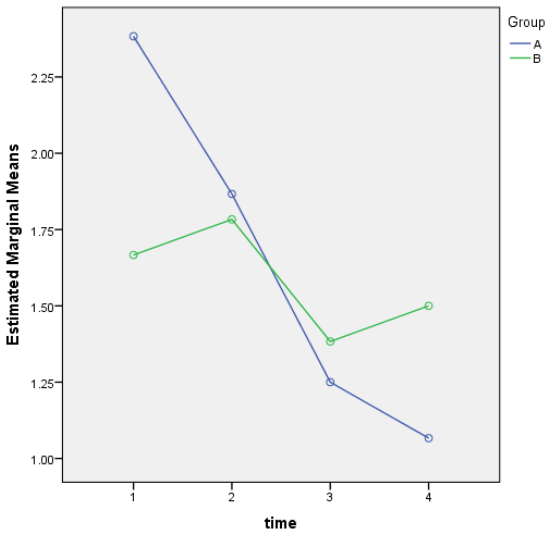


Figure 4.22 Comparative mean post-prandial fullness treatment effect scores by time and group. (Wilk's Lambda = 0.760)

4.5.3.3 Bloating

Figure 4.23 graphically depicts the comparison between Group A and Group B in terms of treatment efficacy of bloating over four time points. Both Group A (p=0.004) and Group B (p=0.023) showed a significant decrease over the four time points however comparatively there was no evidence of a difference in treatment effect between the groups (p = 0.421).

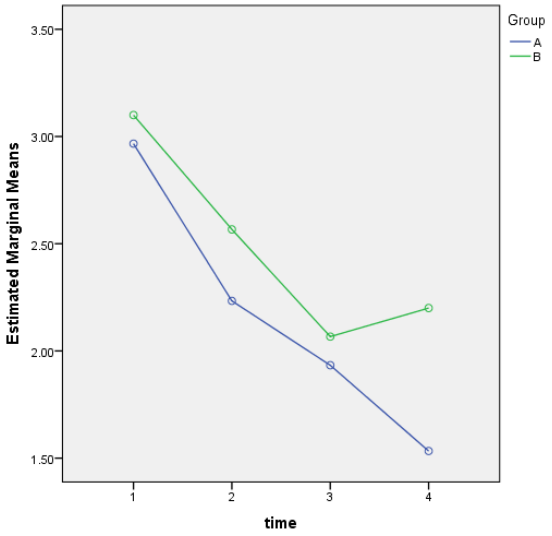


Figure 4.23 Comparative mean bloating treatment effect scores by time and group. (Wilk's Lambda = 0.899)

4.5.3.4 Upper abdominal pain

Figure 4.24, graphically shows the comparison between Group A and Group B in terms of upper abdominal pain over four time points. There was a significant decrease in upper abdominal pain (*p*= 0.048) in Group A, whereas Group B showed a non-significant decrease (*p*= 0.056). Comparatively there was no evidence of a difference in treatment effect between the groups (*p* = 0.850).

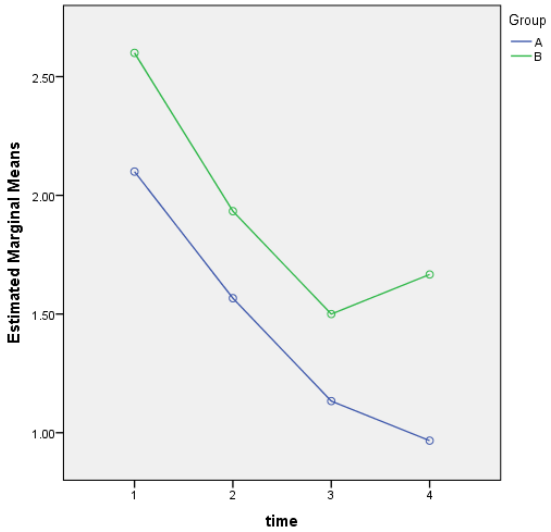


Figure 4.24 Comparative mean upper abdominal pain treatment effect scores by time and group. (Wilk's Lambda = 0.930)

4.5.3.5 Lower abdominal pain

The graph shown in Figure 4.25 depicts the comparative treatments effects between Group A and Group B on lower abdominal pain over four time points. Both Group A (*p*=0.104) and Group B (*p*=0.966) showed no significant difference in effect scores. Comparatively there was no evidence of a difference in treatment effect between the groups (*p* = 0.601).

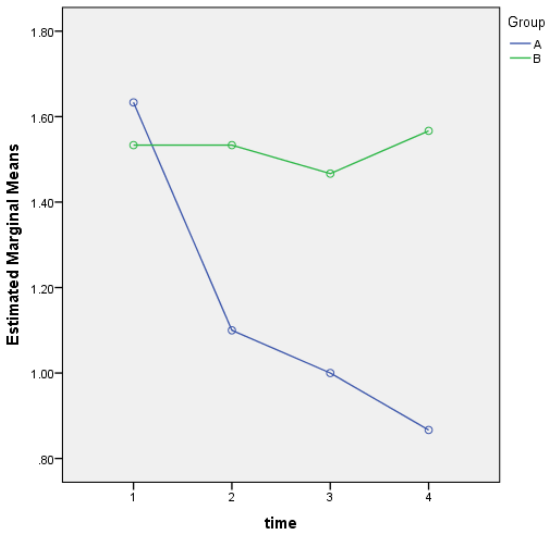


Figure 4.25 Comparative mean lower abdominal pain treatment effect scores by time and group. (Wilk's Lambda = 0.932)

4.5.3.6 Heartburn

Figure 4.26 graphically shows the comparative treatment effects for Group A and Group B on heartburn over the four time points. Both groups showed a significant decrease in the scores, the decrease was marginal in Group A (p=0.046) and highly significant in Group B (p<0.001) n however comparatively there was no evidence of a difference in treatment effect between the groups (p= 0.323).

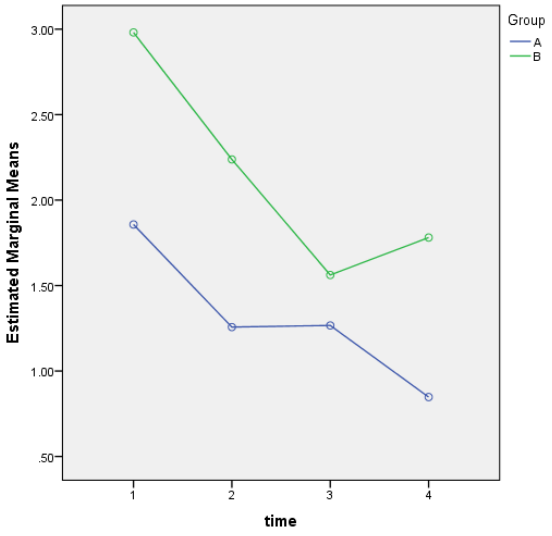


Figure 4.26 Comparative mean heartburn treatment effect scores by time and group. (Wilk's Lambda = 0.877)

4.6 SUMMARY AND CONCLUSION

Due to the small sample size the results graphically depicted above show no statistical significance in treatment effect between the two groups. However there were marginal clinical differences in the two groups over the time period which depicted a decrease in pain and discomfort over time. In terms of symptom characteristics both the groups were relatively homogenous. However, both QOLRAD and PAGI-SYM outcomes suggest that at onset Group B had more severe symptoms than Group A e.g. emotional distress, sleep disturbances, food problems, vitality, nausea, post-prandial fullness, upper abdominal pain and heartburn symptoms were greater in Group B. In terms of clinical outcome measures both groups showed improvement in their pain scores, emotional distress, sleep disturbance, food problems, vitality, post-prandial fullness and abdominal pain over the trial period; however it was noted that Group B in some instances at the fourth time point started to show a mild deterioration in symptoms.

CHAPTER FIVE: DISCUSSION OF RESULTS

5.1 INTRODUCTION

This chapter will include a discussion of the results of Chapter Four. The demographic data of Group A and Group B will be discussed as well as comparative treatment results and disease characteristics. Due to the small sample size (n = 30) there is a greater likelihood of a type II error within the results which would give rise to the groups showing no significant difference as well as the possibility that no difference actually exists.

5.2 DEMOGRAPHIC PROFILE OF PARTICIPANTS

The age range for the study was between 18 and 55 and there was no significant difference (p = 0.841) between the two groups. The majority of the participants in the overall study fell within the 36-45 year age group (n = 12; 40%). This age range is in keeping with current literature which shows that functional gastrointestinal disorders are common between the ages of 30 and 50 years old (Chang, 2004: 31) with a greater incidence progression to actual gastroesophageal disease after the age of 50 (Anderson, 2010: 252). The majority of participants from Group A fell within the 36-45 year age range (n = 7; 46.7%) and Group B had the greater number of participants falling within both the 36-45 (n = 5; 33.3%) and the 46-55 (n = 5; 33.3%) year age group.

The total number of female participants in the study population was 17 (56.7%) and the total number of male participants was 13 (43.4%). Out of this, Group A had four male (26.7%) and 11 female (73.3%) participants, whilst Group B had nine male (60%) and six female (40%) participants. This did not represent a statistically significant difference between the groups (p = 0.065). Chang (2004: 32) says that despite having a limited number of population studies for functional dyspepsia comparing male and female involvement, studies do indicate that overall, the prevalence of functional dyspepsia is slightly higher in men than in woman. However women tend to show a greater prevalence for upper endoscopic investigation. Literature does not show a great difference between the sexes, hence the lack of substantial data.

The majority of the participants in the study were White (n=17; 56.7%), despite this no significant difference in race (*p* = 0.118) was shown between Group A and Group B. Group A had a higher prevalence of White participants (n = 12; 80%) in comparison to Group B (n = 5; 40%). Although limited, literature on race comparisons exist within the field of functional dyspepsia. Literature focussing on western population groups with functional dyspepsia show a greater prevalence within the Black population, such as the Anderson study (2010: 252) which showed a 40.6% incidence in the Black population in comparison to the 35.3% in the White population.

In terms of homogeneity between the two groups, as well as supporting current literature on the known demographics of functional dyspepsia, it can be seen that none of the baseline variables with regards to demographic data (age, gender and race) showed a significant difference between Group A and Group B. As mentioned before, the small sample size increases the risk of a type II error. Despite this the above shows that the group is a good representation of the known demographic characteristics of functional dyspeptic patients. It has to be noted however that the researcher may have indirectly influenced the type of patients seen within the study as the researcher is female, falls between the 36-45 year age group and is White.

5.3 DISEASE CHARACTERISTICS

Sections 5.3.1 and 5.3.2 depict the disease characteristics described by the participants in Group A and B on commencement of the study. The characteristics below conform to the already highlighted definition for functional dyspepsia proposed throughout the literature review in Chapter Two (Yarandi and Christie, 2013: 1). It can also be seen that the groups were fairly homogenous in terms of their description of their symptoms.

5.3.1 Confirmation of diagnosis

According to Allescher (2006: 3) dyspepsia is one of the most common reasons for medical consultations in western countries, but this is not representative of the total number of patients suffering with dyspepsia as only a subgroup of these patients actually consult with a doctor. Young, McCarthy and King *(*2009: 18) further substantiate this by saying that the epidemiological prevalence of dyspepsia in

Western populations is about 45% monthly but only 5-17% consults their medical practitioners. In this particular study the diagnosis was confirmed by several health care specialities either clinically or via endoscopic means. In the study population the general practitioner most commonly diagnosed the condition (n =14; 46.7%). Seven participants in Group A (46.7%) and four in Group B (26.7%) were diagnosed by a gastroenterologist; one participant in Group A (6.7%) and two in Group B (13.3%) were diagnosed by a specialist physician, whereas seven participants in Group A (46.7%) and seven in Group B (46.7%) were diagnosed by a general practitioner. This did not represent a statistically significant difference between the groups (p = 0.533). Eight participants in Group A (53.3%) and 11 in Group B (73.3%) were diagnosed on clinical symptoms and seven in Group A (46.7%) and four in Group B (26.7%) were diagnosed by endoscopic means. Therefore clinical symptoms represented the highest overall confirmation of diagnosis across both groups (n = 19; 63.4%). The cost of more invasive procedures may be a hindrance to endoscopic examination (Richter and Talley, 2007: 1489) and therefore pharmacological intervention is given as a first line treatment and a possible exclusion trial of more sinister pathology (Surjoodeen, 2007: 13).

5.3.2 Symptom characteristics

At the initial consultation, a case history revealed the following symptom characteristics of Group A and B which is in keeping with the Rome III criteria definition of functional dyspepsia (Yarandi and Christie, 2013: 1).

5.3.2.1 Disease characteristics

The disease characteristics subjectively perceived by the participants in Group A and B are discussed in relation to the onset, duration of an episode, frequency and progression. The onset, duration of an episode as well as the progression of symptoms in Group A and Group B showed no significant difference ($p > 0.05$) thus the groups were fairly homogenous in the presentation of these characteristics. Both groups showed that their symptoms had been persistent for a number of years with 60% of Group A (n = 9) and 46.7% of Group B (n = 7) having had the symptoms for longer than five years. Allescher (2006: 4) supports this in his statement that “patients with functional dyspepsia are characterised by chronic and long lasting symptoms”. A greater proportion of participants (53.3%) in Group B felt that their

symptoms were progressing in comparison to Group A (26.7%). Group B had a lower percentage of endoscopic and gastroenterologist referral (see 5.3.1).

Frequency of symptoms showed a statistically significant difference between Group A and Group B (p = 0.030). A total number of 19 participants (63.4%) experienced their symptoms on a daily basis, with 86.7% of these participants coming from Group B (n = 13). Despite the higher percentage of Group B experiencing daily symptoms they did not seek specialist medical attention in comparison to Group A as discussed above. Perhaps here again the cost of invasive procedures is prohibitive (Richter and Talley, 2007: 1491) to the majority of dyspeptic patients Panchamatia (2010: 439) states that patients seeking medical intervention are only around 5% of the total dyspeptic population.

5.3.2.2 Causes

The groups were fairly homogenous with no statistically significant differences (p > 0.05) noted between Group A and Group B in terms of causes of dyspepsia which included: dietary, lifestyle, stress, posture and unknown factors. Overall the participants from both groups highlighted dietary factors (n = 20; 66.7%) and stress (n = 15; 50%) as the main cause for their disease symptoms. Allescher (2006: 4) says that “many patients with functional dyspepsia report an association of gastrointestinal symptoms during or after eating food, it is not usually possible to identify certain food components which cause symptoms”. Dietary factors for both Group A participants (n = 12; 80%) and Group B participants (n = 8; 53.3%) were high. This suggests that diet has to be taken into account when assessing patient symptomatology as well as formulating a treatment methodology for patients despite the fact that Elliot (2013: 183) says that no clear evidence exists to show that dietary changes can alleviate symptoms.

Several studies note that stress is an important causative factor in dyspepsia. Lee, Kindt and Tack (2004: 713) showed that low level vagal stimulation caused by psychological stress and emotions can give rise to functional dyspeptic symptoms. Ringel (2002: 23) noted that functional gastrointestinal disorders result from dysregulation of the bidirectional communication between the gut and the brain (i.e. the brain-gut axis) which is modulated by various psychosocial and environmental factors as highlighted in the bio-psychosocial model. Wade and Halligan (2004:

1400) state that the bio-psychosocial model perspective is necessary in order to understand the presentation and causes of functional pathology. Miwa (2012a: 866) hypothesised that the basis of functional dyspepsia is excessive responsiveness of gastrointestinal functions to stress and stimuli, which can either be direct (e.g. physiological abnormalities) or indirectly (e.g. psychological factors).

5.3.2.3 Location

The participants described the location of their symptoms as being the following: substernal, chest, throat, hypogastric, umbilicus and below umbilicus. The specific locations noted by the participants are in keeping with the typical presentation of symptoms according to Tack *et al.* (2006: 1466), such as upper abdominal and epigastric pain. Substernal manifestation of symptoms was the highest in both groups (group A: n = 11; 73.3% and Group B: n = 11; 73.3%) followed by the throat (n = 9; 60%) and hypogastic (n = 9; 60%) in Group A and the chest (n = 8; 53.3%) and throat (n = 7; 46.7%) in Group B. The two groups were fairly homogenous as there was no significant difference in the location of their symptoms (p = 0.128).

5.3.2.4 Character

A total of 25 participants of the population group (83.3%) described burning to be the most prominent characteristic symptom, of this 86.7% (n = 13) of Group A and 80% (n=12) of Group B experienced the symptom. This is in keeping with the Rome III criteria (Yarandi and Christie, 2013: 1) of the definition of functional dyspepsia: the presence of postprandial fullness, early satiation, epigastric pain, or burning in the absence of organic disease to explain the patients' symptoms.

5.3.2.5 Aggravating factors

The most common aggravating factor across both groups was that of food and stress, which has already been highlighted under causes in 5.3.2.2. Overall for the population, food aggravation was represented by 25 participants (83.3%) and stress was represented by 15 participants (50%) which can further substantiate the causes highlighted in 5.3.2.2. Chang (2004: 36) says that psychosocial stress is a major risk factor for functional gastrointestinal disease and postulates that stress may induce visceral hypersensitivity and altered gastrointestinal motility, which can affect

gastrointestinal symptom severity. These aggravating factors therefore need to be taken into account when formulating a holistic treatment plan.

5.3.2.6 Relieving factors

Various relieving factors were noted by the participants such as change in postural position, relaxation exercises and water consumption. The highest recorded relieving factor for both groups was prescribed and/or over-the-counter medication specific to the treatment of dyspepsia (80%; n = 24) with each group representing 12 participants (80%). Allescher (2006: 6) pointed out that there is no standard medication for the treatment of functional dyspepsia which will eliminate the symptoms effectively in all cases. Although over the counter and prescription medication was the most common relieving factor used, it must have been temporary as all participants were all still symptomatic. Due to ethical constraints when this pilot study was approved it was not possible to allow the participants to halt their medication usage within the study. The use of medication may or may not have influenced the possibility of any treatment effect following spinal manipulative therapy

5.3.2.7 Associated signs and symptoms

The participants highlighted a few symptoms which they associated with their dyspeptic symptoms such as headaches, coughing, depression and constipation. The most frequent across the population was the sensation of bloating (n = 8; 26.6%) followed by headaches (n = 6; 20%). The groups once again were homogenous with no significant differences noted between them ($p > 0.05$). Whilst no supporting literature could be found with regards to associated signs and symptoms, these symptoms do exist whether related to the functional dyspepsia or not. As previously stated, Wade and Halligan (2004: 1400) indicate that bio-psychosocial models are needed to take into account psychological and social factors which can strongly influence the presentation of somatic symptoms in terms of patient functioning, disability and health. Disease is seen to be a consequence at different levels which can be influenced by contextual factors. They also say that the effects of functional pathology may be due to abnormalities of other parts of the body and therefore therapeutic intervention may be needed at several points, where both objective and subjective symptomatology is analysed within the physical, social and

personal context of the patient. Perhaps then it can be said that the associated symptoms may give a clue as to the cause of the functional dyspepsia, given the indirect and direct causes highlighted by Miwa (2012a: 866).

5.3.2.8 Current treatment

As highlighted in 5.3.2.6 the most common relieving factor for both Group A and Group B was the use of over-the-counter and prescription medication. The most common form of treatment across the population (n = 25; 83.3%) was the use of over-the-counter antacids (group A: n = 12; 80% and Group B: n = 13; 86.7%). This conforms to the Phase 1 therapy used to treat functional dyspepsia outlined in the literature review (Elliot, 2013; Surjoodeen, 2007; Hawkey and Wight, 2000). Medications in this class do not require a script and are freely available which could account for their high usage. The use of prescription proton pump inhibitors was currently being used by 14 participants (46.6%) across the population, with a total number of 13 participants (43.3%) having been on prescription medication in the past for dyspepsia. Phase 2 therapy involves the use of prescription drugs (Surjoodeen, 2007; Hawkey and White, 2000). As seen in 5.3.2.1 more than 40% of both Group A and Group B participants had been symptomatic for over five years, this could explain why there was a history of past prescription drug use and not current prescription drug use. One possible reason for this is given by Panchmatia (2010: 444) who says that whilst proton pump inhibitors are potent suppressors of gastric acid, “concerns have been raised about the long-term safety of proton pump inhibitor usage in terms of *C difficile* infections”.

5.4 COMPARATIVE RESULTS OF TREATMENT EFFECT BETWEEN GROUP A AND GROUP B.

In this section of the discussion of the results, the three subjective questionnaires (numerical pain rating scale, QOLRAD and PAGI-SYM) will be discussed in terms of the totality of symptoms experienced across both groups. The comparative results between group A and B showed no statistical significance ($p > 0.05$).

5.4.1 Numerical pain rating scale (NPRS)

The NPRS was used in this study to determine the intensity of the participants’ pain and discomfort level throughout the study. Both groups showed a decrease in their

overall pain rating scores over the first three time points. Group A continued with this trend at the final visit whereas Group B showed a slight increase in pain perception at the last visit. Although symptom characteristics were homogenous across the groups, Group B had a greater mean pain rating scale (i.e. greater severity) at the start of the study than group A.

Over the four time points Group A showed a statistically significant decrease (p = 0.002) in the perception of their pain in comparison to Group B, who, despite measuring a decreased perception of their pain, showed no statistically significant (p = 0.061) change over time. It is interesting to note that Group B participants had a slight increase in their pain rating scale at their post treatment follow up almost back to the initial pre-treatment level. Despite this there was no statistically significant difference between the two groups (p = 0.063). It is possible that Group A showed an improvement due to:

- the analgesic effect of the spinal manipulation (Gatterman, 2005: 305);
- the potential modulating effect on excessive sympathetic output that chiropractic manipulation has been shown to have (Branyon, 2008: 29).

The follow up reading for Group A was still lower than at the last active treatment reading which could suggest that the analgesic effect of the treatment was not just a short term improvement. This may be due to the general changes brought about by manual therapy as noted by Gatterman (2005: 305) such as mechanical changes (e.g. normalisation of joint alignment), soft tissue changes (e.g. normalisation of muscle tone), neurological changes (e.g. autonomic nervous system regulation) and psychological changes (e.g. patient satisfaction).

It could have been chance that contributed to the decreased pain rating in group B over the first three time points, or one could surmise a placebo effect. The known placebo effect in terms of the neurobiological mechanism highlighted by Gupta and Verma (2013: 50) could have contributed to the decreased pain rating in Group B over the first three time points. This effect encompasses the mechanism of endogenous opioid production which results in placebo analgesia.

5.4.2 QOLRAD results

The QOLRAD questionnaire was used to assess the participant's quality of life with regards to their functional dyspepsia. The quality of life of patients afflicted with a functional disease such as functional dyspepsia is important to assess as it has been shown in numerous studies to decrease over time giving rise to greater instances of psychological distress (Chang, 2004: 31). Chang (2004: 31) also pointed out that quality of life tended to improve in patients who received treatment, especially in those patients whose chosen treatment modality led to the improvement of their symptom profile. The QOLRAD questionnaire noted any changes that the participants may have felt with regards to the following parameters: emotional distress, sleep disturbances, food problems, physical functioning and vitality.

Although the comparative QOLRAD results between Group A and Group B did not show any significant difference ($p > 0.05$) across the parameters, there was a trend in both groups towards decreased scores over time, showing a mild improvement, in emotional distress, sleep disturbances, food problems, physical functioning and vitality. What is interesting to note is that all Group B results at the fourth and final visit showed a mild deterioration, whereas Group A maintained the trend towards improvement of quality of life. Interestingly, the placebo group showed a greater statistical significance in the QOLRAD results across all the parameters:

- Emotional distress scores ($p = 0.002$)
- Sleep disturbance ($p = 0.001$)
- Food problems ($p = 0.001$)
- Physical functioning ($p = 0.021$)
- Vitality ($p = 0.003$)

The spinal manipulative group only showed statistical significance across the following parameters:

- Food problems ($p = 0.013$)
- Vitality ($p = 0.028$)

A possible reason for this will be outlined in 5.4.4.

5.4.3 PAGI-SYM

The PAGI-SYM questionnaire was used to assess the following parameters throughout the study: nausea, post-prandial fullness, bloating, upper abdominal pain, lower abdominal pain and heartburn. No significant difference in treatment outcomes was found between the spinal manipulative therapy group and placebo. As mentioned before both groups did show a trend towards improvement of symptoms over the first three time points, except for lower abdominal pain scores for Group B which remained fairly unchanged throughout the study. Group A maintained this positive trend across all time points while Group B showed a slight deterioration of symptoms at the fourth and final visit. However these did not go back to the original scores, and therefore overall did show improvement. Group A, the spinal manipulative group, showed statistically significant improvements across the following parameters:

- Post-prandial fullness (p = 0.001)
- Bloating (p = 0.004)
- Upper abdominal pain (p = 0.048)
- Heartburn (p = 0.046)

Group B, the placebo group, showed statistically significant improvement for the following parameters:

- Bloating (p=0.023)
- Heartburn (p=0.001)

A possible reason for this the difference of outcome between the groups will be outlined in 5.4.4.

5.4.4 Possible mechanism of action for QOLRAD and PAGI-SYM results

It is interesting to note that the placebo group showed a greater improvement in the quality of life parameters in comparison to the group that received manipulation. The spinal manipulation group showed a greater improvement within the physical parameters of symptomatology and pain scores in comparison to the placebo group A possible explanation is outlined in 5.4.4.1 and 5.4.4.2.

5.4.4.1 Group A: The effect of spinal manipulation

A dysfunction in the brain-gut axis has been thought to contribute to functional symptomatology within the gastrointestinal system and a dysregulation of this bidirectional communication between the gut and the brain is modulated by various psychosocial and environmental factors (Ringel, 2002: 23). These psychosocial factors have been shown to play a prominent role in the development of heartburn symptoms as mentioned in the bio-psychosocial model in the literature review. Wu (2012) points out that psychological disorders are commonly associated with abnormal central processing of visceral noxious stimuli. Saying that, it has been suggested that chiropractic treatment modulates sympathetic outflow in functional dyspepsia which would result in an alleviation of symptoms (Hein, 1999: 60). Peterson (2012: 305) says that although it is unknown how manual medicine can reduce the symptoms of dyspepsia, it is highly unlikely that the manual intervention will result in stomach acid regulation, nor would it create a more alkaline stomach environment. He believes that it may be possible for manual medicine to modify "somatovisceral reflexes along with viscerosensory and interosensory pathways", which could lead to the alleviation of symptoms, which is a possible explanation for the improvement of some parameters measured for PAGI-SYM and to a lesser extent for QOLRAD. A large proportion of chiropractic studies have focused on the principle that a vertebral subluxation complex can interfere with the neurophysiologic balance within the body, which could impact on visceral reflex pathways at the level of the spinal joints causing symptoms within the viscera (Leach, 2004: 288). Supporting this, Love and Bull (2003) showed that 58% of surveyed Australian chiropractors perceived that their management of dyspepsia with their chosen treatments (in particular thoracic spine manipulations) was very effective. In terms of the decrease in pain scores for group A, this may also represent the known analgesic effect of spinal manipulative therapy (Gatterman, 2005: 305),

5.4.4.2 Group B: The placebo effect

With regards to Group B their initial improvement over the first three time points could be attributed to the placebo effect. Gupta and Verma (2013: 49) show how placebo use in clinical trials has manifested in psychobiological changes where patients have felt better. Perhaps this is what occurred within Group B where a psychological and neurobiological mechanism came into effect (Gupta and Verma,

2012: 49). Functional dyspepsia has no organic pathology (Tack *et al.,* 2006: 1466) and no gold standard for treatment (Allescher, 2006: 6). Inactive laser would have had no physiological effect on the participants' symptoms, but perhaps because of the interest in their symptoms, the time taken to examine them and the treatment protocol given over a five week period, they felt listened to and validated that their symptoms, despite the lack of organic disease, did exist. The marked decrease within Group B in heartburn scores could be a result of placebo analgesia (Gupta and Verma, 2013: 50) and/or placebo random chance which plays a role in a study with a small sample size.

It is also important to note that because of the small sample size a type II error may have been incurred, which resulted in no significant difference being found between the treatment and the placebo group when one might exist.

5.5 NULL HYPOTHESES

The differences between the two groups could have occurred by chance given the small sample size and large number of variables, however an attempt is made to accept or reject the three null hypotheses that were set prior to undertaking this study:

1. Spinal manipulative therapy will have no effect on patients' dyspeptic symptoms and their perceived quality of life.
    - Accepted for: Emotional distress, sleep disturbance, physical functioning, nausea and lower abdominal pain (although there was a trend towards improvement).
    - Rejected for: pain perception, food problems, vitality, post-prandial fullness, bloating, upper abdominal pain and heartburn.
2. Inactive laser (placebo) will have no effect on patients' dyspeptic symptoms and their perceived quality of life.
    - Accepted for: Emotional distress, sleep disturbance, physical functioning, nausea and lower abdominal pain (although there was a trend towards improvement).
    - Rejected for: pain perception, food problems, vitality, post-prandial fullness, bloating, upper abdominal pain and heartburn.
3. There will be no difference between the two groups.

- Accepted. This may be due to a type II error because of the small sample size as well as the existence of no actual difference.

5.6 CONCLUSION

This pilot study did not show that spinal manipulation treatment was significantly more effective than the placebo for any outcomes. This study should be repeated with selected outcome measurements, and perhaps objective outcome measurements, and a larger sample size in order to explore any benefit.

CHAPTER SIX: CONCLUSION

6.1 CONCLUSIONS

1. The groups were fairly homogenous in terms of demographic data, disease characteristics and symptomatology. Thus they were fairly representative of the typical functional dyspeptic patient described in the Rome III criteria (Yarandi and Christie, 2013: 1).

2. Spinal manipulative therapy and its effect on dyspeptic symptoms and perceived quality of life:

- Showed no statistically significant improvement ($p > 0.05$) for: emotional distress, sleep disturbance, physical functioning, nausea and lower abdominal pain.
- Showed statistically significant improvement for: pain perception ($p = 0.002$), food problems ($p = 0.013$), vitality ($p = 0.028$), post-prandial fullness ($p = 0.001$), bloating ($p = 0.004$), upper abdominal pain ($p = 0.048$) and heartburn ($p = 0.046$).

3. Inactive laser (placebo) and its effect on dyspeptic symptoms and perceived quality of life:

- Showed no statistically significant improvement ($p > 0.05$) for: pain perception, upper abdominal pain, nausea, post-prandial fullness and lower abdominal pain.
- Showed statistically significant improvement for: emotional distress ($p = 0.002$), sleep disturbance ($p = 0.001$), food problems ($p = 0.001$), physical functioning ($p = 0.021$), vitality ($p = 0.003$), bloating ($p = 0.023$) and heartburn ($p = 0.001$).

4. No statistically significant differences were found to exist between the groups. The purpose of the study was to evaluate the appropriateness of the methodology, clinical outcomes were not seen to be relevant as the small sample size could not be expected to show any improvement statistically.

6.2 LIMITATIONS AND RECOMMENDATIONS

1. Budgetary constraints only allowed for a small sample size, it is therefore recommended that the study be repeated using a larger sample size for a number of reasons, including:
    a. The small sample size possibly led to a type II error in that no statistically significant measurements were found despite slight clinical changes improvement in dyspeptic symptoms following spinal manipulation.
    b. If further studies are conducted on this topic a larger sample size could potentially:
        - strengthen the conclusions made in this study
        - ensure that a limited placebo effect takes place
        - subtle changes in subjective data can be more accurately noted

2. Although relatively homogenous in terms of demographics and characteristics, greater homogeneity would be beneficial in terms of symptom severity as there was a slight discrepancy at the outset of the study where overall Group B symptom severity was greater than Group A.

3. Perhaps future studies should make use of food and medication diaries which could track subtle changes that take place within the trial outside of the parameters of the questionnaires, such as medication usage.

4. Future studies should include a longer follow-up. This study showed a trend towards improvement with the manipulation group maintaining this improvement at the follow-up. It would therefore be beneficial to determine how long this improvement lasts.

SOURCES OF REFERENCE

Allescher, H.D. 2006. Functional dyspepsia – a multicausal disease and its therapy. *Phytomedicine*, 13(Supplement 5): 2-11.

Anderson, K. 2010. Gastroeosophageal reflux disease*. Radiologic technology*, 81(3): 251-268.

AstraZeneca. 1997. *QOLRAD-Heartburn-UK-South Africa*. Available: http://www.proqolid.org/instruments/quality_of_life_in_reflux_and_dyspepsia_qolrad (Accessed on 10 July 2011).

Barker, N., Huch, M., Kujula, P., Wetering, M., Snippert, H., Van Es, J., Sato T., Stonge, D., Begthel, H., Van Den Born, M., Danenberg, E., Van Den Brink, S., Korving, J., Abo, A., Peters, P., Wright, N., Poulsom, R., and Cleavers, H. 2010. Lgr5 (+ve) stem cells driven self-renewal in the stomach and build long lived gastric units in vitro. *Cell Stem cell*, 6: 25-36.

Barker, Z. 2005. The effect of spinal manipulation therapy in conjunction with allopathic medication in the management of irritable bowel syndrome. Master's dissertation, University of Johannesburg.

Berkowitz, M.R. 2011. Application of osteopathic manipulative treatment to a patient with unremitting chest pain and shortness of breath undergoing 'rule out myocardial infarction" protocol for one week. *International journal of osteopathic medicine,* 15(2): 73-77.

Blackshaw,L.A. and Gebhart, G.F. 2002. The pharmacology of gastrointestinal nociceptive pathways. *Current opinion in pharmacology*, 2(6): 642-649.

Borzone, R. 2006. Functional gastrointestinal disorders and the enteric nervous system*. Nutritional perspectives: Journal of the council in nutrition of the American chiropractic association,* 29(2): 15-17.

Branyon, B. 2008. Healing hands: using osteopathic manipulative treatment to address visceral structures through somatovisceral reflexes: a case study in gastroesophageal reflux disease*. AAO journal*, 18(4): 29-31.

Bryner, P. and Staerker, P.G. 1996. Indigestion and heartburn: a descriptive study on prevalence in persons seeking care from chiropractors. *Journal of manipulative physiological therapeutics,* 19(5): 315-323.

Budgell, B.2000. Reflex effects of subluxation: The autonomic nervous system. *Journal of manipulative physiologic therapeutics,* 23(2):104-106.

Budgell, B. and Bolton, P. 2012. Visceral responses to spinal manipulation. *Journal of electromyography and kinesiology*, 22(5):777-84.

Budgell, B. and Polus, B. 2006. The effects of thoracic manipulation on heart rate variability: a controlled crossover trial. *Journal of manipulative and physiological therapeutics*, 29(8): 603-10.

Budgell, B., Sato, A., Suzuki, A. and Uchida, S. 1997. Responses of adrenal function to stimulation of lumbar and thoracic interspinous tissues of the rat. Neuroscience research, 28(1): 33-40.

Budgell, B. and Suzuki, A. 2000. Inhibition of gastric motility by noxious chemical stimulation of interspinous tissues in the rat. *Journal of the autonomic nervous system,* 80:162-168.

Chang, L. 2004. Review article: epidemiology and quality of life in functional gastrointestinal disorders*. Alimentary pharmacological therapy*, 20(Supplement 7): 31-39.

Chen, D.Z. and Yin, J. 2010. Gastrointestinal motility disorders and acupuncture. *Autonomic neuroscience: basic and clinical,* 157(1-2): 31-37.

Chiu, J. 2002. How is the motility of gastrointestinal sphincters modulated by acumoxa. *International congress series,* 1238: 141-147.

Clemente, C.D. 1997. *Anatomy: a regional atlas of the human body.* 4th ed. Baltimore: Williams and Wilkins. p 405, 434.

Corazziari, E. 2004. Definition and epidemiology of functional gastrointestinal disease. *Best practice and research clinical gastroenterology,* 18(4): 613-631.

Crossman, A.R. and Neary, D. 2000. *Neuroanatomy an illustrated colour text.* 2nd ed. Edinburgh: Churchill Livingston. p 46.

Dorsher, P.T. and Fleckenstein, J. 2008. Trigger points and classical acupuncture points part: 2 clinical correspondences in treating pain and somatovisceral disorders. *Akupunktur,* 51(4): 6-11.

Dox, I.G., Melloni, B.J. and Eisner, G.M. 1993. *The HarperCollins Illustrated medical dictionary.* 1st ed. New York: HarperCollins. pp 58,139,149,180,196,197,496.

Elliot, D.2013. Common causes of dyspepsia and the difficulties of diagnosis. *Nursing and residential care,* 15(7): 481-483.

Engel, G.L. 1977. The need for a new medical model: a challenge for biomedicine. *Science*, 196(4286): 129-136.

Fukudo, S., Kuwano, H. and Miwa, H. 2012. Management of pathophysiology of functional gastrointestinal disorders. *Digestion,* 85(2): 85-89.

Furness, J.B. 2000. Types of neurons in the enteric nervous system. *Journal of the autonomic nervous system,* 81:87-96.

Furness, J.B. 2006. The organisation of the autonomic nervous system: peripheral connections. *Autonomic neuroscience:basic and clinical,* 130:1-5.

Furness, J.B. 2012. Nature reviews. *Gastroenterology and hepatology,* 9:286-294.

Gatterman, M.I. 2005. *Foundations of chiropractic subluxation*. 2nd ed. St Louis, Missouri: Mosby. pp 305-337.

Gray, S.L., Lacroix, A.Z. and Larson, J. 2010. Proton pump inhibitor use, hip fracture and change in bone mineral density in post-menopausal women: results from the women's health initiative*. Archives of internal medicine*, 170(9): 765-771.

Gupta, U. and Verma, M. 2013. Placebo in clinical trials*.* Perspectives in clinical research. Jan-March, 4(1): 49-52.

Hango, M., Harasawa, S., Mine, T., Susaki, I., Matsueda, K. and Kusamo, M. 2012. Large-scale randomized clinical study on functional dyspepsia treatment with mosopride or leprenone: Japan Mosapride Mega-Study. *Journal of hepatology*, 27(1): 62-68.

Haslett C., Chilvers E.R., Boon N.A., Colledge N.R. and Hunter, J.A.A. eds. 2002. *Davidson's principles and practice of medicine.* Philadelphia: Churchill Livingston.19th ed. pp 750, 775.

Hawkey, C.J. and Wight, N.J.D. 2000. *The British medical association*, f*amily doctors guide to indigestion and ulcers.* London: Dorling Kindersley. pp 11,20,21,50.

Hein, T. 1999. Some effects of Chiropractic manipulation on reflux oesophagitis: a case report. *The British journal of chiropractic,* 3(3): 59-61.

Hipperson, J. 2004. Chiropractic management of infantile colic. *Clinical chiropractic,* 7(4): 180-186.

Holey, L.A. 1995. Connective tissue zones: an introduction. *Physiotherapy*, 81(7): 366-368.

Hubscher, C.H., Ezidin, G. and Kaddumi. 2006. Changes in rat brainstem responsiveness to somatovisceral inputs following acute bladder irritation. *Experimental neurology*, 203(2): 349-357.

Jensen, M.P., Karoly, P. and Braver, S. 1986. The measurement of clinical pain intensity: a comparison of the methods. *Pain*, 27(1): 117-126.

Johnson and Johnson. 2004. *PAGI-SYM*, MAPI research trust, France. Available from www.proqolid.org.

Jonasson, A.K. and Knaap, S.F.C. 2006. Gastroesophageal reflux disease in an 8-year-old boy: a case study. *Journal of manipulative and physiological therapeutics*, 29(3): 245-47.

Kagitani, F., Kimura, A., Sato, A, and Suzuki, A. 1996. The role of the spinal cord as a reflex centre for the somatically induced reflex responses of splenic sympathetic and natural killer cell activity in anaesthetised rats. Neuroscience letters, 217(2-3): 109-112.

Karason, A.B. and Drysdale, I.P. 2003. Somatovisceral response following osteopathic HVLAT: A pilot study on the effect of unilateral lumbosacral high-velocity thrust technique on the cutaneous blood flow in the lower limb. *Journal of manipulative and physiological therapeutics*, 26(4): 220-225.

Kimura, A., Sato, A., Sato, Y. and Suzuki, H. 1996*. A and C reflexes elicited in cardiac sympathetic nerves by single shock to a somatic afferent nerve include spinal and supraspinal components in anaesthetized rats.* Neuroscience research, 25: 91-96.

Koonen, S.D. 2002. A comparative study to determine the efficacy of spinal manipulation and allopathic medication in the treatment of infantile colic. M.Tech., Technikon Witwatersrand.

Leach, R.A. 2004. *The chiropractic theories. A textbook of scientific research*. 4th ed. Baltimore: Lippincott Williams & Wilkins. pp 271-288.

Lebouf-Yde, C., Axen, I., Ahlefeldt, G., Lidefelt, P., Rosenbaum, A. and Thurnhere, T. 1999. The types and frequencies of improved nonmuskuloskeletal symptoms reported after chiropractic spinal manipulative therapy. *Journal of manipulative and physiological therapeutics*, 22(9): 559-564.

Lee, K.J., Kindt, S. and Tack, J. 2004. Pathophysiology of functional dyspepsia. *Best practice and research clinical gastroenterology,* 18(4): 707-716.

Linde, K., Fassler, M. and Meissner, K. 2011. Placebo interventions, placebo effects and clinical practice. *The Royal Society: Biological Sciences*. 366(1572): 1905-12.

Love, Z. and Bull, P. 2003. The management of dyspepsia: a chiropractic perspective. *Chiropractic journal of Australia*, 33(2): 57-63.

Mahadeva, S. and Goh, K.L. 2006. Epidemiology of functional dyspepsia, a global perspective. *World journal of gastroenterology*, 12(17): 2661-2666.

Malliani, A. 1997. The autonomic nervous system: a sherringtonian revision of its integrated properties in the control of circulation. *Journal of the autonomic nervous system,* 64:158-161.

Masarsky, C.S. and Todres-Masarsky, M. 2001. *Somatovisceral aspects of chiropractic an evidence-based approach*, New York: Churchill Livingston. pp 137-139.

McQuay, H.J. and Moore, R.A. 2005. Placebo*. Postgraduate medical journal,* 81(953): 155-160.

Meineche-Schmidt V and Jørgensen, T. 2002. 'Alarm Symptoms' in Patients with Dyspepsia: a Three-year Prospective Study from General Practice. *Scandinavian journal of gastroenterology*, 37(9): 999-1007.

Miwa, H.2012a. Lifestyle in persons with functional gastrointestinal disorders- large scale internet survey of lifestyle in Japan. *Neurogastrointerology motility*, 24(5): 464-471.

Miwa, H.2012b. Why dyspepsia can occur without organic disease: pathogenesis and management of functional dyspepsia. *Journal of gastroenterology,* 47(8): 862-871.

Moore, K.L. and Dalley, A.F. 1999. Clinically *orientated anatomy.* 4th ed. Philadelphia: Lippincott Williams and Wilkins. pp 25,456.

Mosby's medical dictionary. 2009. 8th ed. St Louis: Elsevier. p 1730.

Olafsdottir, E. Forshei, S. Fluge, G. and Markestad, T. 2001. Randomised controlled trial of infantile colic treated with chiropractic spinal manipulation. *Archive of disease in childhood*, 84(2): 138-41.

Pachnis, V and Laranjeira, C.2009. Enteric nervous system development: recent progress and future challenges. *Autonomic neuroscience: basic and clinical,* 151:61-69.

Panchmatia, S. 2010. Drugs for the management of dyspepsia in adults. *Nurse prescribing*, 8(9): 439-44.

Park, D., Son, H.J., Kim, J.J., Paik, S.W., Rhee, J.C, Choi, K.W. Role of autonomic dysfunction in patients with functional dyspepsia. *Digestive and liver disease,* 33(6): 464-471.

Peterson, C. 2012. A case study of chiropractic management of pregnancy-related heartburn with postulated fetal epigenome implications. *Explore*, 8(5): 304-308.

Peterson, D.H. and Bergmann, T.F. 2011. *Chiropractic technique*. 3rd ed. St Louis: Mosby Inc. pp 152,188,211,233.

Pickar, J. 2002. Neurophysiological effects of spinal manipulation. *The spine journal*, 2(5): 357-371.

Pizzolorusso, C., Patrizia, T. Barlafante, G., Certelli, F., Renzetti, C., Cozzolino, V., D'Orazio, M., Fusilli, P., Carinci, F. and D'Incecco, C. 2011. Effect of osteopathic manipulative treatment on gastrointestinal function and length of stay of preterm infants; an exploratory study. *Chiropractic and manual therapies*, 19(1): 15.

Plaughter, G. 1993. *Textbook of clinical chiropractic: a specific biomedical approach*, Baltimore: Williams & Wilkins. p 356.

Richter, J.E. and Talley, N.J. 2007. The building of success. *The American journal of gastroenterology*, 103(3): 507-509.

Ringel, Y. 2002. Brain research in functional gastrointestinal disorders. *Journal of clinical gastroenterology.* 35(1): 23-25.

Rome, P.L. 2010. Neurovertebral influence on visceral and ANS function: some of the evidence to date-part II: Somatovisceral. *Chiropractic journal of Australia*, 40(1): 9-32.

Schafer, R.C. 1991. *Clinical chiropractic. the management of pain and disability: upper body complaints.* 1st ed. Huntington Beach: The Motion Palpation Institute. pp 287-292.

Smith, M.L. 2005. Functional dyspepsia pathogenesis and therapeutic options – implications for management. *Digestive and liver disease*, 37(8): 547-558.

Surjoodeen, E. 2008. The efficacy of a homoeopathic complex (*Carbo vegetabilis* D9, *Lycopodium clavatum* D9, *Nux vomica* D9 and *Robina pseudoacacia* D9)

in the treatment of functional dyspepsia. M.Tech., Durban University of Technology.

Tack, J., Talley, N., Camilleri, M., Holtman, G., Hu, P., Malagelada, J. and Stanghellini, V. 2006. Functional Gastroduodenal disorders. *Gastroenterology,* 130(5): 1466-1879.

Talley, N.J. 1996. Quality of life in functional dyspepsia. *Scandinavian journal of gastroenterology*, 31(221): 21-22.

Tsai, P. and Wang, C. 2012. Efficacy of spinal magnetic stimulation in elderly persons with chronic constipation. *Journal of the Chinese medical association*, 75; 127-131.

Vadachia, R. 2006. A clinical investigation into the effect of spinal manipulative therapy on chronic idiopathic constipation in adults. M.Tech., Durban University of Technology.

Van Zanten, S., Talley, N., Bytzer, P., Klein, K., Whorwhell, P. and Zinsmeister, A. 1999. Design of treatment trials for functional gastrointestinal disorders. *Gut*, Supplement II: 69-77.

Wade, D.T and Halligan, P.W. 2004. Do biomedical models of illness make for good healthcare systems? *British medical journal*, 329(7479): 1398-1401.

Welch, A. and Boone, R. 2007. Sympathetic and parasympathetic responses to specific diversified adjustments to chiropractic vertebral subluxations of the cervical and thoracic spine. *Journal of chiropractic medicine*, 7(3): 86-93.

Weller, B.F. and Wells, R.J. 1992. *Bailliere's nurses dictionary.* 21st ed. London: Balliere Tindall. pp 155,334.

Wiberg, J. and Kerin, R. 1999. A retrospective study of chiropractic treatment of 276 Danish infants with infantile colic. *Journal of manipulative and physiological therapeutics*, 33(7): 536-541.

Wu, J.C. 2012. Psychological co-morbidity in functional gastrointestinal disorders: epidemiology, mechanisms and management. *Journal of neurogastroenterology*, 18(1): 13–18.

Yarandi, S.S. and Christie, J. 2013. Functional dyspepsia in review; pathophysiology and challenges in the diagnosis and management due to coexisting gastroeosophageal reflux disease and irritable bowel syndrome. *Gastroenterology research and practice,* Volume 2013; 1-8.

Young, M.F., McCarthy, P.W. and King, S.J. 2009. Chiropractic manual intervention in chronic adult dyspepsia: A pilot study. *Clinical chiropractic,* 12(1): 28-34.

Internet resources:

www.studyblue.com

www.med.nyu.edu

www.proqolid.org

Appendix A: Red flags in Dyspepsia

Adapted from the Journal of Gastroenterology, Meine-Schmidt (2002)

1. Age of onset cut-off
    1. Current age cut-off: age over 45-56 years
2. Dysphagia
3. Anorexia or early satiety
4. Persistent Vomiting
5. Jaundice
6. Palpable abdominal mass
7. Family history of Gastric cancer
    1. More common in non-Caucasian (esp. black patients)
8. Prior Peptic Ulcer disease history
9. Recent unexplained weight loss
    1. Weight loss more than 3 kg
    2. Weight loss >10% of body weight
10. Signs of significant Gastrointestinal bleeding:
    1. Anemia
    2. Rectal bleeding or Melena

Appendix B: Letter of Information and Consent

Dear participant,

A study to determine the efficacy of spinal manipulative therapy on functional dyspepsia in adults.

Thank you for your interest in the above titled study. Below is an outline on the study design and what would be required from you. Please feel free to ask questions at any stage, also further clarity can be obtained by myself or my supervisor, Dr Nikki De Busser.

Functional dyspepsia can be defined as the "chronic or recurrent pain/discomfort centred in the upper abdomen in the absence of any known structural cause and without any features of irritable bowel disease". Studies show that functional dyspepsia is a common complaint affecting all population groups which places considerable financial drain to public and private resources due to frequent doctors' visits and expensive diagnostic procedures. The development of non-surgical and non-pharmaceutical treatments of functional dyspepsia would therefore make economic sense. This study aims to determine the effect of chiropractic care on your symptoms and sense of wellbeing.

Outline of the Procedures:

All consultations and treatments will take place at the chiropractic clinic at the Durban University of Technology.

You are included in the study if you fulfil the following criteria:

- Referred via a gastroenterologist or General Practitioner
- You are between 18 and 55 years of age.
- Subjects from both sexes and any race.
- You are willing to keep a medication and food diary for the duration of the study.

You will be excluded from the study in the following circumstances:

- Do not fulfil any of the inclusion criteria.
- Pregnancy.
- Known musculoskeletal hypermobility such as Marfans syndrome.
- If you regularly take non-steroidal anti-inflammatory drugs.
- Known gastric pathology, including but not limited to any of the following:
- Barrett's Oesophagus, Coeliac disease, Crohns disease, Gastric/laryngeal cancer, Peptic ulcer, Scleroderma, Zollinger-Ellison syndrome

On acceptance into the study you will complete 2 short questionnaires and will undergo a full case history, a physical examination, as well as an assessment of your spine. Chiropractic treatment using manipulation or laser will then take place once a week for three consecutive weeks, the first treatment will take place at your initial consult. At each consultation you will complete a set of questionnaires. A follow up will be scheduled 2 weeks after your last treatment. You will not need to alter your lifestyle and dietary habits in any way whilst undergoing treatment. Please note that you have a 50% chance of randomly being placed in a placebo group.

Risks or discomforts:

Treatments are generally painless however you may experience mild discomfort, such as muscle stiffness, after your treatments.

Benefits:

It is expected that you will experience a decrease in your dyspeptic symptoms during the course of your treatments. The results of the study may be published at a future date.

Reason/s why you may be withdrawn from the study:

You are free to withdraw from the study at any stage with no consequence. Non Compliance and illness may also result in you being withdrawn from the study.

Remuneration:

This study does not involve any monetary gain or remunerations.

Costs of the study:

There will be no cost to you during the study besides your transportation costs to and from the clinic.

Confidentiality:

All information supplied is treated as confidential and will not be disclosed to anyone other than those directly linked to the study such as the supervisor and researcher.

Research-related Injury:

No injury is expected to occur during the study, any injury or adverse reaction will be attended to by the correct medical intervention. There will be no compensation should any injury or adverse reaction occur.

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

- Researcher: Melanie Sweidan 082 665 4598
- Supervisor: Dr Nikki De Busser 031 201 9569
- Chiropractic day clinic: 031 373 2205
- IREC administrator Lavisha Deonarian (complaints): 031 373 2407

Statement of Agreement to Participate in the Research Study:

I,.....,IDnumber……..... have read this document in its entirety and understand its contents. Where I have had any questions or queries, these have been explained to me by Melanie Sweidan to my satisfaction. Furthermore, I fully understand that I may withdraw from this study at any stage without any adverse consequences and my future health care will not be compromised. I, therefore, voluntarily agree to participate in this study.

Subject's name (print) ……..... Subject's signature:…… .....Date:……

Researcher's name (print).....…….....Researcher's signature:……...Date:.....

Witness name (print) ……..... Witness signature: .....Date:.....……

DURBAN UNIVERSITY OF TECHNOLOGY
CHIROPRACTIC DAY CLINIC
CASE HISTORY

Patient: Date:

File #: __ Age:

Sex: _ Occupation:

Intern: Signature:

FOR CLINICIANS USE ONLY:
Initial visit
Clinician: Signature :

Case History:

Examination:
Previous: Current:

X-Ray Studies:
Previous: Current:

Clinical Path. lab:
Previous: Current:

CASE STATUS:

PTT:	Signature:	Date:

CONDITIONAL:
Reason for Conditional:

Signature: Date:

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

Case Summary signed off: Date:

Intern's Case History:

1. Source of History:

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

3. Present Illness:

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

4. Other Complaints:

5. Past Medical History:

< General Health Status

< Childhood Illnesses

< Adult Illnesses

< Psychiatric Illnesses

< Accidents/Injuries

< Surgery

< Hospitalizations

6. Current health status and life-style:

< Allergies

< Immunizations

< Screening Tests incl. x-rays

< Environmental Hazards (Home, School, Work)

< Exercise and Leisure

< Sleep Patterns

< Diet

< Current Medication
Analgesics/week:
< Tobacco

< Alcohol

< Social Drugs

7. Immediate Family Medical History:

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

8. Psychosocial history:

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

9. Review of Systems:

< General

< Skin

< Head

< Eyes

< Ears

< Nose/Sinuses

< Mouth/Throat

< Neck

< Breasts

< Respiratory

< Cardiac

< Gastro-intestinal

< Urinary

< Genital

< Vascular

< Musculoskeletal

< Neurologic

< Haematologic

< Endocrine

< Psychiatric

APPENDIX D:

PHYSICAL EXAMINATION

Durban University of Technology

PHYSICAL EXAMINATION: SENIOR

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

VITALS:

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

GENERAL EXAMINATION:

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

SYSTEM SPECIFIC EXAMINATION:

CARDIOVASCULAR EXAMINATION

RESPIRATORY EXAMINATION

ABDOMINAL EXAMINATION
NEUROLOGICAL EXAMINATION
COMMENTS
Clinician: **Signature :**

APPENDIX E: CERVICAL EXAMINATION

DURBAN UNIVERSITY OF TECHNOLOGY
REGIONAL EXAMINATION - CERVICAL SPINE

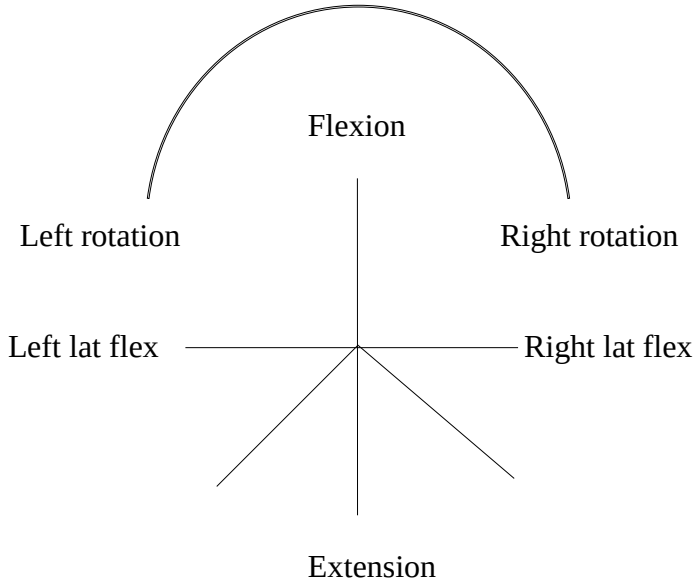
Patient: ..... File No: .....

Date: ..... Student: .....

Clinician:..... Sign: .....

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

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



RANGE OF MOTION:
Extension (70º):
L/R Rotation (70º):
L/R Lat flex (45º):
Flexion (45º):

PALPATION:
Lymph nodes
Thyroid Gland
Trachea

ORTHOPAEDIC EXAMINATION:

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

	Right	Left		Right	Left

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

NEUROLOGICAL EXAMINATION:

Dermatones	**Left**	**Right**	**Myotomes**	**Left**	**Right**	**Reflexes**	**Left**	**Right**
C2			C1			C5		
C3			C2			C6		
C4			C3			C7		
C5			C4					
C6			C5					
C7			C6					
C8			C7					
T1			C8					
			T1					

Cerebellar tests:	Left	Right
Disdiadochokinesis		

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

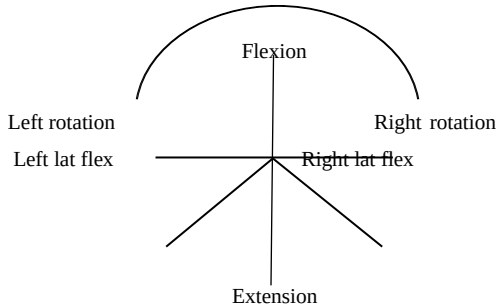
MOTION PALPATION & JOINT PLAY:
Left: Motion Palpation:
Joint Play:
Right: Motion Palpation:
Joint Play:

BASIC EXAM: SHOULDER:
Case History:

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

BASIC EXAM: THORACIC SPINE:
Case History:

ROM:



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

THORACIC SPINE REGIONAL EXAMINATION

DURBAN UNIVERSITY of TECHNOLOGY

Patient:_____File:_____ Date:_____

Intern:_____Signature:_____

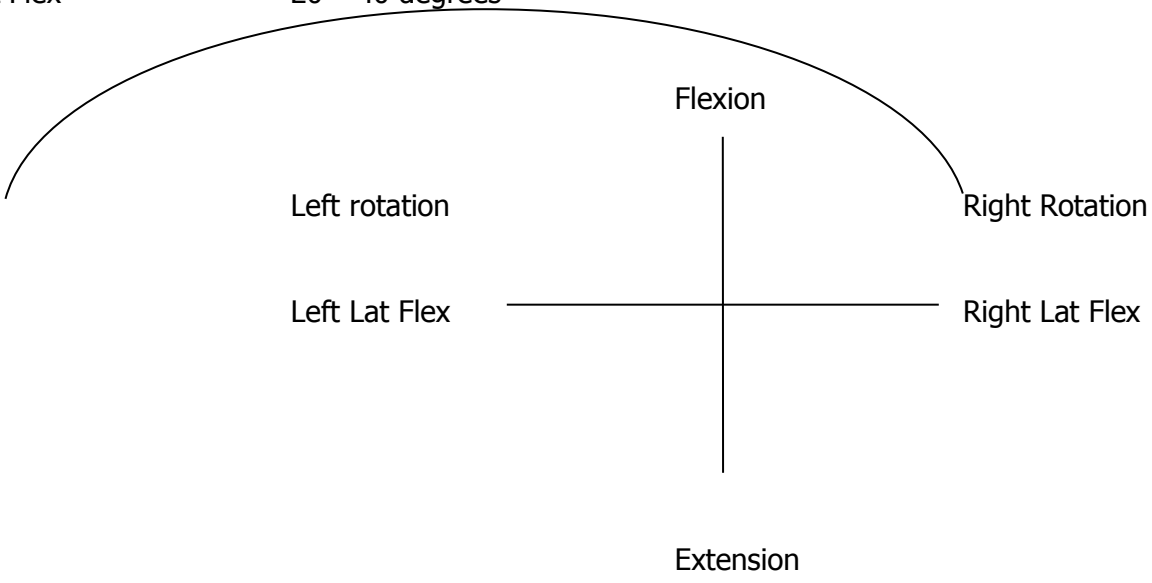
Clinician: _____Signature:_____

STANDING:

Posture (incl. L/S & C/S)
Muscle tone
Skyline view – Scoliosis
Spinous Percussion
Breathing (quality, rate, rhythm, effort)
Deep Inspiration
Scars
Chest deformity
(pigeon, funnel, barrel)

RANGE OF MOTION:

Forward Flexion	20 – 45 degrees (15cm from floor)
Extention	25 – 45 degrees
L/R Rotation	35 – 50 degrees
L/R Lat Flex	20 – 40 degrees



RESISTED ISOMETRIC MOVEMENTS: (in neutral)

Forward Flexion
Extension
L/R Rotation
L/R Lateral Flexion

SEATED:

Palpate Auxillary Lymph Nodes

Palpate Ant/Post Chest Wall
Costo vertebral Expansion (3 – 7cm diff. at 4th intercostal space)
Slump Test (Dural Stretch Test)

SUPINE:
Rib Motion (Costo Chondral joints) SLR
Soto Hall Test (#, Sprains) Palpate abdomen

PRONE:
Passive Scapular Approximation
Facet Joint Challenge
Vertebral Pressure (P-A central unilateral, transverse)
Active myofascial trigger points:

	Latent	Active	Radiation Pattern		Latent	Active	Radiation Pattern
Rhomboid Major				Rhomboid Minor			
Lower Trapezius				Spinalis Thoracic			
Serratus Posterior				Serratus Superior			
Pectoralis Major				Pectoralis Minor			
Quadratus Lumborum							

COMMENTS:_____

NEUROLOGICAL EXAMINATION:

DERMATOMES												
	T 1	T 2	T 3	T 4	T 5	T 6	T 7	T 8	T 9	T 10	T 11	T 12
Left												
Right												

Basic LOWER LIMB neuro:

Myotomes	
Dermatomes	
Reflexes	

KEMP'S TEST:

MOTION PALPATION:

			Right	Left
Thoracic Spine				
Ribs	Calliper (Costo-transverse joints)			
	Bucket Handle	Opening		
		Closing		
Lumbar Spine				

Cervical Spine		

BASIC EXAM	History	ROM	Neuro/Ortho
LUMBAR			
CERVICAL			

APPENDIX G: LUMBAR EXAMINATION

REGIONAL EXAMINATION - LUMBAR SPINE AND PELVIS

Patient:_____ File#:_____Date:_________

Intern\Resident:_____ Clinician:_____

STANDING:

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

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

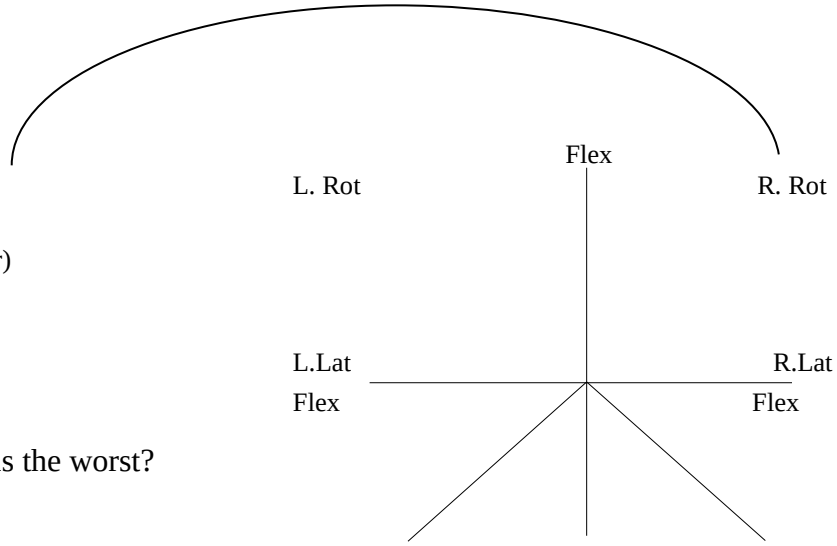
GAIT:

Normal walking
Toe walking
Heel Walking
Half squat

ROM:

Forward Flexion = 40-60° (15 cm from floor)

Extension = 20-35°
L/R Rotation = 3-18°
L/R Lateral Flexion = 15-20°



Which movt. reproduces the pain or is the worst?

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

SUPINE:

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

		Degree	LBP?	Location	Leg pain	Buttock	Thigh	Calf	Heel	Foot	Braggard
SLR	**L**										
	R										

	L	**R**
Bowstring		
Sciatic notch		
Circumference (thigh and calf)		
Leg length: actual -		
apparent -		
Patrick FABERE: pos\neg – location of pain?		

Gaenslen's Test		
Gluteus max stretch		
Piriformis test (hypertonicity?)		
Thomas test: hip \ psoas? \ rectus femoris?		
Psoas Test		

SITTING:

Spinous Percussion
Valsalva
Lhermitte

		Degree	LBP?	Location	Leg pain	Buttock	Thigh	Calf	Heel	Foot	Braggard
TRIPOD Sl, +, ++	L										
	R										

Slump 7 test	L										
	R										

LATERAL RECUMBENT:

	L	R
Ober's		
Femoral n. stretch		
SI Compression		

PRONE:

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

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

NON ORGANIC SIGNS:

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

NEUROLOGICAL EXAMINATION

Fasciculations

Plantar reflex

level	Tender?	Dermatomes		DTR		
		L	R		L	R
T12				Patellar		
L1				Achilles		
L2						
L3				Proprioception		
L4						
L5						
S1						

S2						
S3						

MYOTOMES

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

BASIC THORACIC EXAM

History
Passive ROM
Orthopedic

BASIC HIP EXAM

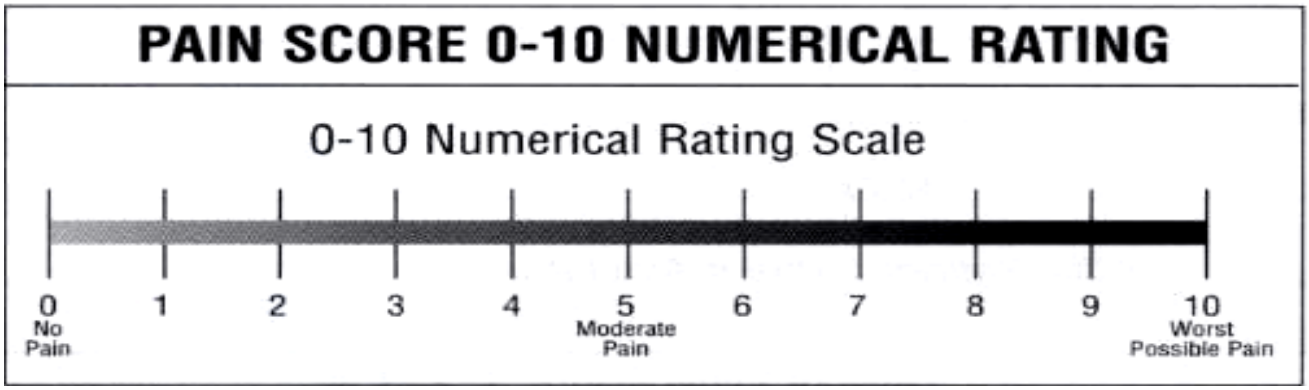
History
ROM: Active
Passive : Medial rotation : A) Supine (neutral) If reduced - hard \ soft end feel
B) Supine (hip flexed): - Trochanteric bursa

MOTION PALPATION AND JOINT PLAY

L R

Upper Thoracics		
Lumbar Spine		
Sacroiliac Joint		

APPENDIX H: NUMERICAL PAIN RATING SCALE



APPENDIX I: QOLRAD QUESTIONNAIRE

QOLRAD
QUESTIONNAIRE FOR PATIENTS WITH SYMPTOMS OF HEARTBURN

PLEASE READ THIS CAREFULLY BEFORE ANSWERING THE QUESTIONS

On the following pages you will find some questions asking about how you have been feeling because of symptoms of heartburn or acid regurgitation.

HEARTBURN is defined as a burning feeling rising from your stomach or lower chest up towards your neck.

ACID REGURGITATION is defined as acid tasting liquid returning to your throat or mouth.

Please answer all of these questions as honestly as you can. For each question, tick the box which best describes how you have been feeling DURING THE PAST WEEK.

1. How often during the past week have you been FEELING TIRED OR WORN OUT BECAUSE OF HEARTBURN OR ACID REGURGITATION?

… All of the time
… Most of the time
… Quite a lot of the time
… Some of the time
… A little of the time
… Hardly any of the time
… None of the time

2. How often during the past week did you AVOID BENDING OVER BECAUSE OF HEARTBURN OR ACID REGURGITATION?

… All of the time
… Most of the time
… Quite a lot of the time
… Some of the time
… A little of the time
… Hardly any of the time
… None of the time

3. During the past week, how much HEARTBURN OR ACID REGURGITATION HAVE YOU HAD BECAUSE OF EATING OR DRINKING?

… A great deal
… A lot
… A moderate amount
… Some
… A little
… Hardly any
… None at all

4. How often during the past week have you FELT GENERALLY UNWELL BECAUSE OF HEARTBURN OR ACID REGURGITATION?

… All of the time
… Most of the time
… Quite a lot of the time
… Some of the time
… A little of the time
… Hardly any of the time
… None of the time

5. How often during the past week was it NECESSARY TO EAT LESS THAN USUAL BECAUSE OF HEARTBURN OR ACID REGURGITATION?

… All of the time
… Most of the time
… Quite a lot of the time
… Some of the time
… A little of the time
… Hardly any of the time
… None of the time

6. How often during the past week has HEARTBURN OR ACID REGURGITATION KEPT YOU FROM DOING THINGS WITH FAMILY OR FRIENDS?

… All of the time
… Most of the time
… Quite a lot of the time
… Some of the time
… A little of the time
… Hardly any of the time
… None of the time

7. How often during the past week did you have A LACK OF ENERGY BECAUSE OF HEARTBURN OR ACID REGURGITATION?

… All of the time
… Most of the time
… Quite a lot of the time
… Some of the time
… A little of the time
… Hardly any of the time
… None of the time

8. How often during the past week have you had DIFFICULTY GETTING A GOOD NIGHT'S SLEEP BECAUSE OF HEARTBURN OR ACID REGURGITATION?

… All of the time
… Most of the time
… Quite a lot of the time
… Some of the time
… A little of the time
… Hardly any of the time
… None of the time

9. How often during the past week has HEARTBURN OR ACID REGURGITATION MADE IT DIFFICULT TO EAT ANY OF THE FOODS OR SNACKS YOU LIKE?

… All of the time
… Most of the time
… Quite a lot of the time
… Some of the time
… A little of the time
… Hardly any of the time
… None of the time

10. How often during the past week did you FEEL TIRED OR WORN OUT DUE TO LACK OF SLEEP BECAUSE OF HEARTBURN OR ACID REGURGITATION?

… All of the time
… Most of the time
… Quite a lot of the time
… Some of the time
… A little of the time
… Hardly any of the time
… None of the time

11. How often during the past week did HEARTBURN OR ACID REGURGITATION WAKE YOU UP AT NIGHT AND PREVENT YOU FROM FALLING ASLEEP AGAIN?

… All of the time
… Most of the time
… Quite a lot of the time
… Some of the time
… A little of the time
… Hardly any of the time
… None of the time

12. How often during the past week have you felt DISCOURAGED OR DISTRESSED BECAUSE OF HEARTBURN OR ACID REGURGITATION?

… All of the time
… Most of the time
… Quite a lot of the time
… Some of the time
… A little of the time
… Hardly any of the time
… None of the time

13. How often during the past week has HEARTBURN OR ACID REGURGITATION MADE FOOD SEEM UNAPPEALING TO YOU?

… All of the time
… Most of the time
… Quite a lot of the time
… Some of the time
… A little of the time
… Hardly any of the time
… None of the time

14. How often during the past week have you FELT FRUSTRATED OR IMPATIENT BECAUSE OF HEARTBURN OR ACID REGURGITATION?

… All of the time
… Most of the time
… Quite a lot of the time
… Some of the time
… A little of the time
… Hardly any of the time
… None of the time

15. How often during the past week have you been ANXIOUS OR UPSET BECAUSE OF HEARTBURN OR ACID REGURGITATION?

… All of the time
… Most of the time
… Quite a lot of the time
… Some of the time
… A little of the time
… Hardly any of the time
… None of the time

16. During the past week, how much HEARTBURN OR ACID REGURGITATION HAVE YOU HAD BECAUSE OF HAVING EATEN FOODS OR SNACKS YOU COULD NOT TOLERATE?

… A great deal
… A lot
… A moderate amount
… Some
… A little
… Hardly any
… None at all

17. How often during the past week have you had ANY WORRIES OR FEARS ABOUT YOUR HEALTH BECAUSE OF HEARTBURN OR ACID REGURGITATION?

… All of the time
… Most of the time
… Quite a lot of the time
… Some of the time
… A little of the time
… Hardly any of the time
… None of the time

18. How often during the past week did you FAIL TO WAKE UP IN THE MORNING FEELING FRESH AND RESTED BECAUSE OF HEARTBURN OR ACID REGURGITATION?

… All of the time
… Most of the time
… Quite a lot of the time
… Some of the time
… A little of the time
… Hardly any of the time
… None of the time

19. How much during the past week has HEARTBURN OR ACID REGURGITATION MADE YOU FEEL IRRITABLE?

… A great deal
… A lot
… A moderate amount
… To some extent
… A little
… Hardly at all
… Not at all

20. How often during the past week have you had to AVOID CERTAIN FOOD, BEVERAGES OR DRINKS BECAUSE OF HEARTBURN OR ACID REGURGITATION?

… All of the time
… Most of the time
… Quite a lot of the time
… Some of the time
… A little of the time
… Hardly any of the time
… None of the time

21. How often during the past week did you HAVE TROUBLE GETTING TO SLEEP BECAUSE OF HEARTBURN OR ACID REGURGITATION?

… All of the time
… Most of the time
… Quite a lot of the time
… Some of the time
… A little of the time
… Hardly any of the time
… None of the time

22. How often during the past week did you FEEL FRUSTRATED BECAUSE THE EXACT CAUSE OF YOUR SYMPTOMS IS NOT KNOWN AND YOU STILL HAVE SO MUCH HEARTBURN OR ACID REGURGITATION?

… All of the time
… Most of the time
… Quite a lot of the time
… Some of the time
… A little of the time
… Hardly any of the time
… None of the time

23. How often during the past week did you have DIFFICULTY SOCIALIZING WITH FAMILY OR FRIENDS BECAUSE OF HEARTBURN OR ACID REGURGITATION?

… All of the time
… Most of the time
… Quite a lot of the time
… Some of the time
… A little of the time
… Hardly any of the time
… None of the time

24. How often during the past week were you UNABLE TO CARRY OUT YOUR DAILY ACTIVITIES (INCLUDING BOTH WORK OUTSIDE THE HOME AND HOUSE WORK) DUE TO HEARTBURN OR ACID REGURGITATION?

… All of the time
… Most of the time
… Quite a lot of the time
… Some of the time
… A little of the time
… Hardly any of the time
… None of the time

25. How often during the past week were you UNABLE TO CARRY OUT YOUR NORMAL PHYSICAL ACTIVITIES (INCLUDING SPORT, LEISURE ACTIVITIES AND MOVING AROUND OUTSIDE THE HOME) DUE TO HEARTBURN OR ACID REGURGITATION?

… All of the time
… Most of the time
… Quite a lot of the time
… Some of the time
… A little of the time
… Hardly any of the time
… None of the time

APPENDIX J:

PAGI-SYM questionnaire

PAGI-SYM
(South African English version)

This questionnaire asks you about the severity of symptoms you may have related to your stomach problem. There are no right or wrong answers. Please answer each question as accurately as possible.

For each symptom, please *circle the number* that best describes how *severe* the symptom has been during the past 2 weeks. If you have not experienced this symptom, circle 0. If the symptom has been very mild, circle 1. If the symptom has been mild, circle 2. If it has been moderate, circle 3. If it has been severe, circle 4. If it has been very severe, circle 5. Please be sure to answer every question.

Please rate the severity of the following symptoms during the past 2 weeks.

		None	Very mild	Mild	Moderate	Severe	Very severe
1.	nausea (feeling sick in your stomach as if you were going to vomit or bring up)	0	1	2	3	4	5
2.	retching (heaving as if to vomit, but nothing comes up)	0	1	2	3	4	5
3.	vomiting	0	1	2	3	4	5
4.	feeling full	0	1	2	3	4	5
5.	feeling of not being able to finish a normal-sized meal	0	1	2	3	4	5
6.	feeling excessively full after meals	0	1	2	3	4	5
7.	loss of appetite	0	1	2	3	4	5
8.	bloating (feeling like you need to loosen your clothes)	0	1	2	3	4	5
9.	stomach or tummy visibly larger	0	1	2	3	4	5

		None	Very mild	Mild	Moderate	Severe	Very severe
10.	upper abdominal (above the navel/belly button) pain	0	1	2	3	4	5

Please rate the severity of the following symptoms during the past 2 weeks.

		None	Very Mild	Mild	Moderate	Severe	Very Severe
11.	upper abdominal (above the navel/belly button) discomfort	0	1	2	3	4	5
12.	lower abdominal (below the navel/belly button) pain	0	1	2	3	4	5
13.	lower abdominal (below the navel/belly button) discomfort	0	1	2	3	4	5
14.	heartburn (burning pain rising in your chest or throat) during the day	0	1	2	3	4	5
15.	heartburn (burning pain rising in your chest or throat) when lying down	0	1	2	3	4	5
16.	feeling of discomfort inside your chest during the day	0	1	2	3	4	5
17.	feeling of discomfort inside your chest at night (during sleep time)	0	1	2	3	4	5
18.	regurgitation or reflux (fluid or liquid from your stomach coming up into your throat) during the day	0	1	2	3	4	5
19.	regurgitation or reflux (fluid or liquid from your stomach coming up into your throat) when lying down	0	1	2	3	4	5
20.	bitter, acid or sour taste in your mouth	0	1	2	3	4	5

APPENDIX K: ARTICLE

A STUDY TO DETERMINE THE EFFICACY OF SPINAL MANIPULATIVE THERAPY ON FUNCTIONAL DYSPEPSIA IN ADULTS

Sweidan, M.J. de Busser, N.L.

Summary

Objective: The objective of the study was to investigate the effect of spinal manipulation versus an inactive laser device (placebo) on the severity, character and sense of wellbeing in the management of adult functional dyspepsia.

Design: A controlled clinical trial using three validated questionnaires to determine pre and post treatment outcomes.

Setting: Chiropractic Day Clinic at the Durban University of Technology.

Subjects: Thirty participants with pre-diagnosed functional dyspepsia were selected after being screened according to the inclusion and exclusion criteria identified by the researcher. These participants were then divided into two groups using consecutive sampling.

Intervention: Group A received an active chiropractic manipulation using diversified technique to pre-identified levels in the cervical, thoracic and lumbar spine. Group B received inactive laser to pre-identified levels in the cervical, thoracic and lumbar spine. Both groups received one treatment a week for three weeks, the fourth and final consultation consisted only of data capturing.

Results: Spinal manipulative therapy showed statistically significant improvement for: pain perception (p = 0.002), food problems (p = 0.013), vitality (p = 0.028), post-prandial fullness (p = 0.001), bloating (p = 0.004), upper abdominal pain (p = 0.048) and heartburn (p =0.046). The placebo group showed statistically significant improvement for: emotional distress (p = 0.002), sleep disturbance (p = 0.001), food problems (p = 0.001), physical functioning (p = 0.021), vitality (p =0.003), bloating (p = 0.023) and heartburn (p = 0.001).

Conclusion: This study showed that spinal manipulation treatment was not significantly more effective than the placebo for any outcomes, however

manipulation did appear to show slightly more favourable results for the numerical pain rating scale and post-prandial fullness.

Abbreviations

NPRS: Numerical pain rating scale
QOLRAD: Quality of life and dyspepsia
PAGI-SYM: Patient assessment of gastrointestinal symptom severity

Introduction

Functional dyspepsia is a non-life threatening condition which, whilst it has not been shown to be associated with increased mortality, has been shown to have a considerable impact on patients' quality of life and health care resources[1]. Advances in medicine and drug therapy over the last 30 years have resulted in several theories being put forward regarding a possible aetiology for functional dyspepsia[2]. It has been postulated to be more of a multi-causal disorder, which ultimately leads to altered processing of afferent information from the gastrointestinal tract to the central nervous system[2]. In functional dyspepsia changes in gut motility, chronic inflammation and changes in gut and intestinal secretion could increase neural afferent inputs within the autonomic nervous system. Treatment therefore should be aimed at altering autonomic reactivity in the area. The somatovisceral reflex can be defined as "a reflex in which visceral functions are activated or inhibited by somatic sensory stimulation"[3]. This reflex is under autonomic nervous system control whereby excitatory sympathetic and inhibitory parasympathetic stimuli work in opposition to each other to regulate homoeostasis and function within the body[4].The autonomic nervous system has provided rich research for the field of neuroscience and various animal studies have been conducted to explain the somatovisceral reflex phenomenon. These studies which elicited a definite link between somatic stimulation and visceral functioning, included amongst others: adrenal function[5], cardiac function[6], splenic sympathetic and natural killer cell activity[7] and bladder functioning[8].

A review of the literature with regards to chiropractic intervention and gastrointestinal disorders showed a possible link in therapeutic benefit within the context of somatovisceral reflex stimulation. The field of chiropractic has suggested positive effects of chiropractic manipulations on musculoskeletal and visceral health[9]. Although several studies regarding spinal manipulative therapy and autonomic functioning have been conducted, few link outcomes to specific levels adjusted[9]. Specific areas along the spine were identified according to their visceral innervations[10]. The researcher performed spinal manipulation using diversified technique[11] to the mid cervical spine (the origin of the phrenic nerve, C3-C5) and the thoraco-lumbar spine (the origin of the lesser splanchnic nerve and the levels of diaphragmatic insertion, T5-L2), in order to elicit and record any autonomic nervous

system changes. Changes were noted according to changes in symptomatology and perceived quality of life in subjects, with a placebo control.

The research problem was addressed using the following theoretical framework:

- The functioning of the autonomic nervous system.
- Literature review of studies showing positive evidence as to the existence of the somatovisceral reflex.
- Somatovisceral theory within chiropractic.
- Possible effects of chiropractic subluxation on visceral pathology based on a literature review.
- A clinical trial to determine the effect of spinal manipulative therapy on gastrointestinal symptoms and patients quality of life.

Methodology

Traditionally the treatment of Dyspepsia had not been considered to be part of a Chiropractor's scope of practice. Anecdotal evidence suggests however that Chiropractors have noticed changes in visceral pathology following spinal manipulation[12]. However, a literature review did not reveal a standard protocol for the treatment of somato-visceral conditions. Therefore it was necessary to look at the methodology of similar studies in order to formulate a research methodology for this study. A minimum of 30 pre-diagnosed participants was required for the study. The diagnosis of functional dyspepsia had to be confirmed by a professional qualified to do so, such as a general practitioner and gastroenterologist, either via clinical means or via endoscopes and barium swallows. In order to ascertain whether the potential participants were good candidates for the study and still symptomatic despite current treatment, an initial telephonic interview by the researcher had to confirm their willingness to participate in the study as well as to ascertain suitability based on the inclusion and exclusion criteria. Willing participants underwent a consultation at the Chiropractic Clinic at the Durban University of Technology. All subjects were asked to read the information letter and complete an informed consent and complete the validated questionnaires. The researcher then took a full case history and performed a general physical examination as well as cervical, thoracic and lumbar regional assessments. The regional assessments also included motion palpation to determine the levels of spinal fixation, which were noted at the first three visits. The researcher made use of validated questionnaires (QOLRAD and PAGI-SYM) and a numerical pain rating scale, which were used to track any changes in patients' symptomatology as they progressed through the study. The QOLRAD questionnaire, has been tested and used in numerous studies testing the efficacy of pharmaceutical drugs on functional dyspepsia[13] and is often a tool used in conjunction with the PAGI-SYM questionnaire[14] when conducting large clinical trials. Both questionnaires were made available to the researcher via a detailed application process through the MAPI trust, who only publish and release validated and tested

questionnaires for clinical trials. The role of validated questionnaires in this study was to prevent researcher bias and misinterpretation of results.

Numerical pain rating scale (NPRS)

The numerical pain rating scale is considered to be a valid method of obtaining a subjective measurement of the intensity of patients' pain and discomfort level[15]. The NPRS was used in this study to determine the intensity of the patients' pain and discomfort level throughout the study. On acceptance into the study patients had to fall between a four and a seven, on the first reading, in order to ensure a more homogenous group. The scale was filled in by the researcher at each visit. Patients were asked to rate their pain and discomfort level out of ten, where zero represented no pain at all and ten represented the highest intensity of pain.

Quality of life and dyspepsia (QOLRAD) questionnaire

This questionnaire was used to assess the participant's quality of life and dyspepsia. The questionnaire was self-administered and took on average five minutes to complete. Each question was scored from 0 to 6. A score of 6 represented a low quality of life and the lower scores represented better health. The questionnaire assessed the following parameters: emotional distress, sleep disturbances, food/drink problems, physical/social functioning and vitality.

Patient assessment of gastrointestinal symptom severity (PAGI-SYM)

This questionnaire was used to assess the participants' symptom severity. The questionnaire was self-administered and took on average five minutes to complete. It consisted of a six point Likert scale ranging from 0 = "none" to 5 = "very severe". The following parameters were assessed: heartburn and regurgitation, post-prandial fullness/early satiety, nausea and vomiting, bloating, upper abdominal pain and lower abdominal pain.

Both groups received one treatment a week for three weeks and both completed the questionnaires at every treatment as well as at their two week post treatment follow-up, which did not include a treatment. At each visit both groups received motion palpation to determine the levels of the spinal fixation. This also ensured that both groups remained homogenous in their assessments. Both groups were asked not to alter diet, lifestyle and medication over the treatment period.

Group A: Spinal manipulative therapy

Group A underwent spinal manipulation using diversified technique[11] to the mid cervical spine (the origin of the phrenic nerve, C3-C5), the thoraco-lumbar spine (the origin of the lesser splanchnic nerve and the levels of diaphragmatic insertion, T5-L2).

Group B: Placebo

Group B received inactive laser to the mid cervical spine (the origin of the phrenic nerve, C3-C5), the thoraco-lumbar spine (the origin of the lesser splanchnic nerve and the levels of diaphragmatic insertion, T5-L2). The choice of the laser as placebo was to ensure that no skin contact was needed for the treatment to take place. The choice to use placebo in this study was based on the fact that previous studies on functional dyspepsia were not able to exclude the placebo effect as they did not have a placebo group[10].

Results

1. Homogeneity across the population group was shown to be evident at the outset of the study in terms of the following:

- The baseline variables with regards to demographic data (age, gender and race) showed no significant difference between Group A and Group B
- Symptom and disease characteristics across the following parameters: confirmation of diagnosis, causes, location, character, aggravating factors, relieving factors, associated signs and symptoms and current treatment was in keeping with the Rome III criteria definition of functional dyspepsia[16].

2. Spinal manipulative therapy and its effect on dyspeptic symptoms and perceived quality of life:

- Showed no improvement for: emotional distress, sleep disturbance, physical functioning, nausea and lower abdominal pain.
- Showed improvement for: pain perception (p = 0.002), food problems (p = 0.013), vitality (p = 0.028), post-prandial fullness (p = 0.001), bloating (p = 0.004), upper abdominal pain (p = 0.048) and heartburn (p =0.046).

3. Inactive laser (placebo) and its effect on dyspeptic symptoms and perceived quality of life:

- Showed no improvement for: pain perception, upper abdominal pain, nausea, post-prandial fullness and lower abdominal pain
- Showed improvement for: emotional distress (p = 0.002), sleep disturbance (p = 0.001), food problems (p = 0.001), physical functioning (p = 0.021), vitality (p =0.003), bloating (p = 0.023) and heartburn (p = 0.001).

4. There was no statistical difference in treatment effect between group A and group B possibly due to a type II error most prevalent in small sample sizes.

Discussion

With regards to the comparative results of Group A and Group B, whilst not statistically significant ($p > 0.05$), both groups showed a trend towards lower scores (improvement of symptoms) over the first three time points with Group A maintaining this downward trend at the fourth visit and Group B showing a slight increase in their scores. This trend occurred for the numerical pain rating scale, QOLRAD and the PAGI-SYM results.

Numerical pain rating scale (NPRS) results

The NPRS was used in this study to determine the intensity of the patients' pain and discomfort level throughout the study. Both groups showed a decrease in their overall pain rating scores over the first three time points. Group A continued with this trend at the final visit whereas Group B showed a slight increase in pain perception at the last visit. Although symptom characteristics were homogenous across the groups, Group B had a greater mean pain rating scale (i.e. greater severity) at the start of the study than Group A.

Over the four time points Group A did show a statistically significant decrease ($p = 0.002$) in the perception of their pain in comparison to Group B, who despite measuring a decreased perception of their pain, showed no statistically significant ($p = 0.061$) change over time. It is interesting to note that Group B participants had a slight increase in their pain rating scale at their post treatment follow up almost back to the initial pre-treatment level. Despite this there was no statistically significant difference between the two groups ($p = 0.063$). Group A may have showed an improvement due to:

- The analgesic effect of the spinal manipulation[17]
- The potential modulating effect on excessive sympathetic output that chiropractic manipulation has been shown to have[18]
- The follow up reading for group A was still lower than at the last active treatment reading which could suggest that the analgesic effect of the treatment was not just a short term improvement. This may have been due to the general changes brought about by manual therapy[17] such as mechanical changes (e.g. normalisation of joint alignment), soft tissue changes (e.g. normalisation of muscle tone), neurological changes (e.g. autonomic nervous system regulation) and psychological changes (e.g. patient satisfaction).

The known placebo effect in terms of the neurobiological mechanism[19] could have contributed to the decreased pain rating in Group B over the first three time points. This effect encompasses the mechanism of endogenous opioid production which results in placebo analgesia.

QOLRAD results

The QOLRAD questionnaire was used to assess the participant's quality of life with regards to their functional dyspepsia. The quality of life of patients afflicted with a functional disease such as functional dyspepsia is important to assess as it has been shown in numerous studies to decrease over time giving rise to greater instances of psychological distress[20]. The quality of life tended to improve in patients who received treatment[20], especially in those patients whose chosen treatment modality led to the improvement of their symptom profile. Although the comparative QOLRAD results between Group A and Group B did not show any significant difference ($p > 0.05$) across the parameters. There was a trend in both groups towards decreased scores over time, showing a mild improvement, in emotional distress, sleep disturbances, food problems, physical functioning and vitality. What is interesting to note is that all Group B results at the fourth and final visit showed a mild deterioration, whereas Group A maintained the trend towards improvement of quality of life. Interestingly the placebo group showed a greater statistical significance in the QOLRAD results across all the parameters:

- Emotional distress scores ($p = 0.002$);
- Sleep disturbance ($p = 0.001$);
- Food problems ($p = 0.001$);
- Physical functioning ($p = 0.021$);
- Vitality ($p = 0.003$).

The spinal manipulative group only showed statistical significance across the following parameters:

- Food problems ($p = 0.013$);
- Vitality ($p = 0.028$).

PAGI-SYM

No significant difference in treatment outcomes was found between the spinal manipulative therapy group and placebo. As mentioned before both groups did show a trend towards improvement of symptoms over the first three time points, except for lower abdominal pain scores for Group B which remained fairly unchanged throughout the study. Group A maintained this positive trend across all time points while Group B showed a slight deterioration of symptoms at the fourth and final visit. However these did not go back to the original scores, and therefore overall did show improvement. Group A, the spinal manipulative group showed the following statistically significant improvements across the following parameters:

- Post-prandial fullness ($p = 0.001$);
- Bloating ($p = 0.004$);
- Upper abdominal pain ($p = 0.048$);
- Heartburn ($p = 0.046$).

Group B, the placebo group, only showed a statistically significant improvement for the following parameters:

- Bloating (p=0.023);
- Heartburn (p=0.001).

It is interesting to note that the placebo group showed a greater improvement in the quality of life parameters in comparison to the group that received manipulation, whereas the spinal manipulation group showed a greater improvement within the physical parameters of symptomatology and pain scores in comparison to the placebo group.

Group A and the effect of spinal manipulation

A dysfunction in the brain-gut axis has been thought to contribute to functional symptomatology within the gastrointestinal system and a dysregulation of this bidirectional communication between the gut and the brain is modulated by various psychosocial and environmental factors[21]. These psychosocial factors have been shown to play a prominent role in the development of heartburn symptoms as mentioned in the bio-psychosocial model in the literature review. Psychological disorders are commonly associated with abnormal central processing of visceral noxious stimuli[21]. Saying that, it has been suggested that chiropractic spinal manipulation modulates sympathetic outflow in functional dyspepsia which would result in an alleviation of symptoms[23]. Although it is unknown how manual medicine can reduce the symptoms of dyspepsia[24], it is unlikely that the manual intervention will result in stomach acid regulation, nor would it create a more alkaline stomach environment. It may then be possible for manual medicine to modify "somatovisceral reflexes along with viscerosensory and interosensory pathways"[24], which could lead to the alleviation of symptoms, which is a possible explanation for the improvement of some parameters measured for PAGI-SYM and less for QOLRAD. A large proportion of chiropractic studies have focused on the principle that a vertebral subluxation complex can interfere with the neurophysiologic balance within the body, which could impact on visceral reflex pathways at the level of the spinal joints causing symptoms within the viscera[25]. Supporting this it has been shown that that 58% of surveyed Australian chiropractors perceived that their management of dyspepsia with their chosen treatments (in particular thoracic spine manipulations) was very effective[12]. In terms of the decrease in pain scores for Group A, this may represent the known analgesic effect of spinal manipulative therapy[17].

Group B and the placebo effect

With regards to Group B their initial improvement over the first three time points could be attributed to the placebo effect. It has been shown how placebo use in clinical trials has manifested in psychobiological changes where patients have felt better[19]. Perhaps this is what occurred within group B where a psychological and neurobiological mechanism came into effect. Functional dyspepsia has no organic pathology[26] and no gold standard for treatment[2]. Inactive laser would have had no physiological effect on the patients' symptoms, but perhaps because of the interest

in their symptoms, the time taken to examine them and the treatment protocol given over a five week period, they felt listened to and validated that their symptoms, despite the lack of organic disease, did exist. The marked decrease within Group B in heartburn scores could show evidence of the known effect of placebo analgesia[19] as well as placebo random chance which plays a role in a study with a small sample size. It is also important to note that because of the small sample size a type II error could have been incurred, resulting in no significant difference to be found between the treatment and the placebo groups.

References

1. Mahadeva, S. and Goh, K.L. 2006. Epidemiology of functional dyspepsia, a global perspective. *World journal of gastroenterology*, 12(17): 2661-2666.

2. Allescher, H.D. 2006. Functional dyspepsia – a multicausal disease and its therapy. *Phytomedicine*, 13(Supplement 5): 2-11.

3. Mosby's medical dictionary. 2009. 8th ed. St Louis: Elsevier. p 1730.

4. Masarsky, C.S. and Todres-Masarsky, M. 2001. *Somatovisceral aspects of chiropractic an evidence-based approach*, New York: Churchill Livingston. pp 137-139.

5. Budgell, B., Sato, A., Suzuki, A. and Uchida, S. 1997. Responses of adrenal function to stimulation of lumbar and thoracic interspinous tissues of the rat. Neuroscience research, 28(1): 33-40.

6. Kimura, A., Sato, A., Sato, Y. and Suzuki, H. 1996. *A and C reflexes elicited in cardiac sympathetic nerves by single shock to a somatic afferent nerve include spinal and supraspinal components in anaesthetized rats.* Neuroscience research, 25: 91-96.

7. Kagitani, F., Kimura, A., Sato, A, and Suzuki, A. 1996. The role of the spinal cord as a reflex centre for the somatically induced reflex responses of splenic sympathetic and natural killer cell activity in anaesthetised rats. Neuroscience letters, 217(2-3): 109-112.

8. Hubscher, C.H., Ezidin, G. and Kaddumi. 2006. Changes in rat brainstem responsiveness to somatovisceral inputs following acute bladder irritation. *Experimental neurology*, 203(2): 349-357.

9. Welch, A. and Boone, R. 2007. Sympathetic and parasympathetic responses to specific diversified adjustments to chiropractic vertebral subluxations of the cervical and thoracic spine. *Journal of chiropractic medicine*, 7(3): 86-93.

10. Young, M.F., McCarthy, P.W. and King, S.J. 2009. Chiropractic manual intervention in chronic adult dyspepsia: A pilot study. *Clinical chiropractic,* 12(1): 28-34.

11. Peterson, D.H. and Bergmann, T.F. 2011. *Chiropractic technique*. 3rd ed. St Louis: Mosby Inc. pp 152,188,211,233.

12. Love, Z. and Bull, P. 2003. The management of dyspepsia: a chiropractic perspective. *Chiropractic journal of Australia*, 33(2): 57-63.

13. AstraZeneca. 1997. *QOLRAD-Heartburn-UK-South Africa*. Available: http://www.proqolid.org/instruments/quality_of_life_in_reflux_and_dyspepsia_qolrad (Accessed on 10 July 2011).

14. Johnson and Johnson. 2004. *PAGI-SYM*, MAPI research trust, France. Available from www.proqolid.org.

15. Jensen, M.P., Karoly, P. and Braver, S. 1986. The measurement of clinical pain intensity: a comparison of the methods. *Pain*, 27(1): 117-126.

16. Yarandi, S.S. and Christie, J. 2013. Functional dyspepsia in review; pathophysiology and challenges in the diagnosis and management due to coexisting gastroeosophageal reflux disease and irritable bowel syndrome. *Gastroenterology research and practice,* Volume 2013; 1-8.

17. Gatterman, M.I. 2005. *Foundations of chiropractic subluxation*. 2nd ed. St Louis, Missouri: Mosby. pp 305-337.

18. Branyon, B. 2008. Healing hands: using osteopathic manipulative treatment to address visceral structures through somatovisceral reflexes: a case study in gastroesophageal reflux disease*. AAO journal*, 18(4): 29-31.

19. Gupta, U. and Verma, M. 2013. Placebo in clinical trials*.* Perspectives in clinical research. Jan-March, 4(1): 49-52.

20. Chang, L. 2004. Review article: epidemiology and quality of life in functional gastrointestinal disorders*. Alimentary pharmacological therapy*, 20(Supplement 7): 31-39.

21. Ringel, Y. 2002. Brain research in functional gastrointestinal disorders*. Journal of clinical gastroenterology.* 35(1): 23-25.

22. Wu, J.C. 2012. Psychological co-morbidity in functional gastrointestinal disorders: epidemiology, mechanisms and management. *Journal of neurogastroenterology*, 18(1): 13–18.

23. Hein, T. 1999. Some effects of Chiropractic manipulation on reflux oesophagitis: a case report. *The British journal of chiropractic,* 3(3): 59-61.

24. Peterson, C. 2012. A case study of chiropractic management of pregnancy-related heartburn with postulated fetal epigenome implications*. Explore*, 8(5): 304-308.

25. Leach, R.A. 2004. *The chiropractic theories. A textbook of scientific research*. 4th ed. Baltimore: Lippincott Williams & Wilkins. pp 271-288.

26. Tack, J., Talley, N., Camilleri, M., Holtman, G., Hu, P., Malagelada, J. and Stanghellini, V. 2006. Functional Gastroduodenal disorders. *Gastroenterology,* 130(5): 1466-1879.