THE RELATIVE EFFICACY OF TWO VARIED CHIROPRACTIC MANIPULATIVE TECHNIQUES IN THE TREATMENT OF MECHANICAL UPPER THORACIC AND NECK PAIN

A dissertation presented to the faculty of Health Services, Technikon Natal in partial fulfillment of the requirements for the Master's Degree in Technology: Chiropractic

by

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I, Bruce Andrew Ritchie, do hereby declare that this dissertation represents my own work.

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This work is dedicated to my parents John and Anne Ritchie who have through great sacrifice made it possible for me to study Chiropractic.

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ABSTRACT

The purpose of this study was to determine the effectiveness of the spinous push versus the transverse process contact rotary type adjustments in the treatment of sub-acute and chronic mechanical upper thoracic and neck pain. It was hypothesized that both adjustments, over a maximum of nine treatments with two treatments per week and a further four week follow-up period, would be effective in terms of improving the patients' cervical ranges of motion, vertebral pressure pain threshold levels and their perceptions of pain and disability.

The study design was a randomized, un-blinded, un-controlled comparative group study with a sample population consisting of thirty consecutive patients (Ave. age 35.4 years; M:F 16:14) suffering from joint dysfunction of the cervical or upper thoracic spine. Each group received one adjustment two times a week for a maximum of nine treatments. Soft tissue therapy was employed in each treatment as a pre-adjustment procedure.

The objective data collected was goniometrically assessed cervical range of motion and algometrically assessed vertebral pressure pain thresholds. The subjective data was collected by means of the CMCC Neck Disability, the Short Form McGill Pain and the Numerical Pain Rating Scale-101 Questionnaires.

Analysis within each group was performed using the Wilcoxon Signed Ranks test comparing the pre-treatment readings to post-treatment, final treatment and four week follow-up readings. The Mann Whitney test was used to compare mean gains in the outcome measures between the two groups at the four measurement stages. The alpha value was set at the 0.05 level of significance.

The spinous push group experienced significant improvement in left and right rotation, forward flexion and right lateral flexion at all three subsequent measurement stages as well as in extension and left lateral flexion at the post-initial treatment stage. Vertebral pressure pain thresholds were significantly improved in the spinous push group at the final treatment and four week follow-up stages. The transverse process contact group experienced significant improvements in extension, right rotation and right lateral flexion at the post-initial stage, while at the final treatment there were significant improvements in flexion, left rotation and right lateral flexion. After the four week follow-up period there were significant improvements in flexion and left and right lateral flexion in the transverse process contact group. Both groups had experienced a significant reduction in pain and disability at the stage of the final treatment which deteriorated slightly over the four week follow-up period but still remained significantly improved from the pre-treatment levels ($p<0.05$). There were no statistically significant differences in the mean gains in outcome measures between the two groups at any of the four measurement stages during the study, although the transverse process contact group did appear to respond better in terms of disability and pain reduction.

From the results, it is evident that the spinous push technique is equally as effective as the transverse process contact adjustment in treating sub-acute and chronic mechanical upper thoracic and neck pain. Further studies in this field are required to refute or validate these findings.

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<u>App</u>: Appendix

<u>AR</u>: Anterior rotation

<u>Ave. Chron</u>: Average chronicity

<u>CMCC</u>: Canadian Memorial Chiropractic College

<u>FIN</u>: Final treatment

<u>F.Tx</u>: Final treatment

<u>F/U</u>: Follow-up

<u>NRS-101</u>: Numerical Rating Scale-101

<u>Post.Tx</u>: Post-initial treatment

<u>Pre.Tx</u>: Pre-initial treatment

<u>4Wks.Fu</u>: Four week follow-up period

1.0 INTRODUCTION

A wide variety of adjustments for mechanical upper thoracic and neck pain are utilized by manipulative therapists (Szaraz 1990:50, 76-78, Haldeman 1992:466-501), but their relative efficacy have received very little attention in the literature (Howe et al. 1983, Cassidy et al. 1992b). Despite the common occurrence of neck pain the exact nature of the pathology remains obscure and the pain is often attributed to mechanical factors. Indeed, when treating patients without knowing the pathological cause underlying the patients' complaints, it becomes no surprise that the results of treatments given are often so unpredictable (Mennell 1990).

Numerous studies have been conducted to determine the value of spinal manipulative therapy in the treatment of mechanical neck pain (Nordemar and Thorner 1981, Sloop et al. 1982, Howe 1983, Brunarski 1984, Terrett and Vernon 1984, Vernon 1988, Nansel et al. 1989b, Nansel et al. 1990, Vernon et al. 1990, Cassidy et al. 1992a, Nansel et al. 1992, Koes et al. 1993). Results of these studies tend to advocate the use of spinal manipulative therapy as an effective treatment for mechanical neck pain. However, only two of the authors give detailed descriptions of the manipulative techniques employed. In order to assess whether a possible difference in efficacy exists between different adjusting techniques, future studies should be carried out comparing the various techniques in a clinical setting. This would allow the manipulative therapist benefit of being able to draw from a set of standardized and tested techniques and therefor allow patients the benefit of more effective treatment.

Brodin (1982) states that only a few spinal pain conditions can be explained by proved pathological findings such as herniated discs, fractured vertebrae, neoplasm's and osteomyelitis. However, the majority of patients with unknown pathology undoubtedly have neck pain. For these patients, studies of function disturbances followed by function treatment are advocated as one part of complete therapy.

A wide variety of treatments including manipulation, mobilization, soft tissue therapy, interferential current therapy, trigger point therapy and pharmaceutical intervention are commonly applied for the treatment of mechanical neck pain (Howe et al. 1983, Cassidy et al. 1992a, Koes et al. 1992a, Koes et al. 1993). The occurrence of mechanical neck pain may produce profound effects on muscle and posture due to the diversity of cervical spine innervation and its hypothesized reflexes that underlie static and dynamic posture (Gatterman 1990:253). It is likely that each treatment protocol may produce different results due to this reflex activity (Leach 1986:132). In order to assess the more effective treatments from the less effective treatments, further clinical trials comparing the above treatment methods are needed.

It is well established that the challenge for research in chiropractic is to produce better clinical trials of manipulative therapy (Brunarski 1984). Unfortunately, there has been wide variation in the definition of manipulation techniques employed in controlled studies of spinal manipulation (Curtis 1987). This study proposes to draw attention to the need for standardization of manipulative procedures in future clinical trials of spinal manipulative therapy.

This study compares the effectiveness of two fundamental rotary-type of chiropractic manipulation techniques commonly employed in the treatment of cervical and upper thoracic joint dysfunction. The spinous push technique (Nansel et al. 1989b, Haldeman 1992:468), employs a spinous process contact with the thrusting hand utilizing only a small amount of cervical rotation. The rotary break technique (Szaraz 1990:50 76-78, Haldeman 1992:469), employs the transverse process or lamina as a point of contact with the thrusting hand and utilizes relatively more, yet not excessive, cervical rotation. This implies different pre-adjustment and thrust postures which place different forces on the patients' spines. The aim of this study was to evaluate the effectiveness of specific rotary-type chiropractic adjustments utilising the spinous process contact as compared to the transverse or lamina contact, in terms of objective and subjective responses, in order to determine the more effective protocol in the chiropractic management of mechanical neck pain and upper thoracic pain.

The first objective was to evaluate the subjective and objective responses of patients who are suffering from mechanical upper thoracic or neck pain to specific rotary-type chiropractic adjustments utilising the spinous process as a short lever contact.

The second objective was to evaluate the subjective and objective responses of patients who are suffering from mechanical upper thoracic or neck pain to specific rotary-type chiropractic adjustments utilizing the transverse process or lamina as a short lever contact.

The third objective was to analyze and interpret the data obtained and to integrate the conclusions reached into the existing protocol of chiropractic management of mechanical neck and upper thoracic pain.

This study draws attention to the need for a better understanding of the biomechanical effects of different adjustment protocols commonly employed by manipulative therapists as well as the significance for standardization of techniques employed in clinical trials of spinal manipulative therapy.

2.0 LITERATURE REVIEW

The following is an overview of the literature related to clinical trials of spinal manipulative therapy for mechanical neck and upper thoracic pain. The theoretic basis for the action and effects of the adjustment as well as the basic clinical, aeteological and epidemiological aspects of mechanical neck pain are presented.

2.1 EPIDEMIOLOGICAL ASPECTS

Neck pain is a common complaint (Howe et al. 1983, Tucci et al. 1986, Gore et al. 1987, Cassidy et al. 1992a, Cassidy et al. 1992b, Koes et al. 1992a, Haldeman 1992:207), and there is a growing awareness among health professionals worldwide of the large burden of illness associated with musculoskeletal disorders of the neck. (Stock 1991).

Kelsey (1982:146) concludes that neck pain affects 40% to 50% of the general population at some time during their lives. Although most patients with mechanical neck pain improve with time, as many as one third can continue to have moderate or severe pain fifteen years after the initial onset (Gore et al. 1987).

Of 318 consecutive medical patients with intractable neck pain who underwent provocation discography and cervical zygapophyseal joint blocks, symptomatic zygapophyseal joints were encountered in 25% of the sample with a possibility that a further 38% suffered zygapophyseal pain, but were not appropriately investigated (Aprill and Bogduk 1992).

In a study conducted at the Technikon Natal Chiropractic Clinic comparing the types of conditions seen at a teaching clinic and in private chiropractic clinics in South Africa, it was found that 54.4% of patients presenting to the teaching clinic and 57.4% of patients presenting to private practitioners complained of neck pain (Drews 1995). It must be noted that this category included patients who had neck pain and associated headaches or arm pain. Fifteen percent of private practice patients and 16.7% of teaching clinic patients had neck pain only (Drews 1995).

Grieve (1988:190) reports that it has been found that there was an 18% incidence of neck pain among 2 500 randomly selected men and women. A slight sex difference was noted - 20% of the women, compared with 16% of the men, experienced neck pain. Other surveys reveal an 18%-67% incidence range of neck pain. In a group of 1 137 working men between the ages of 24 and 54 years, it was found that attacks of neck stiffness occurred in about 27% of those below 30 years of age and in 50% of those over 50 years of age (Grieve 1988:190).

Mennel (1990) found that of 100 consecutive patients complaining of neck pain visiting a medical practitioner in private practice, the duration of symptoms ranged from one day to 41 years. Seventeen percent of the group had suffered for less than six months. Sixty-eight percent of the group were female while 32% were male. Over 50% of the patients were in the middle-age group, i.e. 40-60 years old.

In a study of 15 174 chiropractic patients seen at the CMCC outpatient clinics over a five year period, 39% of all female patients were identified as having cervical conditions compared to 26% of male patients. The influence of age on cervical complaints was also examined and revealed that the average age was 31.3 years for male cervical patients and 31.7 years for female cervical patients (Waalen and Waalen 1993).

Sawyer and Stewart (1984), in a study of 876 patients at the Northwestern College of Chiropractic Clinic, found that 22.3% of the males versus 28.5% of the females had a chief complaint of neck pain.

From the above evidence it would appear that the average age of the mechanical neck pain sufferer is approximately 30 years of age ranging from 20 years of age to approximately 75 years of age. Mechanical neck pain is slightly more common in females who represent approximately 60% of the group.

2.2 AETIOLOGICAL CONSIDERATIONS

Haldeman (1981) states that the cause of spinal pain is multifactorial. The exact cause of most spine pain remains unproved. Most of the theories implicate the intervertebral disc through a variety of mechanisms, and as a result there are likely to be multiple causes. Potentially, almost all anatomical structures within the spine have sensory innervation and are therefor implicated in spinal pain, including the annulus fibrosis, major ligaments, the intervertebral joints and their capsules, the vertebral bodies and all the posterior osseous structures as well as the paraspinous muscles, skin and subcutaneous tissue, duramater and walls of epidural sheaths and arteries (Haldeman 1981, White and Panjabi 1990:380).

Any condition which results in alteration of joint function or structure is capable of causing mechanical neck pain. Derangement of the articular soft tissues and mechanical joint dysfunction may be produced from acute injury, repetitive use injury, faulty posture or co-ordination, aging, immobilization, static overstress, and congenital or developmental defects (Bergmann 1993:55).

White and Panjabi (1990:383) hypothesized that mechanical mechanisms act as causative agents in spinal pain. These agents provide nociceptive stimulus to a specialized pain sensitive nerve endings or to the central nervous system through some other mechanism of nerve stimulation. Abnormal mechanics include abnormal movement, forces and vibrations, high quantity repetitive loading or any combination of these abnormalities either quantitatively or qualitatively.

Gainsbury (1979) provides a comprehensive classification of the various postulated mechanical causes of spinal segmental dysfunction. These are divided into three major groups:

- Extrasegmental causes, for example, adhesions between fascia and the subcutaneous plane; fibrous replacement in the paravertebral muscle groups; shortening of longitudinal ligaments; and meningeal involvement.
- Non-apophyseal intrasegmental causes, for example, discal involvement; segmental muscle spasm; fibrous replacement in segmental muscles; shortening of segmental ligaments; and congenital and acquired anomalies.
- Apophyseal causes, for example, synovitis, degeneration, capsular fibrosis, adhesions and acute joint locking.

Mennel (1990) describes three constant aetiological factors associated with mechanical joint dysfunction in the cervical spine. These include:

- intrinsic trauma,
- immobilization (including disuse and aging),
- factors residual from the healing of some more serious pathological conditions.

Haldeman (1992:169) postulates that spinal pain in certain patients may be due to the subthreshold stimulation of more than one spinal structure through the mechanism of hyperalgesia.

Peters (1984) states that there are anatomical explanations for zygapophyseal joint pain which include lordosis, or thinning of the intervertebral disc which results in the telescoping or imbrication of the posterior articulations. A further consideration for facet syndrome is degenerative changes which occur in all parts of the intervertebral joint complex in patients over 40 years of age. Grieve (1988:177) comments that in the absence of major injury, degenerative disorders account for the greatest incidence of neck pain, the true cause of which may predate the appearance of clinical features by some months or years as muscular imbalance and asymmetric contractures of soft tissue following habitual occupational postures.

2.3 CLINICAL CONSIDERATIONS

2.3.1 SYMPTOMOLOGY

White and Panjabi (1990:407-409) comment on the biomechanical significance of salient clinical features of cervical and upper thoracic spinal pain. They stress cervical spine pain to be found in any combination of sites involving the neck, shoulder and arm with no particular sequence in history of onset in the three regions. Coughing, sneezing or Valsalva's maneuver may aggravate the neck pain and there may be pain referral to the interscapular region.

In a study of 200 patients with pain resulting from somatic dysfunction of the C2-C3 motion segment, 90% (of the patients) reported headaches in the occipital region, often confined to the right side. In 2.5% of the patients, neck stiffness and motion restriction affecting the head and upper cervical spine was reported. In 23% of the patients, tenderness upon pressure was found over the posterior surface of the arch of the axis. Interestingly, 95% of the cases demonstrated a right rotation restriction in the C2-C3 spinal segment in the maximal forced inclination position (Jirout 1985).

In a study of 39 patients complaining of neck pain, the average duration of symptoms was six years with 34 patients describing continuous or fluctuating pain. Ten acknowledged recent trauma while 19 complained of central nervous system symptoms, e.g. giddiness and blurred vision. Thirty-seven complained of arm pain (Sloop et al. 1982).

In a study of 100 consecutive outpatients suffering from mechanical neck pain, all had unilateral neck pain aggravated by movement and local cervical paraspinal tenderness (Cassidy et al. 1992a). In this study, radiographic examination showed variable evidence of spondylosis consistent with the general population. Indeed, in a study of the Roentgenographic findings of the cervical spine in 200 asymptomatic people, it was found that by the age of 60-65 years, 95% of the men and 70% of the women had at least one degenerative change on their Roentgenograms. It was concluded that Roentgenographic abnormalities do not necessarily cause symptoms (Gore et al. 1986).

In a long-term follow-up study of 205 neck pain patients attending an orthopaedic practice, 59% had a history of trauma while 54% had unilateral shoulder pain, with 36% having unilateral arm pain. In fact, the only identifiable symptom of any prognostic value was the presence of severe pain following injury where it was more likely to have an unsatisfactory outcome (Gore et al. 1987).

Grieve (1988:379) concludes that experimental evidence and clinical experience suggest that many abnormalities and anatomical factors combine to produce the various clinical states. Plaugher (1993:52) stresses that positional dyskinesia involving the relative positions and interarticular motion abnormalities of the vertebrae above and below a subluxated articulation is, especially from a chiropractic standpoint, important in the diagnosis of mechanical neck pain. According to Schafer and Faye (1989:28), the key history points of primary joint dysfunction are:

- sharp pain of sudden onset;
- it usually follows stress at some unguarded joint motion;
- the pain is limited to one or adjacent joints;
- the pain is aggravated by movement and usually is at some particular area of motion;
- rest relieves the pain and does not produce stiffness;
- marked swelling or warmth is not associated.

In a study of a series of 20 patients to determine the accuracy of manual diagnosis for cervical zygapophyseal joint pain syndromes, a high level of accuracy was revealed, equal to radiologically controlled diagnostic blocks. This vindicated the criteria chosen by the manipulative therapist for making the diagnosis namely: abnormal 'end-feel' (that is, an abnormal quality of resistance at the extreme range of motion), and reproduction of pain (Jull et al. 1988).

Bergmann (1993:63) has modified the acronym PARTS from Bourdillon and Day, which is used in the identification of joint dysfunction. These are:

- Pain and tenderness - pain perception and tenderness on palpation of the bony and soft tissue structures with regard to location, quality and intensity is evaluated. This is achieved by observation, percussion and palpation.
- Asymmetry - either localized to one level, or at multiple levels. Asymmetry is assessed by using bony landmarks of the vertebrae as reference points and relating them to other positive findings. This is achieved by observation, static palpation or Roentgenographic analysis.
- Range of motion abnormality - active, passive and accessory joint motion changes due to increased, decreased or abnormal movements, are identified using motion palpation and, if required, stress radiography.
- Tone, Texture and Temperature Abnormality - changes in the soft tissues such as the skin, fascia, muscles and ligaments around an area of joint dysfunction are known to occur. These are identified by means of observation, palpation and sometimes instrumentation.
- Special tests - procedures relating to certain technique systems may be necessary for a final diagnosis.

Grieve (1988:378-380) outlines the presentation of chronic mechanical neck pain as follows:

- Local chronic cervical pain with or without arm pain.
- Juxtaposition of hyper- and hypomobility of the cervical spine as a result of spondylotic changes.
- Asymmetrical neck pain worsens during the day and is aggravated by driving, reading, sewing, etc.
- Unilateral occipital and neck pain.
- Restricted and painful cervical rotation and lateral flexion to the painful side.
- Prominent upper and middle trapezius and levator scapulae muscles.

Schafer and Faye (1989:349) describe the signs and symptoms of cervical motion unit dysfunction as including articular grating, stiffness, tenderness, hypertonic or flaccid muscles, occipital headaches, numbness, pain (especially on motion), possible visceral and somatic effects, weakness, altered reflexes, boggy tissues, fibrosis, hyperaemia, segmental atrophy, trigger point development, visual postural imbalance, palpable malalignment, functional spinal unit motion alterations and possible wry-neck..

2.3.2 DIFFERENTIAL DIAGNOSIS OF JOINT DYSFUNCTION

Joint dysfunction implies the loss of one or more movements within the normal range of motion with associated pain, but it is only one of the possible problems that must be differentiated from other causes of joint pain (Schafer and Faye 1989:27). For example, joint pain may be the chief complaint in such systemic diseases as polyarteritis nodosa, gout, systematic lupus erythematosis, dermatomyositis, erythema nodosum and scleroderma. It is also sometimes associated with kidney or pulmonary disease, ulcerative colitis, acromegaly and hemorrhagic dyscrasias (Schafer and Faye 1989:27).

Gatterman (1990:232), provides a summary of common differential diagnoses to be considered when assessing neck pain. These include:

- Muscle syndromes - postural strain.
- Biomechanical disorders - facet joint fixation, facet joint sprain, cervical disc herniation, degenerative disc disease, cervical spondylosis, and fracture.
- Inflammatory disease - rheumatoid arthritis, ankylosing spondylitis, spondylosis and spondylarthrosis.
- Congenital abnormalities - cervical rib, and congenital stenosis.
- Systemic disease - anaemia, leukemia, Paget's disease and osteoporosis.
- Tumours - primary and secondary.

2.4 MODELS OF SPINAL DYSFUNCTION

Cyriax (1993:23) states that the great majority of soft tissue symptoms at the neck originate from different stages of degenerative disc disease. The disc lesion blocks the joint, resulting in extrasegmentally referred dural pain with or without nerve root symptoms or signs. The relatively large interarticular surface area occupied by the disc, as well as the fact that the disc supports most of the weight of axial compression forces, illustrates its potential to be a major factor in the manifestation of fixation dysfunction (Plaugher 1993:58).

However, disorders of the cervical zygapophyseal joints are attracting attention as the possible source of neck pain (Aprill et al. 1990). In this regard the principle evidence being the relief of neck pain in some patients after intra-articular blocks of certain cervical facet joints or the nerves supplying them. In a study of five normal volunteers, the pain patterns evoked by stimulation of the cervical zygapophyseal joints by distending the joint capsules with injections of contrast medium indicated that each joint produced a clinically distinguishable pattern of pain, demonstrating that cervical facet joints can be a primary source of neck pain (Dwyer et al. 1990).

The subluxation complex:

> "A subluxation is an aberrant relationship between adjacent articular structures that may have functional or pathological sequelae, causing an alteration in the biomechanics and/or neurophysiological reflections of these articular structures" (Haldeman 1992:627).

Gatterman (1990:40-47), describes a subluxation as being the result of kinesiopathologic, neuropathophysiologic, myopathologic and histopathologic changes relating to joints and muscles. The kinesiopathologic and myopathologic changes include: hypomobility as a result of muscle spasm caused by a joint sprain or increased muscle spindle activity; ligamentous shortening; intra-articular adhesions; intra-articular jamming due to meniscoid entrapment or disc displacement and hypermobility as a result of disc degeneration or ligamentous sprain. The neuropathophysiologic changes include: nerve irritation resulting in either increased motor, sensory or autonomic changes and nerve compression which may manifest as weakness, atrophy or loss of sensation (Gatterman 1990:40-47).

Lewit (1978:8-9), hypothesized that vertebral joint dysfunction is as a result of entrapment of the free edge of a meniscoid between the two articulating joint surfaces. This causes a tractioning effect on the joint capsule. Both the meniscoid and capsule are highly pain sensitive and this results in reflex activity in the area, e.g. muscle spasm, which is decreased when the meniscoid is freed. Haldeman (1992:206), commented that there are two mechanisms by which pain may arise due to synovial fold pinching in synovial joints:

- traction on pain sensitive tissues such as the synovial fold and fibrous joint capsule; and
- synovial fold traumatic synovitis with associated tissue damage and cell rupture, resulting in the release of pain producing substances such as histamine, bradykinin and potassium ions as well as substance P. All of which cause nociceptive nerve impulses and ischaemia.

Giles and Harvey (1987), have provided support for the above hypothesis by demonstrating the presence of substance P in the capsule and synovial folds of zygapophyseal joints in patients suffering from intervertebral disc prolapse.

Lippitt (1984), describes facet derangement and mechanical pain as the result of synovial hyperplasia and compression of villi following osteoarthritic changes in the facet joint, along with segmental instability and synovitis.

Gainsbury (1985), argues that the entrapment of a roughly crescent-shaped meniscoid between two apophyseal facets will lead to a total loss of mobility, a sign not always present in joint dysfunction. He further states that a large number of meniscoids, if not all, do not appear to be chondrified. Gainsbury (1985) and Gatterman (1995:179) conclude that the potential is promising for some kind of role of synovial tabs, however they do not seem likely to be the primary cause of subluxation.

One of the oldest concepts of the vertebral joint dysfunction is that of vertebral malposition, however, the concept of static misalignment, although initially promising, is hard to support especially as it also may be representative of activity of the surrounding soft tissue (Gatterman 1995:179).

Gillet and Liekens (1969), Schafer and Faye (1989:12-17) and Bergmann (1993:58) hypothesized that the mechanical joint dysfunction follows three phases of development, namely: muscular, ligamentous and articular phases. Following this model, segmental muscle spasm and contraction causes muscular fixations which, with time, causes the ligaments to adapt to the limited range of motion. This adaptation involves contracture formation and shortening of the joint capsule and surrounding ligaments producing ligamentous fixations. Finally, as a result of fibrous adhesions developing between the joint surfaces, as a result of degeneration of the inter-articular soft tissues, articular fixations may develop. The end result is possible bony ankylosis and irreversible fixation.

Adhesions or disorganized fibrous cross-linking between parallel collagen fibres is proposed as a model for spinal dysfunction (Plaugher 1993:57, Gatterman 1995:179). Adhesions may form in ligaments, cartilage, muscles, tendons or fascia and are the by-product of the process of degeneration which results from trauma or immobilisation (Gatterman 1990:45). Gainsbury (1985) argues that it is unlikely that hyaline cartilage can form adhesions as cartilage usually has very few, if any, capillaries and such adhesion formation is not possible without exudation. On the other hand, the synovium has a rich blood supply (Knight and Levick 1983), with the result that the possibility exists of the development of an 'adhesive capsulitis' from an inflammatory reaction within the synovium. This would cause joint dysfunction due to adhesions between folds of the synovium, its connective tissue base and the capsule (Gainsbury 1985).

Plaugher (1993:57) states that muscle spasm reduces spinal mobility and the possible mechanisms eliciting this muscle spasm are many and varied. Muscle spasm is not likely to be the chief cause of most cases of intersegmental hypomobility (Gatterman 1990:45). In one experiment, evidence of fixation dysfunction existed even after patients were completely under anaesthesia, which included myorelaxants. Movement restriction was even more recognisable during narcosis, as the patients were totally relaxed (Lewit 1978:43-52).

Kirkaldy-Willis and Burton (1992:105-109) postulated that spinal degeneration is often initiated by local mechanical derangement, and that changes in structure are absent. The development of individual motion segment dysfunction, secondary to changes in the segmental muscle tone and function, is often the causative factor. Joint hypomobility is then thought to start the degenerative process due to changes in the biomechanics in the area, and this results in joint instability and finally restabilisation through soft tissue fibrosis and bony exostosis.

The above are the dominant biomechanical models for vertebral dysfunction. It must be mentioned that neurological models, e.g. somatosomatic reflexes, somatovisceral reflexes, spinal cord compression and psychoneuroimmunology, as well as trophic models, e.g. aberrant axoplasmic transport, and psychosocial models, e.g. placebo effect, have also been suggested as possible models of joint dysfunction (Gatterman 1995:178-89).

2.5 ADJUSTMENTS

Sandoz (1976) defines an adjustment as a passive manual maneouvre involving the application of a brief, sudden, small amplitude impulse which is delivered at the end of the normal passive range of motion of a joint (termed the elastic barrier of resistance) taking the joint into the paraphysiological range of motion without exceeding the anatomical integrity of the joint. It is usually accompanied by a cracking sound (cavitation) which is caused by a release of gases (primarily carbon-dioxide), within the synovial fluid of the joint.

Bergmann (1993:124) describes the characteristics of an adjustment as a direct or indirect dynamic thrust of controlled depth and speed delivered within the boundaries of the joints anatomic integrity. This process is usually associated with an audible clicking sound.

Mierau et al. (1988), in a study of manipulation and mobilization of the third metacarpophalangeal joint, concluded that manipulation and mobilization are two distinctive therapies with different effects on joint function. Manipulation was associated with radiographically visible gas arthrogram along with an audible clicking sound, while mobilization was associated with neither.

The significance of the audible release as part of a successful adjustment has in recent times attracted much interest (Mierau et al. 1988, Reggars and Pollard 1995, Gal et al. 1995). Brodeur (1995) argues that without the cavitation process, it is difficult to generate the necessary forces on the appropriate ligaments and tendons to initiate reflex relaxation of muscles as well as reflex actions that inhibit pain and hence minimize muscle damage.

Basmajian (1985:28-29) concludes that the adjustment has different characteristics to different health practitioners. Techniques can range from general to specific manipulation, direct or indirect manipulation, contact or non-contact techniques or thrust and non-thrust techniques. He divides thrust techniques into three categories:

- Specific thrust techniques which employ three specific criteria:
    1) spinal locking,
    2) high velocity movement,
    3) overpressure;
- General thrust techniques which employ high velocity stretching procedures;
- Surgical thrust under anaesthesia.

Haldeman (1992:448) believes that despite all the different definitions that have been put forth to describe adjustive techniques, there are three characteristics that most aptly describe a chiropractic adjustment. These are:

- a high velocity, carefully delivered force;
- a specific direction or line of drive (in the planes of articulation); and
- a controlled depth and magnitude thrust applied through a specific contact point employing body weight, muscle power and sometimes mechanical devices.

2.5.1 EFFECTS OF MANIPULATION

Lewit (1978:8-9) postulates that with an adjustment there is a temporary separation of the two joint surfaces and that this would enable the trapped edge of the meniscoid to slip back into the joint space. This same mechanism can free entrapped synovial tissue to which Haldeman attributes joint fixation (Haldeman 1992:206).

Sandoz (1976) writes on the possible effects of the joint crack associated with an adjustment. After a joint 'crack' there is an increase in the passive range of motion of the joint in all directions and, to a lesser extent, in the active range of motion. This is as a result of the addition of the paraphysiological range of motion to the available active and passive ranges of motion. It is brought on by the meniscoids no longer being aspirated towards the centre of the joint. As a result of the separation of the joint surfaces, articular derangements may be reduced and proprioceptive elements may be stimulated.

These are just some of the many theories relating to the possible mechanisms involved in the effects of adjustments. It is, nevertheless, possible that not a single mechanism is taking effect, but probably a combination of more than one.

Nansel et al. (1989b) categorizes the four major hypothesized mechanisms into two basic groups:

- Structural hypotheses:

    1) Meniscoid entrapment theory described by Lewit (1978:8-9).

    2) Intradiscal nuclear displacement theory described by Nansel et al. (1989b) and White and Punjabi (1990: 394). This theory supposes that upon flexion, a fragment of nuclear pulposus material extrudes into a radial fissure and lodges within the annulus fibrosis. Upon extension, the central nucleus can adjust to the redistribution of forces. However, the trapped portion acts to restrict compression and therefor motion along that plane. Manipulation could act to force the fragment circumferentially into another plane, or back into its normal position amongst the central disc material, thus returning normal motion to the joint.

- Reflex Hypotheses:

    3) Reflexes involving capsular afferents described by Wyke (1985: 72-77). Cervical joints are heavily innervated by Type I (static position detectors) and Type II (movement or acceleration detectors) afferent neurons which make polysynaptic connections primarily with gamma-motor neurons in the spine. Changes in capsular pressure

brought about by normal loads and stresses on the joint create, through complex afferent-efferent reflex activities, changes in muscle tone which act to stabilize certain joints while allowing full motion in others. Changes in capsular integrity or pressure changes brought about through misalignment, structural anomalies (meniscoid entrapment), or irritation (oedema), could create aberrant afferent signals which, through normal reflex responses, lead to inappropriate increases in muscle tone, thus restricting motion. Gapping of the joint by an adjustment to create a barrage of capsular afferent discharge, may cause reflex-induced decreases in muscle tone, thus allowing for increased joint movement.

4) Inhibition through muscle tendon organ receptors. This theory recognizes that Golgi tendon organ receptors, through their Type Ib afferents, make inhibitory reflex synapses with alpha motor neurons at the spinal cord. An adjustment that stretches the muscle tendons could cause decreases in muscle tone, thus allowing for greater range of motion in segments regionally related to those paraspinal muscle groups Nansel et al. (1989b).

2.5.2 STUDIES INVOLVING MANIPULATION

Nansel et al. (1989b), in a triple blinded study to determine the effectiveness of unilateral cervical adjustments on goniometrically assessed cervical lateral flexion asymmetries of greater than 10 degrees, concluded that a unilateral cervical adjustment performed on the side of greatest end range restriction, is capable of dramatically ameliorating the asymmetries (a decrease in asymmetry from 13.8 degrees to 1.8 degrees) over the 30-45 minute time period of investigation. The manipulative procedure employed by the author in this study was a patient seated spinous-push technique involving a rotary-type thrust with the contact hand. Furthermore, the 'effectiveness' of the adjustive technique used, appeared to be relatively side specific, since the same adjustments delivered to the side opposite to that of greatest end range restriction were, although statistically significant, only marginally effective (a decrease in asymmetry from 14.3 degrees to 10.7 degrees) in reducing asymmetry magnitudes.

Nansel et al. (1990) studied the effects of a single, unilateral, lower cervical adjustment for the amelioration of cervical lateral flexion passive end range asymmetry. The responses of two groups of asymptomatic subjects were compared:

1) those exhibiting end range asymmetries of greater than ten degrees who, in addition, had suffered previous neck trauma, (n=16); and

2) those who happened to exhibit end range asymmetries of greater than ten degrees, but who had no prior history of neck trauma, (n=16).

Once again, the manipulative procedure employed by the author in this study was a patient seated spinous-push technique involving a rotary-type thrust with the contact hand. All the subjects underwent goniometric (Cybex EDI 320 Electronic Goniometer) re-assessment 30 minutes, 4 hours, 24 hours and 48 hours following the adjustment. A statistically significant amelioration of asymmetries was observed in both groups 30 minutes and 4 hours after manipulation. At 4 hours post manipulation there was no statistically significant difference in end range amelioration between the two groups. (Group 1: 15.2 degrees to 2.7 degrees average decrease in asymmetry; and Group 2: 13.7 degrees to 1.6 degrees average decrease in asymmetry).

After 24 hours a significant difference had appeared in the two groups (Group 1: increase from 3.5 degrees to 8.4 degrees; Group 2: increase from 1.7 degrees to 2.5 degrees). By 48 hours the difference was even more striking; whereas 14 out of 16 of the subjects with no previous neck trauma continued to exhibit asymmetries of less than ten degrees, 12 of the 16 subjects with previous neck trauma had regained asymmetries of greater than ten degrees. These results indicated that among pain-free individuals, the mere presence of passive end range asymmetry as well as the magnitude of the short term relief of cervical manipulation do not distinguish these two categories of subjects.

On the other hand, over long periods of time following manipulation, there appears to be a tendency of individuals who have suffered previous neck trauma to re-establish their aberrant cervical motion characteristics.

A tentative hypothesis offered by the authors as explanation for the observed results was that facilitation of certain spinal reflex pathways via afferent nociceptor input from injured articular joints causes increased gamma- and/or alphamotor efferent activity, which results in increased paraspinal muscle spasm causing a decrease in movement of the affected joints. This is to protect the joint from any further injury. After a few days, the pain and muscle stiffness levels would have decreased to the extent that it no longer reaches conscious levels in the subject. But when movement to the painful side is attempted, reinforcement of these aberrant spinal reflexes causes asymmetric movement to avoid pain. (Nansel et al. 1990).

Nansel et al. (1992) compared the effects of cervical spinal adjustments, delivered bilaterally either to the upper cervical region (C2-C3) or to the lower cervical region (C6-C7), in groups of asymptomatic subjects exhibiting goniometrically verified left-right rotational or left-right lateral flexion passive end range asymmetries of greater than ten degrees. The manipulative procedure employed the spinous-push technique bilaterally on the relevant level with the subject in the seated position. Of the 350 subjects screened, 83 exhibited lateral flexion or rotational passive end range asymmetries of greater than ten degrees while only 15 were found to possess asymmetries in both ranges of motion. Goniometric evaluation both prior to, and again within 30 minutes following manipulation, revealed that lower cervical adjustments were more effective for the amelioration of lateral flexion asymmetries than were upper cervical adjustments, whereas upper cervical adjustments were found to be more effective for the amelioration of rotational asymmetries than those delivered to the lower cervical region. These results are consistent with the view that passive movement restriction exhibited along the rotational axis is attributable to factors related primarily to the upper cervical region, whereas restrictions of passive movement along the lateral axis are more attributable to factors related to the lower cervical region (Nansel et al. 1992).

Sloop et al. (1982) conducted a double blind, randomised, controlled study on the effect of manipulation on 39 patients suffering from chronic neck pain. Thirty-seven of the patients also complained of arm pain. Eighteen patients were assigned to a control group and received an amnesic dose of diazepam intravenously, while 21 patients were assigned to the manipulation group and also received an amnesic dose of diazepam. No details on the exact type of manipulation were given.

Results indicated no significant difference between the two groups as a result of the treatment. However, 57% of the manipulated group compared to 28% of the control group, at three weeks, remarked that the treatment had helped them. After the 12 week period it was found that seven of the nine patients in the manipulation group felt that the treatment had helped them as compared to only two out of the six patients in the control group. This was, however, not statistically significant. Both groups showed improvement with regard to their severity of pain after three weeks of treatment, but there was no significant difference between the two groups. The authors concluded that although a larger percentage of patients in the manipulated group had improved compared to the control group, these improvements were not statistically significant and the value of a single adjustment in patients with chronic neck pain had therefor not been established.

Terrett and Vernon (1984) studied the effect of spinal manipulation on thoracic paraspinal cutaneous pain tolerance levels of 50 asymptomatic subjects. Electrical pain induction was achieved with a Siemens Neuron Stimulator. The stimulus was not sufficient to elicit muscle spasm so that the primary component of the stimulus was sensory stimulation of the skin. The control and manipulation groups received thoracic spine anterior joint springing, while the manipulation group received a rotary type, cross-bilateral adjustment of the restricted segment.

The control group mean tolerance levels were unchanged (1.62 baseline value and 1.86 after five minutes) indicating a sustained sensitivity of the cutaneous pain receptors in the paraspinal area. The group receiving manipulation had a statistically significant elevation of pain tolerance (140%) after ten minutes, (1.37 baseline and 3.3 after ten minutes).

Vernon (1988) presented a single case study of a 22 year old male with a five year history of unilateral neck, scapular and arm pain. Pre- and post-treatment pressure pain threshold readings were taken over the most tender spots in the rhomboids, levator scapulae, trapezii, mid-cervical and sub-occipital muscles. Treatment consisted of a scapular stretch technique - with an audible release on the right, and an anterior thoracic adjustment of T2-T3 on the right. The results indicated an average increase in pressure pain threshold of all trigger points to be 45.7%. The patient indicated verbally that he felt significantly better.

Two years later, Vernon et al. (1990) conducted a similar study on a larger group of patients suffering from chronic mechanical neck pain (majority less than three months) to determine the effect that an adjustment would have on the pressure pain thresholds in the paraspinal areas of joint dysfunction. A control group (*n*=4) received an oscillating rotary mobilization, while the manipulation group (*n*=5) received a rotary adjustment to the involved level. Pressure pain thresholds were measured by blinded examiners using a pressure threshold meter.

The results indicated that a 40% to 50% statistically significant increase in pressure pain thresholds was obtained in the manipulated group which was not evident in the mobilization group drawing attention to the close relationship of joint dysfunction and paraspinal soft tissue pain syndromes.

Koes et al. (1992a) conducted a randomised clinical trial on the effectiveness of manual therapy, physiotherapy and treatment by a general practitioner on chronic non-specific back and neck complaints of greater than six weeks duration. The physiotherapy group received exercises, massage and physical therapeutic modalities including electrotherapy, heat, ultrasound and diathermy. The manual therapy group received manipulation or mobilization according to the directives of the Dutch Society of Manual Therapy. The patients treated by their general practitioners received medication and advice related to posture and exercise, while a fourth group acted as a control group and received detuned ultrasound or short wave diathermy. The treatments were performed for a maximum period of three months and follow-up measurements were taken at three, six and twelve weeks.

Results for patients with chronic neck and low back pain indicated that at three and six weeks the manual therapy group and the physiotherapy group had a much greater improvement in their main complaints and the global perceived effect compared to the general practitioner and control groups. At twelve weeks, however, no statistically significant difference in the group was evident with regards to pain severity or daily functioning, and all groups tended to improve equally. The manual therapy group had a greater improvement in physical functioning at all three measurements compared to the other groups.

Spinal mobility did not seem to change significantly in any of the groups, and its suitability for measuring progress in patients with chronic neck and low back pain was questioned. It is of interest to note that the manual therapy group received the least number of treatments (5.4) as compared to the physiotherapy group (14.7), but no other significant differences were noted between the manual therapy or physiotherapy groups at any of the follow-up measurements.

The authors also performed a one year follow-up on the above study (Koes et al. 1992b), but due to the dropouts and change overs, only analysis with regard to the manual therapy and physiotherapy groups was made. After the twelve month follow-up period manual therapy appeared to be slightly more effective than physiotherapy. Unfortunately, not a clear enough distinction was made between the neck pain and low back pain patients.

Howe et al. (1983), in a randomised, controlled study involving 52 patients, studied the effects of manipulation on acute neck pain (less than four weeks) and/or stiffness with pain referred to the head, shoulder or arm compared to treatment with azapropazone (anti-inflammatory). Details of the adjusting techniques employed were not presented. Seventeen patients received one manipulation, four received two manipulations, two received three manipulations, one received manipulations of the neck and lumbar spine, while only two patients received manipulation and injection. No mention was made of how many times the two patients who received manipulation and injection were treated, nor of the number of injections the control group received.

The results indicated significant improvements in neck pain and stiffness, and shoulder pain and stiffness in the manipulation group immediately after the initial treatment, whereas the control group showed no significant improvement. This significant difference between the two groups' symptoms was no longer evident after the first or third weeks. Significant improvements of the cervical ranges of motion were found in the manipulated group, particularly rotation (average of five degrees) and, to a smaller degree, lateral flexion (average of two degrees). These improvements were still evident for rotation after one and three weeks, but not for lateral flexion after the first week. The control group did not exhibit any improvement in either rotation or lateral flexion during the course of the investigation.

Cassidy et al. (1992b), in a pre-test, post-test study on fifty consecutive unilateral neck pain sufferers with no neurological deficit, examined the effect that a single adjustment would have on pain and range of motion in the cervical spine. The manipulative procedure is described as a third finger contact over the articular pillar at the level of pain or tenderness, rotating the neck away from the painful side as far as possible and applying a low-amplitude, high velocity thrust in the same direction. Pain intensity was measured using the Numerical Rating Scale-101 (NRS-101), while range of motion was measured using a cervical goniometer.

Thirty-seven of the 50 patients experienced an improvement in their pain, indicated by an average improvement of over twelve points on the NRS-101 (Pre-treatment 43.7, post-treatment 31.1). Ranges of motion were also increased. The largest increases were recorded for rotation towards the painful side (average of 5.2 degrees), and lateral flexion to the opposite side (average of 4.5 degrees). A significant relationship between a decrease in pain and an increase in rotation to the same side was found ($p<0.05$), (Cassidy et al. 1992b). This particular study was neither randomised, nor controlled, therefor the validity of the results are questionable.

In a randomised, controlled study, Cassidy et al. (1992a) compared the immediate effects of an adjustment to mobilisation on 100 consecutive patients suffering from unilateral neck pain of mechanical origin with referral into the trapezius muscle. Sixteen patients had neck pain for less than one week, 34 had neck pain for between one week and six months, and the other 50 had neck pain for longer than six months. Fifty-two patients were adjusted using the technique described in the study by Cassidy et al. (1992b). Of the 52 patients adjusted, 85% experienced a decrease in their neck pain (NRS-101 decreased by 17.3 points). It was found that 6% of the manipulated group experienced an increase in pain. The range of motion was increased, particularly ipsilateral rotation, in the manipulation group. The increase was, however, not statistically significant.

In a recent unpublished, uncontrolled study conducted at the Natal Technikon on 30 consecutive low back pain patients, the effectiveness of the lumbar roll and spinous push techniques were compared in the treatment of mechanical lower back pain. The results indicated a statistically significant improvement in pain in both groups but relative improvements were not significant (Jansen 1996).

2.5.3 COMPLICATIONS ARISING FROM MANIPULATION

Kleynhans and Terrett (1985) classify complications arising from spinal manipulative therapy as follows:

- Accidents - serious impairment either permanent or fatal.
- Incidents - consequences of spinal manipulative therapy which are noticeable by their seriousness or their long duration.
- Reactions - consequences which are slight or short lived.
- Indirect complications - consequences of using spinal manipulative therapy where it cannot benefit the condition and delays diagnosis and rational treatment.

Haldeman (1992:585-586) reports that pathological processes such as atherosclerosis, osteophytosis and abnormal flow patterns within one or both arteries can result in ischaemia to the brain and surrounding areas. Trauma to the arterial wall resulting in vasospasm or direct damage due to unduly forceful rotation and extension type adjustments thereby causing emboli to be formed, have been known to cause complications in some instances. These complications are usually synonymous with those of the vertebro-basilar insufficiency syndrome.

Michaeli (1993) in a study analysing the occurrence and nature of complications arising from manipulative physiotherapy in South Africa, found that between 1971 and 1989, approximately 228 050 manipulations had been performed by 153 physiotharepists. It was found that during this period 25 patients reported complications arising from manipulation including dizziness, nausea, headaches, vomiting, nystagmus, blurred vision, loss of consciousness and brachialgia with and without neurological symptoms. Of these, 72% were as a result of general rotary type adjustments, and 28% were due to localised adjustments. All these patients had a full recovery from their complications within an average of 6.3 days. It was not apparent, according to the author, which particular type/s of manipulation were employed when these complications resulted, but it is speculated that they involved end range techniques and not gentle grades.

Although cerebrovascular accidents and other complications have been reported after cervical manipulation, the incidence of such occurrences is very low (Vernon 1988:194-206). At least 123 cases of cerebrovascular accidents after neck manipulation have been cited in the literature (Thiel 1991). Although the exact incidence of this complication is unknown, it has been estimated to occur in less than one per million treatments (Vernon 1988:194-206). Despite this, manipulation is probably safer than most other medical treatments for neck pain (Cassidy et al. 1992a).

2.6 CONCLUSION

The literature review presented here is designed to give an overall understanding of the clinical enigma of non-specific neck and upper thoracic pain and the role of manipulation as a mode of therapy. Conclusions drawn by reviewers on trials of spinal manipulative therapy have not been unanimous (Brennan 1981, Brunarski 1984, Haldeman 1992:437). Nevertheless, there appears to be consensus that spinal manipulative therapy is a therapeutic approach that in many cases offers more immediate pain relief to patients with spinal related disorders than other forms of conservative therapy.

The literature itself, although fairly abundant in efficacy studies of manual therapy, deals very scarcely with chiropractic manipulation and this is due perhaps to fear of negative results from within the profession (Brennan 1981). It is evident that study design is particularly difficult. There are a great variety of designs all of which have the common flaw of lacking a suitable control (Hoehler and Tobis 1984), therefor making it very difficult to judge the true value of the adjustment in the treatment of mechanical spinal syndromes. An interesting approach to this control issue was demonstrated by Sloop et al. (1982) who used IV diazepam in a clinical trial of cervical manipulation to produce amnesia. During follow-up these subjects were unable to remember which treatment they received.

It appears that future studies need to deal with issues involving the standardization of subject selection, stratification, size, diagnostic categories, statistical analysis and manipulitive procedures employed.

3.0 METHODOLOGY

This was an uncontrolled, randomized, consecutive, comparative group study involving a sample group of 30 patients. Advertisements were placed in local Natal newspapers and on radio, and all patients who responded were screened to determine if they suffered from mechanical neck or upper thoracic pain. Only patients between the ages of 18 and 75 years with joint dysfunctions of either the C2-C3, C6-C7, C7-T1 or T1-T2 spinal segmental articulations without hard neurological signs were considered for the study. The minimum chronicity of symptoms for patient acceptance was two weeks in order to support the diagnosis of sub-acute or chronic mechanical neck and upper thoracic pain (Vernon et al. 1990). Once the case history (Appendix F), general physical examination (Appendix G), and regional examination of the cervical and upper thoracic spine (Appendix H) had been completed, the patients were randomly placed in one of the two groups, either the spinous push or the transverse process contact adjustment groups.

This was accomplished by placing thirty cards into a hat, fifteen representing spinous push and fifteen representing transverse process contact rotary-type adjustments. Before the first patient was treated, all thirty cards were drawn consecutively to determine the order as to what group each patient was assigned to upon acceptance into the study. The position of any patient that dropped out was then replaced by the next new patient joining the study.

A radiological study of the spine was conducted at the Technikon Natal Radiography Department when clinically indicated and was reported on by a radiologist before any treatment was performed.

The most fixated articulation was then identified using motion palpation and other signs such as muscle hypertonicity, local tenderness and anatomical asymmetry, and was termed the primary fixation (Mooney and Robertson 1976, Hourigan and Bassett 1989). This fixation listing was adjusted accordingly at each subsequent treatment regardless of subsequent motion palpation findings.

Once the patients had given written consent (Appendix I) for their participation in the study, the initial part of the study began. This entailed the completion of the disability (Appendix A), pain intensity (Appendix B), and pain quality (Appendix C) questionnaires by the patients. These questionnaires were chosen, as they had been demonstrated to exhibit high levels of reliability and validity in measuring neck pain (Melzack 1975, Turk et al. 1985, Jensen et al. 1986, Vernon and Mior 1991).

Ranges of motion of the cervical spine were measured using the cervical range of motion goniometer (CROM), (Performance Attainment Associates, St. Paul, MN). Goniometric reliability in a clinical setting has been shown to be high (Rothstein et al. 1983), and the CROM goniometer has also been shown to be highly reliable when comparing cervical range of motion measurements using different techniques, viz. universal or visual estimation (Tucci et al. 1986, Youdas et al. 1991).

Cervical ranges of motion were measured in all six degrees with the patient sitting in a straight-backed chair, their arms resting at their sides and their feet flat on the ground. The CROM goniometer was placed on the patient as if he/she were putting on a pair of glasses and the velcro straps were fastened behind the head. Measurements were made in the following manner:

1) Cervical Flexion and Extension - The patient was instructed to firstly tuck in his/her chin to include sub-occipital flexion, and then to attempt to put his/her chin on his/her chest. Cervical extension was measured by first getting the patient to tilt his/her head back (sub-occipital extension) and then to try and get his/her forehead parallel to the ceiling. These readings were taken off the sagittal plane meter and recorded on the goniometric data collection sheet (Appendix D). Only one reading for each direction was taken.

2) Lateral Flexion - The patient was instructed to laterally flex his/her neck as far as possible to the left and right without elevating the shoulders or rotating the

head. The two measurements were then read off the lateral flexion meter and recorded on the goniometric data collection sheet (Appendix D).

3) Rotation - For rotation, the magnetic yoke and rotation arm were used. The sagittal plane and lateral flexion meters were checked to ensure that they were at zero, while the rotation meter was set at zero by turning the dial on the rotation meter. The patient was instructed to turn his/her head as far as he/she could to the right and then to the left, keeping their eyes moving along a horizontal line and avoiding any shoulder rotation. The patient's shoulders were stabilized during this process by the observer. The two readings were read off the rotation meter and recorded on the goniometric data collection sheet (Appendix D), (Modified from CROM Procedure Manual 1988: 4-6).

Once the initial ranges of motion were recorded, a single pressure threshold meter (algometer) reading was obtained from each patient. Before the procedure was carried out the patient was instructed to respond with 'yes' when the pressure applied was felt to cause tenderness. With the patient lying prone (head in the neutral position), the spinous process of the superior vertebra of the most fixated motion unit (primary fixated level) was then identified by the observer with the left index finger. The pressure pad was then placed directly over the spinous process and a force directly posterior to anterior was applied through the vertebra. This force was applied at a rate of one kilogram per second until the patient reported discomfort. At this stage the algometer was removed and the reading was recorded on the algometer data collection sheet (Appendix E).

The algometer has received variable reports of reliability. Jansen et al. (1990) found that in a pre-post context to evaluate treatment effects, 26% of the sites selected for testing were significantly different after ten minutes in asymptomatic subjects. On the other hand, Fischer (1986), in a larger group (*n*=50), studied the use of the algometer in the quantification of tender spots and concluded a high reproducibility and an excellent validity of measurements obtained.

It must be stated that, to the authors knowledge, the algometer had not been used prior to this study to quantify pain thresholds in segmental joint dysfunction with the same technique employed as in this study.

Once the primary fixation had been identified, the patients were treated according to the group to which they had been assigned. Patients in both groups received soft tissue therapy to the upper back and cervical musculature before each treatment was performed.

Both groups were adjusted according to principles of the diversified technique (Nansel 1989b, Szaraz 1990:50, 76-78, Haldeman 1992:466-501):

Transverse process contact group:

Patients in this group who presented with a fixation of the C2-C3 or C6-C7 spinal motion unit received a single rotary break adjustment at each consultation. This adjustment had the patient placed in the supine position. The adjuster was positioned in a low squatting position at the head of the patient. An index contact was taken against the articular process of the superior vertebra of the primary fixated motion unit with skin slack taken out in a rotary fashion in the direction posterior-medial to anterior-lateral. The wrist of the thrusting hand was held straight with the contact firm but not hard. During C2 adjustments less flexion of the patient's neck was employed than with fixations of C6. The thumb of the doctor's contact hand was placed on the patient's chin. The indifferent hand cupped the patient's ear with the fingers hooked against the rim of the occiput to provide rotation and cephalad traction. In both C2 and C6 adjustments the neck was rotated away from the contact hand until the fixated segment reached restriction in rotation. A sudden pectoral thrust of short amplitude was delivered at the point of segmental restriction in a rotary fashion (Szaraz 1990:50, 76-78 and Haldeman 1992:466-501).

Patients who presented with primary fixation of the C7-T1, T1-T2 or T2-T3 segmental levels received a single prone combination adjustment at each consultation with the contact taken on the transverse process of the superior vertebra of the primary fixated motion segment. The adjuster assumed a fencer stance at the head of the patient facing cephalad. A high arch was formed with the inferior hand and a padded pisiform contact was slid onto the superior transverse process of the primary fixated level with skin slack taken out in an inferior to superior direction. The cupped indifferent hand was then secured against the rim of the occiput and index and middle fingers were placed against the temporal bone. The occiput was then rotated with the patient's face towards the doctor until rotation was sensed under the contact point. While cephalad traction and rotation was maintained with the indifferent hand, a single high velocity, moderate amplitude thrust with a stiffened contact arm was delivered with an anterior line of drive (Szaraz 1990:50, 76-78 and Haldeman 1992:466-501).

Spinous process contact group:

Patients in this group who presented with a primary fixation of the C2-C3 or C6-C7 spinal motion unit received a single supine spinous push adjustment at each consultation. The adjuster assumed a squatting position at the head of the patient. The patients head was slightly flexed in order to effect separation of the spinous processes. The tip of the index finger of the contact hand was then placed on the end of the spinous process of the cervical vertebra below the one to be adjusted. Then, the contact finger was moved up so that it fit under and slightly lateral to the spinous process of the vertebra to be adjusted. The thumb of the contact hand was then placed on the ramus of the jaw so that an arch was formed between the thumb and index finger. Using the stabilization hand, the head was next brought back into a more relaxed position, and the stabilization hand was placed along the postero-lateral portion of the cervical spine opposite the side to be adjusted. The chin was then elevated slightly and the head flexed laterally about 10 to 15 degrees and rotated slightly toward the side to be adjusted. The joint slack was then reduced (taken to tension) by applying pressure on the spinous process with the contact finger. A high velocity thrust was then made with the contact hand. The function of the stabilization hand was merely to guide the motion of the head as the thrust was applied. The thrust, which was made almost entirely with a rotational motion of the wrist and forearm, acted to lift the spinous process upward while also moving it anteriorly and medially (Nansel et al. 1989b).

Patients in this group who presented with a primary fixation of either the C7-T1, T1-T2 or T2-T3 spinal motion unit received a prone thumb move adjustment at each consultation. The adjuster assumed a ipsilateral low fencer's stance on the side of the patient facing cephalad. A thumb contact was taken on the lateral aspect of the spinous process of the superior vertebra of the primary fixated spinal motion unit by the contact hand. Skin slack was taken out in a lateral to medial direction. The contact hand formed a web resting on the trapezius muscle. The indifferent hand was cupped and the web secured against the rim of the occiput with fingers pointing cephalad and resting on the temporal bone. Traction was then applied to the occiput and cervical spine. Joint slack was then taken out with the contact hand in a rotary direction using the spinous process as a lever. A single high velocity pectoral impulse type of thrust was then delivered in a lateral to medial direction (Szaraz 1990:76).

After the first treatment (within 5 minutes), pain thresholds and ranges of motion of the cervical spine were measured again. Patients received two adjustments per week for a maximum of nine treatments. If any of the patients experienced a full recovery, i.e. a score of zero for 'worst pain experienced' in the NRS-101 questionnaire, the Short Form McGill Pain questionnaire and the CMCC Neck Disabilty Index questionnaire, the second phase of the study began straight away.

The second phase entailed completion of the questionnaires for a second time and measurements of pain threshold and cervical ranges of motion for a third time after the treatment period had ended.

After a further four weeks of no treatment the third phase of the study was completed. The questionnaires, pressure pain thresholds and cervical ranges of motion were once again completed and the patients were then released from the study.

After the completion of the study the data that had been collected was then scored. The neck disability index (App. A) was scored from zero to five for each of the ten categories. The first option received a score of zero while the sixth option received a score of five. These individual scores were then summed and divided into the maximum possible total of fifty to arrive at a percentage disability for each patient at each measuring time. The score for each patient at each measuring time was then recorded in spreadsheet format. Responses for the 'worst' and the 'least' pain in the numerical pain rating scale (App. B) for each patient at each measuring time were recorded separately as raw data in spreadsheet format.

Responses for the quality of pain questionnaire (App. C) were scored with a zero for none, one point for mild, two points for moderate and three points for severe pain. The individual scores were then tallied and divided into a maximum of forty five to obtain a percentage. Each percentage for each patient at the various measuring times were then recorded in spreadsheet format.

Data collected by the algometer and the goniometer did not get scored and was entered into spreadsheet format in its raw form.

The data contained in the spreadsheets then underwent non-parametric statistical analysis. The specific tests employed in this procedure where the Wilcoxon Signed-Ranks test for comparing the data within the two groups and the Mann-Whitney test for comparison of data between the two groups (Hoehler and Tobis 1984, DeGroot 1989:571-584). The results obtained from these tests were then used to discuss and draw conclusions as to the relative efficacy of the spinous push adjustment versus the transverse process contact adjustment and the possible role of manipulation in the treatment of sub-acute and chronic mechanical neck and upper thoracic back pain.

4.0 RESULTS

4.1 INTRODUCTION

Over the period of this study there were sixty-six responses to recruitment activity. Most persons responded to the publicity in the local newspapers and radio stations. The majority were not eligible for reasons such as not fulfilling the admissions criteria or no persisting interest in participation. In total, thirty-six patients were excluded from the study. The most common reasons for exclusion were the identification of the primary fixation as being inappropriate for inclusion into the study (n=13), the presence of hard neurological signs (n=4), the presence of an ossified posterior posticulum (n=4), a history of habitual self adjusting (n=4), and evidence of underlying pathology in which manipulative therapy was contra-indicated (one patient had a Clinical Stage Two malignant melanoma while two patients had radiographic evidence of osteoporosis). Finally, eight patients had discontinued interest in participation in the study before the end of the follow-up period. Therefor the results in this chapter reflect the treatment of thirty patients, fifteen in each group.

The range of motion scores are in degrees while the algometer scores are in kilograms. The results of the character of pain and disability questionnaires are both expressed in percentages.

4.2 ALGOMETER

4.2.1 Results of Wilcoxon Signed Ranks Test

Table 4.1 Comparison of the mean algometer readings in kilograms for the spinous contact and the transverse contact adjustment groups.

ALGOMETER	PRE.TX	POST.TX	F.TX	4WKS.FU
SPINOUS CONTACT	1.74	1.77	1.95	1.90
TRANSVERSE CONTACT	2.28	2.30	2.59	2.50

Statistical analysis at a 5% level of significance revealed significant increases in the algometer readings in the spinous push group at the final treatment and at the four week follow-up stages in the study. The mean gain in the algometer reading at the final treatment was 0.21333 kilograms (p=0.0367), while at the end of the four week follow-up period the mean gain had dropped slightly to 0.16667 kilograms (p=0.0249).

No statistically significant changes were found in the transverse process contact group at any stage in the study despite an overall increase in the algometer readings.

4.2.2 Results of Mann Whitney Test

Table 4.2 Comparison of the mean algometer gains in kilograms for the spinous contact and the transverse contact adjustment groups.

ALGOMETER	POST-PRE.TX	FIN-PRE.TX	F/U-PRE.TX
SPINOUS CONTACT	0.03	0.21	0.16
TRANSVERSE CONTACT	0.02	0.31	0.22

Analysis between the two groups of the difference between the pre-treatment and post-treatment readings, the pre-treatment and final treatment readings as well as the difference between the pre-treatment and four week follow-up readings of each group revealed no statistically significant differences.

4.3 RANGE OF MOTION

4.3.1 FLEXION

4.3.1.1 Results of Wilcoxon Signed Ranks Test

Table 4.3 Comparison of the mean flexion ranges of motion in degrees for the spinous contact and the transverse contact adjustment groups.

FLEXION	PRE.TX	POST.TX	F.TX	4WKS.FU
SPINOUS CONTACT	53.20000	58.26667	58.33333	57.53333
TRANSVERSE CONTACT	51.13334	54.80000	56.86667	57.06667

Analysis of the mean flexion range of motion readings showed statistically significant improvements between pre-treatment and post-initial treatment readings as well as between pre-treatment and final treatment readings in the spinous push group. The mean gains were 5.06667 degrees (p=0.0059) and 5.13333 degrees (p=0.0268) respectively. At the four week follow-up period a slightly smaller yet still significant mean increase from the pre-treatment reading is noted. The mean gain was 4.33333 degrees ($p=0.0157$).

The transverse process contact group also showed statistically significant improvements at the final treatment and follow-up assessment periods. At the final treatment the mean gain in flexion was 5.73333 degrees ($p=0.0135$). At the four week follow-up period a slightly larger and statistically significant increase from the pre-treatment reading was noted. The mean gain was 5.93333 degrees ($p=0.0076$). A mean increase of 3.66666 degrees was noted after the initial treatment but this failed to reach statistical levels of significance ($p<0.05$).

4.3.1.2 Results of Mann Whitney Test

Table 4.4 Comparison of the mean flexion gains in degrees for the spinous contact and the transverse contact adjustment groups.

FLEXION	POST-PRE.TX	FIN-PRE.TX	F/U-PRE.TX
SPINOUS CONTACT	5.06667	5.13333	4.33333
TRANSVERSE CONTACT	3.66666	5.73333	5.93333

Despite there being statistically significant improvements in flexion in both groups, there were no statistically significant differences in the mean flexion range of motion gains between the two groups ($p<0.05$).

4.3.2 EXTENSION

4.3.2.1 Results of Wilcoxon Signed Ranks Test

Table 4.5 Comparison of the mean extension ranges of motion in degrees for the spinous contact and the transverse contact adjustment groups.

EXTENSION	PRE.TX	POST.TX	F.TX	4WKS.FU
SPINOUS CONTACT	69.39999	77.26666	72.93333	71.66666
TRANSVERSE CONTACT	63.46666	67.06667	61.53334	65.46667

Comparison of the extension range of motion readings showed a statistically significant increase within the spinous push group after the initial treatment ($p=0.0002$). This was represented by a mean increase in extension of 7.86667 degrees. This increase was no longer statistically significant at the final treatment and follow-up stages, but was still greater than the pre-treatment mean (Table 4.5). The mean increases were 3.53334 degrees and 2.26667 degrees respectively.

There were no statistically significant changes in the transverse process contact group at any stage in the study.

4.3.2.2 Results of Mann Whitney Test

Table 4.6 Comparison of the mean extension gains in degrees for the spinous contact and the transverse contact adjustment groups.

EXTENSION	POST-PRE.TX	FIN-PRE.TX	F/U-PRE.TX
SPINOUS CONTACT	7.86667	3.53334	2.26667
TRANSVERSE CONTACT	3.60001	-1.93332	2.00001

Analysis of the degree of improvement in extension between pre-treatment readings and final treatment readings revealed no statistically significant difference between the two groups despite the significant improvement in the spinous push group at the post-initial treatment stage ($p<0.05$), (Table 4.5).

4.3.3 LEFT LATERAL FLEXION

4.3.3.1 Results of Wilcoxon Signed Ranks Test

Table 4.7 Comparison of the mean left lateral flexion ranges of motion in degrees for the spinous contact and the transverse contact adjustment groups.

L. LATERAL FLEXION	PRE.TX	POST.TX	F.TX	4WKS.FU
SPINOUS CONTACT	43.53333	46.86667	46.76664	46.20000
TRANSVERSE CONTACT	36.60000	41.06667	40.40000	43.46667

A statistically significant increase in mean left lateral flexion was noted after the first treatment in the spinous push group (p=0.0392) with a mean increase in left lateral flexion of 3.33334 degrees. Increases were maintained at the times of the final treatment and the follow-up of 3.23331 degrees and 2.66667 degrees respectively but neither were statistically significantly different to the pre-treatment means.

After the first treatment the transverse process contact group had experienced an increase in mean left lateral flexion of 3.46667 degrees which was statistically significant (p=0.0029). At the time of the final treatment this increase had diminished to 2.8 degrees and was no longer statistically significant. Interestingly, mean left lateral flexion at the time of the follow-up was at its highest with a mean increase of 5.86667 degrees which was statistically significant (p=0.0030).

4.3.3.2 Results of Mann Whitney Test

Table 4.8 Comparison of the mean left lateral flexion gains in degrees for the spinous contact and the transverse contact adjustment groups.

L. LATERAL FLEXION	POST-PRE.TX	FIN-PRE.TX	F/U-PRE.TX
SPINOUS CONTACT	3.33334	3.23331	2.66667
TRANSVERSE CONTACT	4.46667	3.80000	6.86667

Despite the statistically significant improvements experienced within each of the two adjustment groups, there were no statistically significant differences in improvement noted between the two groups at any stage during the study period (p<0.05).

4.3.4 RIGHT LATERAL FLEXION

4.3.4.1 Results of Wilcoxon Signed Ranks Test

Table 4.9 Comparison of the mean right lateral flexion ranges of motion in degrees for the spinous contact and the transverse contact adjustment groups.

R. LATERAL FLEXION	PRE.TX	POST.TX	F.TX	4WKS.FU
SPINOUS CONTACT	38.26667	43.66667	46.26667	45.20000
TRANSVERSE CONTACT	35.20000	39.33333	39.86666	39.66667

Statistical analysis within each group revealed statistically significant increases in right lateral flexion in both the spinous push and the transverse process contact groups after the first treatment, the final treatment and after the four week follow-up period. After the first treatment the mean gain in right lateral flexion in the spinous contact group was 5.4 degrees (p=0.0007) while in the transverse process contact group the mean gain was 4.13333 degrees (p=0.006). At the stage of the final treatment the mean gain in right lateral flexion in the spinous push group was 8 degrees (p=0.0043) while in the transverse process contact group the mean gain was 4.66666 degrees (p=0.0192). After the four week follow-up period the mean gain in right lateral flexion in the spinous push group was 6.93333 degrees ($p=0.0005$) while in the transverse process contact group the mean gain was 4.46667 degrees ($p=0.0069$).

4.3.4.2 Results of Mann Whitney Test

Table 4.10 Comparison of the mean right lateral flexion gains in degrees for the spinous contact and the transverse contact adjustment groups.

R. LATERAL FLEXION	POST-PRE.TX	FIN-PRE.TX	F/U-PRE.TX
SPINOUS CONTACT	5.40000	8.00000	6.93333
TRANSVERSE CONTACT	4.13333	4.66666	4.46667

Analysis of the degree of improvement in right lateral flexion between pre- and post-initial treatment readings, pre-treatment and final treatment readings as well as between pre-treatment readings and follow-up readings revealed no statistically significant difference between the two groups ($p<0.05$).

4.3.5 LEFT ROTATION

4.3.5.1 Results of Wilcoxon Signed Ranks Test

Table 4.11 Comparison of the mean left rotation ranges of motion in degrees for the spinous contact and the transverse contact adjustment groups.

LEFT ROTATION	PRE.TX	POST.TX	F.TX	4WKS.FU
SPINOUS CONTACT	65.33334	68.06667	71.66667	70.86667
TRANSVERSE CONTACT	58.66667	60.66667	64.86667	63.46667

Statistical analysis within the spinous push group showed a statistically significant increase in left rotation after the first treatment (p=0.0323), with a mean gain of 2.73333 degrees. At the stage of the final treatment the mean increase was 6.33333 degrees and was still statistically significant (p=0.0032). A statistically significant increase of 5.53333 degrees (p=0.0135) was also evident after the four week follow-up period within the spinous push group.

The transverse process contact group had a non-statistically significant increase ($p=0.0597$) of 6.2 degrees at the stage of the final treatment. There were no statistically significant increases in the transverse process contact group with regard to left rotation at any stage in the study ($p<0.05$).

4.3.5.2 Results of Mann Whitney Test

Table 4.12 Comparison of the mean left rotation gains in degrees for the spinous contact and the transverse contact adjustment groups.

LEFT ROTATION	POST-PRE.TX	FIN-PRE.TX	F/U-PRE.TX
SPINOUS CONTACT	2.73333	6.33333	5.53333
TRANSVERSE CONTACT	2.00000	6.20000	4.80000

Analysis of the degree of improvement in left rotation between pre-treatment readings and post-initial treatment readings, pre-treatment and final treatment readings as well as between pre-treatment and four week follow-up readings revealed no statistically significant differences between the two groups ($p<0.05$).

4.3.6 RIGHT ROTATION

4.3.6.1 Results of Wilcoxon Signed Ranks Test

Table 4.13 Comparison of the mean right rotation ranges of motion in degrees for the spinous contact and the transverse contact adjustment groups.

RIGHT ROTATION	PRE.TX	POST.TX	F.TX	4WKS.FU
SPINOUS CONTACT	61.40000	67.53333	69.39999	69.93334
TRANSVERSE CONTACT	60.66666	66.20000	66.60001	65.66667

Comparison of results within both groups revealed a statistically significant increase in the mean right rotation after the first treatment. The spinous push group had a mean increase of 6.13333 degrees (p=0.002) while the transverse process contact group showed an increase of 5.53334 degrees (p=0.0039). Furthermore the spinous push group had a statistically significant increase in mean right rotation at the stage of the final treatment (mean increase of 7.99999 degrees; p=0.0041), and after the four week follow-up period had past (mean increase of 8.53334 degrees; p=0.001).

4.3.6.2 Results of Mann Whitney Test

Table 4.14 Comparison of the mean right rotation gains in degrees for the spinous contact and the transverse contact adjustment groups.

RIGHT ROTATION	POST-PRE.TX	FIN-PRE.TX	F/U-PRE.TX
SPINOUS CONTACT	6.13333	7.99999	8.53334
TRANSVERSE CONTACT	5.53334	5.53334	5.00001

Despite the different degrees of improvement within each group (Table 4.13), there failed to be a statistically significant difference in mean gains of right rotation at any of the stages in the study between the two groups (Table 4.14).

4.4 McGILL PAIN QUESTIONNAIRE

4.4.1 Results of Wilcoxon Signed Ranks Test

Table 4.15 Comparison of the mean McGill Pain scores in percentages for the spinous contact and the transverse contact adjustment groups.

McGILL PAIN	PRE.TX	F.TX	4WKS.FU
SPINOUS CONTACT	23.55	13.63	16.44
TRANSVERSE CONTACT	21.33	2.96	6.66

Statistical analysis of the pain scores within each group indicated significant improvements regarding the amounts of pain. At the stage of the final treatment the spinous push group had an improvement of 9.92% in their pain scores (p=0.0356), while the transverse process contact group showed an improvement of 18.37% (p=0.0001). Even though both groups deteriorated slightly during the four week follow-up period, patients were still significantly better than when they entered into the study (Spinous push group: p=0.0157; Transverse process contact group: p=0.0043).

4.4.2 Results of Mann Whitney Test

Table 4.16 Comparison of the mean McGill Pain score gains in percentage for the spinous contact and the transverse contact adjustment groups.

McGILL PAIN	FIN-PRE.TX	F/U-PRE.TX
SPINOUS CONTACT	-9.92	-7.11
TRANSVERSE CONTACT	-18.37	-14.67

There was no significant difference between the two groups in the amount of improvement (indicated by a negative value), between the pre-treatment and post treatment stages and between the pre-treatment the four week follow-up stages ($p<0.05$).

4.5 CMCC NECK DISABILITY QUESTIONNAIRE

4.5.1 Results of Wilcoxon Signed Ranks Test

Table 4.17 Comparison of the mean CMCC Neck Disability scores in percentages for the spinous contact and the transverse contact adjustment groups.

CMCC NECK DISABILITY	PRE.TX	F.TX	4WKS.FU
SPINOUS CONTACT	27.73	11.87	12.67
TRANSVERSE CONTACT	23.73	7.20	7.73

Statistical analysis of the disability scores within each group indicated significant improvement regarding the levels of disability at both the final treatment and the four week follow-up stages. At the stage of the final treatment the spinous push group had experienced an improvement of 15.86% (p=0.0016), while the transverse process contact group had had an improvement of 16.53% (p=0.0001). Even though both groups had deteriorated slightly by the end of the four week follow-up period, patients in both groups were still significantly better than before the study started (Spinous push group p=0.0001; Transverse process contact group p=0.0001).

4.5.2 Results of Mann Whitney Test

Table 4.18 Comparison of the mean CMCC Neck Disability score gains in percentage for the spinous contact and the transverse contact adjustment groups.

CMCC NECK DISABILITY	FIN-PRE.TX	F/U-PRE.TX
SPINOUS CONTACT	-15.86	-15.06
TRANSVERSE CONTACT	-16.53	-16.00

No statistically significant differences in degree of improvement (indicated by a negative value), in disability scores were noted between the two groups at any stage during the study period ($p<0.05$).

4.6 NUMERICAL PAIN RATING SCALE-101

4.6.1 WORST PAIN EXPERIENCED

4.6.1.1 Results of Wilcoxon Signed Ranks Test

Table 4.19 Comparison of the mean 'Worst Pain Experienced' Numerical Pain Rating Scale-101 scores for the spinous contact and the transverse contact adjustment groups.

NRS-101 WORST SCORE	PRE.TX	F.TX	4WKS.FU
SPINOUS CONTACT	77.33	32.00	44.13
TRANSVERSE CONTACT	64.00	21.40	25.87

Statistical analysis of the NRS-101 pain scores within each group indicated significant improvement regarding the levels of pain at both the final treatment and the four week follow-up treatment stages. At the stage of the final treatment the spinous push group had experienced an improvement of 45.33% (p=0.0002), while the transverse process contact group had had an improvement of 42.60% (p=0.0004). Both groups had deteriorated slightly by the end of the four week follow-up period the patients in both groups were still significantly better than before the study started (Spinous push group p=0.0018; Transverse process contact group p=0.0015).

4.6.1.2 Results of Mann Whitney Test

Table 4.20 Comparison of the mean 'Worst Pain Experienced' Numerical Pain Rating Scale-101 score gains in percentages for the spinous contact and the transverse contact adjustment groups.

NRS-101 WORST SCORES	FIN-PRE.TX	F/U-PRE.TX
SPINOUS CONTACT	-45.33	-33.20
TRANSVERSE CONTACT	-42.60	-38.13

No statistically significant differences in degree of improvement in 'worst' pain scores were noted between the two groups at any stage during the study period ($p<0.05$). Improvement in pain level is indicated by a negative value.

4.6.2 LEAST PAIN EXPERIENCED

4.6.2.1 Results of Wilcoxon Signed Ranks Test

Table 4.21 Comparison of the mean 'Least Pain Experienced' Numerical Pain Rating Scale-101 scores for the spinous contact and the transverse contact adjustment groups.

NRS-101 LEAST SCORE	PRE.TX	F.TX	4WKS.FU
SPINOUS CONTACT	23.33	13.67	12.00
TRANSVERSE CONTACT	17.67	5.20	5.13

Statistical analysis of the NRS-101 pain scores within each group indicated significant improvement in the level of pain (p=0.0234) at the stage of the final treatment the transverse process contact group. This group improved by 12.47%. Both groups had had a statistically significant level of improvement by the end of the four week follow-up period (Spinous push group p=0.0244; Transverse process contact group p=0.0262).

4.6.2.2 Results of Mann Whitney Test

Table 4.22 Comparison of the mean 'Least Pain Experienced' Numerical Pain Rating Scale-101 score gains in percentages for the spinous contact and the transverse contact adjustment groups.

NRS-101 LEAST SCORES	FIN-PRE.TX	F/U-PRE.TX
SPINOUS CONTACT	-9.66	-11.33
TRANSVERSE CONTACT	-12.47	-12.54

No statistically significant differences in degree of improvement in 'least' pain scores were noted between the two groups at any stage during the study (p<0.05). Negative values indicate an improvement (Table 4.22).

4.7 DEMOGRAPHIC DATA

Table 4.23 Demographic data related to the spinous process contact group.

PATIENTS	AGE	SEX	CHRONICITY	TRAUMA	PRIMARY FIX.
1	24	M	6 weeks	None	C7 AR Right
2	36	M	15 years	None	C7 AR Right
3	30	F	6 years	None	C2 AR Right
4	38	M	9 years	Yes	C7 AR Left
5	33	F	12 years	Yes	C2 AR Right
6	42	F	7 years	None	C6 AR Right
7	44	M	2 years	None	C2 AR Left
8	36	F	18 years	Yes	C2 AR Left
9	43	F	20 years	None	C2 AR Left
10	20	F	3.5 months	None	C2 AR Right
11	23	M	6 weeks	None	C2 AR Right
12	27	F	10 years	None	C2 AR Left
13	71	F	8 weeks	Yes	T1 AR Right
14	42	M	10 years	Yes	C7 AR Left
15	38	F	5 years	Yes	C2 AR Left
TOTAL	AVE.	M:F	AVE. CHRON.	Y:N	C2:C6:C7:T1:T2
15	**36.47**	**6:9**	**7.64 years**	**6:9**	**9:1:4:1:0**

Table 4.24 Demographic data related to the transverse process contact group.

PATIENTS	AGE	SEX	CHRONICITY	TRAUMA	PRIMARY FIX
1	19	F	10 months	None	C2 AR Right
2	55	M	10 years	Yes	T1 AR Left
3	55	M	2 years	None	C7 AR Right
4	20	M	2 months	None	C7 AR Left
5	29	M	6 weeks	None	C6 AR Right
6	25	F	1.5 years	None	C2 AR Right
7	48	M	6 months	Yes	C2 AR Left
8	24	F	6 weeks	None	C2 AR Left
9	18	M	8 months	None	C2 AR Left
10	57	M	10 years	None	C2 AR Right
11	31	F	12 years	None	C2 AR Left
12	31	M	2 months	Yes	T2 AR Left
13	21	F	1.5 years	None	C6 AR Right
14	38	M	7 weeks	None	C2 AR Left
15	44	M	4 years	None	C2 AR Right
TOTAL	AVE.	M:F	AVE. CHRON.	Y:N	C2:C6:C7:T1:T2
15	**34.33**	**10:5**	**3.53 years**	**3:12**	**9:2:2:1:1**

5.0 DISCUSSION

5.1 ALGOMETER

5.1.1 DISCUSSION OF THE WILCOXON SIGNED RANKS TESTS

Although there was overall improvements in both adjustment groups (Table 4.1), only the spinous push adjustment group reached statistically significant levels of improvement at the stage of the final treatment and after the four week follow-up period. The literature tends to support this result. Manipulation has been shown over the short term to significantly reduce the paraspinal pain tolerance levels of paraspinal muscle and cutaneous tissue in symptomatic as well as asymptomatic subjects (Terrett et al. 1984, Vernon 1988, Vernon et al. 1990). It may be possible that a direct posterior to anterior force exerted through the vertebra with the algometer using the spinous process as a point of contact may, due to the resultant anterior translation of the vertebra, stress the local articular soft tissues, for example the zygapophyseal joint capsules and intervertebral ligaments, and therefor provide a possible outcome measure for efficacy of manipulation studies on mechanical neck pain. In this study, statistically significant improvement in the mean algometer measurements following manipulative intervention utilizing the spinous push adjustment warrant further investigation into the ability of the spinous push adjustment to reduce paraspinal pain tolerance levels.

5.1.2 DISCUSSION OF THE MANN WHITNEY TEST

There were no statistically significant differences in the mean improvements in pressure pain threshold levels between the two groups at any stage during the study. Attention must be drawn to the comparability of the two groups where a fairly large difference of 0.54 kilograms (Spinous push group: 1.74 kg; Transverse process contact group: 2.28 kg) was noted at the pre-treatment stage. This difference may have affected the results of the statistical analysis. Net improvement at the stage of the final treatment was greatest in the transverse process contact group although this was not a statistically significant difference. A greater amount of passive cervical rotation was employed in the transverse process contact adjustment when compared to the spinous push adjustment. This may result in a greater amount of separation between the joint surfaces during the thrust component of the adjustment thus allowing entrapped meniscoids (Lewit 1978:8-9) or synovial tags (Haldeman 1992:206) to be more effectively released. It is important however not to over-rotate the cervical spine during the transverse process contact type of adjustment since this will help reduce the possibility of post-manipulative cerebrovascular complications (Byfield 1991).

5.2 RANGE OF MOTION

5.2.1 DISCUSSION OF THE WILCOXON SIGNED RANKS TESTS

The results presented in Tables 4.3-14 indicate that patients in both groups showed improvements in their cervical range of over the course of the study. The spinous push group showed a statistically significant increase in all ranges of motion after the initial treatment ($p<0.05$). Improvement in right rotation as well as left and right lateral flexion also reached levels of statistical significance ($p<0.05$) in the transverse process contact group after the initial treatment. The CROM goniometer used to measure range of motion in this study has received favourable reports with regard to inter- and intra-examiner reliability (Youdas et al. 1991). The results of range of motion measured after the first treatment confirmed those that had been previously reported.

Cassidy et al. (1992a) compared the immediate effect of manipulation versus mobilisation of the cervical spine where prior to and immediately after the treatments (within 5 minutes), cervical spine range of motion was recorded in all three planes. The manipulated group (52 patients) were adjusted according to the laterality of the pain and not the motion palpation findings. The adjustment technique was the transverse process contact rotary type adjustment Cassidy et al. (1992a) with the contact of the adjusting hand placed on the articular pillar of the most painful segment and on the side of greatest pain. The mean post-treatment range of motion scores were improved in all three planes of motion but most notably in ipsilateral rotation (towards the side of pain) forward flexion and contralateral flexion (away from the painful side). In terms of post-manipulation range of motion outcome there seems to be little difference in adjusting according to motion palpation findings and adjusting according to pain location and laterality when employing the transverse process contact rotary adjustment. Since motion palpation technique has been shown to be of value in a clinical setting (Russell 1983, Johnston et al. 1983, Alley 1983, Nansel et al. 1989a, Jensen et al. 1993), further studies involving larger sample sizes should be carried out in order to standardize methods of approach in adjusting vertebral subluxations in the treatment of mechanical neck pain.

Nansel et al. (1990) demonstrated using a sample population of 42 asymptomatic subjects exhibiting cervical lateral flexion end-range asymmetries (average asymmetry of approximately 14 degrees), that the seated lower cervical spinous push adjustment significantly reduced the asymmetries. Results indicated that an adjustment delivered to the more restricted side reduced the asymmetries to a larger degree than those delivered to the less restricted side. Post-adjustment goniometric re-assessment was performed within 30-45 minutes following treatments. The post-adjustment mean asymmetry of the group which received the adjustment on the less restricted side was 10.7 degrees, while the group who received the adjustment to the more restricted side had a post-adjustment mean asymmetry of 1.8 degrees. It is possible therefor that the 'listing' of the cervical motion segment to be adjusted using the spinous push technique has bearing on any improvement in short term goneometrically assessed cervical range of motion.

Over the course of the full treatment period, both groups tended to increase their respective ranges of motion or at least to maintain the improvements already gained after the initial treatment. The spinous push group maintained significant improvement in flexion, right lateral flexion as well as in left and right rotation. The transverse process contact group showed similar success by the end of the same treatment period with significant increases in flexion, right lateral flexion and left rotation. It must be noted that the final treatment readings were taken before the patients were adjusted for the final time and may therefor be viewed as an indication of improvement as the result of preceding treatments. There were no statistically significant improvements between the post-treatment range of motion measurements and the final treatment measurements. The value of repeated adjustments for the treatment of mechanical neck and upper thoracic pain in terms of degree of improvement in cervical range of motion beyond the duration of treatment used in this study has therefor yet to be established.

In this study it was evident that both groups tended to maintain their increases in the cervical ranges of motion at four week follow-up period. This result receives varied support from the literature.

In a double-blind controlled study involving the use of adjustments on chronic neck pain sufferers, Sloop et al. (1982) found no significant improvement with regard to range of motion over three week and twelve week follow-up periods, nor was there any correlation between improvements in pain and changes in ranges of motion. In the study by Sloop et al. (1982), the exact technique employed in the manipulation group as well as the approach to where to manipulate was not described which makes it difficult to assess the efficacy of specific manipulations for chronic neck pain. Furthermore, only one treatment was given which may account for the difference in follow-up range of motion assessments between this study and the study by Sloop et al. (1982). It must be noted that the patients were blinded in the study by Sloop et al. (1982) with the use of an amnaesic instravenous dose of diazepam (20 mg) before the treatment was given. A slightly larger sample group of 39 patients were also used which adds to the validity to the results.

Howe et al. (1983) found that a significant improvement in rotation was evident after a three week follow-up period following treatment of mechanical neck pain with manipulation. This would support the findings in this study of a possible value of the long-term effect of the spinous push adjustment with respect to significant increases in cervical spine motion in the transverse plane.

Nansel et al.'s (1990) study was confined to asymptomatic patients with regard to pain. It was found that in the group with a previous history of trauma to the cervical spine, 12 out of the 16 patients regained their limited lateral flexion ranges within 48 hours after a single seated spinous push adjustment. In each case the restricted movement was found to return to the same side as before the adjustment. This was not found in the group with no history of previous trauma to their cervical spines. When the demographic data of the patients in the spinous push adjustment group in this study is analyzed (Table 4.23-24), 66% of the group had a history of previous trauma to their cervical spines yet there was still a significant increase in right lateral flexion after the 3 weeks follow-up period. A possible explanation may be that this study did not accept patients solely on the presence or absence of lateral flexion passive end-range asymmetries but simply on the presence of sub-acute or chronic mechanical neck pain. The study by Nansel et al. (1990) also involved asymptomatic subjects and studied the effects of a single adjustment on range of motion in the cervical spine. This differed fundamentally from this study where multiple treatments were given over a longer period of time.

Nansel et al. (1992) compared the effect of upper (C2-C3) versus lower (C6-C7) cervical adjustments with respect to the amelioration of passive rotational versus lateral flexion end-range asymmetries in otherwise asymptomatic subjects. In the group exhibiting lateral flexion asymmetries, lower cervical adjustments were more effective than upper cervical adjustments in the amelioration of the lateral flexion asymmetries. The opposite was true for the group exhibiting rotational asymmetries where upper cervical adjustments were more effective than lower cervical adjustments. Since the adjustive thrusts (seated spinous push), irrespective of the region to which they were delivered, were performed in a virtually identical manner, it seems likely that the segmental level at which adjustments were delivered, rather than the manner in which they are performed, represents the most important factor responsible for these axis-specific effects. This evidence supports the results obtained in Tables 4.7-14 where statistically significant improvements in rotation and lateral flexion were evident after the initial treatment in both groups ($p<0.05$).

The method of cervical range of motion measurement entailed at least one area of possible measurement error. Efforts were made to control for potential problems. A compass was used to indicate the total range of motion in the transverse plane. The advantage of this method is its simplicity in clinical use. With this technique, it is important to control the patients' position by stabilizing the shoulders during examination. Still, some rotary motion of the middle and upper thoracic spine may occur which cannot be monitored.

5.2.2 DISCUSSION OF THE MANN WHITNEY TEST

There were no statistically significant differences between the two adjustment groups with respect to mean gains in range of motion at any stage in the study. Each group did show improvement in range of motion throughout the study but the spinous push group showed consistently larger ranges of motion than the transverse process contact group (Tables 4.3-14). This indicates that the process of randomization may have resulted in an in-adequate comparability between the two adjustment groups. This seems to be the case if one analyses the demographic data presented in Tables 4.23-24 . A fairly large difference in chronicity and history of neck trauma between the two groups becomes evident. The average chronicity of neck pain in the spinous push adjustment group was 7.64 years compared to 3.53 years in the transverse process contact adjustment group. With regard to a history of neck trauma, 40% of the spinous push adjustment group had a history of neck trauma whereas 20% of the transverse process contact adjustment group had a history of neck trauma. Nansel et al. (1990) has shown that there appears to be a tendency of individuals who have suffered previous neck trauma to reestablish their aberrant cervical motion characteristics to a greater extent than those without previous history of neck trauma. This did not seem to be the case in the spinous push group where a significant improvement in flexion, right lateral flexion and left and right lateral flexion was evident after the four week follow-up period despite the fact that 40% of the group had a previous history of neck trauma. A larger sample size is necessary to ensure adequate comparability through randomization between the two groups.

5.3 DISABILITY

5.3.1 DISCUSSION OF THE WILCOXON SIGNED RANKS TESTS

The CMCC Neck Disability Index questionnaire, a revised form of the Oswestry Low Back Pain Index (Vernon and Mior 1991), has been shown to demonstrate a high degree of test- retest reliability and validity (Vernon and Moir 1991). In this study, two patients did not possess a driver's license. This resulted in a problem in answering Section 8 in which cases the section was ignored and their scores were tallied out of 45, representing 9 sections.

At the stage of the final treatment both adjustment groups had experienced significant improvements in their levels of disability. After the four week follow-up period the improvement was slightly less but still significantly improved from the pre-treatment scores giving credence to a possible long term value of both adjustment types in terms of patient disability. The results support the hypothesis that the spinous push and transverse process contact type adjustments both improve the patients' perceptions of disability related to the neck pain. It must be noted that these results are not conclusive since the study did not include a control group.

5.3.2 DISCUSSION OF THE MANN WHITNEY TEST

There were no statistically significant differences between the two groups in terms of mean improvement between the two groups at any stage during the study. This implies that both forms of treatment were just as effective in decreasing the patients' perceptions of disability related to mechanical neck pain. The use of the CMCC Neck Disability Index in this study was useful in that it was both very understandable and relevant to the patients and their condition. It was generally simple for the patients to complete and is recommended in future studies of this type.

5.4 PAIN

5.4.1 DISCUSSION OF THE WILCOXON SIGNED RANKS TESTS

The McGill Pain questionnaire may be used in a number of measures to assess pain (Melzack 1975, Turk et al. 1985). In this study the questionnaire was utilized to analyze the patients' 'severity' of neck pain and not the 'type' of neck pain from which the patient was suffering. Within each group a significant decrease in pain was experienced at the stage of the final treatment and again after the four week follow-up period. Although the scores after the four week follow-up period in both groups were significantly improved, they had worsened slightly from the final treatment readings. It is interesting to note that the average McGill Pain score before treatment commenced (Table 4.15) was far lower a percentage than the NRS-101 average pre-treatment score (Table 4.19,21), (McGill average of 22.44%; NRS-101 average of 45,58%).

Both the adjustment groups showed statistically significant improvement in their 'worst' pain experienced in the NRS-101 Pain questionnaire at both the final treatment and after the four week follow-up period. The 'least' pain scores were significantly improved only in the transverse process contact group at the stage of the final treatment. However, both groups reached statistically significant levels of improvements after the four week follow-up period. It is interesting to note that between the two groups the average NRS-101 pre-treatment scores differed by 9.495 (spinous push group average of 50.33; transverse process contact group average of 40.835). Once again this draws attention to the inadequate comparability between the two groups.

In the study by Cassidy et al. (1992a) involving 100 patients suffering from mechanical neck pain, 52 patients received a single transverse process contact adjustment administered to the most painful side. Pre- and post-treatment NRS-101 pain scores were taken. The pre-treatment mean was 37.7. This compares favorably to the pre-treatment mean of 40.83 achieved in the transverse process contact adjustment group. In this study by Cassidy et al. (1992a), a mean post-treatment NRS-101 pain score of 20.4 was recorded within 5 minutes after the adjustment. In this study, a final treatment NRS-101 mean score of 13.3 was achieved. This tends to indicate the possible significance of more than one treatment when utilizing the transverse process contact adjustment in the treatment of mechanical neck pain in terms of pain reduction.

5.4.2 DISCUSSION OF THE MANN WHITNEY TEST

There was no significant difference between the two groups in terms of improvement in pain at any stage in the study. However, at the stage of the four week follow-up period the transverse process contact group had far smaller McGill and average NRS-101 pain scores. A possible explanation for this result may once again be as a result of the inadequate comparability of the two treatment groups with respect to the chronicity of the pain and previous trauma. The transverse process contact adjustment may possibly effect a greater separation of the articular surfaces allowing for the more effective freeing of trapped pain sensitive tissues i.e., meniscoid (Lewit 1978:8-9) or synovial tags (Haldeman 1992:206). Another possible reason may be that the adjustment itself is less stressful on other pain sensitive tissues in the area e.g., joint capsules and paraspinal musculature, with the effect that the adjustment has a better prognostic value with respect to pain than the spinous push adjustment. Future studies should address the question of patient comfort during the set-up and thrust components of the spinous push and transverse process contact adjustments.

The large difference in follow-up McGill scores between the two groups may be accounted for by different biomechanical effects that each adjustment may exert on the joints and surrounding soft tissues. The transverse process contact adjustment may stimulate joint mechanoreceptors and nociceptors involved in pain inhibition to a greater degree than the spinous push adjustment. A greater amount of vertebral body rotation during the thrust component of the adjustment may account for this since many of the mechanoreceptors and nociceptors involved with pain inhibition are high threshold receptors (Wyke 1985).

The NRS-101 Pain questionnaire supports the result obtained in the McGill Pain questionnaire in that there are large differences between the two groups at the stages of the final treatment and after the four week follow-up period (Tables 4.15,19,21). This applied to both 'worst' and 'least' pain experience categories. Jensen et al. (1986) favours the NRS-101 questionnaire over the McGill Pain questionnaire on the grounds of ease of administration and scoring. The author is not aware of any studies of manipulative therapy for chronic neck pain making use of the McGill Pain questionnaire as a subjective form of assessing pain.

NOTE: This study utilized soft tissue therapy as an adjunct to spinal manipulative therapy in both adjustment groups. Leboeuf et al. (1987) has shown that in the treatment of repetitive strain injuries of the neck, shoulder and upper limb over a period of five weeks, spinal manipulative therapy alone resulted in a 33.3% improvement in severity of symptoms. Spinal manipulative therapy combined with soft tissue therapy resulted in a 46% improvement in severity of symptoms. The sample size however, was rather small (*n*=38) and did not necessarily represent the typical repetitive strain injury population (Leboeuf et al. 1987). Unfortunately the adjustment techniques were not standardized in the study by Leboeuf et al. (1987). The true value of soft tissue therapy has not yet been established and it is recommended that it should be excluded from studies aimed at assessing the role of spinal manipulative therapy as a form of treatment for mechanical neck and upper thoracic pain.

6.0 CONCLUSIONS AND RECOMMENDATIONS

From the results of this study, it does not appear that there is any statistically significant difference between the spinous push adjustment and the transverse process contact adjustment in the treatment of sub-acute and chronic mechanical neck and upper thoracic back pain. Both adjustment techniques tended to increase the range of motion of the cervical spine in all three planes of motion to a similar degree. These gains in range of motion were still detectable in both groups after a four week follow-up period had passed although they were slightly diminished from the final treatment readings. Naturally these results are by no means conclusive. It is recommended that a larger sample size and double blind measures be employed in future studies of this nature.

It is recommended that future studies of this nature limit themselves to a single specific level in the cervical spine if goniometric analysis is used as a measure of outcome. The reason for this is that axis-specific effects (that is changes in the range of motion in the cervical spine along the same axis as the line of drive of the adjustment), will be more noticeable since adjustments delivered to the upper cervical spine tend to predominantly influence rotation whereas adjustments delivered to the lower cervical spine tend to predominantly influence lateral flexion (Nansel 1992).

It is suggested that passive range of motion be employed as measure of outcome in future studies of this kind. This would exclude possible cortical influences on the degree of movement in the cervical spine. The use of radiographic analysis is suggested as an alternative means of assessing cervical range of motion in chronic conditions since in this study, changes in range of motion tended to be subtle. Furthermore, specific spinal motion units can be accurately monitored using radiographic analysis.

In studies comparing the efficacy of specific types of adjustments it is imperative that the adjustments be performed by a experienced manual therapist since an undergraduate researcher with limited experience may bias the result.

The use of the algometer to assess pressure pain thresholds over the spinous processes of the vertebrae themselves has to the authors knowledge not been performed before. Future studies are needed to establish the value of this procedure as a possible outcome measure.

Adjustments were performed according to motion palpation findings in this study. It is suggested in future studies of this kind to take into account the site of pain as well as the motion palpation findings when adjusting the cervical spine as patient comfort may influence the prognosis.

Considering the results produced in this study, it is the authors opinion that both methods of adjusting are effective in treating sub-acute and chronic mechanical neck and upper thoracic pain. Further research is required to refute or validate these findings. In deciding which method to employ, the individual patient's tolerance for the adjustment as well as personal preference of the manipulative therapist should be taken into account. Future research involving manipulative therapy should attempt to standardize the techniques employed so that the value of specific adjustments can be ascertained.

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APPENDIX A

CMCC NECK DISABILITY INDEX

PATIENT NAME:____ FILE #:______ DATE:________

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

Section 1 - Pain Intensity

- ☐ I have no pain at the moment.
- ☐ The pain is very mild at the moment.
- ☐ The pain is moderate at the moment.
- ☐ The pain is fairly severe at the moment.
- ☐ The pain is very severe at the moment.
- ☐ The pain is the worst imaginable at the moment.

Section 2 - Personal Care (Washing, Dressing etc.)

- ☐ I can look after myself normally without causing extra pain.
- ☐ I can look after myself normally but it causes extra pain.
- ☐ It is painful to look after myself and I am slow and careful.
- ☐ I need some help but manage most of my personal care.
- ☐ I need help every day in most aspects of self care.
- ☐ I do not get dressed, I wash with difficulty and stay in bed.

Section 3 - Lifting

- ☐ I can lift heavy weights without extra pain.
- ☐ I can lift heavy weights but it gives extra pain.
- ☐ Pain prevents me from lifting heavy weights off the floor, but I can manage if they are conveniently positioned, for example on a table.
- ☐ Pain prevents me from lifting heavy weights, but I can manage light to medium weights if they are conveniently positioned.
- ☐ I can lift very light weights.
- ☐ I cannot lift or carry anything at all.

Section 4 - Reading

- ☐ I can read as much as I want to with no pain in my neck.
- ☐ I can read as much as I want to with slight pain in my neck.
- ☐ I can read as much as I want with moderate pain in my neck.
- ☐ I can't read as much as I want because of moderate pain in my neck.
- ☐ I can hardly read at all because of severe pain in my neck.
- ☐ I cannot read at all.

Section 5 - Headaches

- ☐ I have no headaches at all.
- ☐ I have slight headaches which come in-frequently.
- ☐ I have moderate headaches which come in-frequently.
- ☐ I have moderate headaches which come frequently.
- ☐ I have severe headaches which come frequently.
- ☐ I have headaches almost all the time.

Section 6 - Concentration

- ☐ I can concentrate fully when I want to with no difficulty.
- ☐ I can concentrate fully when I want to with slight difficulty.
- ☐ I have a fair degree of difficulty in concentrating when I want to.
- ☐ I have a lot of difficulty in concentrating when I want to.
- ☐ I have a great deal of difficulty in concentrating when I want to.
- ☐ I cannot concentrate at all.

Section 7 - Work

- ☐ I can do as much work as I want to.
- ☐ I can only do my usual work, but no more.
- ☐ I can do most of my usual work, but no more.
- ☐ I cannot do my usual work.
- ☐ I can hardly do any work at all.
- ☐ I can't do any work at all.

Section 8 - Driving

- ☐ I can drive my car without any neck pain.
- ☐ I can drive my car as long as I want with slight pain in my neck.
- ☐ I can drive my car as long as I want with moderate pain in my neck.
- ☐ I can't drive my car as long as I want because of moderate pain in my neck.
- ☐ I can hardly drive at all because of severe pain in my neck.
- ☐ I can't drive my car at all.

Section 9 - Sleeping

- ☐ I have no trouble sleeping.
- ☐ My sleep is slightly disturbed (less than 1 hr. sleepless).
- ☐ My sleep is mildly disturbed (1-2 hrs. sleepless).
- ☐ My sleep is moderately disturbed (2-3 hrs. sleepless).
- ☐ My sleep is greatly disturbed (3-5 hrs. sleepless).
- ☐ My sleep is completely disturbed (5-7 hrs. sleepless).

Section 10 - Recreation

- ☐ I am able to engage in all my recreation activities with no neck pain at all.
- ☐ I am able to engage in all my recreation activities, with some pain in my neck.
- ☐ I am able to engage in most, but not all of my usual recreation activities because of pain in my neck.
- ☐ I am able to engage in a few of my usual recreation activities because of pain in my neck.
- ☐ I can hardly do any recreation activities because of pain in my neck.
- ☐ I can't do any recreation activities at all.

APPENDIX B

NUMERICAL RATING SCALE -101 QUESTIONNAIRE

Patient Name :____________ File No. :____ Date :_______

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

____

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

____

APPENDIX C

MEASUREMENT OF PAIN

SHORT-FORM McGILL PAIN QUESTIONNAIRE

RONALD MELZACK

PATIENT'S NAME: ____________________ DATE: __________

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

NO PAIN |————————————————————————| WORST POSSIBLE PAIN

PPI

0 NO PAIN _____
1 MILD _____
2 DISCOMFORTING _____
3 DISTRESSING _____
4 HORRIBLE _____
5 EXCRUCIATING _____

FIGURE 10.5. The short-form McGill Pain Questionnaire. Descriptors 1-11 represent the sensory dimension of pain experience and 12-15 represent the affective dimension. Each descriptor is ranked on an intensity scale of 0 = none, 1 = mild, 2 = moderate, 3 = severe. The Present Pain Intensity (PPI) of the standard long-form MPQ and the Visual Analogue Scale are also included to provide overall pain intensity scores. Copyright 1984 Ronald Melzack.

APPENDIX D

TECHNIKON NATAL

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GONIOMETER READINGS

PATIENT NAME:____________________ FILE No:__________

TREATMENT No:______

	Before Treatment	After Treatment
Flexion		
Extention		
R. lat. flexion		
L. lat. flexion		
R. Rotation		
L. Rotation		

APPENDIX E

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ALGOMETER READINGS

PATIENT NAME:______________________________ FILE No:______

	Before Treatment	After Treatment
1		
2		
3		
4		
5		
6		

APPENDIX F

TECHNIKON NATAL CHIROPRACTIC DAY CLINIC

CASE HISTORY

Patient: ______________________ Date # __________

File #: __________

X-ray #: __________

Age: ________ Sex: ______ Occupation: __________

Intern: ____________________ Signature: ____________

FOR CLINICIAN'S USE ONLY

Initial visit clinician: Signature:

Case History:

Examination:

Previous: TN Other

Current: TN Other

X-ray Studies:

Previous: TN Other

Current: TN Other

Clinical path. lab.:

Previous: TN Other

Current: TN Other

Case status:

PTT: Conditional: Signed off: Final sign out:

Recommendations:

Intern's case history

1. Source of history:

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

3. Present illness:

Location

Onset

Duration

Frequency

Pain (character)

Progression

Aggravating factors

Relieving factors

Associated S & S

Previous occurrences

Past treatment and outcome

4. Other complaints:

5. Past history:

General health status

Childhood illnesses

Adult illnesses

Psychiatric illnesses

Accidents/injuries

Surgery

Hospitalizations

6. Current health status and life-style:
   - Allergies
   - Immunizations
   - Screening tests
   - Environmental hazards (home, school, work)
   - Safety measures (seat belts, condoms)
   - Exercise and leisure
   - Sleep patterns
   - Diet
   - Current medication
   - Tobacco
   - Alcohol
   - Social drugs

7. Family history:
   - Immediate family:
     - Age
     - Health
     - Cause of death
     - DM
     - Heart disease
     - TB
     - HBP
     - Stroke
     - Kidney disease
     - CA
     - Arthritis
     - Anaemia
     - Headaches
     - Thyroid disease
     - Epilepsy
     - Mental illness
     - Alcoholism
     - Drug addiction
     - Other

8. Psychosocial history:

Home situation

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.

PHYSICAL EXAMINATION

Underline abnormal findings in RED and elaborate on back of relevant page, if necessary.
Mark "NAD" if normal.

Patient:______________________________ File #______

Last name First name

Clinician:__________________ Signature:__________________

Intern:__________________ Signature:__________________

Date:________________

Height:____________ Weight:____________ Temp:____________

Rates: Heart:_______ Pulse:_______ Respiration:__________

Blood pressure: Arms: L / R /

Legs: L / R /

General appearance:

STANDING EXAMINATION.

Minor's sign
Skin changes
Posture
erect
Adam's
"Ranges of motion:

T/L spine: Flexion: 90 Fingers to floor
Extension: 50
R.lat.flex.: 30 Fingers down leg
L.lat.flex.: 30 Fingers down leg
Rot.to R.: 35
Rot.to L.: 35

Flex.

L.Rot. R.Rot.

L.lat flex. R.lat. flex.

Ext.

/ = pain-free limitation; // = painful limitation.

Romberg's sign.
Pronator drift.
Trendelenburg's sign.
Gait.
rhythm
balance
pendulousness
on toes
on heels
tandem
Half squat.
Scapular winging.
Muscle tone.
Spasticity/Rigidity.

Shoulder:
- skin
- symmetry
- ROM - glenohumeral
  - scapulo-thoracic
  - acromioclavicular
  - elbow
  - wrist

Chest measurement
- inspiration
- expiration

Visual acuity

Breast examination:
- Inspection:
  - skin
  - size
  - contour
  - nipples
  - arms overhead
  - hands against hips
  - leaning forward.
- Palpation:
  - axillary lymph nodes.

SEATED EXAMINATION.

- Spinal posture
- Head
  - scalp
  - skull
  - face
  - skin
- Eyes
  - conjunctiva
  - sclera
  - eyebrows
  - eyelids
  - lacrimal gland
  - nasolacrimal duct
  - alignment
  - corneal reflex
  - ocular movement

	L			R	
III	IV	VI	III	IV	VI

  - visual fields
  - accomodation
  - iris
  - pupils
  - red reflex
  - optic disc

vessels
general background
macula
vitreous
lens

Ears:
auricle
ear canal
drum
auditory acuity
Weber test
Rinne test

Nose:
external
internal
septum
turbinates
olfaction

Sinuses (frontal & maxillary):
tenderness
transillumination

Mouth and pharynx:
lips
buccal mucosa
gums and teeth
roof
tongue
inspection
movement
taste
palpation
pharynx
inspection
CN X

Neck:
posture
size
swelling
scars
discoloration
hair line

ROM:

Flexion:	45	chin to larynx chin to sternum
Extension:	55	forehead parallel to floor
L.lat.flex:	40	
R.lat.flex:	40	
L.rot.:	70	
R.rot.:	70	

Flex.

L.Rot. R.Rot.

L.Lat. flex. R.lat. flex.

Ext.

lymph nodes
trachea
thyroid
carotid arteries (thrills, bruit)

CN V
CN VII
CN VIII (nystagmus)
CN IX
CN XI
TMJ
- Inspection
  - ROM
  - deviation
- Palpation
  - crepitus
  - tenderness

- Neurological:
  - Dermatomes
    - C5
    - C6
    - C7
    - C8
    - T1
  - Tendon reflexes
    - biceps
    - triceps
    - brachioradialis
  - Muscle strength
    - C5
    - C6
    - C7
    - C8
    - T1
  - Coordination:
    - point-to-point
    - dysdiadochokinesia
- Thorax:
  - Chest:
    - Inspection:
      - skin
      - shape
      - respiratory distress
      - rhythm (respiratory)
      - depth "
      - effort "
      - intercostal/supraclavicular retraction
    - Palpation:
      - tenderness
      - masses
      - respiratory expansion
      - tactile fremitus
    - Percussion:
      - lungs (posterior)
      - diaphragmatic excursion
      - kidney punch
    - Auscultation:
      - breath sounds
        - vesicular
        - bronchial
      - adventitious sounds
        - crackles (rales)
        - wheezes (rhonchi)
      - voice sounds
        - broncophony
        - whispered pectoriloquy
        - egophony

Cardiovascular:
auscultation (aortic murmurs)
Allen's test

SUPINE EXAMINATION

JVP
PMI
auscultation heart (L.lat.recumbent)
respiratory excursion
percussion chest (anterior)
breast palpation

The abdomen:

Inspection:
- skin
- umbilicus
- contour
- peristalsis
- pulsations
- hernias (umbilical/incisional)

Auscultation:
- bowel sounds
- bruit

Percussion:
- general
- liver
- spleen

Palpation:
- superficial reflexes
- cough
- light
- rebound tenderness
- deep
- liver
- spleen
- kidneys
- aorta
- intra-/retro-abdominal wall mass
- shifting dullness
- fluid wave

Acute abdomen:
- where pain began and now
- cough
- tenderness
- guarding/rigidity
- rebound tenderness
- Rovsing's sign
- psoas sign
- obturator sign
- cutaneous hyperaesthaesia
- rectal exam
- Murphy's sign.

Male genitals and hernias.

Inspection:
- skin
- prepuce
- glans
- meatus
- nits/lice
- scrotum
- inguinal/femoral bulges

Palpation:
- penis (tenderness/induration)
- testes
- epididymis
- inguinal canal
- femoral canal
- cremasteric reflex

Auscultation:
- scrotal mass.

Peripheral vasculature:

Inspection:
- skin
- nail beds
- pigmentation
- hair loss

Palpation:
- pulses - radial, brachial, femoral, popliteal, post.tibial, dorsalis pedis
- lymph nodes - epitrochlear, femoral (horizontal & vertical)
- temperature (feet & legs)

Manual compression test

Retrograde filling (Trendelenburg) test

Arterial insufficiency test

Musculoskeletal:

ROM

hip
- flex. 90/120
- ext. 15
- abd. 45
- add. 30
- int rot 40
- ext rot 45

knee
- flex. 130
- ext. 0/15

ankle
- plantar flex 45
- dorsiflex 20
- inversion 30
- eversion 20

leg length

Neurological:

dermatomes

L1

L2

L3

L4

L5

S1

muscle strength

hip flexion

knee extension

ankle dorsiflexion

plantar flexion

tendon relexes

patellar

Achilles

plantar reflex

Rectal examination:

Inspection

sacrococcygeal & perianal areas

Palpation

sphincter tone

tenderness

induration

nodules

prostate

seminal vesicles

<u>Mental status</u>

Appearance and behaviour:

level of consciousness

posture and motor behaviour

dress, grooming, personal hygiene

facial expression

affect

Speech and language:

quantity

rate

volume

fluency

aphasia (prn)

Mood

Thought processes (logical, relevant, organised)

Memory and attention:

orientation (time, place, person)

remote memory

recent memory

new learning ability

Higher cognitive functions:

information and vocabulary (general & specialised knowledge)

abstract thinking.

APPENDIX H

TECHNIKON NATAL

TECHNIKON NATAL CHIROPRACTIC DAY CLINIC.

REGIONAL EXAMINATION -- CERVICAL SPINE.

PATIENT: ____________________

FILE # : ____________________ DATE: ____________________

INTERN/RESIDENT: ____________________

SUPERVISING CLINICIAN : ____________________

OBSERVATION :

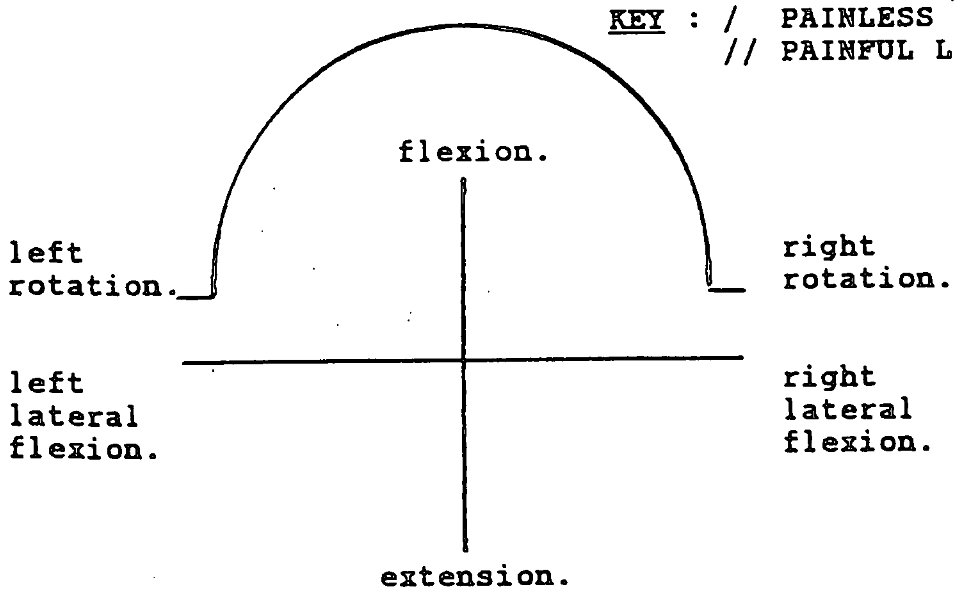
Posture
Swellings
Scars
Discoloration
Hair Line
Bony and soft tissue contours

Shoulder position:
Left =
Right =
Muscle spasm
Facial expression

RANGE OF MOTION:

Flexion = 45 degrees.
Extension = 70 degrees.
L/R Rotation = 70 degrees.
L/R Lateral flexion = 45 degrees.

KEY : / PAINLESS LIMITATION.
// PAINFUL LIMITATION.



PALPATION : lymph nodes.
trachea.
thyroid gland.

ORTHOPAEDIC EXAMINATION :

Tenderness
Active MF Trigger Points :
SCM.
Trapezius.
Scaleni.
Levator Scapulae.
Posterior Cervical musculature.

Doorbell Sign
Kemp's Test
Cervical Distraction
Halstead's Test
Hyperabduction Test (Wright's)
Shoulder abduction Test
Dizziness rotation Test
Brachial Plexus Tension

Cervical Compression
Lateral Compression
Adson's Test
Costoclavicular Test
Eden's (traction) Test
Shoulder depression Test.
Lhermitte's Sign
O'Donoghue Manoeuvre

Remarks : ____

____

____

____

NEUROLOGICAL EXAMINATION :

DERMATOMES: Left	Right.
C2	
C3	
C4	
C5	
C6	
C7	
C8	
T1	

MYOTOMES: Left	Right.
C1	
C2	
C3	
C4	
C5	
C6	
C7	
C8	
T1	

REFLEXES: Left	Right.
C5	
C6	
C7	

VASCULAR :

	LEFT.	RIGHT.
BLOOD PRESSURE.		
CAROTIDS.		
SUBCLAVIAN ARTERIES.		
WALLENBERG'S TEST.		

COMMENTS:

MOTION PALPATION :

Jt.play		Left						Right					Jt.play	
P/A	Lat	Fle	Ext	LF	AR	PR		Fle	Ext	LF	AR	PR	P/A	Lat
							C0							
							C1							
							C2							
							C3							
							C4							
							C5							
							C6							
							C7							
							T1							
							T2							
							T3							
							T4							

APPENDIX I

TECHNIKON NATAL

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LETTER OF INFORMED CONSENT

I, ______________________________, hereby state that I am willing to participate in Bruce Ritchie's Research Dissertation. I will adhere to the best of my ability to the requirements of the study and the instructions of the researcher. All information that I furnish will be truthfully done so and I understand that this information will be dealt with in the strictest of confidence.

Signed____________________

Witness____________________