MECHANICAL TRACTION VERSUS JOINT MOBILISATION IN THE TREATMENT OF ACUTE NON-SPECIFIC NECK PAIN IN ADULT PATIENTS

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A DISSERTATION SUBMITTED IN FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MAGISTER SCIENTAE (PHYSIOTHERAPY) IN THE DEPARTMENT OF PHYSIOTHERAPY, UNIVERSITY OF PRETORIA

DATE:

7JULY 2013

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DECLARATION

“I, the undersigned, hereby declare that the work contained in this dissertation is my original work and that I have not previously, in its entirety or in part, submitted it at any university for a degree.”

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Acknowledgements

- Prof AJ van Rooijen, Physiotherapy Department, UP for her guidance in the review of this study.
- Mrs A Marais, Physiotherapy Department, UP for her guidance in the review of this study.
- Dr CA Eksteen, Physiotherapy Department, UP for her guidance in the review of this study.
- Mrs E Korkie, Physiotherapy Department, UP for her guidance in the review of this study.
- Mrs E van Niekerk, Head of Physiotherapy OPD, Steve Biko Hospital.
- Prof Bekker, Biostatistician for the UP, for the data analysis and guidance.
- Mandy Engelbrecht, editor.
- Michiel Breed, my husband, for supporting me and believing in me.

Abstract

Background

Non-specific neck pain (NS-NP) is a common phenomenon resulting in physical and social dysfunction, high utilisation of healthcare and economic burden. In South Africa the incidence of one or more episodes of neck pain in working people between the ages of 25 and 29 years of age is reported to range between 25% and 30% while approximations of the incidence of neck pain for people aged 45 years and above rise to 50%. The hypothesised point prevalence of acute NS-NP in the adult population is 10%.

Mechanical traction and joint mobilisation are treatment modalities used for acute NS-NP. The value of mechanical traction for neck pain has been questioned because studies pertaining to the effectiveness thereof are limited, with small sample sizes and are of poor quality.

Aim:

To assess whether mechanical traction or joint mobilisation of the cervical spine was more effective in the treatment of acute NS-NP in adult patients, when combined with secondary treatment categories [electrotherapy (E.T.), exercise and soft tissue joint mobilisation (STM)].

Methodology:

A descriptive retrospective analysis was conducted on the clinical records of patients suffering from acute non-specific neck pain who were treated at the Physiotherapy Outpatient Department of the Steve Biko Hospital from 2000-2011 . Non-probability purposive sampling was done. The inclusion criteria were as follows: age 18-50 years, acute NS-NP with or without referred pain, pain rated on the Visual Analogue Scale at first treatment and discharge, treated with joint mobilisation or mechanical traction and more than one treatment in a two week period. The exclusion criteria were as follows: cervical pathology, fractures, malignancy, surgery, whiplash-associated disorders and involvement in litigation or compensation claims. A total of 109 records were included. The outcomes of this study was calculated by the change in reported pain intensity as measured with a Visual Analogue Scale (VAS) in the patient records and by assessing clinical improvement. Regression analysis was employed for data analysis.

Results:

The treatment groups differed marginally (p=0.08) with respect to a positive change in VAS with joint mobilisation indicating a greater change in VAS scores with a mean change in VAS of 3.94mm, while the secondary treatment categories differed significantly (p=0.03) with respect to a positive change in VAS with exercise and STM with a mean change in VAS of 4.20mm seeming more effective in reducing acute NS-NP. Traction had an increased risk of poor clinical outcome in terms of pain reduction (OR:-3.26; 95% CI; 1.16-9.15). Compared to the joint mobilisation group, the traction group's risk for poor clinical outcome was increased by 3.26. Relative to E.T., exercise and STM prevented a poor clinical outcome (OR=0.39; 95% CI; p=0.04).

Conclusion:

Joint mobilisation combined with exercise and STM had a clinically significant, positive outcome in the treatment of acute non-specific neck pain, as opposed to mechanical traction combined with exercise and STM.

Keywords:

The following keywords were used in the thesis: acute neck pain, non-specific neck pain, mechanical traction, manual therapy, joint mobilisation, cervical spine, treatment modalities, multi-modal treatment.

Table of Contents

CHAPTER 1. 16

1.1 Introduction 16

1.2 Problem statement 19

1.3 Research Question 19

1.4 Aim of the study 19

1.5 Research hypothesis: 20

1.6 Significance of the study 20

1.7 Dissertation outline 20

CHAPTER 2. 22

2.1 Introduction 22

2.2 The implications of pain on the utilisation of the health care sector 23

2.3 The incidence of neck pain 25

2.4 Prevalence of neck pain 26

2.5 Prognostic factors 28

2.6 Inflammation and pathology 28

2.7 Non-specific neck pain 29

2.8 Acute non-specific neck pain 32

2.9 Causative factors of neck pain 33

2.9.1 Structural causes 33

2.9.2 Demographic factors 33

2.9.3 Physical Factors 34

2.9.4 Psychosocial factors 34

2.9.5 Traumatic factors 35

2.10 Risk factors of neck pain 35

2.11 Diagnosis of non-specific neck pain 36

2.12 Treatment for non-specific neck pain 38

2.13 Manipulation and joint mobilisation 53

2.14 Mechanical Traction 66

2.15 Conclusion 86

CHAPTER 3. 88

3.1 Introduction 88

3.2 Research question 88

3.3 Aim of the study 88
3.4 Research hypothesis 88
3.5 Study design 89
3.6 Research setting 91
3.7 Unit of Analysis 91
3.8 Sampling Method 91
3.8.1 Inclusion and exclusion criteria 93
3.8.2 Sample size 94
3.9 Outcome measures 95
3.9.1 The Visual Analogues Scale 95
3.9.2 Patient clinical outcomes 96
3.10 Pilot study 96
3.11 Data collection 97
3.11.1 Data collection sheet 97
3.12 Statistical considerations 99
3.13 Data Analysis 99
3.13.1 Descriptive Statistics 99
3.13.2 Multivariate linear regression analysis and logistic regression analysis 100
3.14 Ethical consent 100
3.15 Conclusion 101
CHAPTER 4. 102
4.1 Introduction 102
4.2 Research Question 102
4.3 Research Aim 102
4.4 Research hypothesis: 102
4.5 Demographic data 103
4.5.1 Units of analysis 103
4.5.2 Age 103
4.5.3 Occupation 104
4.6 Descriptive statistics 104
4.7 Data collection procedure 105
4.8 Summary of collected data 106
4.9 Confounding variables 109

4.10 Interaction effect 113
4.11 Treatment Outcomes 115
4.11.1 Change in the VAS scores 116
4.11.2 Clinical outcome 118
4.12 Conclusion 120
CHAPTER 5. 121
5.1 Introduction 121
5.2 Research question 121
5.3 Research aim 121
5.4 Research hypothesis 121
5.5 Demographic data 122
5.5.1 Units of Analysis 122
5.5.2 Age 123
5.5.3 Occupation 124
5.6 Descriptive Statistics 125
5.7 Confounding Variables 131
5.8 Interaction 132
5.9 Treatment Outcomes 132
5.9.1 Change in VAS scores 132
5.9.2 Clinical Improvement 134
5.10 Conclusion 136
CHAPTER 6. 137
6.1 Introduction 137
6.2 Limitations 137
6.2.1 Reporting of pain 137
6.2.2 Poor attendance of treatment sessions 137
6.2.3 Outcome measures 137
6.2.4 Type of mechanical traction used 137
6.3 Recommendations 138
6.4 Clinical application 138
6.5 Concluding remarks 139

List of Figures

Figure 2.1: Classification system for non-specific neck pain (Fritz and Brennan, 2007) ... 47
Figure 3.1: Retrospective study design ... 90
Figure 3.2: Sampling method ... 94
Figure 4.1: Distribution of ages (n=136) ... 103
Figure 4.2: Occupation distributions for the joint mobilisation group ... 104
Figure 4.3: Occupation distributions for the traction group ... 104
Figure 4.4: Data collection procedure ... 105
Figure 4.5: No interaction between the treatment groups and the secondary treatment categories with respect to age as a variable ... 113
Figure 4.6: No interaction between the treatment groups and the secondary treatment categories with respect to the VAS score at onset of treatment as a variable ... 114
Figure 4.7: No interaction between the treatment groups and the secondary treatment categories with respect to the VAS score at discharge from treatment as a variable ... 114
Figure 4.8: No interaction between the treatment groups and the secondary treatment categories with respect to the change in the VAS score as a variable ... 115
Figure 4.9: No interaction between the treatment groups and the secondary treatment categories with respect to the number of treatment sessions received as a variable ... 115

List of Tables

Table 2.1: Summary of possible causes of neck pain 33
Table 2.2: Summary of risk factors associated with neck pain (Haldeman et al, 2008) 35
Table 2.3: Evidence based proposed management of NS-NP 39
Table 2.4: Matched treatment components for each classification category 48
Table 2.5: Neck pain impairment/function-based diagnosis, examination and intervention recommended classification criteria 51
Table 2.6: Benefits and risks for the use of joint mobilisation for neck pain 54
Table 2.7: Evidence from studies conducted on the effects of joint joint mobilisation on acute and chronic NS-NP 58
Table 2.8: Effects of traction on the cervical spine 68
Table 2.9: Contraindication of mechanical traction... 72
Table 2.10: Current parameters used for traction: initial traction characteristics based on movement restrictions of the cervical spine 73
Table 2.11: Studies pertaining to the efficacy of cervical traction 75
Table 3.1: Inclusion and Exclusion Criteria 93
Table 3.2: Variables from data 97
Table 4.1: Summary of treatment groups and outcome variables 106
Table 4.2: Summary of secondary treatment categories and outcome variables ... 108
Table 4.3: Summary of primary treatment groups and secondary treatment categories with respect to age as a variable if VAS at onset > 4 & VAS at onset < 12 110
Table 4.4: Summary of primary treatment groups and secondary treatment categories with respect to VAS at onset as a variable if VAS at onset > 4 & VAS at onset < 12 110
Table 4.5: Summary of primary treatment groups and secondary treatment categories with respect to VAS at discharge as a variable if VAS discharge > 4 & VAS onset < 12 111
Table 4.6: Summary of primary treatment groups and secondary treatment categories with respect to the change in VAS as a variable if VAS onset > 4 & VAS onset < 12 112
Table 4.7: Summary of primary treatment groups and secondary treatment categories with respect to number of treatments received as a variable if VAS onset > 4 & VAS onset < 12 112
Table 4.8: Regression analysis indicating the change in VAS score for the primary treatment group and secondary treatment categories with respect to VAS at onset, age, number of treatments received if VAS onset > 4 & VAS onset < 12 117
Table 4.9: Regression analysis indicating the change in VAS score of the primary treatment groups and secondary treatment categories with respect to VAS at onset and number of treatment received if VAS onset > 4 & VAS onset < 12 117

Table 4.10: Regression analysis of the change in VAS scores for the primary treatment groups and secondary treatment categories with respect to the number of treatments received if VAS onset > 4 & VAS onset < 12 118
Table 4.11: Logistic analysis with regards to clinical improvement in the primary treatment groups and secondary treatment categories with VAS at onset, age and number of treatments received as variables if VAS onset > 4 & VAS onset < 12 118
Table 4.12: Logistic analysis with regards to clinical improvement in the primary treatment groups and secondary treatment categories with age and the number of treatments received as variables if VAS onset > 4 & VAS onset < 12 119
Table 4.13: Logistic analysis of the clinical improvement for the primary treatment groups and secondary treatment categories with the number of treatments as variable if VAS onset > 4 & VAS onset < 12 120
Table 5.1: Inclusion and Exclusion Criteria 122
Table 5.2: Distribution of occupation categories for the joint mobilisation and traction treatment groups 125
Table 5.3: Possible confounding variables 126

List of Appendices

Appendix 1: Data Collection Sheet 159
Appendix 2: Raw statistical data 161
Appendix 3: Approval letter from Ethics Committee 168
Appendix 4: Approval letter from Steve Biko Academic Hospital 169
Appendix 5: Letter from Language Editor 171
Appendix 6: Approval letter from Steve Biko Hospital Physiotherapy Outpatient Department 172

GLOSSARY

Abbreviations

AAOMPT: American Academy of Orthopaedic Manual Physical Therapy

APTA: American Physical Therapy Association

CI: Confidence Interval

E.T.: Electrotherapy

IASP: International Association for the Study of Pain

ICD: International Statistical Classification of Diseases and Related Health Problems

ICF: International Classification of Functioning, Disability, and Health

IFOMT: International Federation of Orthopaedic Manual Therapy

N: Number of observations

NS-NP: Non-specific neck pain

OPD: Outpatient Department

P: Probability

SBH: Steve Biko Hospital

SD: Standard deviation

STM: Soft Tissue Joint mobilisation

VAS: Visual analogue scale

Definition of terms

Neck pain: The Bone and Joint Decade 2000-2010 Task Force on Neck Pain and Its Associated Disorders define neck pain as pain felt locally in the anatomical region of the cervical spine with or without radiation to the head, trunk and upper limbs (Guzman J, Haldeman S, Carroll LJ, Carragee EJ, Hurwitz EL, Peloso P, Nordin M, Cassidy JD, Holm LW, Côte P, van der Velde G, Hoff-Johnson S, 2008) and states that all neck pain should have a local pathological cause that can be diagnosed and treated and some authors categorize neck pain based on triggering factors such as whiplash-associated disorders, occupational neck pain, sports-related neck pain and non-specific neck pain (NS-NP).

Non-specific neck pain: Non-specific neck pain or mechanical neck pain is defined as pain that has no identifiable aetiology (i.e. inflammation or infection) that could be reproduced by neck movement or provocation tests (Bronfort, Evans, Nelson, Aker, Goldsmith and Vernon, 2001). Mechanical neck pain will be referred to as NS-NP in this study.

Acute neck pain: In this study acute pain is defined as neck pain lasting up to four weeks. The work of the Quebec Task Force and Cochrane Back Group (van Tulder M, Furlan A, Bombardier C, Bouter L, Editorial Board of the Cochrane Collaboration Back Review Group, 2009) supports this definition.

Joint mobilisation: "Joint mobilisation is a low velocity, small or large amplitude passive movement technique or neuromuscular technique which creates movement in a joint. The movement is performed within the patient's physiological range of cervical motion." (Gross AR, Hoving JL, Haines TA, Goldsmith CH, Kay T, Aker P, Bronfort G. Cervical Overview Group, The Cochrane Collaboration, 2004).

Manual therapy: A specialised area of physical therapy for the management of musculoskeletal conditions, based on clinical reasoning, and which employs highly specific manual techniques and therapeutic exercises (IFOMPT Standards Document, 2008).

Mechanical traction: Mechanical traction refers to a mechanical device that uses a traction force to separate two parts of the body in order to lengthen the tissues that connect the parts in question (IFOMPT Standards Document, 2008). Traction can be applied either mechanically via a mechanical device applying tension to the spinal column or manually with the therapist's hands by grasping the patient and using his/her own force to generate a traction force to the spine . Two types of mechanical traction exists: constant or static and intermittent mechanical traction as meant by the researcher.

Exercise: "Exercises involve bodily activities related to the neck region" (Tsakitzidis G, Remmen R, Dankaerts W, Van Royen P, 2013).

Soft tissue joint mobilisation: Soft tissue joint mobilisation comprises massage, as a manipulation of soft tissues with the hand, foot, arm or elbow on soft tissue structures (Haraldsson BA, Gross AR, Myers CD, Ezzo JM, Morien A, Goldsmith C, Peloso PM, Bronfort G; Cervical Overview Group, 2012).

CHAPTER 1.

INTRODUCTION

1.1 Introduction

Musculoskeletal problems comprise 18.7% of consultations in the primary health care sector and rheumatology departments of district hospitals (White, Lenith, Prescott, 2004) with neck pain being one of the three most commonly reported musculoskeletal complaints (Hoving, Gross, Gasner, Kay, Kennedy, Hondras, Haines, Bouter, 2004). Neck pain is a common complaint in industrialised countries and a significant portion of direct health care costs are associated with neck pain due to visits to healthcare providers, sick leave and related loss of productivity (Gross, Hoving, Haines, Goldsmith, Kay, Aker, Bronfort and the Cervical Overview Group, 2004). Neck pain is only second to the occurrence of lumbar pain in the general population and in musculoskeletal practice (Vernon, Humphreys, Hagino, 2007; Cleland, Whitman, Fritz, Palmer, 2005). Two thirds of the population will experience neck pain at least once in their lifetime and one third of the population will have at least one episode of neck pain in a year (Côte, Cassidy, Carroll, Kristman, 2004; Croft, Lewis, Papageorgiou, Thomas, Jayson, McFarlane, Silman, 2001; Hoving et al, 2004). Acute neck pain is most often idiopathic and roughly 40% of adults suffering from acute NS-NP will recover fully while 30% will have persistent mild symptoms and a further 30% will experience chronic NS-NP of moderate or severe intensity (Australian Acute Musculoskeletal Pain Guideline Group, 2004).

For the greater part of acute neck disorders no identifiable underlying disease or abnormal anatomical structure can be found partly due to the fact that plain radiography is not indicated for patients suffering from acute neck pain unless red flags are present upon examination and as a result these patients are classified as suffering from NS-NP (Binder A, 2007; Binder AI, 2007). Patients with no diagnosis of the underlying systemic cause of neck pain (e.g. tumours, trauma such as fractures or whiplash, infection, nerve root disorders, inflammatory diseases such as rheumatoid arthritis, and congenital diseases) fall into a group classified as suffering from mechanical disorders which entail degenerative disorders of vertebral discs and spinal joints. The causes of neck pain are multifaceted but most often neck pain is caused by localised mechanical problems. NS-NP arises from disruption of the joints, cervical discs and soft tissue supporting the spine. Degenerative disc disease and cervical facet joint arthropathy are familiar mechanical triggers of neck pain as well as ligament and muscle injuries caused by trauma or excessive strain on these structures. (Karnath BM, 2012). Neck pain that strikes patients in whose clinical and associated characteristics do not enable a therapist to diagnose the cause of pain and whose source of pain could not be found by special investigations is defined as “Cervical Spinal Pain of Unkown or Uncertain Origin” by the International Association for the Study of Pain (IASP) (Merskey and Bogduk, 2011).

The proposed method of diagnosis for NS-NP should include a subjective evaluation that consists of history taking as well as an objective examination of the patient. If the patient’s history reveals possible serious spinal pathology or indication of nerve root syndrome a more intensive evaluation of the patient is needed that includes neurological testing (van Tulder, Becker, Bekkering, Breen, del Real, Hutchinson, Koes, Laerum, Malmivaara, 2006). With acute NS-NP radiological imaging is rarely indicated as a diagnostic tool as it is not a reliable tool for patients suffering from NS-NP (Rubenstein and van Tulder, 2008). Rubenstein and van Tulder (2008) found no systematic reviews which evaluated the diagnostic precision of the history-taking process by the therapist in adult patients suffering from acute NS-NP. The Australian Musculoskeletal Pain Guidelines Group (2004) states that once serious causes of the patient’s pain have been excluded by the treating therapist, precise identification of the source of acute NS-NP is not needed.

Joint mobilisation is used by physiotherapists to diagnose and treat soft tissue and joint structures in order to reduce pain; increase range of motion; reduce inflammation; bring about relaxation; and exact a positive effect on tissue repair, extensibility, movement facilitation and increase in function (APTA and AAOMPT; Deyle, Fritz, Gill, Jones, Rot, Sizer, Courtney, 2011). Joint mobilisation of the cervical spine is commonly used for the rehabilitation of NS-NP but controversy exists regarding the efficacy, potential benefits and harmful effects of these techniques for acute pain (Gross et al, 2002). Gross et al (2005) reported that joint mobilisation is commonly used in the treatment of neck pain but the effectiveness is short-lived and inconclusive when used alone. Intermittent mechanical cervical traction and exercise seem to be the most effective forms of treatment to combine with joint mobilisation of the cervical spine. When joint mobilisation is performed in conjunction with these aforementioned treatment techniques, a long-term reduction of acute neck pain and increase in function was observed (Hurwitz, Carragee, Van der Velde, Caroll, Nordin, Guzman, Peloso, Holm, Côte, Hogg-Johnson, Cassidy, Haldeman, Bone and Joint Decade Task Force on Neck Pain and its associated Disorders, 2000-2010).

The effects of traction are mainly mechanical and should only be used in conditions where the mechanical effects of traction will produce an improvement in the patient's symptoms, i.e. in mechanical disorders (Moeti and Marchetti, 2001). Traction is always used in conjunction with other treatment modalities and is rarely used alone. Very little is known about the application and clinical results of continuous and intermittent mechanical cervical traction when applied to patients suffering from acute NS-NP (Van der Heijden, Beurskens, Assendelft, De Vet, Bouter, 1995). In studies pertaining to the effects of traction, traction was found to have pain-inhibiting effects due to the inhibition of nociceptive impulses and mobilisation of vertebral joints (Chung, Lee, Kang, Park, Kang, Shim, 2002).

Intermittent acute NS-NP neck pain is widely reported to react well when treated as cervical pathology with radiating pain for which intermittent cervical mechanical traction might be indicated (Browder, Erhard, Pieve, 2004). Graham, Gross, Goldsmith and the Cervical Overview Group (2006) indicated that intermittent cervical traction was found to reduce neck pain and it was found that mechanical cervical traction, when combined with exercise, showed a clinically important reduction in neck pain and increase in function (Saal, Saal, Yurth, 1996; Cleland et al, 2005). No studies could link the mechanical effects of traction with clinically relevant outcome measures pertaining to acute NS-NP. Traction is commonly used for the treatment of NS-NP pain in physiotherapy practice (Micholvitz and Nolan, 2005) and yet the effectiveness thereof remains restricted and unconvincing due to the limited number of good randomised controlled trials available with big enough sample sizes in order to determine and extrapolate the effects of mechanical traction as an intervention for acute NS-NP (Gross et al, 2002; Graham et al, 2006, van der Heijden et al, 1995). Extensive heterogeneity is present among neck pain epidemiological studies which limits the ability to analyse and group data as most of the epidemiological studies of neck pain do not report on the source of the pain (Hoy, Brooks, Blyth & Bachbinder, 2010; Way and Bogduk, 2008). More dependable data regarding the effect of traction on pain and restricted function of activities of daily living related to acute non-specific neck pain is needed to guide clinical practice.

1.2 Problem statement

Neck pain is a universal problem which is costly to society and can lead to dysfunction such as chronic neck pain, headaches, restricted mobility, activity limitations, career burden and disability (Linton, Hellsing, Hallden, 1998). Many forms of treatment are used for acute NS-NP and are accepted as standard forms of treatment thereof, but a systematic literature review found a restricted number of high quality clinical trials. There is initial evidence to encourage the use of joint joint mobilisation and mechanical traction for the relief of acute neck pain but these have not been studied in adequate detail to determine the effectiveness thereof (Van der Heijden et al, 1995; Kjellman, Skargren, Oberg; 1999). Mechanical traction is used frequently for the treatment of neck pain as part of a multimodal treatment program in an outpatient physiotherapy setting (Michlovitz and Nolan, 2005). Further clinical research is necessary to determine the most advantageous treatment method for acute NS-NP in adult patients.

1.3 Research Question

Which treatment had a better outcome in reducing acute NS-NP in adult patients as measured on the VAS: mechanical traction or joint mobilisation of the cervical spine when used in combination with secondary treatment categories (E.T.; exercise and STM)?

1.4 Aim of the study

<u>Primary Aim:</u> To assess which treatment had a better outcome in reducing acute NS-NP in adult patients as measured on the VAS: mechanical traction or joint mobilisation of the cervical spine when used in combination with secondary treatment categories (E.T.; exercise and STM).

<u>Secondary Aim:</u> To assess which combination of treatment modalities most often used in this clinical setting had a better outcome in reducing acute NS-NP in adult patients as measured on the VAS: E.T. or exercise and STM?

1.5 Research hypothesis:

Hypothesis: Mechanical traction in combination with secondary treatment categories had a better outcome in reducing acute NS-NP in adult patients as measured on the VAS when compared to cervical joint mobilisation in combination with secondary treatment categories.

Null hypothesis: Mechanical traction in combination with secondary treatment categories did not have a better outcome in reducing acute NS-NP in adult patients as measured on the VAS when compared to cervical joint mobilisation in combination with secondary treatment categories.

1.6 Significance of the study

Seeing that limited information is available on the efficacy of interventions for non-specific neck pain in adult patients, the present study will provide baseline evidence which will indicate whether mechanical traction of the cervical spine, or joint mobilisation of the cervical spine combined with secondary treatment categories (E.T., exercise and STM) has a better outcome in reducing non-specific neck pain in adult patients. The study made use of the recorded VAS in the patient records to establish how patients improved and to determine the outcome of this study.

1.7 Dissertation outline

Chapter 1 highlights the need for cumulative evidence on the efficacy of physical treatment modalities for non-specific neck pain in adult patients. In this chapter the research problem is stated and, in addition, the study objectives and significance is explained.

In **Chapter 2,** a review of relevant literature in the field of physiotherapy treatment modalities and outcomes thereof for adult patients suffering from acute NS-NP is discussed.

Chapter 3 describes the research methodology used in the study. The study design, units of analysis, sampling and ethical considerations are discussed. Furthermore, the research instruments and the statistical methods for analysis are outlined.

The results of the data analysis are presented in **Chapter 4**.

Chapter 5 discusses the results of the study and compares the results with that of previous studies.

Chapter 6 provides a summary of the study and draws conclusions based on the findings. The clinical significance of the findings is highlighted. Limitations of the study as well as recommendations for future research are also outlined in this chapter.

CHAPTER 2.

LITERATURE REVIEW

2.1 Introduction

The purpose of this literature review was to assess the evidence concerning the use of mechanical traction versus joint mobilisation for the treatment of acute NS-NP in adult patients.

For this chapter, competency texts and journal studies were sourced in order to review current evidence on and research findings for effective physiotherapy treatment modalities for such as mechanical traction, joint mobilisation, electrotherapy and exercise for acute NS-NP in adult patients. A structured database search of two computerised bibliographical databases, MEDLINE (Index Medicus) and CINAHL (Cumulative Index of Nursing and Allied Health Literature), was performed to identify English-only citations from 1990 to 2013. The database searches delivered results from medical professions in North America and Europe, including orthopaedics, manual medicine, chiropractic, osteopathic, physiotherapy and nursing literature. The author searched information on the effectiveness of manual therapy and mechanical traction for neck pain. The searches further focused on articles, books and reviews relating to the reliability, validity and use of non-operative treatment methods and outcome measures for acute NS. The following keywords neck pain, acute neck pain, non-specific neck pain, mechanical neck disorders, mechanical traction, constant traction, intermittent traction, manual therapy, manipulation, joint mobilisation, cervical spine, known treatment modalities, non-operative treatment, incidence, prevalence and risk factors for acute NS in adult patients were used in the literature search. Additional articles were identified from the references of the articles selected from the database search results. The main results of a search investigating mechanical traction versus joint mobilisation for acute NS-NP in adult patients is presented in this chapter. Relatively few articles have reviewed the efficacy of mechanical traction for the treatment of non-specific neck pain. The author identified no other relevant published or unpublished studies (in English) relating to these two treatment strategies for acute NS-NP in adult patients. The literature search was performed continuously throughout 2011 up to and including 2013 in order for the most recently published studies to be included in the review. The search strategy produced 365 hits of which 247 were excluded as they did not conform to the primary and secondary aims of this study.

2.2 The implications of pain on the utilisation of the health care sector

Absence from work as a result of illness and disability pension has an individual and a socio-economic burden as a result in the Western World. In Sweden, musculoskeletal disorders that include lower back pain and neck pain are the two leading musculoskeletal problems that result in long-term illness, absence from work and disability pension (Hansson, Boström and Harms-Ringdahl, 2006). Musculoskeletal problems comprise 18.7% of consultations in the primary health care sector and rheumatology departments of district hospitals (White, Lenith, Prescott, 2004) with neck pain one of the three most commonly reported musculoskeletal complaints (Hoving et al, 2004). Neck pain is a common complaint in industrialised countries and causes a major medical as well as a socio-economic burden for these countries due to substantial consumption of medical resources, absenteeism from work, as well as disability in the case of chronic neck pain (Hansson, Boström & Harms-Ringdahl, 2006). A significant proportion of direct health care costs are associated with neck pain caused by underlying cervical disorders due to visits to health care providers, sick leave and related loss of productivity (Gross et al, 2004). The direct and indirect financial burden of acute and chronic spinal pain that includes both cervical and lumbar pain accounts for 0.8% - 2.1% of the gross domestic product in industrialised countries directly due to the utilisation of health services and indirectly due to production losses, more precisely as a result of wealth lost to society as a result of loss of productivity (Lynton & Reinhold, 2003; Gross et al, 2004). Neck pain is the second largest cause of work absenteeism, with lumbar pain being the primary cause (Andersson, 1997). Neck pain is one of the most common musculoskeletal conditions that are referred to physiotherapists by general practitioners (Aker, Gross, Goldsmith and Peloso, 1996).

The known financial consequences of neck pain are substantial as a consequence of the utilisation of medical resources. One per cent of the Netherlands health care expenses for 1996 were related to neck pain, while work absenteeism related to neck pain amounted to 1.4 million Euro (Borghouts, Bart, Vondeliing, Bouter, 1999). Disability as a result of the progression of acute NS-NP to chronic NS-NP of the economically active population was 4.6% amongst the Saskatchewan population (Côte, Cassidy, Carroll, 2000) and 0.6% of the Canadian population (Côte, van der Velde, Cassidy, Carroll, Hogg-Johnson, Carragee, Haldeman, Nordin, Hurwitz, Guzman, Peloso, 2008). Disability accounted for 50% of total costs related to chronic NS-NP pain (Borghouts et al, 1996) and it was reported that 2.5% of all disability claims were related to chronic NS-NP (Borghouts et al, 1999).

2.2 The physiology of pain

Pain is defined by the IASP (Merskey and Bogduk, 2011) as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage". The Australian Acute Musculoskeletal Pain Guidelines Group (2004) defines acute pain as pain that has been present for less than three months and this term does not describe the severity or quality of the experienced pain whereas chronic pain has been present for a minimum of three months.

Neck pain is defined as pain felt dorsally in the cervical spine and can be referred to the head, upper limbs, and dorsal area of the scapula as well as the anterior chest wall (Chaitow and DeLaney, 2000). Referred pain is characterised as a deep, aching pain with a pressure-like trait and can be easily differentiated from radicular pain that is characterised as sharp, shooting and lancinating pain that travels along a narrow band in the upper limbs (Bogduk, 1999, Haslett, Chilvers, Boon, Colledge, 2002). Neck pain may arise from any structure in the cervical area which includes intervertebral discs, ligaments, muscles, facet joints, dura as well as nerve roots. Neck pain has a large number of potential causes which include tumours, trauma such as fractures or whiplash, infection, inflammatory diseases such as rheumatoid arthritis, and congenital diseases (Joeren et al, 1998).

The following are known cervical disorders:

- Cervical spondylosis: results from degeneration of the cervical spine due to ageing and may cause axial neck pain, radiculopathy, myelopathy or a combination thereof. Diagnosis of cervical spondylosis usually made by the clinical examination alone and present with neck pain exacerbated by movement, poorly localised tenderness, reduced cervical range of motion and vague paresthesias of the upper limb.

- Axial neck pain: Most common cause of neck pain and may radiate to the head and shoulders and involve the C2, C3 and C4 nerve roots and C2-3 facet joints which may give rise to occipital or cervicogenic headaches. The diagnosis of axial neck pain may be difficult if no radicular symptoms are present.
- Cervical radiculopathy: Disc herniations might happen suddenly and compress the cervical nerve roots causing cervical radiculopathy or the nerve roots might be compressed as a result of spondylosis that developed over time. Disc herniations are usually the result of trauma or degenerative processes in the spine. Physical findings on which a diagnosis can be made include pain in the neck and arm as well as a combination of motor, sensory and reflex fall out. The diagnosis is most often based on examination and physical findings which may or may not include radiologic imaging.
- Cervical myelopathy: This is a possible complication of cervical spondylosis as a result of spinal cord compression and has a gradual onset in patients with a history of chronic cervical, shoulder and arm pain. MRI is the best diagnostic tool when cervical myelopathy is suspected to be present. (Karnath, 2012)
- Cervical facet syndrome: This is defined as axial pain possibly secondary to the involvement of the posterior aspects of the cervical spine. The facet joints have been implied to be a probable source of neck pain (Windsor RE, Hankley D, Cone-Sullivan LA, King FJ, Hiester ED, 2012).

2.3 The incidence of neck pain

Neck pain is only second to the occurrence of lumbar pain in the general population and in musculoskeletal practice (Vernon, Humphreys, Hagino, 2007; Cleland, Whitman, Fritz, Palmer, 2005). Cervical disorders are an increasingly common phenomenon that affects patients' physical and social functioning (Gross, Kay, Kennedy, Gasner, Hurley, Yardley, Hendry, McLaughlin, 2002; Ezzo, Heraldson, Gross, Myers, Morien, Goldsmith, Bronfort, Peloso, 2007; Gross, 2004). Two thirds of the population will experience neck pain at least once in their lifetime and one third of the population will have at least one episode of neck pain in a year. During any six-month period, 54% of adults suffer from neck pain (Côte, 2004, Croft et al, 2001; Hoving et al, 2004).

A great proportion of the general world population experience NS-NP neck pain at some point during their lives, but for the majority (80%) neck pain doesn't interfere with their daily activities. Every year, 11%-14.1% of the population reports neck pain that limits their performance of daily activities (Haldeman, Caroll, Cassidy, Schubert, Nygren, 2008). In the general population, acute NS-NP has a lifetime prevalence of 22%-70% and a point prevalence of 10%-20% (Bogduk et al, 1999; Childs, Cleland, Elliot, Teyhen, Wainner, Whitman, Sopky, Godges, Flynn, 2008; Bronfort, Evans, Nelson, Vernon, 2001), whereas chronic NS-NP has a lifetime prevalence of 50% and a point prevalence of 13% (White, Lewith, Prescott, 2004). In South Africa the incidence of one or more episodes of acute neck pain in socio-economically active population between the ages of 25 and 29 years of age is reported to range between 25% and 30% while approximations of the incidence of sub-acute and chronic neck pain for people aged 45 years and above rise to 50% (Wood, Colloca and Matthews, 2001).

Kamwendo, Linton and Moritz (1999) stated that infrequent neck and shoulder pain was felt by 32% of medical secretaries and constant neck pain was experienced by 17%, of which 13% reported an associated disability. In a comparable study, 27% of data entry workers reported a constant discomfort in the neck and shoulder pain was reported by 10%-15% (Sauter, Schleifer, Knuston, 1991). This correlates with studies performed by Waalen and Waalen (1993), Guez, Hildingsson, Nilsson, Toolanen (2002) and Cassou, Derriennic, Monfort, Norton, Touranchet (2002).

2.4 Prevalence of neck pain

The prevalence of neck pain increases in manual and office workers when compared to the general population, due to the sustained static load placed on the cervical spine and shoulder girdle during working hours as a result of poor and akward occupational postures (Edmondston, Chan, Chi Wing Ngai, Warren, Williams, Glennon & Netto, 2007). Côte et al (2000) reported that neck pain is associated with low socio-economic status and occupational factors such as repetitive tasks, static tasks, awkward occupational postures, as well as heavy lifting. Research has shown that the prevalence of neck pain in females, compared to males, was as high as

77.8% (Chiu, Lau, Ho, Ma, 2006). Neck pain also showed a higher prevalence in individuals above the age of 50 years (Hoving et al, 2004; Joeren et al, 1998; Joeren et al, 1999). Palmer, Walker-Bone and Griffin (2001) found that chronic neck pain is more prevalent among male construction workers, nurses, armed service members and unemployed individuals due to psychosocial factors (cognitive, social and behavioural factors) and not occupational factors. The opposite of this was found in a study performed by Hush, Michaleff, Maher and Refshauge in 2009 who reported the physical factors of occupations such as persistent sitting postures and cervical flexion as predictors of neck pain but these physical factors (poor posture, cervical ROM and cervical muscle endurance) have not been prospectively tested in office workers without neck pain. Cervical symptoms were found to be more common in individuals who worked with their arms above shoulder level for more than one hour per day. The prevalence of musculoskeletal pain is increasing among adolescents, which is ascribed to repetitive movements and static postures of the neck, shoulder girdle and upper limbs that are associated with the increased use of computers. The prevalence of acute NS-NP among adolescents in South Africa is 53.6% with the main predisposing factors being computer use outside of school and poor neck flexor muscle endurance (Mafanya and Rhoda, 2001).

A high prevalence of neck pain was found in different population groups (Bovim, Schrader, Sand, 1994; Côte et al, 2000; Guez et al, 2002; Ndlovu, 2006; Slabbert, 2010). Changes in the prevalence of neck pain in various populations ranged from 67.7% in the Saskatchewan population (Côte et al, 2002) to 43% in the Swedish population (Guez et al, 2002) and 34.4% in Norwegian adults (Bovim et al, 1999). In Durban, South Africa, research has indicated a 50% prevalence among the black populations (Ndlovu, 2006), 45% in the white population (Slabbert, 2010) and 36.8% in the coloured population (Muchna, 2011) for sub-acute and chronic neck pain.

Approximations as to the prevalence of acute NS-NP not caused by whiplash in adult patients are difficult to acquire, as prevalence studies do not differentiate between different kinds of neck pain. Howard, Vernon, Kirn Humphreys and Hagino (2005) hypothesized that acute neck pain not related to whiplash has a point prevalence of 10%.

2.5 Prognostic factors

Prognostic factors for acute and chronic neck pain have been identified in previous studies and include the following: age, sex, occupation, severity of symptoms, localisation of symptoms, duration of symptoms and radiological findings (Joeren et al, 1998; Hoving et al, 2004). Hoving et al (2004) reported that irrespective of the treatment modality used to treat neck pain, a less favourable outcome was found for patients older than 40 years who had accompanying lower back pain due to the chronic nature of pain. Severe acute and chronic neck pain has an unsatisfactory outcome with treatment as well as a poor prognosis (Borghouts, Koes, Bouter, 1998). It can, therefore, be posited that there is a definite association between the localisation and severity of acute and chronic neck pain and a poor prognosis. The duration of neck pain, as well as the number of previous episodes of neck pain is directly associated with the rate and quality of improvement of neck pain as a result of physiotherapy treatment. It was also found that there is a statistically significant worse prognosis for patients who experienced more than three episodes of neck pain in five years (Joeren et al, 1998). Research has found no definitive link between degenerative changes in the cervical spine and the level of pain, neither has it found any link between the severity of radiological findings (degenerative changes of joints and intervertebral discs) and worst outcome in the case of neck pain (Joeren et al, 1998). Hill, Lewis, Papageorgiou, Dziedzic and Croft (2004) state that gender and not the age of a patient predicts the onset of neck pain (females get neck pain earlier in their life than males). Age, not gender, predicts the perseverance of neck pain (most frequent between 45 to 59 years of age with age greater than 40 years indicating a poor prognosis). Hush et al (2009) found that the forecasts of neck pain with moderate to large sample sizes were female gender and extraordinary psychological stress while factors that protected adults from neck pain were found to be increased cervical spine mobility and regular exercise.

2.6 Inflammation and pathology

Acute musculoskeletal disorders that include acute NS-NP reflect the site and nature of injury/pain/inflammation or infection, whereas chronic disorders reflect cultural and psychosocial factors irrespective of the nature of the original acute disorder indicating that acute pain will respond and resolve quicker to therapy compared to chronic pain. This is in part due to the fact that with acute pain the emotional response humans have toward pain is highly valuable because the learned fear-avoidance behaviour with respect to acute pain radically decreases health risks but when it comes to chronic pain, fear-avoidance beliefs lead to less activity and eventually more pain (Traue, Jerg-Bretzke, Pfingsten and Hrabal, 2011). If acute NS-NP is not impeded from becoming chronic pain, it might lead to a substantial economic burden for the patient, as well as society in general. Childs, Cleland, Elliot, Tayhen, Wainner, Whitman, Sopky, Godges and Flynn (2008) state that 30% of patients suffering from acute NS-NP will develop chronic symptoms and 5% of these patients will become disabled by chronic neck pain (Kroeling, Gross, Goldsmith, 2005. The rate of recurrence and development of chronic symptoms (lasting at least three months) are high for patients suffering from neck pain (Childs et al, 2008; Jensen, 2007; Hill et al, 2004). Borghouts et al (1998) states that 50%-80% of patients suffering from neck pain will experience a relapse within one to five years after the initial onset of symptoms. According to Picavet and Schouten (2003), only 6.3% of patients suffering from neck pain will not have a relapse in the following year.

If serious pathology (e.g. infection, tumours, osteoporosis, spinal fractures or dislocations, or nerve root compression) is ruled out, patients suffering from neck pain can be categorised into two groups: patients with a nerve root disorder and patients suffering from non-specific pain (Childs et al, 2008). Non-specific neck pain is defined as neck pain resulting from tissue damage that is caused by excessive stress and strain that is placed on the soft tissue supporting the vertebral column (McCaffery & Beebe, 1999). In the case of non-specific pain, no definite patho-anatomical cause or systemic disease for the patient’s symptoms can be identified (Childs et al, 2008; Borghouts et al, 1998; Hoving, Gross, Gasner, Kay, Kennedy, Hondras, Haines, Bouter, 2001). Only 15% of patients suffering from neck pain get a definite diagnosis for their symptoms from a medical practitioner (Lynton & Reinhold, 2003), the other 75% will be diagnoses as suffering from NS-NP acute or chronic in nature.

2.7 Non-specific neck pain

Some authors tend to categorise neck pain based on triggering factors such as whiplash-associated neck pain, occupational neck pain, sports-related neck pain, and NS-NP (Spitzer, Skovron, Salmi, Cassidy, Duranceau, Suissa, 1995; Borghouts et al, 1998; Doshimer, Kelly, 2005; Bongers, Ijmker, Van Den Heuvel, 2006). Bogduk and McGuirk (2006) argue that the causes of common neck pain are unknown; the only identifiable causes are due to serious but rare conditions like tumours and fractures.

In 50%-80% of cases, no systemic or underlying cause can be identified for individuals suffering from neck pain (Fritz and Brennan, 2007; Heintz & Hegedus; 2008). These individuals fall into a group of patients classified as suffering from mechanical disorders which include degenerative disorders. When a patho-anatomical diagnosis of neck pain cannot be made, the IASP recommends that the term "cervical spinal pain of unknown origin" be applied (Merskey and Bogduk, 2011). Annually, 44% of patients with non-specific neck pain seek medical treatment, of which one third of who receive some type of non-operative treatment (Haldeman, Caroll, Cassidy, Schubert, Nygren, 2008).

The natural progression of non-specific neck pain is unknown and though it is frequently self-limiting and dissipates within a few weeks of onset, it can severely restrict daily function, lead to substantial medical consumption and eventually have prolonged sick leave and disability as a consequence and thus places a heavy burden on the patient, employers and health care services (Côte, Cassidy, Caroll, 2003). The aetiology of non-specific neck pain is ambiguous but has been found in some studies to be linked to poor posture and habitual postures that wield a great amount of strain on the cervical support structures (Farfan, 2000), while other studies have found no connection between cervico-thoracic posture and neck pain (Grimmer, 1996). Previous studies have also made a connection between sustained loading activities and the amount of daily work hours of patients suffering from non-specific neck pain (Ariens, van Mechelen, Bongers, Bouter and van der Wal, 2001a). Binder (2007) affirmed that the beginning of non-specific neck pain is almost imperceptible and is frequently caused by poor posture, depression and anxiety, strain on the cervical spine or work and leisure activities.

Literature indicates various treatment approaches for non-specific neck pain but because for most patients suffering from non-specific neck pain no definitive pathology can be identified the medical model fails to direct treatment. Patients suffering from NS-NP generally receive conservative treatment from a physiotherapist or general practitioner. A shift has been observed in recent international literature with an increasing amount of research into disorders of the cervical spine being directed towards the understanding of the pathophysiology of neck pain (Jull et al 2007, Jull et al, 2009) which corresponds with the clinical reasoning model used by physiotherapists during examination of patients with neck pain.

Proposed interventions for NS-NP from the literature with level of evidence and strength of recommendation for practice and where possible reported whether the intervention was applied for acute or chronic NS-NP:

Tsakitzidis et al (2013) concluded that the diagnosis of NS-NP does not make available strong ‘evidence based’ directions for treatment. Strong evidence of benefit was only find in favour of a multimodal treatment regime combining supervised exercises and joint mobilisation and not for a multi-disciplinary approach. In a recent systematic literature review performed by the Cochrane Collaboration and the Cervical Overview Group in 2007 of the most beneficial treatment for sub-acute or chronic NS-NP, strong evidence were found to support a multi-modal approach consisting of joint mobilisation and exercise was found to have the biggest effect on pain relief, increased function and global perceived effect. Moderate evidence was found to support the use of intermittent mechanical traction for the short term relief of pain in patients suffering from NS-NP with degenerative changes and cervical radiculopathy.

Although NS-NP has been defined, the expression continues to be a general and vague concept. Clinicians have a strong conviction that NS-NP is a heterogenic condition and that patients should be treated based on the fact that NS-NP is heterogeneous but NS-NP is rather described as being a condition that involves several smaller homogenous subsets, with each subset likely to respond to a specific type of treatment which explains why particular conservative therapies is more effective for certain subsets of patients that for the whole heterogeneous group of NS-NP patients (Tsakitzidiz et al, 2013).

A very important conclusion from the available literature on NS-NP was that to my best knowledge no studies were found that focus on underlying mechanisms for pain and limited function in patients suffering from NS-NP only evidence on ruling out cervical radiculopathy and evaluating self-reported pain and disability were found (Rubenstein and van Tulder, 2007, Vernon, 2008). It is also apparent treatment techniques targeting the underlying mechanisms for NS-NP versus a 'one size fits all' approach for patients suffering from NS-NP where the identification of subgroups of patients suffering from NS-NP based on diagnosis of causative structures and targeted treatment modalities may result in a better treatment outcome.

2.8 Acute non-specific neck pain

Acute neck pain is most of the time caused by trauma whereas chronic pain is a result of degenerative changes in the cervical spine (Karnath; 2012). There is no consistent definition of acute pain and literature describes it as lasting from days to months. I have defined acute pain in this study as neck pain lasting up to four weeks. The work of the Quebec Task Force and Cochrane Back Group (van Tulder et al, 2009) supports this definition.

Degenerative changes occur over an extended period of time but injuries for instance a disc herniation have a tendency to cause acute mechanical neck pain. Acute neck pain might be caused in the adult population from typical activities (e.g. lifting, stretching, twisting) in various life settings (e.g. domestic, occupational and recreational). Acute NS-NP can result from imparted sustained loads internally to the soft tissues of the cervical spine caused by single episodes of overstrain or repetitive episodes of micro-trauma or may arise from external loads (e.g. falls, strike on head or neck).

Vernon et al (2005) found only one study of moderate evidence on the application of exercise and passive physiotherapy techniques including joint mobilisation for the treatment of acute NS-NP so no convincing evidence could be provided for this multi-modal approach. No studies for the treatment of acute NS-NP in adult patients with the use of massage, traction, ultrasound therapy or acupuncture. Only two trials on the treatment of acute NS-NP in adult patients Ekberg and Wildhagen (1996) could be appropriately generalised to the treatment of acute NS-NP in a general clinical setting. There is an arresting deficiency of high-quality trials of the typical treatment modalities employed in the treatment of acute NS-NP in adult patients (Vernon et al, 2005) and no studies were found researching the effect of joint mobilisation, soft tissue joint mobilisation, ultrasound, traction, electrotherapeutics or massage for acute NS-NP in adult patients. Also no studies were found that tested whether combinations of these therapy modalities are more effective than single therapies or which combination of therapies are effective in the treatment of patients suffering from NS-NP.

2.9 Causative factors of neck pain

2.9.1 Structural causes

Non-specific neck pain can arise from any structure that can be found in the cervical spine, such as the following: (i) intervertebral discs, (ii) ligaments, (iii) muscles, (iv) facet joints, (v) dura and nerve roots, and (vi) bones and periosteum (Hoving et al, 2001). Other possible causes of neck pain are summarised in Table 2.1 (Bogduk, 1999).

Table 2.1: Summary of possible causes of neck pain

	Non-threatening causes of neck pain	**Threatening causes of neck pain**
Common causes	Pain in the cervical spine; origin unknown Whiplash incidents Pain arising from cervical structures such as facet joints, intervertebral discs and cervical musculature	Fractures
Uncommon Causes	Hyoid syndrome Rheumatoid/reactive/psoriatic arthritis Ankylosing Spondylitis Crystal Athropathies	Tumours Infections Dissecting Aneurysms Spinal Haematomas Metabolic disorders

2.9.2 Demographic factors

Chiu, Lee, Sum, Wan, Wong, Yuen (2004) indicated that 62% of females and 38% of males in Hong Kong suffer from neck pain. This higher prevalence of neck pain in females agrees with Bland (1994), Borghouts et al (1999), Croft et al (2001), Guez et al (2002), Ndlovu (2006) and Slabbert (2010) who all found that women were more prone to developing neck pain. Based on population demographics provided by Statistics South Africa, the female population has a greater incidence and prevalence of neck pain (Statistics South Africa, 2010).

2.9.3 Physical Factors

Chiu et al (2002) defines poor posture as a posture in which the head is thrust forward with excessive spinal curves in the sagittal plane, sloping or hunched shoulders, a protruding abdomen and hyperextended knees. In a study conducted by Giles and Singer (1998), it was concluded that poor posture significantly increases the biomechanical stresses on the cervical spine. These biomechanical stresses were indicated as a risk factor for the development of neck pain (Edmondston et al, 2007).

Work postures, repetitive movements and high forces are seen as causative factors in the development of neck pain (Larsson, Sogaard, Rosendal, 2007). Ariens, Bongers, Douwes, Miedema, Hoogendoorn, van der Wal, Bouter, van Mechelen (2001) indicated that a lack of job control, high and low skill discretion, low job satisfaction and high quantitative job demands all cause neck pain.

Neck pain is more common in sedentary, overweight workers (Holmstrom, Lindell, Moritz, 2002), which coincides with Croft et al (2001) contention that poor physical health is a risk factor to developing neck pain.

Mechanical neck pain is also described as postural neck pain due to the fact that sustained static loading of the cervical spine and shoulder girdle during work, sport and leisure activities place a great postural strain on the cervical structures that may lead to neck pain (May & McKenzie, 2002). Due to computerisation and automation in most industries, heavy physical duties have been largely reduced, but have instead been replaced by long periods of sitting which has caused the rate of neck pain to increase in careers in which it was previously less prevalent.

2.9.4 Psychosocial factors

Linton (2000) divides the psychosocial aspects of neck pain into four groups, namely cognitive factors (beliefs concerning pain, disability and perceived health), emotional factors (anxiety, depression and distress), social factors (work and family issues), and behavioural factors in response to pain (coping with pain and pain behaviour). Côte et al (2004) described a positive relationship between neck pain and co-morbidities (i.e. depression, smoking, headaches and lower back pain). Separated, divorced and widowed people have a higher incidence of neck pain (Croft et al, 2001).

Childs et al. (2008) recommended that clinicians be conscious of psychosocial factors which may be promoting the development of chronic neck pain and disability or that may aid in the progression of acute neck pain to chronic neck pain.

2.9.5 Traumatic factors

Previous episodes of neck and head trauma, including whiplash-associated injuries, are causative factors in the development of further neck pain (Guez et al, 2002).

2.10 Risk factors of neck pain

The risk factors associated with neck pain can be divided into two groups: (a) non-modifiable and (b) modifiable factors. These factors are summarised in Table 2.2.

Table 2.2: Summary of risk factors associated with neck pain (Haldeman et al, 2008)

Non-modifiable factors	Modifiable factors
Age Gender Genetics	Smoking Exposure to environmental nicotine Participation in physical activity that requires a straining cervical position/posture e.g. cycling High quantitative job demands, e.g. operating heavy machinery, heavy lifting Low social support Sedentary position Repetitive cervical movement during work/leisure activities Previous cervical injury Previous lower back pain Psychological distress

In terms of pain suffered by patients who experience chronic neck pain (more than three months), the following forecasts with regard to poor clinical outcome were made:

- Less severe pain at the onset of treatment;
- Chronic pain or current episode of pain lasting more than 6 months;
- A history of earlier episodes of neck and/or shoulder pain;
- Neuralgia of hands or fingers; and
- Numerous accompanying musculoskeletal complaints.

This indicates that if one of these characteristics are present in a patient suffering from acute NS-NP the probability of that patient experiencing chronic neck pain in the future increases.

In terms of functional disability in patients suffering from neck pain for more than three months, the following are probable risk factors of developing chronic neck pain:

- Age $\geq$ 40 years;
- Limited daily function at the onset of treatment;
- Current symptoms lasting more than six months;
- Neuralgia in hands or fingers; and
- Loss of upper-limb strength (Bot, van der Waal, Terwee, van der Windt, Scholten, Bouter and Dekker, 2005).

Van der Heijden et al (1995) found that the prognosis of neck pain seems to worsen in the presence of radiating pain as well as a rising number of episodes of neck pain.

Psychosocial factors have previously been stressed as risk factors for the development of chronic neck pain, but it is not clear whether these factors are a cause of neck pain or simply the results of the pain (Hellsing et al, 1994).

2.11 Diagnosis of non-specific neck pain

The patient's complaint and physical clinical examination is the most successful manner for a physician to diagnose neck pain (Larsson et al, 2007). According to the ICD, a diagnosis of mechanical neck pain can be based on neck pain without symptoms of serious medical or psychological disorders with accompanying (1) restrictions of cervical and upper thoracic range of motion, (2) headaches, and (3) referred or radiating pain in the upper limb/s. After a diagnosis has been made, a patient suffering from neck pain (in accordance with the ICF) can be classified as follows:

- Neck pain with joint mobility restrictions;
- Neck pain with headaches;
- Neck pain with weak movement coordination; and
- Neck pain with pain radiating into a specific region (Childs et al., 2008).

Degenerative changes to the structures of the cervical spine may be probable causes of NS-NP, despite the fact that degenerative changes may be seen in a-symptomatic people, are non-specific and are predominant in the elderly population. Although the origin of neck pain might be linked to degenerative changes identified on diagnostic imaging, the specific tissue that is the causative factor of the patient's pain is usually not known (Childs et al, 2008).

After a clinicians has ruled out serious red flags during assessment of a patient suffering from neck pain, a patho-anatomical diagnosis does not necessarily lead the physiotherapist to a specific treatment modality for that patient. Therefor a classification system was designed to guide the clinical decision making in finding a matching treatment approach for the specific subset of symptoms the patient presents with. This classification system was defined by Fritz et al in 2007 and updated in 2009 as part of the American Physical Therapy Association Orthopaedic section ICF Guidelines. From this classification system it can be deduced that a patient suffering from acute NS-NP is classified under neck pain with mobility deficits and should present with the following clinical presentation:

- Age <50 years
- Acute neck pain (<12 weeks)
- Restricted cervical ROM
- Segmental hypomobility of the cervical and thoracic spine
- Symptoms isolated to the cervical region but referred pain might be present

In a study performed by Way and Bogduk in 2008 a patho-anatomic cause for neck pain could not be determined for 25% of their study population who suffered from neck pain which refutes the unpublished and common belief that it is hopeless to find a patho-anatomic diagnosis for neck pain (Way and Bogduk, 2008). In a British study (Frank, de Souza, Frank, 2008) a diagnosis of neck pain was not sought after with the use of intrusive tests but by performing minimally invasive procedures in the study by Way and Bogduk (2008) a diagnosis was defined in over 60% of the participants who pursued investigations and in over 80% of the participants who followed through with the tests. They found the single most common cause of NS-NP to be facet joint pain in 55% of the study participants.

2.12 Treatment for non-specific neck pain

Inadequate information is available concerning which rehabilitative conservative management or combination therapy is most effective in the treatment of acute or chronic mechanical neck pain (Gross et al, 2002). Despite the extent, costs, and morbidity of neck pain, surprisingly little research has evaluated specific treatments for acute NS-NP and very little is known about the natural history of acute NS-NP (Bronfort et al, 2001). The table below indicates proposed treatment for acute, sub-acute and chronic NS-NP (Tsakitzidis et al, 2013).

Table 2.3: Evidence based proposed management of NS-NP

Proposed management from the literature[1]	**Best available graded evidence[2]**	**Conclusions for practice based on consensus by expert panel in terms of 'strong' or 'weak' combined with recommendations in terms of 'in favour' or 'against'[3]**
Diagnosis, assessing self-rated pain and prognosis		
History taking	No evidence from literature	Strong - in favour
Excluding red flags	A - Best available evidence from literature	Strong - in favour
Diagnostic imaging	No evidence from literature	Weak - against
The "Neck Disability Index" as instrument for self-rated disability	Level of evidence not applicable. Valid instrument	Strong - in favour
Confirm radiculopathy: spurling's test, traction/neck distraction, shoulder abduction, valsalva's manoeuvre	C - Lowest level of evidence	Weak - in favour

Rule our radiculopathy: negative upper limb tension test	C - Lowest level of evidence	Weak - in favour
Diagnose facet joint spinal pain: local anaesthetic block when no clinical diagnosis	C - Lowest level of evidence	Weak - in favour
Unfavourable prognostic elements: severity of pain; previous attacks; old age or concomitant low back pain	C - Lowest level of evidence	Weak - in favour
Pathologic radiological findings (e.g. degenerative changes) are not associated with worse prognosis	C - Lowest level of evidence	Weak - against
Treatment of NS-NP: Manual therapy; Joint Therapy		
Chronic NS-NP: multimodal approach: joint mobilisations/manipulations combined with supervised exercises	A - Best available evidence from literature: effect on pain and function in short and long term	Strong - in favour
Acute and chronic NS-NP: manipulation and joint mobilisation alone	B - Moderate level of evidence; no effect	Weak - against
Chronic NS-NP: traction	C - Lowest level of evidence; no effect	Weak - against
Soft tissue therapy		

Acute and chronic NS-NP: massage	C - Lowest level of evidence; no conclusion	Weak – against
Exercises		
Chronic NS-NP: supervised exercise: e.g. stretching and strengthening programs focusing on the cervical region, specific cranio-cervical flexion-exercises	B - Moderate level of evidence; effect on pain/function in the long term	Weak - in favour
Chronic NS-NP: stretching and strengthening exercises alone	C - Lowest level of evidence; no effect	Weak – against
Chronic NS-NP: supervised exercise: stretching and strengthening of the shoulder region and exercises improving general condition	C - Lowest level of evidence; effect on pain/function in the short term	Weak - in favour
Chronic NS-NP: supervised exercies: eye-fixation and proprioceptive exercises	B - Moderate level of evidence; effect on pain/function in the short term	Weak - in favour
Chronic NS-NP: isolated home exercises, isolated group exercises, neck schools	C - Lowest level of evidence; no effect	Weak – against
Electrotherapy		

Chronic NS-NP: transcutaneous electrical nerve stimulation (TENS) or electrical muscle stimulation (EMS) on trigger points	C - Lowest level of evidence; no effect	Weak - against
Acute and chronic NS-NP: low level laser therapy (LLLT); pulsed electromagnetic fields (PEMF)	C- Lowest level of evidence; Effect in the short term on pain/function (LLL); on pain (PEMF)	Weak - in favour
Chronic NS-NP: thermal and ultrasonic agents	C - Lowest level of evidence; no effect	Weak - against
Multimodal treatment		
Sub-acute/chronic NS-NP: supervised exercises in combination with manipulation and/or joint mobilisation and forms of education	A - Highest level of evidence; Effect on pain/function in the long term	
Chronic NS-NP: manipulation/joint mobilisation combined with electrotherapy or medication or other non-invasive modalities	C - Lowest level of evidence; no effect	
Multidisciplinary treatment		
Chronic NS-NP: multidisciplinary approach	C - Lowest level of evidence; no	Weak - in favour

	conclusion	
Medication		
Chronic NS-NP: local anaesthetic injection with lidocain into myofascial trigger points	C - Lowest level of evidence; Effect on pain in the short term	Weak - in favour
Acute and chronic NS-NP: paracetamol, NSAID's, opiods analgesics	C - Lowest level of evidence; Effect on pain in the short term	Weak - in favour
Chronic NS-NP: botulinium toxin A	B - Moderate level of evidence; no effect	Weak - against
Acute NS-NP: subcutaneous carbon dioxide insufflations	C - Lowest level of evidence; no effect	Weak - against
Acupuncture		
Chronic NS-NP: acupuncture (e.g. trigger points)	B - Moderate level of evidence; Effect on pain in the short term	Weak - in favour
Other therapies		
Chronic NS-NP: pillows in combination with exercises	C - Lowest level of evidence; Effect on pain in the short and long term	Weak - in favour

Chronic NS-NP: use of collars or oral splints	B - Moderate level of evidence; no effect	Weak - against
Acute and chronic NS-NP: isolated educational programs	B - Moderate level of evidence; no effect on pain or function in the short or long term	Weak - against
Chronic NS-NP: counselling programs for specific groups e.g. (female) computer workers	B - Moderate level of evidence; pain intensity and disability on short and medium term	Weak - in favour
1. All different management approaches (reflect to diagnosis, assessment of self-rated pain, prognosis and treatment) found in literature and extracted as relevant by the SR-team		
2. Best available evidence was defined following the GRADE system, based on the methodological quality of the included studies - following three categories: grade A, B and C (Guyatt, Gutterman, Baumann, Addrizzo-Harris, Hylek, Phillips, Raskob, Lewis, Schünemann, 2006)		
3. Conclusions to administer or not administer proposed management was made by an expert panel, on the basis of tradeoffs between benefits on the one hand, and risk, burdens and costs on the other (Guyatt et al, 2006)		

The table above indicates moderate evidence of no effect on acute NS-NP reduction when joint manipulation or joint mobilisation was used in isolation and low level of evidence of no effect on pain reduction in adults suffering from acute NS-NP. LLLT and PEMF indicated a low evidence based short-term reduction in pain and increase in function for acute NS-NP, the same was found to be true for paracetamol and non-steroidal anti-inflammatories. An isolated education program had moderate evidence of no effect on pain reduction and increased function on acute NS-NP in the short and long term.

The literature point toward the effectiveness of a multimodal treatment approach consisting of at least two different types of therapy modalities for the treatment of acute and chronic NS-NP. Combining stretching/strengthening exercises and joint mobilisation for the reduction of sub-acute and chronic NS-NP pain indicated an increase in function and favourable global perceived effect in the long term (Gross et al, 2007). There is a lack of information on the specific influence of the individual treatment modalities for NS-NP to the overall impact of the therapy.

Within physiotherapy there is a great variety in choices of therapeutic intervention which indicate a degree of uncertainty about the best treatment strategies for patients suffering from neck pain. Increased variability in treatment protocols is thought to adversely affect the quality of care; this may partly explain why research on physiotherapy outcomes has exposed smaller effect sizes for patients suffering from neck pain than patients with any other musculoskeletal conditions (Fritz and Brennan, 2007). Jensen et al stated that clinicians are comfortable with obscurity and have the faculty to self-monitor data collection and thinking processes, by integrating subsets of information into workable sets based on clinical experience and supportive decision making (Jensen, Gwyer, Shepard, Hack, 2000). This substantiates the variety of treatment modalities and combination of treatment modalities used by physiotherapists for the treatment of acute NS-NP in adult patients as opposed to a standardised treatment approach.

Why are some of the treatment modalities used by physiotherapists in a clinical setting if there are no strong evidence of good treatment effect? Treatment modalities that have a short-term relief in pain and increase in function have a definitive place in physiotherapy treatment protocols if used in combination with modalities that have been indicated to have a long term effect on the treatment outcome (Sterling, Jull, Wright, 2001).

While numerous therapy interventions are recognised as accepted treatment for NS-NP (Rush & Shore, 1994), all-encompassing research with respect to the value of non-operative treatment approaches such as mechanical traction, exercise programs, US, TENS, patient education and non-steroidal anti-inflammatory medications is lacking (Gross, Aker and Goldsmith, 2000). The Philadelphia Panel (2009) found weak evidence indicating that TENS was more effective in the treatment of acute NS-NP pain than the use of a cervical collar. There was also no evidence from controlled trials and cohort studies that supported the use of therapeutic exercise programmes in the treatment of acute NS-NP pain. Moderate evidence of short- and long-term reduction in pain and increase in function in chronic NS-NP for supervised exercises such as stretching and strengthening exercises of the cervical, shoulder and thoracic areas (Kay et al, 2005; Gross et al, 2007). Targeted strengthening of specific muscle groups supposing an underlying cause for the symptoms was ill-described in the majority of studies and due to this no firm conclusions could be drawn for the selection of appropriate 'evidence-based' exercises for the relief of acute NS-NP. A systematic review of literature regarding the use of exercises that have been indicated to have the greatest effect on acute and chronic NS-NP by the Cervical Overview Group have shown that a combination of exercises for local cervical spine stabilisers and global exercises are most effective (Gross, Goldsmith, Hoving, Haines, Peloso, Aker, Santaguida, Myers and the Cervical Overview Group, 2007). A large number of studies found on the use of STM for NS-NP have major methodological flaws e.g. often an absence of uniform definition of massage technique, dosage, mode of performance and indication for the management (Gross et al, 2007; Vernon et al, 2007) resulting in no definite conclusions regarding the efficacy thereof.

Classification systems exist to direct treatment and improve outcomes of physiotherapy, yet little research has been done to examine a proposed classification system for patients suffering from non-specific neck pain. Fritz and Brennan (2007) developed such a classification system for neck pain (Figure 2.1).

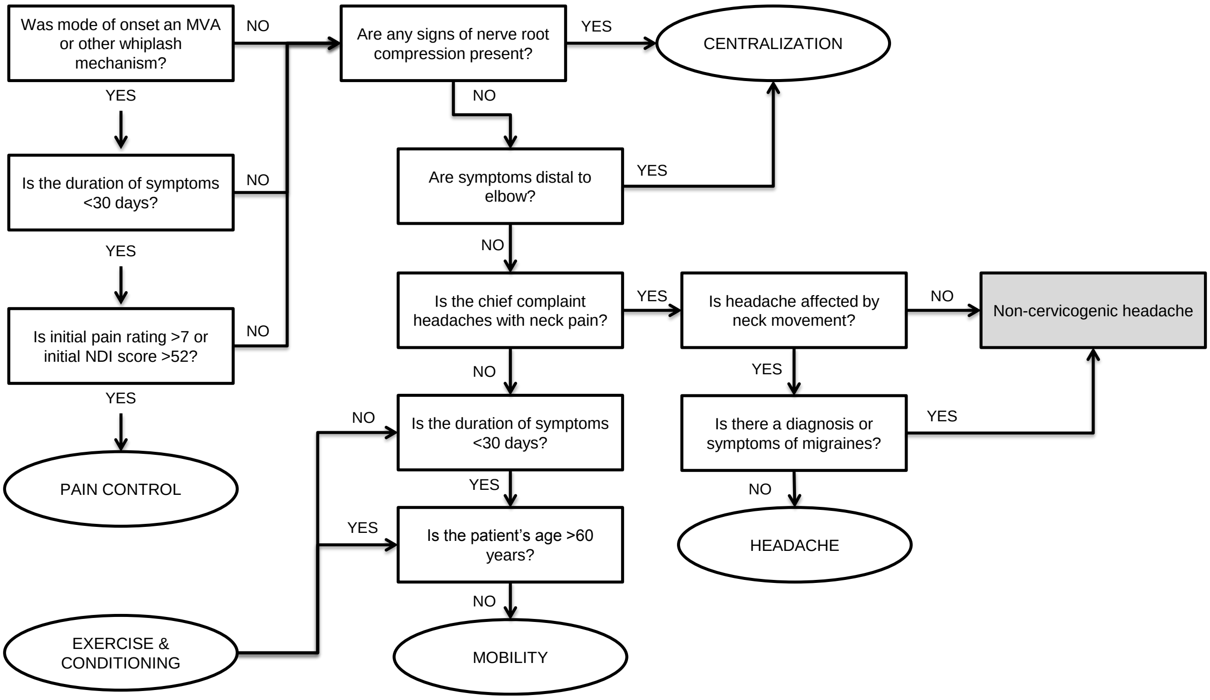

Figure 2.1: Classification system for non-specific neck pain (Fritz and Brennan, 2007)

This figure indicates a decision making process that a clinician can follow in a clinical setting once a subjective evaluation has been done that indicates the best probable matched treatment modality or combination of treatment modalities to be used for the patient's symptom classification; i.e. if a patient presents with acute NS-NP due to a mobility deficit according to the table below a combination of cervical joint mobilisation and exercises are recommended for the best possible result.

Table 2.4: Matched treatment components for each classification category

Classification	Criteria	Proposed matched treatment components
Mobility	The listed interventions must both be received within the first three sessions	Cervical or thoracic joint mobilisation or manipulation Strengthening exercises for the deep neck flexor muscles
Centralisation	Either of the listed interventions must be received	Mechanical or manual cervical traction (at least 50% of the sessions) Cervical retraction exercises (at least 50% of the sessions)
Exercise and conditioning	The listed interventions must both be received in at least 50% of the sessions	Strengthening exercises for the upper quarter muscles Strengthening exercises for the neck or deep neck flexor muscles
Pain Control	The listed interventions must both be received within the first three sessions, imjoint mobilisation with a cervical collar or similar device cannot be used	Cervical spine joint mobilisation Cervical range of motion exercises
Headache	The listed interventions must all be received	Cervical spine manipulation or joint mobilisation

		Strengthening exercises for the deep neck flexor muscles Strengthening exercises for the upper quarter muscles

NS-NP has been said to be caused by mechanical causes such as disruption of the cervical joints, surrounding soft tissue including muscles and ligaments and cervical discs (Karnath, 2013). Fritz and Brennan (2007) indicate the use of joint mobilisation and exercise therapy to be used in the clinical setting by Physiotherapists for cervical mobility deficits (i.e. facet joint syndrome), pain control and headache and suggest the use of mechanical traction and exercise where centralisation as a result of cervical disc involvement was found to be the cause of pain. According to this classification system for neck pain, Fritz and Brennan (2007) determined that patients suffering from acute NS-NP, who are younger than 60 years with no referred symptoms distal to the elbow and no signs of nerve root compression, should receive joint mobilisation and exercise as treatment.

This classification system as proposed by Fritz and Brennan is reinforced by the ICD and ICF who developed a recommended treatment intervention classification system for guidance of treatment strategies for NS-NP. The classification criteria for non-specific neck pain, as categorised by the ICD and ICF, are stated in Table 2.5.

Table 2.5: Neck pain impairment/function-based diagnosis, examination and intervention recommended classification criteria

Impairment-based category (with ICD-10 associations)	Symptoms	Impairments of body function	Interventions
Neck pain with mobility deficit	• Unilateral neck pain • Neck motion limitations • Onset of symptoms often paired with a recent unguarded movement or position • Referred upper limb pain might be present	• Limited cervical range of motion • Neck pain reproduced at end of ranges of active and passive movement • Restricted cervical and thoracic segmental mobility • Neck and neck-related upper limb pain reproduced by provocation of involved cervical or upper thoracic segment	• Cervical joint mobilisation/manipulation • Thoracic joint mobilisation/manipulation • Stretching exercises • Coordination/strengthening and endurance exercises
Neck pain with headache	• Intermittent, unilateral neck pain with referred headache • Headache is precipitated or aggravated by neck movements or sustained positions	• Headache reproduced by provocation of involved upper cervical segment • Limited cervical range of motion • Restricted upper cervical segmental mobility • Strength and endurance deficits in deep neck	• Cervical joint mobilisation/manipulation • Stretching exercises • Coordination, strengthening and endurance exercises

		flexors	
Neck pain with movement coordination impairments	• Neck pain with referred upper limb pain • Symptoms often linked to precipitating trauma and might be present for a long period of time	• Strength, endurance and coordination deficits of deep neck flexors • Neck pain at mid-range motion that worsens with end range movement or positions • Neck and neck-related upper limb pain with provocation of involved cervical segments • Cervical instability might be present	• Coordination, strengthening and endurance exercises • Patient education • Stretching exercises
Neck pain with radiating pain	• Neck pain with referred pain into upper limb • Upper limb numbness and weakness might be present	• Neck and neck-related pain reproduced by cervical extension, side-bending, and rotation towards the painful side and upper limbs tension tests • Neck and neck-related pain relieved by cervical distraction • Might have upper limb sensory or strength deficits	• Upper limb nerve joint mobilisation • Traction • Thoracic manipulation/joint mobilisation

From this classification it can be seen that the proposed treatment of neck pain is directly related to the causative structures and treatment should be directed at the underlying causes of neck pain. The ICF and ICD (Childs et al, 2008) agrees with the classification system proposed by Fritz and Brennan (2007) and recommend joint joint mobilisation and stretching, strengthening and coordination exercises be used as a multimodal approach if cervical joint involvement (Neck pain with mobility deficits and Neck pain with headache) could be found on examination. For pain caused by the strain of the soft tissues that support the cervical spine (Neck pain with movement coordination impairments) it is proposed that therapists employ stretching, strengthening and coordination exercises of the cervical muscles and that mechanical traction and joint mobilisation should be used where cervical disc involvement could be diagnosed as the cause of pain (Neck pain with radiating pain).

2.13 Manipulation and joint mobilisation

The Guide to Physical Therapist Practice (APTA, 2001) define manipulation and joint mobilisation as a “manual therapy technique comprised of a continuum of skilled passive movements to joints and/or related soft tissues that are applied at varying speeds and amplitudes, including a small amplitude/high velocity therapeutic movement”. Manipulation and joint mobilisation are used by a physiotherapist to diagnose and treat soft tissue and joint structures in order to modulate pain, increase range of motion, decrease inflammation, bring about relaxation and have a positive effect on tissue repair, extensibility and/or stability, movement facilitation and an increase in function. Manipulation has hypo-algesic properties which may be attributed to stimulation of descending inhibitory pathways which results in pain relief. Manipulation also brings about relief due to the restoration of normal spinal biomechanics which might potentially reduce mechanical stresses and increase the even distribution of joint forces in the cervical spine.

Manual therapy is one treatment strategy deemed appropriate for patients suffering from neck pain (Cleland et al, 2005). Nearly 37% of physiotherapists who routinely use manual therapy techniques for patients with spinal disorders in clinical practice perform manipulation and/or joint mobilisation to the cervical spine in patients with neck pain (Hurley et al, 2002). The effectiveness of manual therapy in patients with neck pain and cervico-genic headaches has been supported by an increasing number of high quality, randomised controlled trials (Bronfort et al, 2001b; Evans et al, 2002; Hoving et al, 2002; Jull et al, 2002) and systematic reviews (Bronfort et al, 2001a; Gross et al, 2002), suggesting its effectiveness in treating neck pain. Estimates of harm when using cervical manipulations range from one in 20,000 to five in 10,000,000 and estimates of harm from cervical joint mobilisation have rarely been reported (Gross et al, 2004). The benefits and risks of joint mobilisation are summarised in Table 2.6.

Table 2.6: Benefits and risks for the use of joint mobilisation for neck pain

Benefits of joint mobilisation	**Risks of joint mobilisation**
Cervical and thoracic joint mobilisation has immediate hypo-algesic effects through the stimulation of descending inhibitory mechanisms (Paungmali, O'Leary, Souvlis and Vincenzino, 2003).	Vertebral Artery Insufficiency with a risk of 6 in 10 million or 0.00006% (Hurwitz et al., 1996)
Thoracic manipulation gives an immediate increase in cervical range of motion and decrease in neck pain in patients suffering from primary non-specific neck pain (Flynn et al., 2004; Cleland et al., 2004).	Risk of stroke due to cervical manipulation is one in 100 000 or 0.001% (Hurwitz et al., 1996).
	Risk of death due to cervical manipulation is 3 in 10 million or 0.000003% (Childs et al., 2008).

Joint mobilisation of the cervical spine is commonly used for the rehabilitation of non-specific neck pain but controversy exists regarding the efficacy, potential benefits and harmful effects thereof (Gross et al, 2002). Gross et al (2005) reported in a study that joint mobilisation is commonly used in the treatment of neck pain, but the effects are short-term and inconclusive. In a randomised controlled trial performed by Cleland, Childs, McRae, Palmer and Stowell (2005), it was found that manual therapy, of which manipulation and joint mobilisation can be used individually, in tandem or as part of a multi-modal treatment regime for the treatment of acute NS-NP. When used alone, both single and multiple sessions of joint mobilisation were found to have a non-significant benefit in reducing neck pain when assessed against placebo, control groups and other treatment modalities. Gross et al. (2002) found that a single session of joint mobilisation is not recommended to treat and reduce pain associated with acute NS-NP, but the right dosage parameters needed for the relief of non-specific neck pain could not be established either. They concluded that physiotherapists, who use a single dose of joint mobilisation for non-specific neck pain without adding patient education or exercise to the treatment session, need to change their treatment to a more global approach to care for these specific patients. They also recommend that physiotherapists not employing joint mobilisation for the treatment of non-specific neck pain need to do so. Intermittent cervical traction and exercise are the most effective forms of treatment to combine with joint mobilisation of the cervical spine in order to treat non-specific neck pain (Hurwitz et al, 2000-2010). When joint mobilisation is performed within this multi-modal regime, the treatment appears to have a positive long-term effect on the patient by reducing pain, increasing function, as well as increasing the global perceived effect by the patient. Gross et al. (2002) established that the use of joint mobilisation alongside an exercise program reduces pain and increases good clinical outcome in patients suffering from acute NS-NP and that it is the recommended multi-modal treatment program for acute NS-NP. Other therapies used to treat non-specific neck pain, which include medication and massage or modalities such as electrotherapies, thermal agents and orthoses used with joint mobilisation, have no clear positive effect on the reduction of non-specific neck pain in adult patients (Hurwitz et al, 2000-2010).

In a high quality randomised controlled trial performed by Evans et al (2002) it was found that patients with a diagnosis of chronic NS-NP had a decrease in pain when treated with exercise. The patients who were treated with a combination of joint mobilisation and exercise were most satisfied with their physiotherapy care. The validity of this finding is reinforced in the study performed by Ylinen, Takala, Nykänen, Häkkinen, Mälkiä, Pohjolainen, Karppi, Kautiainan and Airaksinen in 2009. The study found a significant reduction in neck pain and disability in females enduring chronic NS-NP after being treated with a 12-month strength and endurance training programme. This study also found that an exercise program focusing on stretching and aerobic exercises was inferior to a strengthening program that targeted stabilising muscles in reducing the use of analgesics and increasing cervical range of motion in female patients experiencing chronic NS-NP. Jette et al (1996) found that endurance exercise programs had better clinical outcome with respect to the overall health awareness in patients suffering from neck pain compared to general exercise programs. Joint mobilisation has also been proven to increase the range of motion during upper limb tension tests and to decrease pain and disability in patients with cervico-brachial pain syndrome in the short term (Cleland et al., 2003). Hurwitz et al. (1996) indicated that 2 out of 3 high-quality randomised controlled trials showed that patients treated with cervical joint mobilisation for acute neck pain had shown short-term relief from pain. Gross and the Cervical Overview Group (2009) did a systematic review of literature pertaining to treatment strategies of NS-NP that combined joint mobilisation with an exercise program of some sort and found that it is more effective than either joint mobilisation or exercise alone for the treatment of sub-acute and chronic NS-NP.

The effects of joint mobilisation and that of cold packs, TENS, acupuncture and ultrasound were compared in four trials and no significant evidence was found to suggest that any one of the treatments had a better outcome in the treatment of sub-acute and chronic and acute NS-NP. Medication, massage, electrotherapy, thermal agents and orthoses used in combination with cervical joint mobilisation for the treatment of acute and chronic NS-NP were found to have no clear effect (Hurwitz et al, 2000-2010). When manipulation and joint mobilisation (combined) was compared to placebo treatment, there was no evidence of a reduction in pain and increase in patient function for sub-acute and NS-NP for both of these modalities. Manipulation and joint mobilisation (combined) was compared to a no-treatment approach and it was found that there were short and long-term benefits of pain reduction and increased function for chronic NS-NP as well as for headache sufferers. Due to a lack of data from current randomised controlled trials, no deductions can be made regarding the use of manipulation for acute neck pain. The outcome of studies pertaining to this treatment found that it might be beneficial to use joint mobilisation in the treatment of acute neck pain in the short-term when it is combined with other treatment modalities (Hurwitz, 1996) (refer to

Table 2.7 for studies pertaining to joint mobilisation for neck pain).

Increasing volumes of research support the use of joint mobilisation in combination with exercise for the successful treatment of non-specific neck pain with respect to pain reduction, patient perceived improvement and cost effectiveness of treatment (Hoving et al, 2002). Gross et al (2004) found evidence in a recent Cochrane review of joint mobilisation and manipulation for non-specific neck pain that included 33 randomised controlled trials (42% of the trials were of high quality), that the most effective treatment intervention for non-specific neck pain (with or without headaches) was a combination of joint mobilisation and exercise. This treatment combination reduced pain and increased the patients' gratification. Manipulation and joint mobilisation, when used alone, were not as effective in reducing non-specific neck pain as when they were used in combination with an exercise program.

Table 2.7: Evidence from studies conducted on the effects of joint joint mobilisation on acute and chronic NS-NP

Source	Intervention	Results	Limitations
Bronfort et al, 2001	Good quality RCT (Level I Evidence): Manipulation and exercise vs. manipulation alone for chronic neck pain. Methodologically sound: randomised, single-blinded with good follow-up; 191 patients were included in the sample. Ages 20-65 included in the RCT with a primary complaint of NS-NP. Patients were excluded if there was serious pathology or a definite diagnosis for the neck pain.	A statistically significant group difference was found for combined therapy (cervical manipulation and exercise). This was superior to cervical manipulation alone in the reduction of chronic neck pain. The effect lasted two years.	Patients were divided into three groups: one group receiving manipulation alone, one group receiving exercise only and a group receiving a combination of manipulation and exercise. The pain rating across all three study groups differed in intensity with the exercise group having more pain compared to the other two groups. This influenced the outcome of the study as the exercise group indicated a greater magnitude of change in pain scores. The study design was found to be less than optimal, when comparing costs of treatment modalities.
Jull, Trott, Potter, Zito, Niere, Shirley,	Good quality RCT (level I evidence) with good randomisation. The study was	A combination of cervical manipulation and exercise was	A number of the participants, especially in

Source	Intervention	Results	Limitations
Emberson, Marshchner, Richardson, 2002	unblended and blinded with a good follow-up; sample size=200. Manipulation and exercise vs. manipulation alone for cervicogenic headaches.	more effective for patients with cervicogenic headaches in the long term than cervical manipulation alone.	the control group, sought other active therapies during the study for their headaches.
Gross A, Hoving L, Haines, T, Goldsmith C, Kay TM, Aker P, Bronfort G and the Cervical Overview Group, 2004	Systematic review of Level I evidence studies which provided results from 14 high quality trials. Two independent authors conducted the citation identification. Joint mobilisation plus exercise prescription for sub-acute and chronic non-specific neck pain. Joint mobilisation alone or exercise alone for sub-acute and chronic non-specific neck pain. Joint mobilisation alone or combined with other physical therapy (e.g., heat, massage, traction, ultrasound or electric muscle stimulation); for sub-acute and chronic non-specific neck pain.	33 RCTs were not in favour of joint mobilisation alone or used with other forms of physical therapy (e.g., heat, massage, traction, ultrasound or electric muscle stimulation) for reducing pain (acute or chronic) and increasing function when compared to no treatment given. Joint mobilisation combined with exercise brought about pain relief and an increase in function when compared to nil treatment given. Neither manipulation nor joint mobilisation was found to be the superior treatment.	A language bias was present in the review as well as a publication bias.
Hurwitz, et al,2000-2010	Systematic review of 14 RCTs (level II evidence), 2 cohort studies (level III evidence), 14 cases series (level IV evidence) and 37 case reports (level V evidence). Two investigators searched for the citations. Most of the studies had	Evaluation of the existing RCTs revealed (1) Joint mobilisation had higher mean improvements in neck mobility and pain reduction when compared to cervical collar and combination of cervical collar and	14 RCTs, 2 cohort studies, 14 case series and 37 case reports were included in the review.

Source	Intervention	Results	Limitations
	weak study designs, very few studies used control groups and bias was present in most of the studies. The outcomes, especially in the case series and case reports, were subjective and the validity and reliability was unknown. For acute neck pain no RCTs were done on the efficacy of manipulation. One moderate-quality RCT was found on the efficacy of joint mobilisation for acute neck pain. This study used the VAS scale as a self-report measure. Two low-quality RCTs compared Maitland joint mobilisation of the cervical spine with other treatments for acute whiplash patients.	TENS for acute neck pain; (2) the group that received Maitland joint mobilisation plus a cervical collar plus advice about joint mobilisation indicated a statistically significant decrease in pain as measured on the VAS scale and as compared to rest and analgesics.	
Cleland et al, 2005	A good quality RCT (level I evidence). Ages 18-60 were included with a primary complaint of non-specific neck pain. Patients with serious pathology were excluded from the trial. 36 patients were included in the trial and the VAS scale was used as a self-report measure. Good randomisation procedures were followed, the study was blinded with a control group but there was no proper follow-up with patients. Thoracic	No differences were found in key demographic variables (age and gender) or baseline levels of pain and disability was detected between the manipulation and placebo group at baseline. The change in pain on the VAS scale was 15.5 mm for the manipulation group and 4.2 mm for the placebo group. Immediate pain relief in patients	

Source	Intervention	Results	Limitations
	manipulation vs. placebo manipulation of the thoracic spine.	with a primary complaint of neck pain after thoracic manipulation.	
Tseng, Wang, Chen, Hou, Chen, Lieu, 2006	Clinical prediction rule for the use of thrust manipulation of the thoracic spine. 100 patients (34 males; 66 females) participated. Dx included in study: cervical spondylosis with or without radiculopathy, herniated disc of cervical spine, myofascial pain syndromes or cervicogenic headache. Outcome measures: pain relief, perceived improvement, patient satisfaction. Only manipulation was used as treatment. 60 patients responded to cervical spine manipulation; 40 patients were non-responders.	Six predictors for the immediate response to cervical manipulation in patients with neck pain were identified in the study: (i) scores below 11.5 on the Neck Disability Index (ii) bilateral upper limb symptoms (iii) not in a sedentary position more than five hours\day (iv) reduction of symptoms with joint mobilisation of cervical spine (v) no increase in symptoms with cervical extension (vi) spondylosis without radiculopathy. If four or more of the predictors are positive, the probability of success for the use of thoracic thrust manipulation increased from 60%-89%. Manipulation of cervical spine not indicated in cervical radiculopathy. Cervical spine joint mobilisation combined with thoracic thrust manipulation can be used for patients with cervical radiculopathy.	The Neck Disability Index was used as a self-report measure, not VAS. Heterogeneity of neck pain syndromes included in study: cervical spondylosis with or without radiculopathy, herniated cervical disc, myofascial pain syndromes and cervicogenic headaches.
Gross et al, 2002	Systematic review of high quality RCTs	Manipulation and joint mobilisation	

Source	Intervention	Results	Limitations
	to answer the following questions: Therapy question: Does manipulation or joint mobilisation of the cervical spine, alone or in combination with other care, improve pain, function, patient satisfaction and other clinically important outcomes? Harm question: What are the risks and side effects of manipulation and/or joint mobilisation? NS-NP, neck disorders with headaches of cervical origin and neck disorders with radicular symptoms were included. Manipulation and joint mobilisation were chosen as interventions and pain reduction, increased function and patient satisfaction were outcomes. From the citation search these questions were answered and a clinical practice guideline for the use of joint mobilisation in the treatment of adults suffering from non-specific neck pain was developed.	therapy: 28 review articles included with fair methodological quality but heterogeneous in terms of populations, interventions and outcomes. Some indication that a combination of manipulation and joint mobilisation with exercise and E.T. had a favourable outcome for neck pain and inconclusive evidence was found for the efficacy of manipulation alone or joint mobilisation alone for neck pain. Joint mobilisation combined with cervical exercise is recommended for the treatment of non-specific neck pain. Joint mobilisation less effective in the treatment of non-specific neck pain when used alone. A single session of manual therapy to reduce pain is not recommended; the number of sessions needed to reduce neck pain is not known. Of the 20 trials included for joint mobilisation and/or manipulation of	

Source	Intervention	Results	Limitations
		cervical spine, seven reported complications ranging from one in 20,000 to five in 10,000,000. The adverse effects include minimal benign reaction lasting >24hrs, some/more/new discomfort, dizziness, visual disturbances and ear symptoms.	
Flynn, Wainner, Whitman, Childs, 2007	Thoracic spine manipulation in 26 patients with primary complaint of neck pain; case series (level IV evidence) with patients treated with thoracic manipulation with no comparison group.	Clinically meaningful decrease in pain and increase in cervical active range of motion in all available ranges except for extension with the use of thoracic manipulation.	Case series: no control group.
Fernández de las Peňas, Fernández Carnero, Plaza Fernández, Lomas Vega, Miangolarra Page, 2004	Thoracic spine manipulation vs. no manipulation in whiplash-associated disorder.	Significant reduction in neck pain in the group treated with thoracic spine manipulation compared to the control group.	Lesser quality RCT with <80% follow up, no blinding and improper randomisation.
Vernon, Humphreys, Hagino, 2007	The efficacy of cervical manipulation and /or joint mobilisation for chronic neck pain, systematic review of high quality RCT's.	Level II evidence that patients suffering from chronic neck pain not related to whiplash-associated disorders, shared clinically important improvements at six weeks and with follow up 2 years post therapy	Only studies published throughout 2005 were reviewed.
Jensen, 2007	Systematic review of studies published	Manual therapy (consisting of	Possible selection bias.

Source	Intervention	Results	Limitations
	through 2005. Manual therapy (consisting of manipulation, joint mobilisation and traction) alone vs. Manual therapy (consisting of manipulation, joint mobilisation and traction) combined with exercise for the treatment of neck pain.	manipulation, joint mobilisation and traction) combined with cervical directed exercises are effective in the treatment of neck pain. No evidence could be found that manual therapy (consisting of manipulation, joint mobilisation and traction) alone reduces acute or chronic neck pain.	
Cleland et al. (2003)	11 patients, mean age 51.7 years, diagnosed with cervical radiculopathy treated with a standardised treatment approach of manual therapy, cervical mechanical traction and strengthening of the deep neck flexors and scapula-thoracic stabilisers.	10 of the 11 patients showed a clinically significant reduction in pain and increase in function after a mean of 7.1 treatment sessions. It can be concluded from this study that a multi-modal treatment approach consisting of joint mobilisation, mechanical traction and exercise will reduce pain and increase function in patients with cervical radiculopathy.	No cause-effect relationships could be made due to the study being a case series; level IV evidence.
Hoving et al., 2002	Joint mobilisation and exercise treatment strategy for patients suffering from non-specific neck pain with a pain score greater than 3 out of 10 on the VAS; 138 patients. Randomised controlled trial, level I evidence with good randomisation.	Statistical and clinical improvement in patients with mechanical neck pain when treated with joint mobilisation and exercise. Manual therapy deemed a safe and effective form of therapy for patients suffering from bilateral or	

Source	Intervention	Results	Limitations
		unilateral referred symptoms related to non-specific neck pain.	
Heintz & Hegedus, 2008	Use of a treatment-based classification system to plan and direct early intervention of patients suffering from non-specific neck pain. One patient treated with 10 physiotherapy sessions over a 13-week period with mechanical cervical traction, cervical retraction exercises and cervical joint mobilisation.	By week 3 of the 13-week treatment period, the patient indicated 0 out of 10 on the VAS which was maintained at a 6-week follow-up appointment.	No measurements were taken to document improvement of deep neck flexor strength; difficulty to determine dosage parameters due to the little literature available with respect to optimal treatment parameters for non-specific neck pain.

Table 2.7 indicates that cervical joint mobilisation together with exercise and intermittent mechanical cervical traction is more effective than only using joint mobilisation for neck and neck-related arm pain. Gross et al (2004) found that the use of joint mobilisation alone or in combination with other therapies that include STM, US, TENS and mechanical traction was not effective in the reduction of acute NS-NP but that exercise therapy in combination with cervical joint mobilisation showed an increase in daily function and decrease in pain, this was reiterated by Hoving et al in 2001. In a Level I study performed by Gross et al in 2002 joint mobilisation combined with exercise as well as E.T. was found to be more effective that the use of joint mobilisation in isolation whereas Jensen et al (2007) found a combination of joint mobilisation and mechanical traction should be used alongside exercise therapy to reduce NS-NP in adult patients. A lack of data exists for the use of joint mobilisation alone or in combination with exercise therapy for the treatment of acute non-specific neck pain as most studies studied NS-NP and did not differentiate between acute, sub-acute and chronic pain.

2.14 Mechanical Traction

The effects of traction are mainly mechanical and this treatment must only be used in painful conditions where the mechanical effects of traction (lengthening of the spine via increase in intervertebral disc spaces, joint mobilisation of the vertebral joints and relaxation of spinal muscles) will produce improvement in the patient's symptoms, i.e. in the case of mechanical disorders of the spine and specifically NS-NP (Moeti & Marchetti, 2001). Mechanical traction is frequently used as an adjunct treatment modality in outpatient rehabilitation (Michlovitz and Nolan, 2005) and literature suggests that exercise as an adjunct treatment is useful in maintaining the mechanical effects of traction (Borestein, Wiesel and Boden, 1996). Furthermore, it has been indicated that postural exercises specifically might help to maintain the effects of intermittent mechanical cervical traction on NS-NP (Waldrop, 2006).

Traction is commonly used by physiotherapists in the treatment of lower back pain and the efficacy thereof has been proven in multiple studies (Clarke, van Tulder, Blomberg, de Vet, van der Heijden, Bronfort, Bouter, 2007). The rationale for the use of traction in practice is based on mechanical and spinal reflex mechanisms resulting in reflex lengthening of spinal soft tissues. Spinal lengthening via an increase of intervertebral space and relaxation of the spinal muscles is thought to be the most important of the proposed mechanisms by which mechanical cervical traction could be effective (van der Heijden et al, 1995). Mechanical cervical traction for neck pain is indicated as an intervention for herniated disc, degenerative disc disease and hypo-mobile facet joints all of which are said to be causative factors of NS-NP.

There are varying opinions regarding the application and clinical results obtained from cervical traction and due to a lack of evidence in the available literature, conclusions regarding the efficacy and mechanical effect of traction on the treatment of mechanical neck disorders cannot be made (Moeti & Marchetti, 2001; van der Heijden et al, 1995). The effects of traction on the cervical spine are summarised in Table 2.8.

Table 2.8: Effects of traction on the cervical spine

Source	**Effects of traction on cervical spine**	**Type of study**
Chung et al, 2002	Reduces pain and causes a regression of herniated cervical disk.	RCT (level I evidence)
Cameron, 1999	Distraction of the z-joints; widening of the intervertebral foramen.	Textbook
Saunders, Saunders, Chaska, 2004	Distraction of vertebral bodies, increase in tension of ligamentous and muscular structures that surround the affected segment based on spinal reflex mechanisms.	Textbook
Moeti & Marchetti, 2001	Traction prevents or reduces adhesions within the dural sleeve.	Case series (level IV evidence)
Windsor, Nieves, Sullivan, Hiester, 2004	Reduction of the compression in foramen and intradiscal pressure	Expert opinion (Level V evidence)
Furman, Simon, Puttlitz, Falco, 2007	Traction relieves radicular pain.	Expert opinion (Level V evidence)
www.aetna.com/cpb/medical/data/500_599/0569.html	It inhibits nociceptive impulses, increases mobility and diminishing mechanical stress. As yet these proposed mechanisms have not been supported by enough empirical data.	Expert opinion (Level V evidence)
Van der Heijden et al, 1995	Spinal lengthening d/t an increase in the intervertebral spaces and the relaxation of the paraspinal mm is said to be the most important mechanisms by which traction could be effective.	Systematic review of RCTs (Level II evidence)
Moffett, Hughes, Griffiths, 1990	Cervical traction is one of the most commonly used treatments for neck and arm pain but	RCT (Level I evidence)

Source	Effects of traction on cervical spine	Type of study
	the mechanism is poorly understood.	
Constantoyannis, Konstantinou, Kourtopoulos, Papadakis 2002	Traction reduces the intradiscal pressure. Intermittent traction increases circulation to the tissues and decreases swelling of the tissues and thus reduces the inflammatory response. The gentle alternating stretching and relaxation of the cervical soft tissue prevents scar tissue formation in the dural sleeve.	Case series (Level IV evidence)
Tsao & Pidcoe, 2008	Cervical traction reduces the disc herniation.	Expert opinion (Level V evidence)
Graham, Gross, Goldsmith, Klaber Moffet, Haines, Burnie, Peloso, 2008	Mechanical traction causes parting of the vertebral bodies.	Systematic review of RCTs (Level I evidence)

All of the studies in Table 2.8 indicate the mechanical effects associated with cervical traction but none of these studies could link these effects to clinically relevant outcome measures in literature pertaining to acute NS-NP. While the cause of neck pain might be complex in some cases, neck pain is, for the most part, caused by local mechanical problems such as impairment to joints, discs or soft tissue of the cervical spine. Degenerative disc disease and hypo-mobile cervical facet joints are familiar causes of acute NS-NP as well as muscle and ligament injury that are related to sustained postures or taxing activities (Karnath, 2012). Mechanical traction is indicated for the treatment of herniated discs, degenerative disc disease and hypo-mobile spinal facet joints which are postulated to be the causes of acute NS-NP according to Karnath (2012) and Kisner & Colby (1996). Only three Level I evidence studies could be found on the effects of mechanical traction for the treatment of NS-NP and proposed traction to reduce pain, reduce herniated cervical discs and produce separation of vertebral joints (Chung et al, 2002 and Gross et al, 2008). The increase of intervertebral spaces and relaxation of spinal muscles have been suggested to be the mechanism behind the reduction of NS-NP in a Level II study when mechanical traction was applied (van der Heijden et al, 1995) while Moffet et al (1990) indicated that although cervical mechanical traction is most commonly used for the treatment of neck pain the mechanism by which it reduces pain and increase function is poorly understood. Most of the studies available on the effects of traction are either too dated, have heterogeneous neck pain samples, and are of poor quality (Level IV).

Traction is commonly used for the treatment of NS-NP pain in physiotherapy out-patient practice (Michlovitz & Nolan, 2005) and yet the effectiveness thereof remains restricted and unconvincing (Gross et al, 2002; Graham et al, 2006, van der Heijden et al, 1995). Mechanical traction for the cervical spine can be applied continuously or intermittently (Graham et al, 2006). Continuous traction is found to be effective in the treatment of herniated spinal discs, muscular spasm and restrictions in the soft tissue surrounding the spinal column. Mechanical continuous traction is more effective than manual continuous traction but is limited by the fact that pulleys with weights do not take up the slack well over time to sustain the necessary constant traction on the spinal column. Continuous mechanical traction was also found to be ineffective in creating separation of the vertebrae. Intermittent mechanical traction is traction that is used with a mechanical device with tension that is alternately applied and released. This type of mechanical traction is effective for the treatment of spinal joint hypo-mobility and degenerative disc disease (causes of NS-NP) due to its mobilising effect. No deductions can be made as to whether one form of traction for neck pain is more effective than another or more effective than other forms of conservative treatment approaches. Similarly, no assumptions can be made that traction is not effective in the treatment of neck pain specifically acute NS-NP (Wainner & Gill, 2000). Continuous traction is recommended for severe or acute nerve root symptoms whereas intermittent traction is recommended for gross radiological degenerative changes and seems to be more effective than constant traction, both in terms of popularity and positive outcomes. Intermittent cervical traction is widely reported to have good results in the treatment of cervical pathology with radiating pain (Browder et al, 2004; Constantoyannis et al, 2002; Moeti & Marchetti, 2001; Saal, Saal, Yurth, 1996, Harris, 1997).

Southard (2012) explains the physical effects of mechanical cervical traction to include:

- the gentle stretching of joint capsules which is directly related to the angle of pull of the traction device and the position of the cervical spinal segments;
- enlarged inferior-superior aspects of the cervical intervertebral foramina;
- lengthening of the cervical muscles posterior to the vertebral spine;
- increase blood supply to the soft tissues and cervical discs and
- reduction of intradiscal pressure.

Southard (2012) further proposed that mechanical traction be applied for local joint hypo-mobility and the concomitant increase muscle tone that responds well to manual or positional traction. This is thus a further indication for the use of mechanical cervical traction for acute NS-NP. Although acute stage of injury is a contraindication of mechanical traction it is not to be confused with acute NS-NP where the cause of pain is of mechanical nature and not traumatic in nature as with whiplash.

Side effects of cervical mechanical traction [noted in one of ten trials in a systematic review by Graham et al. (2006)] include headaches, after the application of cervical mechanical traction, as well as an increase in blood pressure and respiratory constraints, caused by the halter of the cervical traction positioned over the tempero-mandibular joint. This particular systematic review by Graham et al in 2006 of five studies started to shift research findings in favour of intermittent mechanical cervical traction, as moderate evidence was found to support the use of intermittent mechanical cervical traction in the reduction of non-specific neck pain in comparison to previous literature that indicated limited evidence of no benefit to patients suffering from NS-NP (Graham et al, 2008). Moderate evidence was found in a single high quality randomised controlled trial and several low quality trials that continuous mechanical traction had no benefit for reducing pain associated with mechanical neck disorders (Graham et al, 2008). No current reviews assess mechanical traction and acute NS-NP (Graham et al., 2008). The contraindications of mechanical traction is set out in the table below (Southard, 2012).

Table 2.9: Contraindication of mechanical traction

Contraindication	Relative Contraindications
Acute conditions such as sprains and strains related to whiplash	Pregnancy
Already weakened soft tissue	Osteoporosis
Joint instability/hypermobility	Hiatal Hernia
Structural disease secondary to infection, tumor	Claustrophobia
Vascular compromise	
Fractures	
Tumors	
Bone disease or infection	
Cardiac conditions	

The only parameters (which are now outdated) for the use of mechanical traction for neck pain were published in 1996 by Erhard. The current parameters are as follows:

Table 2.10: Current parameters used for traction: initial traction characteristics based on movement restrictions of the cervical spine

Movement restriction	**Cervical position**	**Type of force**	**Max:min force ratio**
Capsular	In a flexion position	Gentle oscillatory	5:1
Flexion restriction	In slight pain-free flexion	Minimum and maximum force	2:1
Closing restriction	In a flexion position	Minimum and maximum force	3:1

Southard (2012) describes the angle of pull of the spinal joints for optimal stretch of the joint capsules and cervical muscaluture to be:

- Cervical spine occipit (C1-C2): 0-5 degrees of cervical flexion
- Mid cervical spine (C2-C5): 10-20 degrees of cervical flexion
- Lower cervical spine (C5-C7): 25-30 degress of cervical flexion.

This document also states that continuous mechanical traction is used less often in clinical settings and should be applied for the reduction of intervertebral discs for 10 minutes and for joint mobilisation of cervical facet joints, 15-20 minutes.

The limited amount of literature available regarding the efficacy of mechanical traction for neck pain identifies the following limitations in available RCT's, systematic reviews of RCT's, case series, retrospective reviews and prospective longitudinal studies:

- A lack in efficacy due to a small sample size.
- Poor study design, conduction and a lack of clear-cut descriptions of critical methodological features and results.
- No clinically relevant outcome measures for pain, mobility and functional status are indicated.
- Inadequate selection of the study population as well as inadequate statistical analysis.
- Heterogeneous populations, interventions and outcome measures.

When taking the above studies into account, it is not possible to draw a strong or valid conclusion about the mechanism or evidence of the effects of mechanical traction. The Philadelphia panel (2009) found no reliable data for the use of mechanical traction for acute (<4 weeks) neck pain, which correlated with the findings of the Quebec Task Force (1987). Insufficient evidence exists regarding the use of mechanical cervical traction for the reduction of acute non-specific neck pain either alone or as part of a multi-modal treatment approach.

Table 2.11: Studies pertaining to the efficacy of cervical traction

Source	Intervention	Results	Limitations
Graham et al, 2006	Systematic review of high quality RCTs and quasi-RCTs. The participants were adults who suffered from acute (<30 days), sub-acute (30-90 days) and chronic (>90 days) neck disorders including mechanical neck disorders, whiplash-associated disorders, myofascial neck pain and degenerative changes, neck disorders with headache and neck disorders with radicular symptoms. Interventions included in the review was mechanical traction (whether combined with other treatment modalities or not and whether compared with a control group or not). The outcome measures included were pain relief, disability/function, patient satisfaction and global perceived effect. Ten trials were selected: Seven publications representing six trials which investigated chronic neck pain with some radicular symptoms. Two trials studied acute and chronic	(i)Traction vs. Placebo: Continuous and intermittent traction used for mechanical neck disorders. The diagnostic subgroups and outcomes were similar, but traction types were heterogeneous as continuous and intermittent mechanical traction was studied. (ii)Intermittent traction: moderate evidence of reduction in pain when intermittent traction was used for mechanical neck disorders when compared to control group and placebo. The effects were short-term. (iii) Continuous traction: Static traction vs. placebo and control for chronic mechanical neck disorders revealed moderate evidence of no pain reduction. Studies were small and of poor methodological quality. (iv) Mechanical traction vs. manual traction: limited evidence of no difference from multiple low quality RCTs when intermittent mechanical	Only one high quality RCT in review. Heterogeneous cervical syndromes compared including acute, sub-acute and chronic neck pain. Overall the selected studies were of poor methodological quality with poor blinding and concealment and allocation was poorly described.

Source	Intervention	Results	Limitations
	neck pain. Two trials investigated mixed neck disorders of a sub-acute and chronic nature.	traction was compared to manual traction, continuous traction vs. manual traction and continuous traction vs. placebo for pain relief in mechanical neck disorders. Level II evidence supports the use of intermittent cervical traction for neck pain. Two conclusions were drawn from this review: one favouring the use of intermittent mechanical traction and the other refuting continuous traction for neck pain.	
Taghi Joghataei, 2004	Randomised Controlled Trial (RCT) of 30 patients randomly assigned to receive a treatment program of ultrasound and exercise with or without intermittent cervical traction (level II evidence).	Two groups of patients, one receiving intermittent cervical traction in combination with ultrasound and exercise and the other group receiving only ultrasound and exercise. Both groups received ten treatment sessions with improvement becoming evident in the traction group after only five sessions. The group that received intermittent cervical traction with ultrasound and exercise showed greater increases in grip strength after five treatment	Level II evidence study.

Source	Intervention	Results	Limitations
		sessions. There was no statistically significant difference between the two groups at discharge.	
Saal et al, 1996	Cervical traction and exercise. 26 patients with cervical radiculopathy secondary to cervical disc disease.	92% of the patients avoided surgery due to the combination of cervical traction and exercise for the treatment of cervical radiculopathy and 20 patients indicated good to excellent outcomes post-intervention.	No control group; case series (level IV evidence); Outcome questionnaire used in the study not validated. The study did not investigate which of the conservative treatment methods (medication, traction, exercise, cervical collar) significantly impacted favourable outcome in terms of pain reduction.
Cleland, Childs, Fritz, Whitman, Eberhart, 2007	Prospective cohort study (level II evidence). Ages of participants between 18 and 60 years with a primary complaint of neck pain. No patients with serious pathology were included and the treatment regimen was standardised. 78 patients were included in the study. Identification of a predictor for short-term success in the treatment of	The pre-test probability of success with this regime consisting of mechanical/manual traction, manual therapy and cervical and thoracic manipulation and/or joint mobilisation and deep cervical flexor strengthening, was 53% and the post-test probability for success post intervention was 71%.	The clinical prediction rule needs to be validated by future studies as an objective tool.

Source	Intervention	Results	Limitations
	patients diagnosed with cervical radiculopathy: One of these predictor variables is a multi-modal treatment regime that includes mechanical/manual traction, manual therapy including cervical and thoracic joint mobilisation and/or manipulation and deep cervical flexor strengthening.		
Raney, Peterson, Smith, 2008	Prospective cohort study; a clinical prediction rule to recognise patients suffering from neck pain who were likely to benefit from treatment with cervical mechanical traction was identified by the treatment of 68 patients with six sessions of intermittent mechanical traction.	Five variables as part of the clinical prediction rule were identified: (1) peripheralisation with joint mobilisation of C4-7 (2) positive shoulder abduction test (3) age 55 years or more (4) positive ULTT (5) positive cervical distraction test. If three out of five of these variables tested positive, then the likelihood of success with traction increases from 44% to 79.2%. Four out of five has a positive likelihood of 90.2% of neck pain that is likely to respond to mechanical traction.	No control group.
Cleland et al, 2005	Case series (level IV evidence): 11 patients of all ages were included in the study. Patients who had operations, serious pathology, central	At the six-month follow-up, 91% of patients showed clinically important reduction in perceived pain and increase in function after an average	Poor follow-up and no control group. The same physiotherapist evaluated and treated the

Source	Intervention	Results	Limitations
	nervous system symptoms and systemic diseases were excluded from the study. Manual therapy, cervical mechanical traction and strengthening exercises for 11 patients suffering from cervical radiculopathy.	of 7.1 treatments was reported.	patients with the help of two physiotherapy assistants; no cause-effect relationship conclusions could be drawn due to the study being a case series of low evidence (level IV).
Waldrop et al, 2006	Case series (level IV evidence): 6 patients, ages 40 to 51 years participated. Patients with serious pathology and previous neck surgery were excluded from the study. Intermittent mechanical cervical traction, thoracic thrust, joint manipulation, cervical ROM and strengthening exercises for six patients suffering from cervical radiculopathy. No control group.	A decrease of between 13% and 88% in the perceived disability over an average of 10 treatments. Cannot conclude which treatment modality most effective due to the use of a multi-modal treatment regime.	The patients were examined and treated by the same physiotherapist, which reduces the validity of the study secondary to bias in the tester determining improvement with discharge. The patients could have threatened validity by reporting increased levels of improvement. No control group and no blinding of testers. Level IV evidence.
Moeti & Marchetti, 2001	Case series (level IV evidence): 15 patients were included with a primary complaint of cervical radiculopathy. Patients with serious pathology were excluded. Cervical traction, cervical	Full resolution of symptoms in 53% of the 15 patients with cervical radiculopathy at discharge. Cannot conclude which treatment modality was most effective due to the use of	Various other adjunct therapies were used alongside the traction in this study so the change in the Neck Disability Index

Source	Intervention	Results	Limitations
	retraction exercises, scapular strengthening exercises and joint mobilisation/manipulation for 15 patients suffering from cervical radiculopathy. No control group.	a multi-modal treatment regime.	and Numeric Pain Rating Scale cannot be safely attributed to the use of traction.
Browder, Erhard, Piva, 2004	Case series (level IV evidence) investigating the effectiveness of a multi-modal treatment programme for seven female patients with grade I cervical compressive myelopathy. Intermittent mechanical cervical traction and thoracic manipulation for a median of 9 sessions. VAS scale was used as outcome measure.	Reduction in pain and dysfunction over an average of nine treatments. The median reduction in pain scores was 50 mm at discharge from a baseline of 60 mm at start of treatment on the 100 mm VAS scale.	Level IV evidence.
Van der Heijden et al, 1995	Systematic blinded review of high quality RCTs. 3 studies of good methodological quality were included for neck pain: (i)Intermittent cervical traction vs. Isometric exercises of cervical muscles. (ii)Continuous cervical traction, heat and exercises vs. Sham traction/collar/placebo ultrasound and placebo analgesics. (iii)Continuous/intermittent mechanical	(i)No decrease in pain and disability. (ii)No reduction of pain or disability. (iii)Significant difference in the reduction of pain and dysfunction with mechanical traction only.	Poor description of randomisation process. Small sample size. Incompatible co-interventions. No blinding of patients or outcome measures or assessor, incompatibility of prognosis at baseline.

Source	Intervention	Results	Limitations
	traction and manual traction with heat, education and isometric exercises vs. heat, education and isometric exercises.		
Olivero & Dulebohn, 2002	Retrospective review of 81 patients suffering from cervical radiculopathy (level III evidence). Poor follow-up of patients. No randomisation and no control. Traction and cervical collar for the treatment of cervical radiculopathy.	A 74% success rate (60 out of 81 patients who were treated with traction). No side-effects from cervical traction were reported in the study. 18 cases of the initial 81 were therapeutic failures.	No RCTs which compare operative vs. non-operative treatment. No control group.
Graham N, Gross A, Goldsmith CH, Klaber Moffett J, Haines T, Burnie SJ, Peloso PMJ, 2008	Systematic review of RCTs of neck disorders (with radicular symptoms, headache, whiplash-associated disorders, myofascial neck pain and degenerative changes). Interventions included: (i) Continuous traction vs. Placebo traction. (ii) Continuous traction vs. Placebo tablet. (iii) Continuous traction vs. placebo short-wave diathermy. (iv) Continuous traction vs. Placebo heat. (v)Continuous traction vs. Placebo tablet	(i) Moderate evidence: no reduction of pain. (ii) Moderate evidence: no reduction of pain. (iii) Moderate evidence: no reduction of disability. (iv) Moderate evidence: no reduction in disability. (v) Moderate evidence: no reduction in disability. (vi) None. (vii) Low quality evidence: no statistical difference for reduction of pain for patients with neck pain with radiculopathy, degenerative changes or both.	Studies examining acute, sub-acute and chronic neck pain were included; neck disorders with radiculopathy, neck disorders with headache as well as neck disorders with whiplash associated disorders (grades 1 and 2) were included in the study; high risk of selection bias.

Source	Intervention	Results	Limitations
	(vi) No RCTs on the use of intermittent traction vs. Placebo could be found in the searched databases. (vii) Continuous traction, exercise and education vs. exercise and education. (viii) Intermittent traction, heat, exercise and education vs. heat, exercise and education. (ix) Intermittent traction vs. continuous traction; intermittent and continuous traction vs. manual traction (x)Continuous traction vs. non-steroidal anti- inflammatory medication.	(vii) Low quality evidence that traction decreases pain compared to control group for neck pain with radiculopathy, degenerative changes or both. (viii) Low quality evidence that patients with neck disorders reported less pain when intermittent traction was combined with heat, exercise and education when compared to only exercise, heat and education. (ix) No difference between intermittent and continuous traction or mechanical and manual traction. (x) No pain reduction.	
Fritz & Brennan 2007	Prospective longitudinal study: preliminary examination of a proposed treatment-based classification system to direct the choice of treatment in patients suffering from neck pain. Outcome measures were NDI, NPRS and number of treatments. Treatments received by patients were categorised as being matched or non-matched to the classification of the patients (Figure 2.1 and Table 2.4). Outcomes	113 patients received matched interventions and 161 received non-matched interventions. There were no differences at baseline between the matched and non-matched groups for age, sex, duration of symptoms, NDI and pain rating scores. The group receiving matched interventions had greater pain relief compared to the non-matched group.	The study design prohibited the drawing of conclusions about the effectiveness of the classification system for improving clinical outcome. Lack of standardisation of intervention methods. No random assignment between matched and

Source	Intervention	Results	Limitations
	of patients who received matched treatments were compared to outcomes of non-matched treatments. 274 patients were included in the study. Patients were excluded if they only received one treatment and if they suffered from non-cervicogenic headaches.	Where distal/referred symptoms were present and centralisation of symptoms was needed, two treatments applied: (1) manual/mechanical traction and (2) cervical retraction exercises.	non-matched groups.
Constantoyannis, Konstantinou, Kourtopoulos, Papadakis, 2002	Intermittent ‘on-the-door’ cervical traction; case series (level IV evidence). No control, no blinding. 4 patients included with diagnosis of herniated cervical discs.	The four cases described in this series indicate traction as a possible successful treatment in patients with herniated cervical discs or recurrent episodes of cervical radiculopathy. All four patients were treated with mechanical cervical traction shortly after presentation of symptoms.	Level IV evidence.
Cleland et al. (2003)	11 patients, mean age 51.7 years, with diagnosis of cervical radiculopathy treated with a standardised treatment approach of manual therapy, cervical mechanical traction and strengthening of the deep neck flexors and scapula-thoracic stabilisers.	10 of the 11 patients showed a clinically significant reduction in pain and increase in function after a mean of 7.1 treatment sessions. It can be concluded from this study that a multi-modal treatment approach consisting of joint mobilisation, mechanical traction and exercise will reduce pain and increase function in patients with cervical radiculopathy.	No cause-effect relationships could be detected, due to the study being a case series; level IV evidence.

Source	Intervention	Results	Limitations
Heintz & Hegedus, 2008	One patient, aged 51 years, was treated with 10 physiotherapy sessions over a 13-week period with a treatment regimen consisting of mechanical cervical traction, cervical joint mobilisation and cervical retraction exercises for non-specific neck pain.	The patient reported 0 out of 10 on the VAS after the 3rd physiotherapy session and this was maintained at a 6-week follow-up appointment. Thus the patient had no pain during the remaining seven treatment sessions.	No measurements were taken to document improvement in deep neck flexor strength. It was difficult to determine dosage parameters due to the little evidence available with respect to optimal treatment parameters for non-specific neck pain.

Only three high quality studies were found that investigated the use of mechanical traction for the reduction of pain and increase in function in adult patients suffering from acute NS-NP. Graham et al (2006) found moderate reduction of acute NS-NP with the use of intermittent mechanical traction in the short term and moderate low quality evidence that continuous mechanical traction did not reduce pain in patients suffering from chronic NS-NP. Intermittent mechanical traction combined with exercises was found to have low quality evidence of a reduction in acute NS-NP but so did continuous mechanical traction combined with exercise. When continuous mechanical traction was compared to placebo, other physical modalities and medication moderate evidence of no pain reduction was found (Graham et al, 2008). In a Level II study the use of intermittent mechanical traction, US and exercise showed a definite increase in function after only five sessions of treatment when compared to only US and exercise but no significant difference was seen between the two groups after ten treatment sessions (Taghi Joghataei, 2004). However few these studies are it does lie a basis for the use of mechanical traction combined with exercises for the treatment of acute NS-NP. This premise is further strengthened by the clinical prediction rule set out by Childs et al in 2007 that states that when mechanical traction is used alongside joint mobilisation and exercise for the reduction of NS-NP a pre-test probability of the success of this multimodal treatment regime is 53% and post-test probability of success at discharge of 71% in the short term.

The Australian Acute Musculoskeletal Pain Guidelines Group (2004) indicated moderate evidence to substantiate the positive effect on the reduction of acute NS-NP with a home exercise program with long term effect. This evidence-based guide also provides Level I and II evidence from research studies to confirm that a multimodal treatment regime that consists of cervical joint mobilisation and exercises in combination or exercise and other physiotherapy modalities (US, TENS, mechanical traction, massage etc.) are more effective in reducing acute NS-NP in the short term in comparison with rest, use of cervical collar and single modality approaches. No Level I or II studies could be found on the effect of cervical joint mobilisation in isolation compared to placebo for acute NS-NP and insufficient Level I studies regarding the use of electrotherapy (E.T.) for acute NS-NP compared to placebo was found which means that no conclusion could be drawn on the effectiveness of these therapies when used as single modality treatment approaches for acute NS-NP in adult patients. The Australian Musculoskeletal Pain Guidelines Group (2004) did not find any randomised controlled trials (Level I or II) on the use of mechanical traction whether it be constant or intermittent for the treatment of and effectiveness for acute NS-NP and insufficient evidence that mechanical traction is of no benefit when compared to other physiotherapy interventions when used in isolation for the treatment of acute NS-NP in adult patients.

Despite constant progress in understanding the aetiology of general spinal pain and lower back pain, valid information regarding the causes and effective treatment of neck pain is not available. This is partly due to the fact that neck pain disables a smaller proportion of the population when compared to lower back pain and therefore attracts less research attention and funding. There are also very few population-based studies on neck pain and previous cross-sectional research used broad definitions of neck pain and failed to distinguish between mild and severely disabling cervical conditions. Scarce data on the clinical course, prognosis and treatment of acute neck pain is available (Joeren et al, 1999; Borghouts et al, 1998). More research on the effect of mechanical traction on pain, function, patient satisfaction and on specific subgroups of cervical disorders and symptom duration is necessary in order to guide further clinical practice (Graham et al, 2006).

2.15 Conclusion

Despite the prevalence, poor prognosis, associated risk of disability and economic burden of neck pain, there remains a significant gap in literature that fails to give sufficient, high quality evidence that effectively guides conservative treatment of this specific patient population. This largely stems from poorly understood clinical course of neck pain along with inconclusive results relating to the efficacy of universally used physiotherapy modalities. The lack of trials to guide physiotherapists in clinical practice, forces these therapists to approach the treatment of neck pain with a plethora of interventions that include ultrasound, TENS, massage, manual therapy, therapeutic exercises, traction and functional training.

One reason for the poor outcomes in the studies reported in the physiotherapy literature is that many of the studies researching conservative treatment for the management of neck pain have heterogeneous patient populations and treatment modalities. A lot of the literature has a combination of all or some of the following clinical cervical conditions grouped together in the same clinical trial: acute whiplash, sub-acute and chronic mechanical disorders and chronic cervical headaches. The identification of a homogenous target group would likely enhance the potential to initiate targeted interventions and specifically evaluate responses to the treatment of neck pain.

Despite the high prevalence of mechanical neck pain, a large gap exists in current literature which has failed to provide sufficient, conclusive evidence supporting one specific physiotherapy intervention over another in the conservative treatment of acute, sub-acute and chronic NS-NP. The inconsistencies that currently exist among physiotherapists concerning treatment modalities for mechanical neck pain can largely be blamed on inconclusive evidence. The current trends in research support the use of joint mobilisation combined with exercise and suggest that mechanical intermittent cervical traction in combination with manual therapy and exercise should be considered as a treatment option for neck pain (Childs et al, 2004; Kay, Gross, Goldsmith, Santaguida, Hoving, Bronfort, 2005; Vernon et al, 2005). The efficacy of mechanical traction as treatment modality for neck pain has repeatedly been questioned because literature pertaining to the effectiveness thereof has generally been restricted and unconvincing. More dependable information about the effect of traction on pain and dysfunction related to NS-NP is needed to guide further clinical practice. This study aims to generate more dependable research regarding the use of mechanical traction versus joint mobilisation of the cervical spine for acute NS-NP with respect to secondary treatment outcomes (ultrasound and TENS, exercise and STM).

CHAPTER 3.

METHODOLOGY

3.1 Introduction

The study design, units of analysis, sampling methods and ethical considerations are discussed in this chapter. Furthermore, the research instruments and the statistical methods for analysis are outlined.

3.2 Research question

Which treatment had a better outcome in reducing acute NS-NP in adult patients as measured on the VAS: mechanical traction or joint mobilisation of the cervical spine when used in combination with secondary treatment groups (E.T.; exercise and STM)?

3.3 Aim of the study

Primary Aim: To assess which treatment had a better outcome in reducing acute NS-NP in adult patients as measured on the VAS: mechanical traction or joint mobilisation of the cervical spine when used in combination with secondary treatment categories (E.T., exercise and STM).

Secondary Aim: To assess which combination of treatment modalities most often used in this clinical setting had a better outcome in reducing acute NS-NP in adult patients as measured on the VAS: E.T. or exercise and STM?

3.4 Research hypothesis

Hypothesis: Mechanical traction in combination with secondary treatment categories had a better outcome in reducing acute NS-NP in adult patients as measured on the VAS when compared to cervical joint mobilisation in combination with secondary treatment categories.

Null hypothesis: Mechanical traction in combination with secondary treatment categories did not have a better outcome in reducing acute NS-NP in adult patients as measured on the VAS when compared to cervical joint mobilisation in combination with secondary treatment categories.

3.5 Study design

This study is a retrospective analysis of clinical patient records at the Physiotherapy OPD of the Steve Biko Academic Hospital. The records of patients diagnosed with acute NS-NP from January 2000 up to December 2011 were used. This study utilised information that had been noted in these clinical records for reasons other than research, such as recording evaluation and treatment information and tracking progress (Hess, R. 2004).

This study falls within the quantitative research paradigm. Quantitative research is conclusive in nature as it tries to quantify the research aims and understand how common it is by looking for projectable results to a larger population. It is an investigation into an identified research problem, based on testing a hypothesis calculated with numbers and reviewed by the use of statistical techniques. The quantitative research approach was used in this particular study in order to determine whether the predictive generalisations of treatment effect on acute NS-NP in the adult population of the hypothesis formulated by the principle researcher held true by investigating the different treatment effects of mechanical traction and joint joint mobilisation for acute NS-NP in order to propose the most effective multimodal treatment regime to physiotherapists in clinical settings. Quantitative research was also chosen as the reality of the research is independent of the researcher and can be studied objectively. The research method is based primarily on deductive forms of logic and the study aims were tested in cause-and-effect order. The overall goal of this research method was to determine generalisations that contribute to the research aim and enable the researcher to predict, explain and understand the effect of mechanical traction and joint mobilisation on the treatment of acute NS-NP in adult patients to potentially project to a larger population. Furthermore, this research aimed to describe the characteristics of adult patients suffering from acute NS-NP (Creswell, J.W. 1994) as set out in the following diagram.

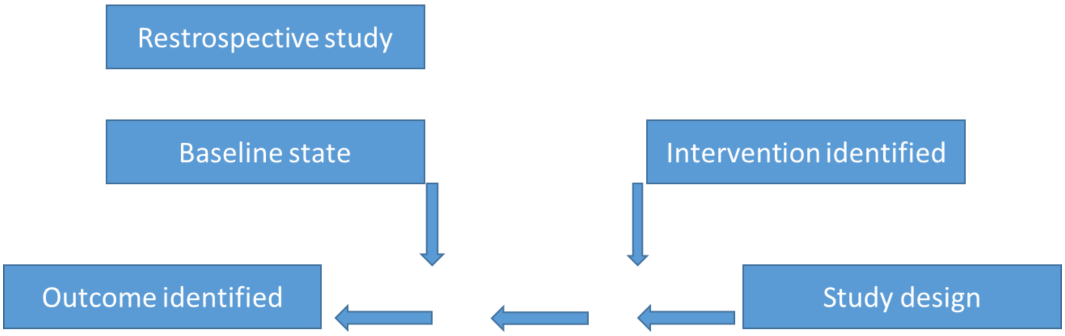

Figure 3.1: Retrospective study design

This study is a descriptive, retrospective review of clinical records and included clinical notes of consulting doctors and physiotherapists. The systematic evaluation of patient records have guided various clinical research projects for over 80 years (Wu & Ashton, 1997). The scientific use of existing clinical records of patients is common in epidemiological studies (Jansen et al, 2005), quality assessment and improvement studies (Allison, Wall, Spettell, Calhoun, Fargason, Kobylinski, Farmer & Kief, 2000), professional education and training, evaluation of patient treatments (Wu & Ashton, 1997), as well as clinical research (Hellings, 2004). This particular study design makes up 25% of all reported scientific articles in medical journals (Worster & Haines, 2004). The advantages of retrospective chart reviews include the fact that it is a relatively inexpensive manner in which to research readily available data and the generation of hypotheses that can be tested prospectively (Hess, 2004; Worster & Haines, 2004). The limitations of a descriptive, retrospective research design are incomplete documentation of patient charts with information that is unrecoverable or unrecorded, as well as a problem in the verification of captured data and discrepancies in the quality of the recorded data among different health care practitioners (Hess, 2004).

Patient records are defined in this study as information that was gathered and generated by a health professional for the sole purpose of providing health care for the personal advantage to the patient. The information noted in the health records has clinical validity and value when collected by a health care professional due to the clinical training and expertise of the health care professional in his/her field. Research records, on the other hand, are records that are amassed for the single reason of providing information in order to prove or disprove a hypothesis with the intent of conducting research (www.eprost.med.miami.edu).

A descriptive research design is the research design of choice when the present day practice, i.e. the use of joint mobilisation for the alleviation of acute NS-NP, is challenged by the use of mechanical traction for the same purposes (Grove, Burns & Gray, 2013).

3.6 Research setting

There is a smaller chance of error or bias in the research study if the research setting can be controlled. The research environment in quantitative research designs can vary from a natural setting that extends no control, i.e. real life, to a highly controlled setting that is designed specifically for conducting research, such as a laboratory. In this particular research study a partially-controlled research environment was chosen which gave the principal researcher some degree of control and ability to manipulate the setting by assuring that the clinical records being researched are as similar as possible, i.e. the Physiotherapy OPD of the Steve Biko Academic Hospital (www.unc.edu/courses/2009fall/nurs).

3.7 Unit of Analysis

The unit of analysis were defined by clinical records of adult patients suffering from acute NS-NP who received physiotherapy treatment at the Physiotherapy OPD of the Steve Biko Hospital.

The unit of analysis consisted of records of patients treated at the Physiotherapy Department of the Steve Biko Hospital for acute, NS-NP during the period 1 January 2000 – 31 December 2010. An eleven-year period ensured that enough records were available to meet the inclusion and exclusion criteria of the study.

3.8 Sampling Method

Probability sampling is considered the best sampling method when following a quantitative research design. It was, however, not possible to use probability sampling for this study due to financial and time constraints. Furthermore, the principal researcher did not have access to a list of the population as the study population was hidden and hard to find among the patient records. Therefore, non-probability sampling was chosen as the sampling method for this study. All of the patient records of the physiotherapy outpatient department (POPD) treated for acute, sub-acute and chronic neck pain and at Steve Biko hospital (SBH) comprised the population; each patient record is a unit of analysis. In order to select a sample from this population, purposive sampling was used.

Purposive sampling is a form of non-probability sampling where the decisions regarding which units of analysis would be included in the study sample is taken by the principal researcher. This decision is based on the specialist knowledge of the principal researcher on the research topic and/or in the research field. Purposive, non-probability sampling was used in this retrospective review study, seeing that specific predefined group/characteristics were targeted. The only negative to purposive sampling is that the researcher would only be able to generate opinions regarding the target population and inference is not possible, as with probability sampling (Jupp, 2006).

Records of adult patients who sought help for acute NS-NP were selected from the Physiotherapy Department at the Steve Biko Hospital for the period 1 January 2000–31 December 2010. Clinical records of patients that had acute NS-NP and no clear underlying cause for their symptoms, such as whiplash- associated disorders, cervical radiculopathy or osteopenia were selected. According to the literature findings, joint mobilisation and mechanical traction are seldom used alone for the treatment of NS-NP, but are combined with other physical therapy modalities [E.T., exercise and STM (Graham et al, 2006)]. From the review of data collected from the clinical records the most prevalent modalities used alongside joint mobilisation and mechanical traction in the treatment of acute NS-NP was E.T. and exercise and STM, therefor these modalities were noted in the study as adjunct treatments and the effect of these adjunct therapies on acute NS-NP was also researched. Therefore these clinical records were divided into two treatment groups: (1) mechanical traction of the cervical spine combined with secondary treatment categories (E.T., exercise and STM) and (2) joint mobilisation of the cervical spine combined with secondary treatment categories (E.T., exercise and STM) in the treatment of acute NS-NP.

Each record was chosen by using purposive sampling and the clinical records chosen for inclusion in the review was chosen by the principle researcher and each member of the population had an equal chance of being in the sample. The selection of the records was done by die principal investigator and was based on the criteria on the data collection sheet (Attached as Appendix 1).

3.8.1 Inclusion and exclusion criteria

The ICF diagnosis for neck pain with mobility deficits and the associated ICD diagnosis for neck pain are confirmed with a reasonable level of certainty when the patient is not older than 50 years and presents with the following signs and symptoms (Childs et al, 2008):

- Acute neck pain (less than 12 weeks);
- Symptoms isolated to the cervical spine; and
- Restricted cervical range of motion.

The information above determined the inclusion and exclusion criteria, as presented in Table 3.1:

Table 3.1: Inclusion and Exclusion Criteria

Inclusion Criteria	**Exclusion criteria**
Adults between 18 and 50 years of age	Cervical fractures/dislocations/ subluxations/instabilities/ radiculopathies/spondylilosthesis
Male/Female	Previous cervical surgery
Limited function of ADL due to pain and/or disability	Vertebral artery insufficiency
Acute neck pain of less than 12 weeks	Osteoporosis/osteopenia
Limited cervical range of motion(ROM)	History of malignancy/rheumatoid arthritis/upper motor neuron signs
Adult patients with acute NS-NP that had 1 or more treatments in a two-week period	Acute cervical sprains/strains or whiplash-associated disorders
	Involvement in litigation/compensation claims
	Incomplete data in the clinical record

After the data collection process it was found that therapists did not note the cervical ROM in the clinical records and as incomplete data was an exclusion criteria for this study limited cervical ROM was then removed as an inclusion criterion, the same was true for limited function in ADL. The final inclusion criteria is reflected in the data collection sheet (Appendix 1).

The following figure represents the sampling method used by the principle researcher:

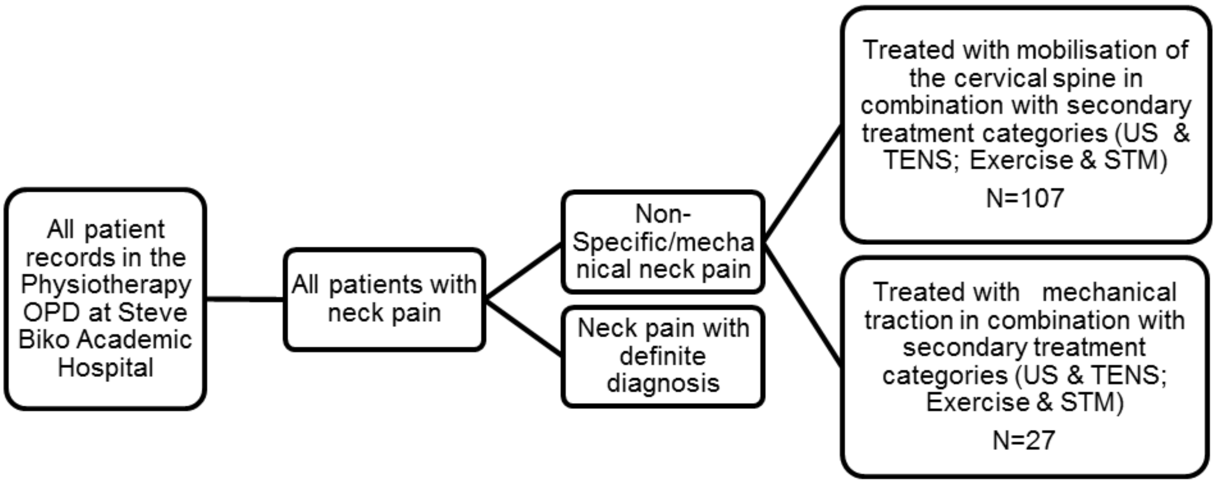

Figure 3.2: Sampling method

3.8.2 Sample size

Factors such as the VAS score at onset of treatment, the VAS score at discharge, any change in the VAS score from onset until discharge, age, and the number of treatment sessions were taken into account as variables. As five such factors were anticipated to play a role, by convention, ten to fifteen subjects needed to be included for each factor, thus 100 units of analysis, 50 for each sample group, were needed make up the sample size of the study. A total of 109 files satisfied the inclusion and exclusion criteria and were included for the joint mobilisation group and 29 files were selected for the traction group as they were the only patients with a clear diagnosis of acute NS-NP who fitted the inclusion criteria treated over a period of eleven years at the SBH POPD. Files were not considered for inclusion if the data captured on the file was incomplete, if the patient only came for one treatment session or if the follow-up appointment was in more than two weeks. Definite diagnosis of cervical radiculopathy, myelopathy, osteo-arthritis and whiplash-associated disorders were excluded; only files with a diagnosis acute NS-NP, acute mechanical neck pain or no diagnosis were included.

3.9 Outcome measures

3.9.1 The Visual Analogues Scale

The *Visual Analogue Scale* (VAS) is used to determine the pain that the patient experienced as recorded in the clinical reports. The VAS is a self-report measure consisting of a vertical or horizontal line anchored with "0" at one end representing "no pain" and "100" at the opposite end representing "the worst pain ever". The VAS represents a continuum of pain intensity and is a 100 mm long and marked at 10 mm intervals. The patient was asked to make a mark somewhere along the line to rate their pain level and the VAS was scored by measuring from "no pain" to the mark made by the patient allowing data that can be analysed with parametrical statistical techniques that increase the statistical power of this review. The VAS is the most commonly used pain intensity measurement in clinical trials and is one of the most reliable measures of pain (Jensen & Karoly, 2001; Jensen, Chen and Brugger, 2003; Ho, Spence and Murphy, 1996).

3.9.1.1 Validity and reliability of the VAS scale

Validity and reliability are the two most important criteria by which a quantitative instrument's adequacy is evaluated (Polit, Beck and Hungler, 2001). Validity refers to the extent to which an instrument measures what is supposed to be measured (Sarantakos, 1997). The validity of an instrument, unlike reliability, is extremely difficult to establish.

The VAS is a reliable and valid measure of pain intensity and the measurement continuum is believed to be more sensitive than a numeric scale. The validity of the VAS is supported by a great amount of evidence for the assessment of pain intensity (Jensen & Karoly, 2001; Jensen et al, 2003; Ho et al, 1996).

Jensen et al (2003) divides the severity of pain on the VAS into the following categories: Mild pain (10 mm–40 mm); Moderate pain (50 mm–60 mm) and severe pain (70 mm–100 mm).

For this retrospective analysis, the data of the VAS were extracted as it is easy to use in different clinical settings, the therapists had precious training in using the scale in a clinical setting, and it is sensitive to the treatment effect. Due to the VAS being a self-report measure it is reproducible in the clinical and research setting (Ho et al, 1996; Kahl & Cleland, 2005). A patient reporting no pain during treatment or a patient who was discharged from treatment, automatically received a VAS score of 0 out of 10.

A 33% decrease in pain is a reasonable standard for a treatment to be deemed acceptable relief (Jensen & Chen, 2003). Todd, Funk, Funk & Bonacci (1996) stated that a 13 mm change in a patient's pain severity on a 100 mm VAS scale, in the case of acute pain, is considered a minimal clinical significant change.

The reliability of the VAS has not been established in its use in out-patient departments where several different physiotherapists apply it to their patients, only in clinical trials

3.9.2 Patient clinical outcomes

The change in the VAS scores from the onset of treatment until discharge was calculated by subtracting the VAS score at discharge from the VAS score at onset of treatment. A 13 mm change in the patient's pain severity as measured on a 100 mm VAS scale was considered to be a minimal clinical significant change in a patient's perceived pain by Todd et al (1996) and Jensen et al (2003). The calculated change in VAS scores was then compared to the 13 mm change needed for a minimum clinically significant change in perceived pain and this was captured as a Yes/No answer on the data collection sheet (Appendix 1).

3.10 Pilot study

A pilot study was done to assess the feasibility of the study in terms of subject availability and time and money spent by the principal researcher. The aim of the pilot study further helped to develop and improve the instruments used for the data capturing and also helped in identifying possible problems with the study design. The pilot study aided in honing the plans for the data collection and analysis for this particular study. No changes were made to the data collection process or the data collection sheet after the pilot study was concluded. The study was found to be feasible with regards to time and funding needed to conduct the study.

3.11 Data collection

All of the physiotherapy records of patients treated at the physiotherapy OPD of the Steve Biko Hospital from 1 January 2000 to 31 December 2011 was screened for eligibility for the study according to the inclusion and exclusion criteria. From these records only the patients with a diagnosis of neck pain of unknown origin or NS-NP neck pain were reviewed for inclusion in the study by the principal investigator. No bias could have occurred due to the clear data collection categories set out in the data collection sheet (Appendix 1).

The validity of the data collection process was captured by conforming to the inclusion and exclusion criteria on which the sample group selection was based. The data was extracted from the physiotherapy patient evaluation forms and captured on the standard data collection sheet. The physiotherapists who treated the patients with mechanical neck pain used a standardised evaluation form that consists of a patient interview history, physical evaluation and clinical notes section.

3.11.1 Data collection sheet

A data collection sheet (attached as Appendix 1) was used to collect the relevant information from the evaluation form. The following data were extracted from the physiotherapist patient evaluation form:

Table 3.2: Variables from data

Variables	**Justification**
Age	Criteria for diagnosis of neck pain with or without mobility deficits; age less than 50 years (Childs et al, 2008). Age is a non-modifiable risk factor for neck pain. A younger patient has a better prognosis for the outcome of treatment (Haldeman et al, 2008).
Occupation	Factors that may influence the duration of dysfunction associated with neck pain include

Variables	Justification
	the physical requirements of patients' jobs (Haldeman et al, 2008). Sedentary, repetitive work is linked to neck and shoulder pain and the type of occupation of the patient is more strongly linked to the site of pain than the gender of the patient (Haldeman et al, 2008; Hellsing et al, 1994). Prolonged postural loads on the cervical spine may increase the risk of neck pain (Edmondston et al, 2007).
Severity of symptoms	Factors that may influence the duration of dysfunction associated with neck pain include the severity of symptoms (Haldeman et al, 2008). Jensen et al (2003) defines severity of pain on the VAS as follows: mild pain (10 mm-40 mm); moderate pain (50 mm-60 mm) and severe pain (70 mm-100 mm).
Mechanical traction of the cervical spine combined with secondary treatment categories (E.T. and exercise and STM) or manipulation and/or joint mobilisation of the cervical spine combined with secondary treatment categories (E.T. and exercise and STM).	Sub-treatment groups of the retrospective analysis.
Number of treatments	In a study performed by Clair et al (2004) results indicated that the number of treatment sessions deemed necessary to reduce pain varies among patients with neck pain and the patient's response to the treatment received did not correlate with the number of physiotherapy sessions received.
Patients suffering from acute NS-NP were divided into two categories: (1)	NS-NP for less than four weeks (Vernon et al, 2005). There exists a statistically significant

Variables	Justification
primary treatment (first time treatment for symptoms) and (2) secondary treatment (patients with an acute episode of symptoms of chronic neck pain diagnosis).	link between the duration of symptoms and the number of previous episodes of neck pain and improvement (Anonymous, 1966). A complaint of acute neck pain on the first treatment was the only outcome variable found to predict favourable outcome in terms of pain relief (Rubenstein, Knol, Leboeuf-Yde, de Koekkoek, Pfeifle, van Tulder, 2008).
Patient clinical outcome	Todd et al (1996) stated that a 13 mm change in a patient's pain severity on a 100 mm VAS scale, in the case of acute pain, is deemed as minimal clinical significance change. Captured as a Yes/No answer on the data collection sheet (VAS at discharge – VAS at onset = change in VAS).

3.12 Statistical considerations

The study set out to compare the outcomes of mechanical traction vs. joint mobilisation in combination with secondary treatment categories (E.T., exercise & STM) for acute NS-NP in adult patients. Descriptive statistics as well as multivariable linear regression was used to analyse the data. The data was analysed by a qualified biostatistician.

3.13 Data Analysis

3.13.1 Descriptive Statistics

Descriptive statistics were calculated for the baseline characteristics of each classification category, including, for continuous variables (age, VAS score at onset of treatment, VAS score at discharge, change in VAS score and number of treatment sessions received), means with standard deviations, frequency, percentage and cross-tabulation for discrete variables (nominal and ordinal), that included the treatment group, secondary treatment categories and clinical outcome.

3.13.2 Multivariate linear regression analysis and logistic regression analysis

Multivariate linear regression analysis was employed to determine the extent to which there is a linear relationship between continuous variables (age, VAS score at onset of treatment, VAS score at discharge, change in VAS score and the number of treatment sessions received) and discrete variables (clinical outcome). This was used to determine whether the change in VAS score was clinically significant for either treatment group with respect to the secondary treatment category.

Logistic regression analysis was used to predict the outcome of a categorical continuous variable (a continuous variable that can take on a limited number of values, the magnitudes of which are not meaningful, but whose ordering of magnitudes may or may not be meaningful) based on one or more predictor variables. Logistic regression measured the relationship between a categorical continuous variable and a discrete variable. Logistic regression was employed to determine which treatment group had a better clinical outcome with respect to the secondary treatment category.

3.14 Ethical consent

The research process was conducted in accordance with the Declaration of Helsinki. Access to clinical records was essential for the completion of this research study and consent was not practical. The research concerned therapeutic intervention which could benefit the patients whose records were studied. It was not anticipated that contact would have been made with patients as a result of the research findings.

Access to the patient records was restricted to specific categories of information, as set out in the data collection sheet (Appendix 1), which was approved by the Research Ethics Committee of the Faculty of Health Sciences. The data collector was formally instructed about his/her duty of confidentiality and signed a declaration stating that all data extracted from patients' files was to be treated confidentially.

Each participant in the study was assigned a unique study number. This number was randomly linked to the data. Names of patients and file numbers do not correlate with the study number. This prevented the documentation of patients' data and protected their identity. The Access to Patients' Data Form, with which the relevant information from the hospital record system was retrieved for this study, was approved by the Chief Executive Officer (CEO) of the Steve Biko Hospital (Appendix 4).

The study received approval from the Research Ethics Committee of the University of Pretoria, approval number: S158/2011.

3.15 Conclusion

In conclusion, a descriptive retrospective analysis was conducted on 109 clinical records of patients suffering from acute NS-NP. Non-probability purposive sampling was done and the outcomes used in this study were the VAS and the assessment of clinical improvement at the end of treatment. The analysis of the data is presented in the next chapter.

CHAPTER 4.

RESULTS

4.1 Introduction

This chapter presents the results of the data analysis in the form of column charts, line charts, pie charts and tables.

4.2 Research Question

Which treatment had a better outcome in reducing acute NS-NP in adult patients as measured on the VAS: mechanical traction or joint mobilisation of the cervical spine when used in combination with secondary treatment groups (E.T., exercise and STM)?

4.3 Research Aim

Primary Aim: To assess which treatment had a better outcome in reducing acute NS-NP in adult patients as measured on the VAS: mechanical traction or joint mobilisation of the cervical spine when used in combination with secondary treatment categories (E.T., exercise and STM).

Secondary Aim: To assess which combination of treatment modalities most often used in this clinical setting had a better outcome in reducing acute NS-NP in adult patients as measured on the VAS: E.T. or exercise and STM?

4.4 Research hypothesis:

Hypothesis: Mechanical traction in combination with secondary treatment categories had a better outcome in reducing acute NS-NP in adult patients as measured on the VAS when compared to cervical joint mobilisation in combination with secondary treatment categories.

Null hypothesis: Mechanical traction in combination with secondary treatment categories did not have a better outcome in reducing acute NS-NP in adult patients as measured on the VAS when compared to cervical joint mobilisation in combination with secondary treatment categories.

4.5 Demographic data

4.5.1 Units of analysis

In total, 136 units of analysis adhered to the inclusion and exclusion criteria and were included for the data analysis: n=107 for the joint mobilisation group and n=29 for the mechanical traction group.

4.5.2 Age

The age range of patients included in the review was 12-78 years of age with most of the patients in the age range of 45-55 years (n=34), followed closely by 25-35 years (n=18) and the least patients in the 5-15 years range (n=1). The mean age 47.62 (SD=14.79) for the joint mobilisation group and 52.52 (SD=11.56) for the traction group.

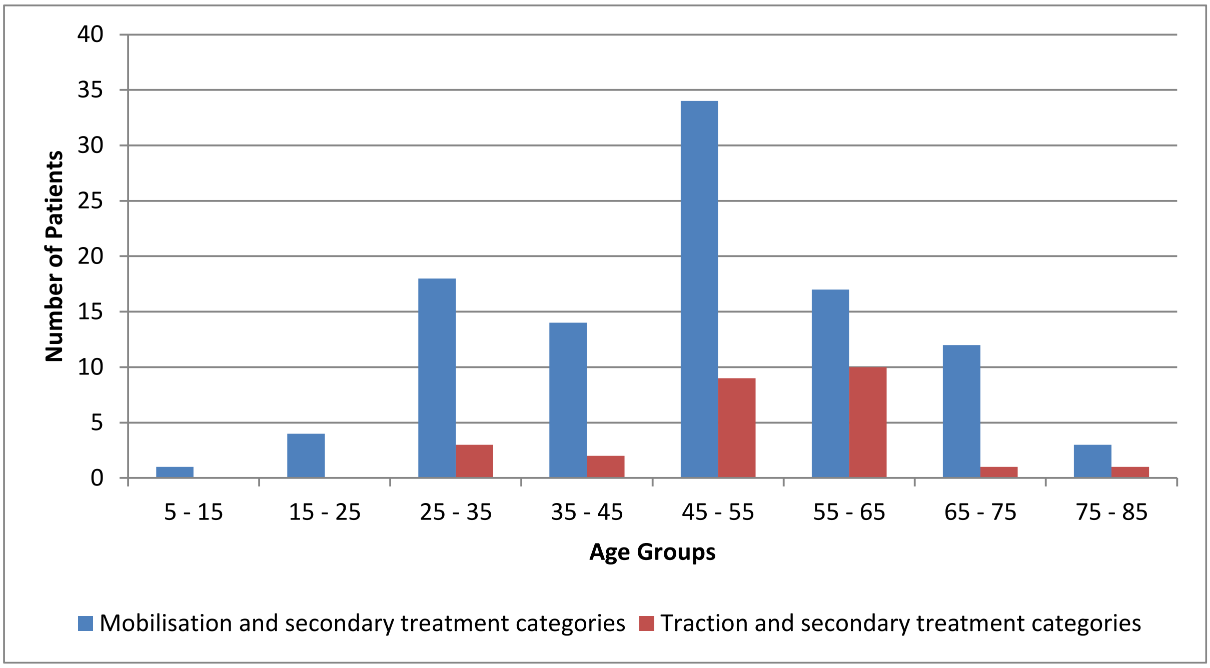

Figure 4.1: Distribution of ages (n=136)

During the analysis of the data it was found that age had no influence on the outcome of the study and therefore all the ages in the units of analysis were included, and the previous inclusion criteria by the ICF and ICD of ages between 18 and 50 was removed to allow for the inclusion of all ages.

4.5.3 Occupation

The units of analysis were divided into three categories with respect to occupation as captured on the data collection sheets: employed, unemployed and pensioners. The data is summarised in Figure 4.2.

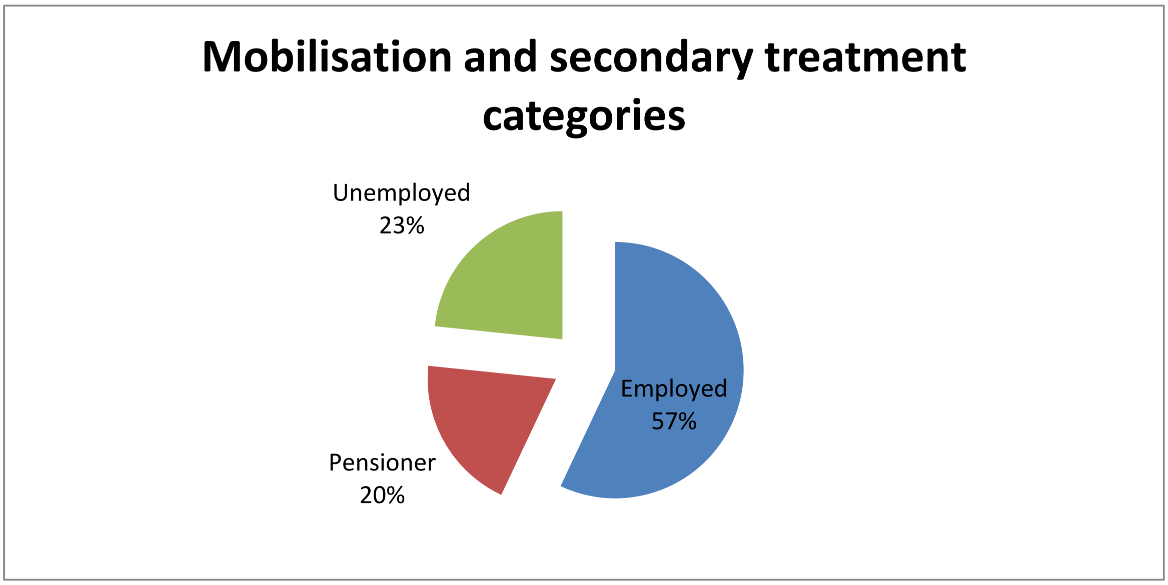

Figure 4.2: Occupation distributions for the joint mobilisation group

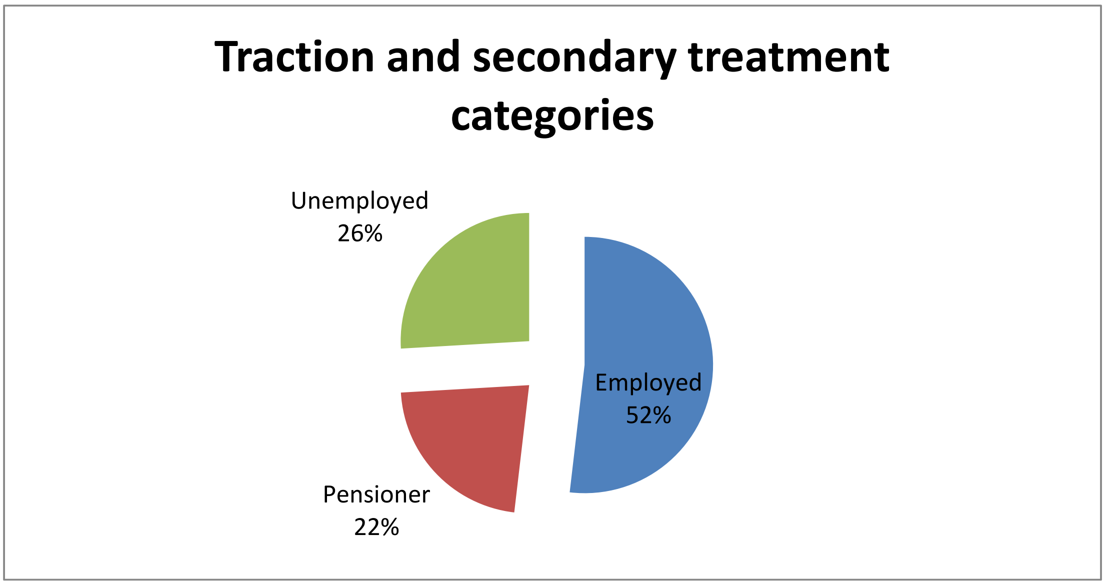

Figure 4.3: Occupation distributions for the traction group

4.6 Descriptive statistics

The summary of the data that was collected used mean, standard deviation, median and range for continuous variables (age, VAS score at onset of treatment, VAS score at discharge, change in VAS score from onset to discharge, age and number of treatments received) and frequency, percentage and cross-tabulation for discrete variables (nominal and ordinal), that included treatment groups, secondary treatment categories and clinical outcome.

4.7 Data collection procedure

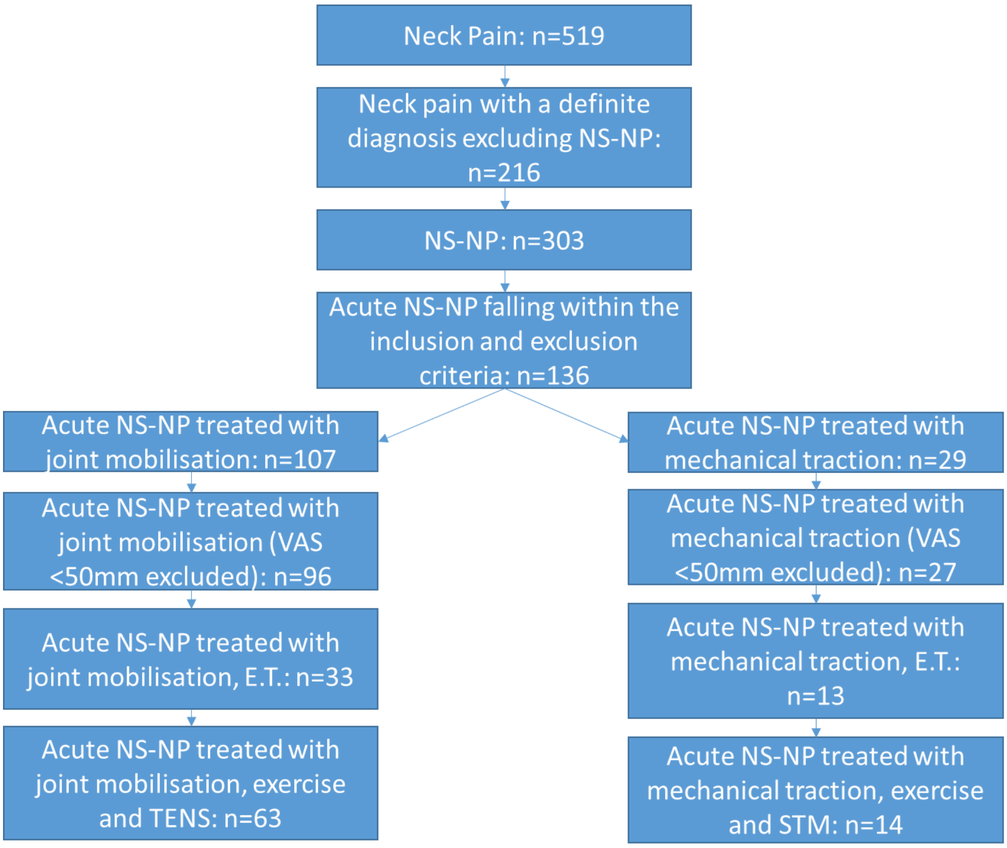

Figure 4.4: Data collection procedure

The above figure details the collection process of clinical records in the Steve Biko Hospital Physiotherapy OPD followed by the principle researcher. All the files at the OPD within the period of January 2000 – December 2010 were checked for a diagnosis of neck pain and 519 files were found. These 519 files were then examined by the researcher and divided into two categories: neck pain with a definite diagnosis excluding NS-NP (n=216) and NS-NP (n=303). The clinical records stating a diagnosis of NS-NP was then further evaluated and only files that fit the inclusion and exclusion criteria was chosen by the researcher (n=136). Due to the small sample of files with a diagnosis of acute NS-NP the principle researcher included all ages in the initial sample instead of the age range set out in the inclusion criteria.

4.8 Summary of collected data

It was apparent from the data analysis that traction was only used as a treatment option if the patient rated their pain on the VAS as being greater than or equal to five out of ten. There was a greater number of units of analysis in the joint mobilisation group with a VAS rating of less than 50 mm, compared to the traction treatment group, and it was thus decided by the biostatistician that a pain rating greater or equal to 50 mm on the 100 mm VAS scale was to be incorporated as a new inclusion criteria for the study for both of the treatment groups. The reason for this is that the data collected from the two treatment groups were homogenous so as to more accurately compare the retrieved data in the joint mobilisation and mechanical traction groups in order to increase the quality of the study.

A total of 109 files were initially included for the joint mobilisation treatment group and 29 files for the traction treatment group, based on the inclusion and exclusion criteria. From the joint mobilisation group 13 files were excluded from the study due to the VAS score at onset being ≤50mm on a 100 mm scale and two files were excluded from the traction group for the same reason. The final number of units of analysis that was included in the study was 96 units in the joint mobilisation group and 27 units in the traction group. The following data was summarised from these units of analysis:

Table 4.1: Summary of treatment groups and outcome variables

Outcome variables	**Joint mobilisation [n=96] Mean (SD)**	**Traction [n=27] Mean (SD)**
Age	47.62 (14.79)	52.52 (11.56)
VAS score at onset of treatment	7.62 (1.61)	7.85 (1.23)
VAS score at discharge	3.67 (3.03)	4.78 (3.01)
Change in VAS score from onset to discharge	3.94 (2.87)	3.07 (3.06)
Number of treatment sessions	3.49 (1.99)	4.33 (2.92)

The data summarised in Table 4.1 indicate that the mean age for the joint mobilisation treatment group was 47.62 years with a standard deviation of 14.79 years. The mean VAS score at the onset of treatment for the joint mobilisation group was 76.2 mm on a 100 mm VAS with a standard deviation of 16.1 mm. The mean VAS score at discharge in the joint mobilisation treatment group was 36.7 mm with a standard deviation of 30.3 mm, which shows a mean change of 39.4 mm in the VAS score, with a standard deviation of 28.7 mm.

The traction treatment group showed a mean age of 52.52 years with a standard deviation of 11.56 years. The VAS score at the onset of treatment had a mean of 78.5 mm with a standard deviation of 12.3 mm with the VAS discharge score showing a mean of 47.8 mm with a standard deviation of 30.3 mm. The overall change in the VAS score for the traction group showed a mean of 30.7 mm with a standard deviation of 30.6 mm on a 100 mm VAS. The mean change of 30.7 mm indicated a clinically significant change in the VAS score when traction was combined with secondary treatment categories (E.T., exercise and STM).

This data indicates that there is no significant difference (less than 3%) in the VAS score at onset of treatment between the two treatment groups after the data was adjusted for joint mobilisation onset VAS scores ≤ 5. The VAS onset scores for joint mobilisation was 76.2 mm (SD=1.61) and for traction it was 78.5 mm (SD=1.23). The VAS scores at discharge indicate that the joint mobilisation group (mean 36.7 mm; SD=3.03) had a better reduction in pain when compared to the traction group (mean 47.8 mm; SD=3.02). The overall change in the VAS scores was greater for the joint mobilisation group with a mean of 39.4 mm (SD=2.87) than it was for the traction group with a mean of 30.7 mm (SD=3.06) on a 100 mm VAS scale. On average, the traction group received more treatment sessions (mean 4.33; SD=2.92) than the joint mobilisation group (mean 3.49; SD=1.99).

Multivariable linear regression was employed to assess treatment groups and secondary treatment categories with respect to the change in the VAS score. Age, VAS score at the onset of treatment and the number of treatment sessions were considered as possible confounders. No interaction was found to be present between the primary treatment groups and the secondary treatment categories.

Table 4.2: Summary of secondary treatment categories and outcome variables

Outcome Variables	E.T. [n=46] Mean (SD)	Exercise & STM [n=77] Mean (SD)
Age (in years)	51.35 (14.89)	47.10 (13.70)
VAS score at onset of treatment	7.78 (1.56)	7.60 (1.52)
VAS score at discharge	4.78 (2.99)	3.40 (2.90)
Change in VAS score from onset to discharge	3.00 (3.03)	4.20 (2.78)
Number of treatment sessions	3.74 (2.23)	3.64 (2.27)

The mean age for the E.T. group was 51.35 years with a standard deviation of 14.89 years, while the exercise % STM group had a mean age of 47.10 years with a standard deviation of 13.70 years. The VAS score at the onset of treatment for the E.T. group was 77.8 mm on a 100 mm VAS (SD=1.56) and the exercise and STM group was 76.0 mm (SD=1.52). The VAS score at discharge for the E.T. group had a mean of 47.8 mm with a standard deviation of 2.99 mm and the exercise and STM group had a mean VAS score of 34.0 mm with a standard deviation of 2.99 mm. The E.T. group had a mean change in the VAS score of 30.0 mm (SD=3.03), the exercise and STM group showed a mean change of 42.0 mm (SD=2.78) in the VAS score. The mean number of treatments for the E.T. group was 3.74 treatment sessions with a standard deviation of 2.23 and the exercise and STM group had a mean of 3.64 treatment sessions with a standard deviation of 2.27.

When the secondary treatment categories were compared to the mean age for the E.T. group, it was found to be 51.35 years with a standard deviation of 14.89 years and the mean age for the exercise and STM was 47.10 years with a standard deviation of 13.70 years. There was no significant difference (less than 3%) between the VAS onset scores of the E.T. group (mean 77.8 mm; SD=1.56) and the exercise and STM group (mean 76.0 mm; SD=1.52). There was, however, a significant difference in the VAS score at discharge between the E.T., with the exercise and STM group showing a mean of 34.0 mm (SD=2.99) and the E.T. group a mean of 47.8 mm, indicating that exercise and STM, when combined with either of the primary treatment groups, had a better outcome. The overall change in the VAS score was better for the exercise and STM group (mean of 42.0 mm, SD=2.78) with a mean change in the VAS score for the E.T. group of 30.0 mm (SD=3.03). There was no significant difference in the number of treatment sessions between the E.T. group (mean 3.74; SD=2.23) and the exercise and STM group (mean 3.64; SD=2.27).

The primary treatment groups and secondary treatment categories were assessed with respect to clinical improvement (indicated by a change of VAS score of more than 13 mm on a 100 mm scale and captured on the data sheet as a Yes/No answer) using multivariable regression. Age, VAS score at onset of treatment, and the number of treatment sessions were considered as possible confounders. No interaction was found to be present between the primary treatment groups and secondary treatment categories.

A total of 74 patients (77.08%) in the joint mobilisation group showed a clinical improvement with 22 (22.92%) patients in this group experiencing no clinically significant change in their pain from the onset of treatment until discharge. Of the 27 units of analysis in the traction group, 55.56% (n=15) showed a clinical improvement with regards to a reduction in their perceived pain, while 44.44% (n=12) of the traction group did not show clinical improvement in their symptoms.

4.9 Confounding variables

The treatment groups and secondary treatment categories were assessed with respect to clinical improvement of perceived pain using multivariable regression analysis. Age, VAS score at the onset of treatment and the number of treatments received were considered as possible confounding variables. After the data was analysed, only the number of treatments were found to be a confounding variable by the biostatistician using regression analysis as it could influence the outcome of the data. No interaction was present between the primary treatment groups and the secondary treatment categories.

Table 4.3: Summary of primary treatment groups and secondary treatment categories with respect to age as a variable if VAS at onset > 4 & VAS at onset < 12

Secondary treatment categories	**Joint mobilisation group**	**Traction group**	**Total**
E.T.	33 (n) 50.30 (Mean) 15.05 (SD)	13 (n) 54.00 (Mean) 14.75 (SD)	46 (n) 51.35 (Mean) 14.89 (SD)
Exercise & STM	63 (n) 42.21 (Mean) 14.57 (SD)	14 (n) 51.14 (Mean) 7.88 (SD)	77 (n) 47.10 (Mean) 13.70 (SD)
Total	96 (n) 47.62 (Mean) 14.79 (SD)	27 (n) 52.52 (Mean) 11.56 (SD)	123 (n) 48.69 (Mean) 14.24 (SD)

Table 4.3 is a summary of all the data from the joint mobilisation treatment group as well as the traction treatment group with respect to the secondary treatment categories (E.T., exercise and STM) with age as a variable, as discussed in the data analysis section.

Table 4.4: Summary of primary treatment groups and secondary treatment categories with respect to VAS at onset as a variable if VAS at onset > 4 & VAS at onset < 12

Secondary treatment categories	**Joint mobilisation group**	**Traction group**	**Total**
E.T.	33 (n) 7.73 (Mean) 1.59 (SD)	13 (n) 7.92 (Mean) 1.55 (SD)	46 (n) 7.78 (Mean) 1.56 (SD)
Exercise & STM	63 (n) 7.56 (Mean) 1.63 (SD)	14 (n) 7.79 (Mean) 0.90 (SD)	77 (n) 7.60 (Mean) 1.52 (SD)
Total	96 (n)	27 (n)	123 (n)

	7.62 (Mean) 1.61 (SD)	7.85 (Mean) 1.23 (SD)	7.67 (Mean) 1.54 (SD)

Table 4.4 is a summary of all the data from the joint mobilisation treatment group as well as the traction treatment group with the VAS score at the onset of treatment as the variable with respect to the secondary treatment categories (E.T., exercise and STM) as discussed in the data analysis section.

Table 4.5: Summary of primary treatment groups and secondary treatment categories with respect to VAS at discharge as a variable if VAS discharge > 4 & VAS onset < 12

Secondary treatment categories	**Joint mobilisation group**	**Traction group**	**Total**
US & TENS	33 (n) 4.49 (Mean) 2.99 (SD)	13 (n) 5.54 (Mean) 2.96 (SD)	46 (n) 4.78 (Mean) 2.99 (SD)
Exercise & STM	63 (n) 3.25 (Mean) 2.99 (SD)	14 (n) 4.07 (Mean) 3.00 (SD)	77 (n) 3.40 (Mean) 2.99 (SD)
Total	96 (n) 3.67 (Mean) 3.03 (SD)	27 (n) 4.78 (Mean) 3.02 (SD)	123 (n) 3.92 (Mean) 3.05 (SD)

Table 4.5 is a summary of all the data from the joint mobilisation treatment group as well as the traction treatment group with respect to the secondary treatment categories (E.T., exercise and STM) as discussed in the data analysis section. The VAS score at discharge from treatment is the variable in this case.

Table 4.6: Summary of primary treatment groups and secondary treatment categories with respect to the change in VAS as a variable if VAS onset > 4 & VAS onset < 12

Secondary treatment categories	**Joint mobilisation group**	**Traction group**	**Total**
E.T.	33 (n) 3.24 (Mean) 2.99 (SD)	13 (n) 2.39 (Mean) 3.15 (SD)	46 (n) 3.00 (Mean) 3.03 (SD)
Exercise & STM	63 (n) 4.31 (Mean) 2.75 (SD)	14 (n) 3.17 (Mean) 2.95 (SD)	77 (n) 4.20 (Mean) 2.78 (SD)
Total	96 (n) 3.94 (Mean) 2.87 (SD)	27 (n) 3.07 (Mean) 3.06 (SD)	123 (n) 3.75 (Mean) 2.92 (SD)

Table 4.6 is a summary of all the data from the joint mobilisation treatment group as well as the traction treatment group with respect to the secondary treatment categories (E.T., exercise and STM) as discussed in the data analysis section. Change in the VAS score from onset to discharge was the variable in this case.

Table 4.7: Summary of primary treatment groups and secondary treatment categories with respect to number of treatments received as a variable if VAS onset > 4 & VAS onset < 12

Secondary treatment categories	**Joint mobilisation group**	**Traction group**	**Total**
E.T.	33 (n) 3.58 (Mean) 2.14 (SD)	13 (n) 4.15 (Mean) 2.48 (SD)	46 (n) 3.74 (Mean) 2.23 (SD)
Exercise & STM	63 (n)	14 (n)	77 (n)

	3.44 (Mean) 1.92 (SD)	4.50 (Mean) 3.37 (SD)	3.64 (Mean) 2.27 (SD)
Total	96 (n) 3.49 (Mean) 1.99 (SD)	27 (n) 4.33 (Mean) 2.92 (SD)	123 (n) 3.68 (Mean) 2.24 (SD)

Table 4.7 is a summary of all the data from the joint mobilisation treatment group as well as the traction treatment group with respect to the secondary treatment categories (E.T., exercise and STM) as discussed in the data analysis section. The number of treatment sessions received is the variable in this case.

4.10 Interaction effect

Multivariable linear regression analysis was used to evaluate the treatment groups (traction and joint mobilisation) and the secondary treatment categories (E.T., exercise and STM) with respect to change in the VAS score, age, VAS score at onset of treatment and the number of treatments received. No interaction was present between the treatment groups and the secondary treatment categories with respect to the following variables: age, VAS score at onset of treatment, VAS score at discharge from treatment, change in VAS score and the number of treatments received as seen in the following linear graphs.

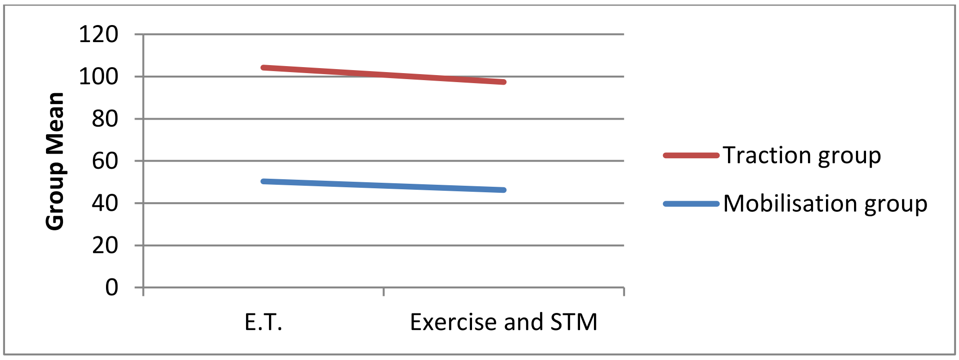

Figure 4.5: No interaction between the treatment groups and the secondary treatment categories with respect to age as a variable

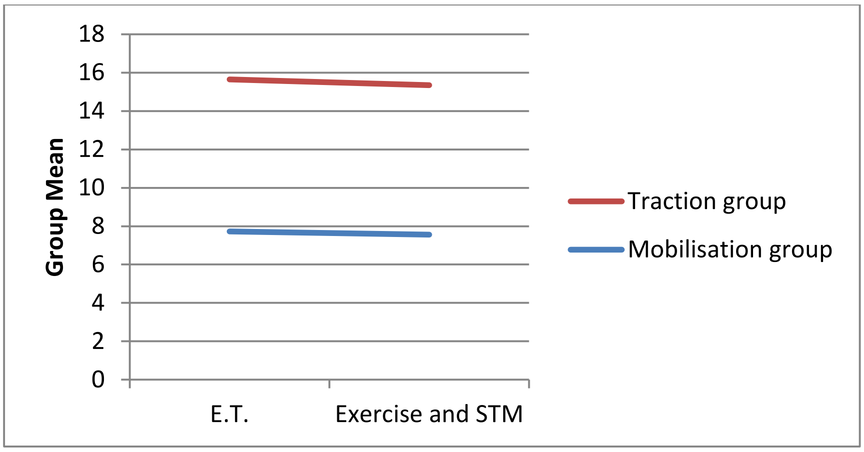

Figure 4.6: No interaction between the treatment groups and the secondary treatment categories with respect to the VAS score at onset of treatment as a variable

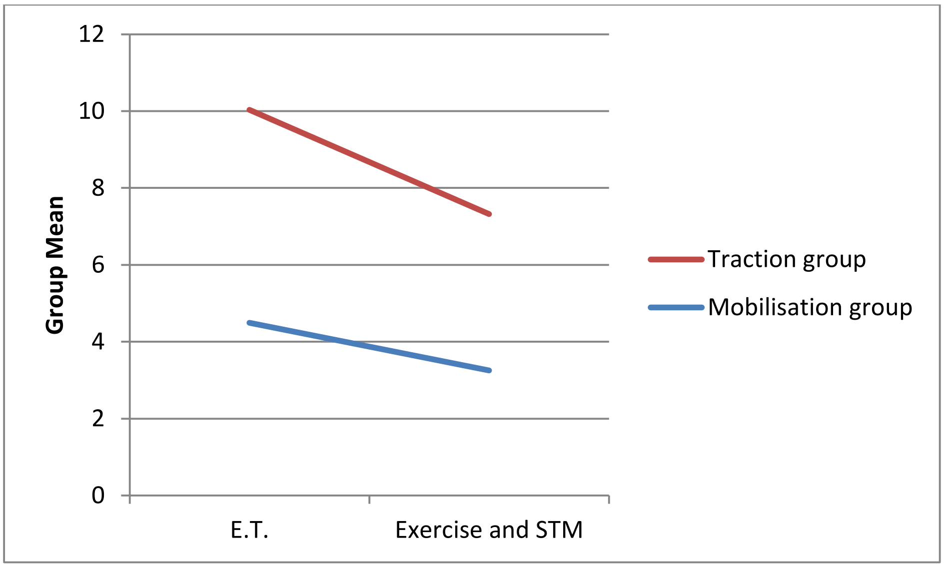

Figure 4.7: No interaction between the treatment groups and the secondary treatment categories with respect to the VAS score at discharge from treatment as a variable

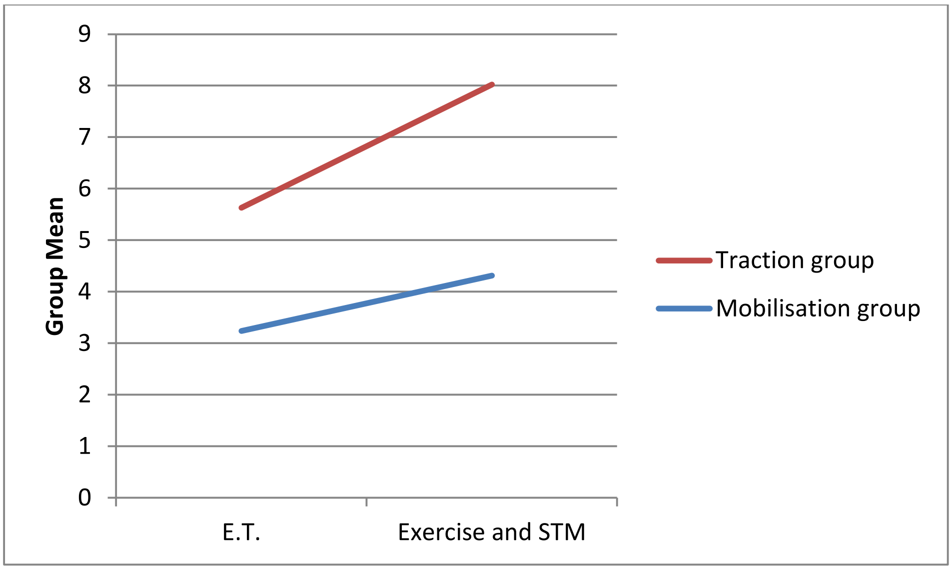

Figure 4.8: No interaction between the treatment groups and the secondary treatment categories with respect to the change in the VAS score as a variable

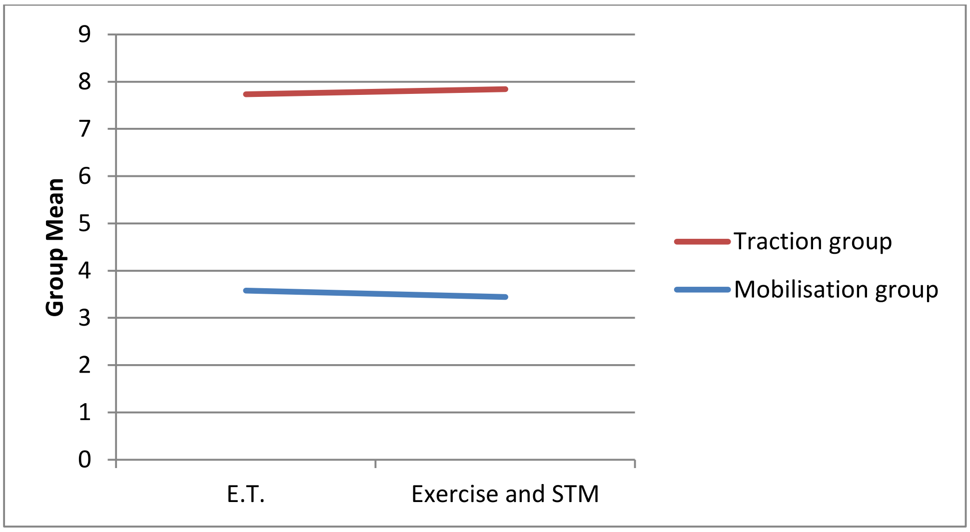

Figure 4.9: No interaction between the treatment groups and the secondary treatment categories with respect to the number of treatment sessions received as a variable

4.11 Treatment Outcomes

The treatment outcomes for this study included facilitating a change in VAS score and ensuring clinical improvement.

Regression analysis is a statistical technique used to estimate the relationships among variables when the focus is on a relationship between a discrete variable, i.e. a clinical outcome measured as yes/no, and a continuous variable, in this case the change in VAS scores. Multivariable linear regression analysis was employed in the data analysis of this study.

Multivariable regression analysis was used to test whether age, VAS scores at onset of treatment and the number of treatment sessions received were confounding variables with respect to the change in VAS scores when the treatment groups and the secondary treatment categories were analysed.

4.11.1 Change in the VAS scores

The change in VAS scores is a continuous outcome in the study. The following tables show the multivariable linear analysis of data with respect to the change in VAS scores. A continuous variable is defined as an outcome that is measured on a scale that varies continuously, i.e. for any two valid continuous measurements there is always one in-between. Continuous outcomes include outcomes that are numerical, such as the change in the VAS scores (The Cochrane Collaboration). The following legend can be used to read the data in Table 4.8 to Table 4.13.

Regression analysis legend:	
Abbreviation used in tables:	**Meaning:**
SS	sample size
df	data field
MS	mean squared
MSE	standard mean error
F	phi coefficient
Prob	Probability
R-squared/R2	coefficient of determination
Adj	Adjusted
t	t-value/mean
conf	Confindence
rx	Treatment
c-2	secondary categories
P>ltl	p-value/statistical significance
LR	likelihood ratio
chi2	chi squared
z	z-score/standard deviation

Table 4.8: Regression analysis indicating the change in VAS score for the primary treatment group and secondary treatment categories with respect to VAS at onset, age, number of treatments received if VAS onset > 4 & VAS onset < 12

Source	SS	df	MS		Number of Obs	123
Model	180.93	5	36.19		F(5,117)	4.92
Residual	859.75	117	7.35		Prob > F	0.004
Total	1040.69	122	8.53		R-squared	0.17
					Adj R-squared	0.14
					Root MSE	2.71
Change in VAS	Coefficient	Standard Error	t	P>|t|	95% Conf	Interval
1 group	-0.99	0.61	-1.63	0.11	-2.2	0.21
1 sec_rx_c-2	1.1	0.51	2.14	0.04	0.08	2.12
vas_onset	0.2	0.17	1.21	0.23	1.29	0.54
age	-0.02	0.02	-1.04	0.3	-0.54	0.02
no_rx	0.38	0.11	3.29	0.001	0.15	0.6
_cons	1.23	1.73	0.71	0.48	-2.21	4.67

Age was not found to be statistically significant (p=0.3) and was excluded from the data analysis. The regression analysis was run without age as a variable, the findings of which are detailed in Table 4.9.

Table 4.9: Regression analysis indicating the change in VAS score of the primary treatment groups and secondary treatment categories with respect to VAS at onset and number of treatment received if VAS onset > 4 & VAS onset < 12

Source	SS	df	MS		Number of Obs	123
Model	173.06	4	43.26		F(5,117)	5.88
Residual	867.63	118	7.35		Prob > F	0.0002
Total	1040.69	122	8.53		R-squared	0.17
					Adj R-squared	0.14
					Root MSE	2.71
Change in VAS	Coefficient	Standard Error	t	P>|t|	95% Conf	Interval
1 group	-1.08	0.6	-1.8	0.07	-2.28	0.11
1 sec_rx_c-2	1.17	0.51	2.31	0.02	0.17	2.18
vas_onset	0.23	0.17	1.41	0.16	-0.94	0.56
no_rx	0.38	0.11	3.34	0.001	0.16	0.61
_cons	0.06	1.32	0.05	0.96	-2.55	2.67

VAS at onset of treatment was not found to be statistically significant with a p value of 0.16 and was excluded as a variable from further analysis.

The traction group received more treatment sessions overall when compared to the joint mobilisation group and this was found to be statistically significant (p=0.001; 95% CI). The data was adjusted accordingly. With a p value of 0.30 (95% CI) and a VAS score at the onset of treatment of p=0.16; 95% CI, age was not found to be statistically significant. The data was analysed again after making adjustments for the number of treatments received and the following was found:

Table 4.10: Regression analysis of the change in VAS scores for the primary treatment groups and secondary treatment categories with respect to the number of treatments received if VAS onset > 4 & VAS onset < 12

Change in VAS	Coefficient	Standard Error	t	P>|t|	95% Conf	Interval
1 group	-1.07	0.6	-1.77	0.08	-2.3	0.13
1 sec_rx_c-2	1.14	0.51	2.23	0.03	0.13	2.15
no_rx	0.42	0.11	3.79	0	0.2	0.64
_cons	1.73	0.58	2.95	0.004	0.57	2.88

The treatment groups are marginally different (p=0.08) with respect to change in the VAS scores (means adjusted for number of treatments received: 3.48 for the joint mobilisation group vs. 2.77 for the traction group).

The secondary treatment categories differ significantly (p=0.03) with respect to the change in VAS scores (means adjusted for the number of treatments received: 2.74 for the joint mobilisation group and 3.88 for the traction group).

No interaction was found between the treatment groups and the secondary treatment categories with respect to the change in VAS scores, as discussed earlier in this chapter.

4.11.2 Clinical outcome

Clinical outcome as measured by a Yes/No answer according to the reduction of pain from onset to discharge as set out in the change of VAS scores is a discrete variable because it can only assume a countable, finite number of values. Logistic regression was used to predict the outcome of the discrete variable, clinical outcome. Logistic regression measured the relationship between the continuous variable or change in VAS scores and the discrete variable, i.e. clinical outcome, by using probability scores as the predicted values of the continuous variable.

Table 4.11: Logistic analysis with regards to clinical improvement in the primary treatment groups and secondary treatment categories with VAS at onset, age and number of treatments received as variables if VAS onset > 4 & VAS onset < 12

Logistic regression					Number of Obs	123
					LR chi2 (5)	22.62
					Prob > chi2	0.004
Log likelihood = -59.10					Pseudo R2	0.16
Clinical implication	Odds Ratio	Standard Error	z	P>|z|	95% Conf	Interval
1 group	3.1	1.65	2.12	0.03	1.09	8.83
1 sec_rx_c-2	0.41	0.19	-1.91	0.06	0.17	1.02
vas_onset	1.06	0.17	0.37	0.71	0.78	1.44
age	1.01	0.02	0.79	0.43	0.98	1.05
no_rx	0.55	0.12	-2.85	0.004	0.37	0.83

The VAS score at onset of treatment (p value of 0.71) was not found to be clinically significant and was excluded in the following round of data analysis.

Table 4.12: Logistic analysis with regards to clinical improvement in the primary treatment groups and secondary treatment categories with age and the number of treatments received as variables if VAS onset > 4 & VAS onset < 12

Logistic regression					Number of Obs	123
					LR chi2 (5)	22.49
					Prob > chi2	0.0002
Log likelihood = -59.26					Pseudo R2	0.16
Clinical implication	Odds Ratio	Standard Error	z	P>|z|	95% Conf	Interval
1 group	3.1	1.65	2.12	0.03	1.09	8.81
1 sec_rx_c-2	0.41	0.19	-1.92	0.06	0.17	1.02
age	1.01	0.02	0.76	0.45	0.98	1.05
no_rx	0.56	0.11	-2.85	0.004	0.38	0.83

Age was not clinically significant with regards to clinical outcome for the primary treatment groups or the secondary treatment categories, and was excluded as a variable.

The data was adjusted for the number of treatments received, as it was found to be clinically significant with a p value of 0.004. Age (p=0.45) and the VAS scores at onset (p=0.71) were not clinically significant and were not taken into account in the final data analysis.

Table 4.13: Logistic analysis of the clinical improvement for the primary treatment groups and secondary treatment categories with the number of treatments as variable if VAS onset > 4 & VAS onset < 12

Logistic regression					Number of Obs	123
					LR chi2 (5)	21.91
					Prob > chi2	0.0001
Log likelihood = -59.55					Pseudo R2	0.16
Clinical implication	**Odds Ratio**	**Standard Error**	**z**	**P>|z|**	**95% Conf**	**Interval**
1 group	3.26	1.72	2.24	0.03	1.16	9.15
1 sec_rx_c-2	0.39	0.18	-2.06	0.04	0.16	0.96
no_rx	0.56	0.11	-2.89	0.004	0.38	0.83

Traction has an increased risk for a poor clinical outcome (OR=3.26; 95% CI; 1.16-9.15), i.e. relative to the joint mobilisation group, the traction group had a 3.26-fold increase in risk for poor clinical outcome. Relative to E.T., exercise and STM was preventative of a poor clinical outcome (OR=0.39; 95% CI; p=0.04; 0.16-0.96).

4.12 Conclusion

A total of 123 units of analysis consisting of 96 units of analysis in the joint mobilisation group and 27 units of analysis in the traction group adhered to the initial and adjusted inclusion and exclusion criteria. The VAS scores at onset were a mean of 76.2 mm and 78.5 mm for the joint mobilisation group and the traction group respectively. The VAS scores at discharge from treatment were a mean of 36.7 mm for the joint mobilisation group and 47.8 mm for the traction group with an overall change in the VAS scores being a mean of 39.4 mm and 30.7 mm for the joint mobilisation group and traction group respectively. The number of treatments received was a mean of 3.49 sessions for the joint mobilisation group and 4.33 sessions for the traction group. A total of 46 units of analysis received E.T. as an additional treatment modality and 77 units of analysis received exercise and STM. The overall change in VAS scores had a mean change of 30.0 mm and 42.0 mm for the E.T. category, and exercise and STM category respectively. No interaction could be detected between the primary treatment groups and the secondary treatment categories during the data analysis.

CHAPTER 5.

DISCUSSION

5.1 Introduction

This chapter discussed the results of the data analysis and compares the results to previous studies examined during the literature review in Chapter 2.

5.2 Research question

Which treatment had a better outcome in reducing acute NS-NP in adult patients as measured on the VAS: mechanical traction or joint mobilisation of the cervical spine in combination with secondary treatment groups (E.T., exercise and STM)?

5.3 Research aim

Primary Aim: To assess which treatment had a better outcome in reducing acute NS-NP in adult patients as measured on the VAS: mechanical traction or joint mobilisation of the cervical spine with respect to secondary treatment categories (E.T., exercise and STM).

Secondary Aim: To assess which combination of treatment modalities most often used in this clinical setting had a better outcome in reducing acute NS-NP in adult patients as measured on the VAS: E.T. or exercise and STM?

5.4 Research hypothesis

Hypothesis: Mechanical traction in combination with secondary treatment categories had a better outcome in reducing acute NS-NP in adult patients as measured on the VAS when compared to cervical joint mobilisation in combination with secondary treatment categories.

Null hypothesis: Mechanical traction in combination with secondary treatment categories did not have a better outcome in reducing acute NS-NP in adult patients as measured on the VAS when compared to cervical joint mobilisation in combination with secondary treatment categories.

5.5 Demographic data

5.5.1 Units of Analysis

A total of 136 units of analysis were collected in adherence to the inclusion and exclusion criteria as set out in Chapter 3. A total of 107 units of analysis were included for the joint mobilisation treatment group and 29 units of analysis were included for the mechanical traction treatment group.

During the data analysis, the inclusion and exclusion criteria were revised and amended to exclude the age limit criteria of 18-55 years, as age did not prove to have an effect on the outcome of the study. Pain ratings of five or more out of a possible ten on the VAS scale were excluded, based on the discovery during the analysis of the data from the mechanical traction units of analysis that patients in the mechanical traction treatment group only received mechanical traction as the primary treatment modality if they had a pain rating of more than five out of ten on the VAS. This is similar to the inclusion criteria set out in a study done by Walker et al. (2008), where a pain rating greater than three out of ten on the VAS was one of the inclusion criterions. This was done to keep the primary treatment groups homogenous in order to prevent poor methodological quality as found in systematic reviews done by Graham et al. (2008) and van der Heijden et al. (1995), where the heterogeneity of treatment groups prevented inference to be made regarding the efficacy of the treatment protocols utilised for neck pain.

The revised inclusion and exclusion criteria are indicated in the following table.

Table 5.1: Inclusion and Exclusion Criteria

Inclusion Criteria	**Exclusion criteria**
All ages	Cervical fractures/dislocations/ subluxations/instabilities/ radiculopathies/spondylilosthesis (Bogduk, 1999)
Male/Female	Previous cervical surgery (Waldrop et al., 2006)
Adult patients with acute NS-NP that had 1 or more treatments in a two-week period (Fritz and Brennan, 2007)	Vertebral artery insufficiency
Acute neck pain of less than 12 weeks (Philadelphia Panel, 2009;	Osteoporosis/osteopenia (Bogduk, 1999)

Inclusion Criteria	Exclusion criteria
Graham et al., 2006)	
Pain ≥ 50mm on the VAS (Browder et al., 2004)	History of malignancy/rheumatoid arthritis/upper motor neuron signs (Bogduk, 1999)
Adult patients with acute NS-NP that had 1 or more treatments in a two-week period (Fritz and Brennan, 2007)	Acute cervical sprains/strains or whiplash-associated disorders (Guez et al., 2002)
	Involvement in litigation/compensation claims (Childs et al., 2008)
	Incomplete data in the clinical record

The 136 included units of analysis were filtered according to the revised inclusion and exclusion criteria and a final 123 units of analysis were included for the data analysis which comprised 96 units of analysis in the joint mobilisation treatment group and 27 units of analysis in the mechanical traction treatment group.

The sample size necessary for good statistical power (as calculated by the biostatistician) needed for this study was 50 units of analysis in each primary treatment group. The principal researcher found only 27 units of analysis for the mechanical traction group that adhered to the strict inclusion and exclusion criteria from all of the patient records of the Physiotherapy OPD at Steve Biko Academic Hospital, for the period 2000-2011. Possible reasons for this is that current literature proposes the use of mechanical traction for neck pain with nerve root impingement and not for mechanical neck pain, it might also be due to the fact that there is so little research regarding the effectiveness of mechanical traction for NS-NP or that neither the physiotherapists nor the patients felt comfortable with the application of mechanical cervical traction.

5.5.2 Age

Most of the existing research on joint mobilisation and/or mechanical traction for neck pain only included patients between the ages of 18 and 65 years (Bronfort et al., 2001; Cleland et al., 2005; Cleland et al., 2007). Hill et al (2004) researched the clinical course of neck pain in adults over a period of 12 months and found that the age range of 45-59 years was predictive of chronic neck pain. This was reiterated by Hoving et al. (2004) who found that age ≥ 40 years with accompanying lumbar pain and headaches were predictors of worst outcome and a predisposing factor for the development of chronic neck pain (Childs et al, 2008).

The mean age for the joint mobilisation group was 47.62 (SD=14.79) years, and the mechanical traction treatment group had a calculated mean age of 52.52 (SD=11.56) years. From this data it can be assumed that patients, who were thought to benefit from mechanical traction as a primary treatment modality in the clinical setting, had a 10% higher age margin in comparison to the joint mobilisation group. Raney, Peterson, Smith, Cowan, Rendeiro, Deyle and Childs (2008) constructed a clinical prediction rule for patients suffering from neck pain who might benefit from intermittent mechanical cervical traction. This clinical prediction rule quantified that patients who will benefit most from intermittent mechanical cervical traction were aged 55 years or older. This might explain why patients with a mean age of 52.52 (SD=11.56) years received mechanical traction instead of joint mobilisation for acute NS-NP in this particular clinical setting.

Figure 4.1 shows the age distribution among the 123 included units of analysis in both the primary treatment groups. The most prevalent ages of patients in this study receiving joint mobilisation as primary treatment modality for acute NS-NP seems to be 45-55 years (N=34) followed by 25-35 years of age (N=18) with the least prevalent age group receiving joint mobilisation for acute NS-NP being 5-15 years of age (N=1).

The most prevalent ages of patients receiving mechanical traction for NS-NP were 55-65 years (N=10), followed closely by 45-55 years (N=9). No traction was given to patients aged 5-25 years.

5.5.3 Occupation

The data analysis indicated that occupation was not a confounding variable and had no effect on the outcome of the study. No single work situation or workplace was evident or over-represented, thus the occupation data was divided into three categories in order to ease the data analysis process as the patients included in the study had a too wide variety of occupations in order to determine a specific pattern. These categories were labelled as employed, unemployed and pensioners.

Both the joint mobilisation treatment group and the traction treatment group illustrated an even distribution of patients over each of the three occupation categories as seen in Table 5.2.

Table 5.2: Distribution of occupation categories for the joint mobilisation and traction treatment groups

	Joint mobilisation Group	**Mechanical Traction Group**
Employed	61 (57%)	14 (52%)
Unemployed	21 (23%)	6 (26%)
Pensioners	25 (20%)	7 (22%)

5.6 Descriptive Statistics

Descriptive statistics were employed to describe and summarise the data, in order to allow patterns to emerge. The reasons for choosing descriptive statistics for this review were due to the fact that it gathers and condenses a large amount of data into a manageable and organised manner. Descriptive statistics is a straightforward process that translates results obtained from the data collection process into distribution of frequency, means and medians and establishes standard deviation. This form of statistics can also identify further areas of research and deals with the data collected from the clinical records instead of establishing conclusions. The limitations of the use of descriptive statistics are the fact that this type of statistics lack the ability to identify the cause behind acute NS-NP and the most effective combination of treatment because it can only define and report on observations and cannot give statistical calculations that can be extrapolated to the population that was studied.

Data summary used mean, standard deviation, median and range for continuous variables (age, VAS scores at onset of treatment, VAS scores at discharge, change in VAS scores from onset to discharge, age and number of treatments received) and frequency, percentage and cross-tabulation for discrete variables, (nominal and ordinal), that included the primary treatment groups, secondary treatment categories and clinical outcome.

At the onset of the multivariable linear regression analysis age, VAS scores at onset of treatment and the number of treatments received were thought to be confounding variables.

Table 5.3: Possible confounding variables

	Change in VAS scores	Clinical improvement
Age	p=0.303	p=0.76
VAS score at onset of treatment	p=0.161	p=37
Number of treatment sessions received	p=0.001	p=0.004

Table 5.3 illustrates that both age and the VAS score at onset of treatment were found to be clinically insignificant after linear regression analysis for the two treatment outcomes (change in VAS scores and clinical improvement). The number of treatments received was found to be clinically significant (p=0.001) for the change in VAS scores as well as for clinical improvement (p=0.004), and was thus found to be a confounding variable. As the number of treatments received could play a role in the outcome of the study as it could correlate positively or negatively with both the continuous and discrete variables, the data was adjusted for this possibility.

Age was found to have no impact on either the continuous or discrete variables and inevitably on the outcome of the study, which also held true for the VAS scores at onset of treatment.

From the data it was apparent that mechanical traction was only considered as the primary treatment modality for acute NS-NP when the patient presented with pain $\geq$ 5 out of 10 on the VAS. Browder, Erhard and Piva (2004) indicated that a baseline pain rating of 50 mm on a 100 mm VAS should be an inclusion criterion for choosing mechanical cervical traction for NS-NP. In order for the two treatment groups to remain homogenous all units of analysis with a pain rating of $\leq$ 5 out of 10 were excluded from the study.

A total of 134 units of analysis were included by the principal investigator based on the initial set of inclusion and exclusion criteria (N=109 for the joint mobilisation group and N=29 for the traction group). Thirteen of these units were excluded from the joint mobilisation group with a VAS rating of ≤ 5 out of 10 and two units of analysis were excluded from the traction group for this same reason. That brought the number of units of analysis included in the final data analysis to 123 with the joint mobilisation group comprising 109 units of analysis and the traction group 27 units of analysis. These 123 units of analysis adhered to the revised inclusion and exclusion criteria as set out in Table 5.1.

Age, VAS scores at onset of treatment, VAS scores at discharge, change in VAS scores and number of treatments received were summarised for the joint mobilisation group (N=96) and the mechanical traction group (N=27) during the data analysis. The results of this summary indicated that there was no significant difference (< 3%) in the VAS scores at onset of treatment for both the joint mobilisation group (76.2 mm) and the mechanical traction group (78.5 mm) once all the patients presenting with pain scores ≤ 5 on the VAS were excluded from the data.

The joint mobilisation group had a lower calculated mean age of 47.62 (SD=14.79) years in relation to the mechanical traction group with a mean age of 52.52 (SD=11.56) years and correlates with the treatment classification system that was devised by Fritz and Brennan (2007) indicated that patients suffering from acute NS-NP, aged less than 60 years would benefit most from cervical joint mobilisation and exercise as multimodal treatment strategy. This, however, had no influence on the outcome of the study.

The patients who received joint mobilisation as the primary treatment modality indicated a greater decrease in their VAS scores at discharge from physiotherapy treatment with a mean of 36.7 mm (SD=30.3) when likened to the traction group with a mean VAS score of 47.8 mm (SD=30.1) at discharge. The joint mobilisation group also demonstrated a greater change in their VAS scores from the onset of physiotherapy treatment until discharge from treatment when compared with the traction treatment group. The joint mobilisation group had a mean change of 39.4 mm (SD=28.7) in the VAS score, while the mechanical traction group showed a mean change of 30.7 mm (SD=30.6) in the VAS score. This resulted in both treatment groups showing a clinically significant change in pain, as a 13 mm change on a 100 mm VAS is needed to bring about clinically significant improvement in pain (Todd, 1996). Joint mobilisation as primary treatment modality, however, indicated a greater relief from acute NS-NP when compared to the use of mechanical traction. This is in accordance with studies performed by Fritz and Brennan (2007), who devised a classification system on which the choice of treatment modality for neck pain should be based. According to Fritz and Brennan (2007), joint mobilisation should be the treatment of choice for patients suffering from acute NS-NP. The results from a high quality trial conducted by Cleland et al (2005) indicated an overall mean change of 15.5 mm on the VAS with joint mobilisation as primary treatment modality compared to a 4.2 mm change on the VAS for the placebo group. Gross et al. (2004), however, identified 33 trials in a Cochrane review that did not favour the use of joint mobilisation alone for the relief of acute neck pain. Gross et al (2002) indicated that physiotherapists should use joint mobilisation and exercise for the treatment of NS-NP.

The mechanical traction group received more physiotherapy treatments with a mean of 4.33 (SD=1.99) sessions in comparison with the joint mobilisation group that received a mean of 3.50 (SD=2.92) therapy sessions. Hellsing et al (1994) noted that a mean of three treatment sessions were needed for the treatment of acute NS-NP and up to five treatment sessions were considered to be cost effective, a good use of resources and effective in the reduction of acute neck pain. Mechanical traction just barely falls into these parameters, while joint mobilisation for acute neck pain fits easily into the parameters set out by Hellsing et al (1994). In previous studies investigating mechanical traction for neck pain, Cleland et al (2005) indicated a decrease in acute neck pain over an average of 7.1 treatment sessions of a multi-modal approach consisting of cervical joint mobilisation, mechanical cervical mechanical traction and exercise. Waldrop et al (2006) indicated pain relief over an average of ten treatment sessions using a combination of mechanical traction and strengthening exercises for the treatment of neck pain. Browder et al (2004) found that nine treatment sessions of intermittent mechanical cervical mechanical traction and thoracic manipulation brought about a clinically significant relief of 50 mm on the VAS in patients suffering from cervical myelopathy.

The data from this study indicated that the mechanical traction group showed a clinically significant relief from pain over an average of 4.33 sessions. The possible explanation for this significant relief from pain in only 4.33 treatment sessions, when compared to previous literature, might be ascribed to the combination of mechanical traction with the secondary treatment categories. Graham et al. (2008) found limited evidence to support the use of intermittent mechanical cervical mechanical traction combined with exercise and heat for NS-NP when compared to just exercise and heat. Another explanation for the pain relief over fewer treatment sessions during this study might be the fact that a population suffering from acute cervical non-specific pain was used as a case study, instead of a population suffering from sub-acute or chronic non-specific pain.

Multivariable linear regression analysis was employed to investigate the primary treatment groups and secondary treatment categories with respect to the change in VAS scores from onset of treatment until discharge. No interaction was found to be present during the data analysis between the primary treatment groups and the secondary treatment categories.

The secondary treatment categories were analysed with respect to the following variables: age, VAS scores at onset of treatment, VAS scores at discharge from treatment, change in VAS scores as well as the number of treatment sessions received. When the data analysis for the E.T. category was compared to the exercise and STM category, a mean age of 51.35 (SD=14.89) years was calculated for the E.T. category and 47.10 (SD=13.70) years was calculated for the exercise and STM category. As age did not play any role in the treatment outcomes, this information was neglected. There was no significant difference (< 3%) between the VAS scores at onset of treatment for the E.T. category (mean 7.78; SD=1.56) and the exercise and STM category (mean 7.60; SD=1.56). This was also true for the number of treatments received with the E.T. category receiving a mean of 3.74 (SD=2.23) physiotherapy sessions and the exercise and STM category receiving a mean of 3.64 (SD=2.27) therapy sessions.

There was, however, a significant difference in the VAS scores at discharge from treatment as well as the change in VAS scores from onset until discharge between the two secondary treatment categories. The exercise and STM category fared far better in relieving pain when combined with either one of the primary treatment groups in relation to the E.T. category, which is in harmony with a systematic review by Kay, Gross, Goldsmith, Santaguida, Hoving and Bronfort (2005) which determined that specific cervical exercises might be effective for the treatment of acute non-specific pain. The exercise and STM category revealed a pain measure with a mean of 34.0 mm (SD=2.90 mm) on the VAS at discharge from physiotherapy and an overall mean change in the VAS scores of 42.0 mm (SD=27.8 mm). The E.T. category was calculated as having a mean of 47.8 mm pain score (SD=29.9 mm) on the VAS at discharge from treatment and a mean change of 30.0 mm (SD=30.3 mm) on the VAS. Although both the E.T. category and the exercise and STM category indicated a clinically significant change in the VAS scores and thus pain relief, as indicated by Todd (1996), it would seem as if the exercise and STM category in combination with either joint mobilisation or mechanical traction brings about a greater decrease in acute NS-NP. This correlates with evidence found by Jette et al (1996) that endurance exercise programs produced better clinical outcomes with respect to the patients' general health perceptions in adults suffering from neck pain. The inverse was found to be true when the Philadelphia Panel (2009) found no evidence from randomised controlled trials that proved that exercise is an effective form of therapy for acute neck pain. Gross et al (2004) found in a study performed by the Cervical Overview Group that joint mobilisation in combination with E.T. was not effective in reducing acute or chronic neck pain when compared to joint mobilisation and exercise therapy which was found to bring about pain relief and an increase in function. This was reiterated by Hurwitz et al (1996) who stated that joint mobilisation, when combined with exercise, is more effective in neck pain relief than joint mobilisation combined with electrotherapies such as E.T.. This result measures up to studies done by Bronfort et al (2001), Jull et al (2002), Gross et al (2002) and Jensen (2007).

The primary treatment groups and secondary treatment categories were also assessed with respect to clinical improvement using multivariate linear regression analysis. A total of 77.08% (N=74) of the 96 patients who received joint mobilisation as primary treatment modality indicated a clinical improvement of their symptoms with their change in VAS scores > 13 mm (Todd, 1996) with 22.92% (N=22) of patients having no clinical improvement of their acute NS-NP. In the mechanical traction group 55.56% (N=15) of the 27 patients suffering from acute NS-NP had shown a clinical improvement of their symptoms with 44.44% (N=12) having no clinical improvement at discharge from physiotherapy treatment. This once again strengthens the finding that joint mobilisation is more effective than mechanical traction in combination with secondary treatment modalities for acute NS-NP if the change in VAS scores and clinical improvement is used as outcome measures. This is supported by the classification system devised by Fritz and Brennan (2007) for choosing an appropriate treatment modality for acute NS-NP, i.e. joint mobilisation. This is also in agreement with the management strategies proposed for the treatment of acute NS-NP with or without headaches, mobility deficits, movement coordination problems or referred pain by the ICD and ICF (2008), which is a proposed multi-modal treatment strategy of cervical joint mobilisation and strength and endurance exercises.

5.7 Confounding Variables

The primary treatment groups (joint mobilisation and mechanical traction) and secondary treatment categories (E.T., exercise and STM) were evaluated with respect to the change in VAS scores and clinical improvement of perceived pain using multivariate regression analysis. Age, VAS scores at onset of treatment, and the number of treatment sessions received were initially thought to be confounding variables. After the data sets were run, age (p=0.303) and VAS scores at onset of treatment (p=0.161) were not found to be statistically significant and were not confounders. The number of treatments received scored a p value of 0.001 and was statistically significant with respect to the change in VAS scores and clinical outcome. This is important due to the fact that Hellsing et al. (1994) determined that a mean of three physiotherapy sessions is necessary to bring about pain relief in patients suffering from acute NS-NP and that five sessions were considered cost-effective, good use of resources and effective in the reduction of acute NS-NP. The number of treatment sessions received was, therefore, found to be a confounding variable.

In the case of clinical improvement of perceived pain, age had a p value of 0.449 and the VAS score at onset of treatment had a p value of 0.714. Both age and the VAS scores at onset of treatment were not statistically significant and were not confounding variables in the data analysis of clinical improvement as a treatment outcome. The number of treatments was once again found to be a statistically significant confounder with a p value of 0.004. As the number of treatment sessions received could influence both the treatment outcomes, i.e. change in VAS scores and clinical improvement, the data was adjusted accordingly in the analysis to compensate for this confounding variable.

5.8 Interaction

Interaction might arise when the relationship between three or more variables are considered. When there is an interaction effect, it means the main effects do not collectively explain all of the influence of the continuous and discrete variables.

During the analysis of the continuous variable (age, VAS scores at onset of treatment, VAS scores at discharge, change in VAS scores and number of treatment sessions) and the discrete variable (joint mobilisation/mechanical traction, E.T./exercise and STM) no interaction was found between the primary treatment groups and the secondary treatment categories with respect to age, VAS scores at onset of treatment, VAS scores at discharge, change in VAS scores and the number of treatment sessions received. This means that the principal outcomes of the study will collectively explain the influence of the continuous (age, VAS scores at onset of treatment, VAS scores at discharge, change in VAS scores and number of treatment sessions) and discrete variables (joint mobilisation/mechanical traction, E.T./exercise and STM). Any change that occurs during the analysis of the primary treatment groups will have no influence on the behaviour of the secondary treatment categories and vice versa.

5.9 Treatment Outcomes

5.9.1 Change in VAS scores

A continuous variable is defined as a variable that is measured on a scale that is continuously variable, i.e. for any two valid continuous measurements there is always one in between. Continuous variables include variables that are numerical, such as the change in VAS scores (The Cochrane Collaboration).

Regression analysis is a statistical technique for estimating the relationships among variables when the focus is on a relationship between a continuous variable, i.e. the change in VAS scores, and a discrete variable, i.e. clinical improvement as measured by a Yes/No answer.

When the multivariable regression analysis was run for the change in VAS scores, age was not found to be statistically significant (p=0.30) for the primary treatment groups and secondary treatment categories. For this reason, age was excluded from the next data analysis. The VAS scores at onset of treatment had a p value of 0.16 and were not statistically significant for the primary treatment groups and secondary treatment categories and were excluded from further analysis.

The patients who received mechanical traction as primary treatment modality for their acute NS-NP seemed to receive more treatments when likened to the joint mobilisation group. This was found to be a statistically significant difference with a p value of 0.001 with a 95% confidence interval. The data was adjusted accordingly to eliminate confounding data and the primary treatment groups were found to be marginally different (p=0.08) with respect to the change in VAS scores from onset of physiotherapy treatment up to discharge from therapy (the means were adjusted for the number of treatment sessions received: 2.74 for the joint mobilisation group and 3.88 for the mechanical traction group).

The mean change in VAS scores between onset and discharge was 42.0 mm (SD=27.8 mm) for the exercise and STM treatment category and 30.0 mm (SD=30.3 mm) for E.T. in combination with the primary treatment groups. The secondary treatment categories differed significantly with respect to the changes in VAS scores. There were no significant differences in the number of treatment sessions received between the exercise and STM category and the E.T. category and age did not play a role either. According to research, joint mobilisation together with exercise was most effective in long-term pain reduction, increased function and increased global perceived effect (Bronfort et al, 2001; Jull et al, 2002; Gross et al, 2002 and Gross et al 2004). E.T. combined with joint mobilisation indicated moderate evidence of no change in pain and function for patients suffering from acute NS-NP (Hurwitz et al, 1996). Cervical mechanical traction in combination with exercise indicated a clinically important reduction in neck pain and increase in function in patients suffering from cervical radiculopathy (Cleland et al, 2005). Waldrop et al (2006) found that a combination of intermittent cervical mechanical traction and strengthening exercises brought about a decrease in the perceived disability of patients suffering from neck pain. Van der Heijden et al (1995) and Graham et al (2006) found that there was no reduction in neck pain when mechanical traction was combined with E.T.. From this study it can be reasoned that exercise and STM in combination with either joint mobilisation or mechanical cervical mechanical traction is superior to the use of E.T. in the reduction of pain as seen by the change in the VAS scores at discharge from treatment. This result is concurrent with the recommendations by the ICD and ICF that cervical joint mobilisation should be considered in order to reduce NS-NP, headaches and neck pain related disability and that combining cervical joint mobilisation with coordination, strengthening and endurance exercises is more effective for the reduction of NS-NP, whether acute or chronic in nature, than the use of joint mobilisation alone (Childs et al., 2008). This study also concluded that mechanical cervical intermittent mechanical traction should be used in combination with cervical and thoracic joint mobilisation and strengthening exercises in order to decrease pain and disability related to NS-NP and neck-related arm pain.

5.9.2 Clinical Improvement

Clinical improvement was measured as a change in VAS scores being more than 13 mm on a 100 mm scale and recorded as a Yes/No answer. Clinical improvement of the patient's perceived pain was a discrete variable because it could only assume a countable, finite number of values.

Multivariate logistic regression analysis was employed to predict the outcome of the discrete variable. Multivariate logistic regression analysis furthermore measured the relationship between the continuous variable (the change in VAS scores) and the discrete variable (clinical improvement) by using probability scores as the predicted values of the continuous variable.

Age and the VAS scores at onset of treatment were not found to be statistically significant with respective p values of 0.45 and 0.71 for clinical improvement of perceived pain. The number of treatments received was statistically significant with regards to clinical improvement as a treatment outcome with a p value of 0.004. The data was adjusted for the number of treatments being a confounding variable and mechanical traction was then found to have an increased risk for a poor clinical outcome in pain relief (OR=3.26; 95% CI; 1.16-9.15). This meant that relative to joint mobilisation as primary treatment modality, mechanical traction had a 3.26-fold increase in risk for poor clinical improvement of pain when employed as the primary treatment modality for acute NS-NP. Exercise and STM were found to prevent a poor clinical outcome (OR=0.39; 95% CI; p=0.04; 0.16-0.96) when compared to E.T.. This correlates with a study by Graham et al (2006) that found low quality evidence that mechanical traction and exercise reduces acute neck pain when compared to a control group that only received exercises for acute neck pain. From this it can be concluded that when coupled with exercise and STM, either mechanical traction (corroborated by research from Joghataei, 2004; Saal et al, 1996; van der Heijden et al, 1995; Cleland et al, 2005; Cleland et al, 2007 and Moeti and Marchetti, 2001), or joint mobilisation (Gross et al, 2002; Gross et al, 2004) will have a better clinical outcome than when either of these treatments were used alongside E.T., although joint mobilisation in combination with exercise and STM seems to have a greater clinical improvement in acute NS-NP relative to mechanical traction as found to be true in studies performed by Bronfort et al (2001), Jull et al (2002), Gross et al (2002), Gross et al (2004), Hurwitz et al (1996) and Jensen (2007). Jette et al (1996) revealed that patients suffering from neck pain indicated an increase in physical function, clinical improvement and general health perceptions when treated with joint mobilisation and flexibility and strengthening exercises. The use of cervical joint mobilisation and exercise programs for patients experiencing neck pain symptoms indicated better outcomes on the Neck Pain Disability Index post treatment. Together with this, E.T. in combination with either joint mobilisation (as demonstrated by Graham et al, 2008) or mechanical traction (as verified by Gross et al, 2002 and Gross et al, 2004) have poorer clinical outcomes with respect to pain relief. Based on the literature, current practice patterns and this study, there seems to be a cohort of patients with neck pain who respond favourably to the combination of joint mobilisation, exercise therapy and possibly mechanical cervical mechanical traction interventions, as seen in the study by Childs, Fritz, Piva and Whitman (2004).

Joint mobilisation and mechanical traction were never used in isolation as studies indicated that joint mobilisation used alone was not effective in reducing neck pain (Jull et al, 2002; Gross et al, 2002; Gross et al, 2004) and the same was true for mechanical traction (van der Heijden et al, 1995). When the joint mobilisation group and the mechanical traction group were compared to each other with respect to the secondary treatment categories, exercise and STM, when combined with either two of the two primary treatment groups, proved to be more effective than E.T. in combination with joint mobilisation (Bronfort et al, 2001; Jull et al, 2002; Gross et al, 2002; Gross et al, 2004; Jensen, 2007) and mechanical traction (Graham et al, 2008; van der Heijden et al, 1995; Moeti and Marchetti, 2001; Waldrop, 2006; Cleland et al, 2005; Cleland et al, 2007; Saal et al, 1996, Graham et al, 2006 and Joghataei, 2004) for acute NS-NP. This is in accordance with high quality RCTs and systematic reviews of high quality RCTs indicating that exercise in combination with joint mobilisation and mechanical cervical mechanical traction is effective for the treatment of acute NS-NP.

5.10 Conclusion

This study used a homogenous sample group, a singular diagnosis of acute NS-NP and reliable outcome measures and instruments. The findings of the study correlated with other good quality (Level I and II) research studies and can be summarised by stating that joint mobilisation was marginally more effective in the reduction of acute NS-NP when compared to mechanical traction. Both joint mobilisation and mechanical traction in combination with exercise and STM indicated clinically significant reductions in pain as measured by the overall change on the VAS. Mechanical traction ran the risk of poor clinical outcome when used for the treatment of acute NS-NP, but when coupled with exercise and STM, the exercise and STM, as a combination intervention, was effective in reducing pain. E.T. in combination with either cervical joint mobilisation or mechanical cervical traction did indicate a decrease in acute cervical non-specific pain as measured on the VAS but joint mobilisation in combination with exercise and STM seemed to be the most effective in reducing acute NS-NP.

CHAPTER 6.

LIMITATIONS, RECOMMENDATIONS AND CLINICAL APPLICATION

6.1 Introduction

The limitations of the study, recommendations for further study and the clinical application of the conclusions of the study will be discussed in this chapter.

6.2 Limitations

6.2.1 Reporting of pain

The use of the VAS scale as a report measure for pain might have been unreliable due to its use by various clinicians and limited by patients not understanding how the VAS works; this could have been the result of language barriers between the patients and the treating physiotherapist as the review was set in a provincial hospital.

The patients may also have a different interpretation of pain and specifically neck pain as defined by the IASP (2011) and Chaitow and Delaney (2000).

6.2.2 Poor attendance of treatment sessions

It was observed that physiotherapy was recommended for patients suffering from acute NS-NP. These patients either never arrived for their appointments of failed to arrive for follow-up appointments, which might have been due to financial burdens, transport problems or cultural beliefs. The poor attendance of treatment sessions and follow-up appointments severely limited the number of patient files that might have met the inclusion criteria.

6.2.3 Outcome measures

Only pain relief was used as an outcome measure and not cervical range of motion or disability scales as used in studies pertaining to treatment modalities for NS-NP. Cervical range of motion could have provided more insight into the mechanical effects of mechanical traction and joint mobilisation.

6.2.4 Type of mechanical traction used

The type of mechanical traction used for treatment by the physiotherapists in this study was not homogenous. Continuous and intermittent mechanical traction was used for the treatment of acute NS-NP. Sometimes only one type of mechanical traction was used throughout the treatment cycle and occasionally intermittent mechanical traction was interspersed with continuous mechanical traction.

6.3 Recommendations

A randomised clinical trial should be done on the effectiveness of intermittent cervical mechanical traction for acute NS-NP as not one Level I study on the effectiveness of mechanical traction for acute NS-NP could be found in literature (Australian Acute Musculoskeletal Pain Guidelines Group, 2004). The trial should be conducted in different clinical settings and should include a larger population with a long-term follow-up and the sample should only consist of patients suffering from acute NS-NP of which no underlying cause could be determined lasting less than three months. The trial should include a placebo group, an intermittent mechanical traction group alone and an intermittent mechanical traction group in combination with exercise. Pain as measured on the VAS, cervical range of motion and a neck pain questionnaire should be used as outcome measures. With a sufficiently large sample group, different age groups should be analysed in order to clarify whether age does play a role in treatment outcome and long-term chronicity.

Studies of incidence of acute NS-NP are needed to more accurately assess the aetiology of acute NS-NP with or without referred pain among the South African population. Longitudinal studies are required to assess changes in incidence and prevalence of acute NS-NP (Owen, Keene and Olson, 2002).

A survey should be done in order to assess the availability of mechanical traction units in private as well as public physiotherapy OPD practices. This survey should also determine the optimal frequency of use of mechanical cervical traction for neck pain and assess for which cervical conditions mechanical traction is used and when mechanical traction was chosen as a treatment modality.

6.4 Clinical application

The literature review highlights the importance of following a classification system in order to direct treatment for neck pain (Fritz and Brennan, 2007). This classification system needs to be applied when deciding on a treatment modality for a specific condition or set of symptoms in order to standardise and optimise care in clinical practice. Current research (including this study) recommends the use of cervical joint mobilisation and exercise for patients with acute NS-NP.

6.5 Concluding remarks

This study found that joint mobilisation in combination with exercise and STM is the most effective treatment option for acute NS-NP when compared to mechanical traction in combination with exercise and STM. This corresponds to findings of studies done by Bronfort et al, (2001); Gross et al, (2004); and Gross et al (2002) that found the combination of joint mobilisation and exercise effective in the treatment of mechanical neck pain.

The data also indicated that exercise and STM increased the effectiveness of cervical mechanical traction but was not clinically significant, which reiterates findings in literature by Graham et al (2006) and Cleland et al (2007).

An RCT is needed with a large sample size, proper randomisation and long-term follow-up to successfully assess whether cervical mechanical traction is a proper treatment for NS-NP.

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Appendix 1: Data Collection Sheet

File no.	Age	Group A: Traction						Group B: Manipulation and/or Joint mobilisation					
		Occupation	Severity of Symptoms (VAS) - Onset	Severity of Symptoms (VAS) - Discharge	No. of Rx's Received	Primary Rx	Secondary Rx	Occupation	Severity of Symptoms (VAS) - Onset	Severity of Symptoms (VAS) - Discharge	No. of Rx's Received	Primary Rx	Secondary Rx

DATA COLLECTION KEY:

Occupation:	**Key**
Employed	1
Unemployed	2
Retired	3
Treatment received:	
Mechanical traction of the cervical spine in combination with secondary treatment categories (US & TENS; exercise and STM)	A
Manipulation and/or joint mobilisation of the cervical spine in combination with secondary treatment categories (US & TENS; exercise and STM)	B

Appendix 2: Raw statistical data

```
. for var  age vas_onset vas_dc ch_vas no_rx: table  group if  vas_onset > 4 &  vas_onset < 12,
c(N X mean X sd X) format(%9.3f)

->  table group if vas_onset > 4 & vas_onset < 12, c(N age mean age sd age) format(%9.3f)

----------------------------------------------
    group |     N(age)   mean(age)     sd(age)
----------+-----------------------------------
    Ma+Mo |         96      47.615      14.788
 Traction |         27      52.519      11.557
----------------------------------------------

->  table group if vas_onset > 4 & vas_onset < 12, c(N vas_onset mean vas_onset sd vas_onset)
format(%9.3f)

----------------------------------------------------------
    group |    N(vas_on~t)  mean(vas_on~t)    sd(vas_on~t)
----------+-----------------------------------------------
    Ma+Mo |             96           7.615           1.612
 Traction |             27           7.852           1.231
----------------------------------------------------------

->  table group if vas_onset > 4 & vas_onset < 12, c(N vas_dc mean vas_dc sd vas_dc)
format(%9.3f)

----------------------------------------------------
    group |    N(vas_dc)  mean(vas_dc)    sd(vas_dc)
----------+-----------------------------------------
    Ma+Mo |           96         3.672         3.033
 Traction |           27         4.778         3.017
----------------------------------------------------

->  table group if vas_onset > 4 & vas_onset < 12, c(N ch_vas mean ch_vas sd ch_vas)
format(%9.3f)

----------------------------------------------------
    group |    N(ch_vas)  mean(ch_vas)    sd(ch_vas)
----------+-----------------------------------------
    Ma+Mo |           96         3.943         2.867
 Traction |           27         3.074         3.063
----------------------------------------------------

->  table group if vas_onset > 4 & vas_onset < 12, c(N no_rx mean no_rx sd no_rx) format(%9.3f)

-------------------------------------------------
    group |    N(no_rx)  mean(no_rx)    sd(no_rx)
----------+--------------------------------------
    Ma+Mo |          96        3.490        1.989
 Traction |          27        4.333        2.922
-------------------------------------------------
```

```
. for var  age vas_onset vas_dc ch_vas no_rx: table   sec_rx_cat2 if  vas_onset > 4 &  vas_onset
< 12, c(N X mean X sd X) format(%9.3f)

->  table sec_rx_cat2 if vas_onset > 4 & vas_onset < 12, c(N age mean age sd age) format(%9.3f)

----------------------------------------------
sec_rx_ca |
t2        |     N(age)   mean(age)     sd(age)
----------+-----------------------------------
       ET |         46      51.348      14.893
  Exc+STM |         77      47.104      13.696
----------------------------------------------

->  table sec_rx_cat2 if vas_onset > 4 & vas_onset < 12, c(N vas_onset mean vas_onset sd
vas_onset) format(%9.3f)

----------------------------------------------------------
sec_rx_ca |
t2        |    N(vas_on~t)  mean(vas_on~t)    sd(vas_on~t)
----------+-----------------------------------------------
       ET |             46           7.783           1.562
  Exc+STM |             77           7.597           1.524
----------------------------------------------------------

->  table sec_rx_cat2 if vas_onset > 4 & vas_onset < 12, c(N vas_dc mean vas_dc sd vas_dc)
format(%9.3f)

----------------------------------------------------
sec_rx_ca |
t2        |    N(vas_dc)  mean(vas_dc)    sd(vas_dc)
----------+-----------------------------------------
       ET |           46         4.783         2.988
  Exc+STM |           77         3.396         2.989
----------------------------------------------------

->  table sec_rx_cat2 if vas_onset > 4 & vas_onset < 12, c(N ch_vas mean ch_vas sd ch_vas)
format(%9.3f)

----------------------------------------------------
sec_rx_ca |
t2        |    N(ch_vas)  mean(ch_vas)    sd(ch_vas)
----------+-----------------------------------------
       ET |           46         3.000         3.026
  Exc+STM |           77         4.201         2.779
----------------------------------------------------

->  table sec_rx_cat2 if vas_onset > 4 & vas_onset < 12, c(N no_rx mean no_rx sd no_rx)
format(%9.3f)

-------------------------------------------------
sec_rx_ca |
t2        |    N(no_rx)  mean(no_rx)    sd(no_rx)
----------+--------------------------------------
       ET |          46        3.739        2.225
  Exc+STM |          77        3.636        2.265
-------------------------------------------------
```

```
. for var  age vas_onset vas_dc ch_vas no_rx: table   sec_rx_cat2 group if   vas_onset > 4 &
vas_onset < 12, c(N X mean X sd X) format(%9.3f) colrow

->  table sec_rx_cat2 group if vas_onset > 4 & vas_onset < 12, c(N age mean age sd age)
format(%9.3f) col row

----------------------------------------
sec_rx_ca |            group
t2        |    Ma+Mo  Traction     Total
----------+-----------------------------
       ET |       33        13        46
          |   50.303    54.000    51.348
          |   15.045    14.748    14.893
          |
  Exc+STM |       63        14        77
          |   46.206    51.143    47.104
          |   14.574     7.882    13.696
          |
    Total |       96        27       123
          |   47.615    52.519    48.691
          |   14.788    11.557    14.244
----------------------------------------

->  table sec_rx_cat2 group if vas_onset > 4 & vas_onset < 12, c(N vas_onset mean vas_onset sd
vas_onset) format(%9.3f) col row

----------------------------------------
sec_rx_ca |            group
t2        |    Ma+Mo  Traction     Total
----------+-----------------------------
       ET |       33        13        46
          |    7.727     7.923     7.783
          |    1.587     1.553     1.562
          |
  Exc+STM |       63        14        77
          |    7.556     7.786     7.597
          |    1.634     0.893     1.524
          |
    Total |       96        27       123
          |    7.615     7.852     7.667
          |    1.612     1.231     1.535
----------------------------------------

->  table sec_rx_cat2 group if vas_onset > 4 & vas_onset < 12, c(N vas_dc mean vas_dc sd vas_dc)
format(%9.3f) col row

----------------------------------------
sec_rx_ca |            group
t2        |    Ma+Mo  Traction     Total
----------+-----------------------------
       ET |       33        13        46
          |    4.485     5.538     4.783
          |    2.991     2.961     2.988
          |
  Exc+STM |       63        14        77
          |    3.246     4.071     3.396
          |    2.990     2.999     2.989
          |
    Total |       96        27       123
          |    3.672     4.778     3.915
          |    3.033     3.017     3.052
----------------------------------------
```

```
->  table sec_rx_cat2 group if vas_onset > 4 & vas_onset < 12, c(N ch_vas mean ch_vas sd ch_vas)
format(%9.3f) col row

----------------------------------------
sec_rx_ca |             group
t2        |    Ma+Mo  Traction     Total
----------+-----------------------------
       ET |       33        13        46
          |    3.242     2.385     3.000
          |    2.990     3.150     3.026
          |
  Exc+STM |       63        14        77
          |    4.310     3.714     4.201
          |    2.754     2.946     2.779
          |
    Total |       96        27       123
          |    3.943     3.074     3.752
          |    2.867     3.063     2.921
----------------------------------------

->  table sec_rx_cat2 group if vas_onset > 4 & vas_onset < 12, c(N no_rx mean no_rx sd no_rx)
format(%9.3f) col row

----------------------------------------
sec_rx_ca |             group
t2        |    Ma+Mo  Traction     Total
----------+-----------------------------
       ET |       33        13        46
          |    3.576     4.154     3.739
          |    2.136     2.478     2.225
          |
  Exc+STM |       63        14        77
          |    3.444     4.500     3.636
          |    1.924     3.368     2.265
          |
    Total |       96        27       123
          |    3.490     4.333     3.675
          |    1.989     2.922     2.242
----------------------------------------
```

```
. regress    ch_vas  i.group i.sec_rx_cat2  vas_onset  age no_rx if  vas_onset > 4 &  vas_onset
< 12

      Source |       SS       df       MS              Number of obs =     123
-------------+------------------------------           F(  5,   117) =    4.92
       Model |  180.934049     5  36.1868098           Prob > F      =  0.0004
    Residual |  859.752943   117  7.34831575           R-squared     =  0.1739
-------------+------------------------------           Adj R-squared =  0.1386
       Total |  1040.68699   122  8.53022124           Root MSE      =  2.7108

------------------------------------------------------------------------------
      ch_vas |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     1.group |  -.9929467   .6085181    -1.63   0.105    -2.198085    .2121914
1.sec_rx_c~2 |   1.099179   .5145661     2.14   0.035      .080108     2.11825
   vas_onset |   .2040486   .1679893     1.21   0.227    -.1286454    .5367425
         age |  -.0185141    .017885    -1.04   0.303    -.0539345    .0169063
       no_rx |   .3769857   .1144509     3.29   0.001     .1503218    .6036496
       _cons |   1.233646   1.737225     0.71   0.479    -2.206837    4.674128
------------------------------------------------------------------------------

. regress    ch_vas  i.group i.sec_rx_cat2  vas_onset   no_rx if  vas_onset > 4 &  vas_onset <
12

      Source |       SS       df       MS              Number of obs =     123
-------------+------------------------------           F(  4,   118) =    5.88
       Model |   173.05973     4  43.2649325           Prob > F      =  0.0002
    Residual |  867.627262   118  7.35277341           R-squared     =  0.1663
-------------+------------------------------           Adj R-squared =  0.1380
       Total |  1040.68699   122  8.53022124           Root MSE      =  2.7116

------------------------------------------------------------------------------
      ch_vas |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     1.group |   -1.08461   .6022236    -1.80   0.074    -2.277176    .1079569
1.sec_rx_c~2 |   1.174523   .5095471     2.31   0.023     .1654808    2.183565
   vas_onset |   .2337322    .165574     1.41   0.161    -.0941495    .5616138
       no_rx |   .3819697   .1143842     3.34   0.001     .1554578    .6084816
       _cons |   .0592397   1.316018     0.05   0.964    -2.546834    2.665313
------------------------------------------------------------------------------
```

```
. regress    ch_vas  i.group i.sec_rx_cat2     no_rx if  vas_onset > 4 &     vas_onset < 12

      Source |       SS       df       MS              Number of obs =     123
-------------+------------------------------           F(  3,    119) =    7.12
       Model |  158.407504     3  52.8025014           Prob > F      =  0.0002
    Residual |  882.279488   119  7.41411334           R-squared     =  0.1522
-------------+------------------------------           Adj R-squared =  0.1308
       Total |  1040.68699   122  8.53022124           Root MSE      =  2.7229

------------------------------------------------------------------------------
      ch_vas |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     1.group |  -1.067749   .6046114    -1.77   0.080     -2.26494    .1294416
1.sec_rx_c~2 |   1.137005   .5109716     2.23   0.028     .1252303     2.14878
       no_rx |   .4215899    .111349     3.79   0.000     .2011079     .642072
       _cons |   1.725376   .5845289     2.95   0.004       .56795    2.882801
------------------------------------------------------------------------------

. margins   group, asbalanced

Predictive margins                                Number of obs   =        123
Model VCE    : OLS

Expression   : Linear prediction, predict()
at           : group            (asbalanced)
               sec_rx_cat2      (asbalanced)

------------------------------------------------------------------------------
             |            Delta-method
             |     Margin   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       group |
          0  |   3.843135    .289857    13.26   0.000     3.275026    4.411245
          1  |   2.775386   .5292151     5.24   0.000     1.738143    3.812629
------------------------------------------------------------------------------

. margins    sec_rx_cat2, asbalanced

Predictive margins                                Number of obs   =        123
Model VCE    : OLS

Expression   : Linear prediction, predict()
at           : group            (asbalanced)
               sec_rx_cat2      (asbalanced)

------------------------------------------------------------------------------
             |            Delta-method
             |     Margin   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
 sec_rx_cat2 |
          0  |   2.740758   .4228418     6.48   0.000     1.912003    3.569513
          1  |   3.877763   .3647726    10.63   0.000     3.162822    4.592704
------------------------------------------------------------------------------
```

```
. logistic     clin_imp  i.group i.sec_rx_cat2  vas_onset  age no_rx if  vas_onset > 4 &
vas_onset < 12

Logistic regression                               Number of obs   =        123
                                                  LR chi2(5)      =      22.62
                                                  Prob > chi2     =     0.0004
Log likelihood = -59.197082                       Pseudo R2       =     0.1604

------------------------------------------------------------------------------
    clin_imp | Odds Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     1.group |   3.101753   1.654796     2.12   0.034     1.090154    8.825234
1.sec_rx_c~2 |   .4137142   .1912923    -1.91   0.056     .1671567    1.023946
   vas_onset |   1.059482    .167339     0.37   0.714     .7774123    1.443896
         age |   1.013325   .0169066     0.79   0.428     .9807244    1.047009
       no_rx |   .5512183   .1153778    -2.85   0.004     .3657254    .8307919
------------------------------------------------------------------------------

. logistic     clin_imp  i.group i.sec_rx_cat2    age no_rx if  vas_onset > 4 &  vas_onset < 12

Logistic regression                               Number of obs   =        123
                                                  LR chi2(4)      =      22.49
                                                  Prob > chi2     =     0.0002
Log likelihood = -59.264168                       Pseudo R2       =     0.1595

------------------------------------------------------------------------------
    clin_imp | Odds Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     1.group |   3.097289   1.651741     2.12   0.034      1.08905    8.808775
1.sec_rx_c~2 |   .4115851   .1901732    -1.92   0.055     .1664031    1.018024
         age |   1.012681   .0168386     0.76   0.449     .9802096    1.046228
       no_rx |   .5606985    .113702    -2.85   0.004     .3768056     .834337
------------------------------------------------------------------------------

. logistic     clin_imp  i.group i.sec_rx_cat2     no_rx if  vas_onset > 4 &  vas_onset < 12

Logistic regression                               Number of obs   =        123
                                                  LR chi2(3)      =      21.91
                                                  Prob > chi2     =     0.0001
Log likelihood = -59.554091                       Pseudo R2       =     0.1553

------------------------------------------------------------------------------
    clin_imp | Odds Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     1.group |    3.25881   1.716528     2.24   0.025     1.160651    9.149902
1.sec_rx_c~2 |   .3902208   .1782016    -2.06   0.039     .1594386    .9550529
       no_rx |   .5613814   .1122404    -2.89   0.004      .379378    .8306993
------------------------------------------------------------------------------

. log close
```

Appendix 3: Approval letter from Ethics Committee

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Health Sciences Research Ethics Committee

25/11/2011

Number	:	**S158/2011**
Title	:	Mechanical traction vs. manipulation and/or mobilisation in the treatment of non-specific neck pain in adult patients
Investigator	:	N Botha, Department of Physiotherapy, University of Pretoria (SUPERVISOR: Ms E Korkie)
Sponsor	:	**None**
Study Degree:		**M.PhysT**

This Student Protocol was reviewed by the Faculty of Health Sciences, Student Research Ethics Committee, University of Pretoria on 24/11/2011 and found to be acceptable. The approval is valid for a period of 3 years.

Prof M J Bester	BSc (Chemistry and Biochemistry); BSc (Hons)(Biochemistry); MSc (Biochemistry); PhD (Medical Biochemistry)
Prof R Delport	(female)BA et Scien, B Curationis (Hons) (Intensive care Nursing), M Sc (Physiology), PhD (Medicine), M Ed Computer Assisted Education
Prof J A Ker	MBChB; MMed(Int); MD – Vice-Dean (ex officio)
Dr NK Likibi	MBB HM – (Representing Gauteng Department of Health) MPH
Dr MP Mathebula	Deputy CEO: Steve Biko Academic Hospital
Prof A Nienaber	(Female) BA (Hons) (Wits); LLB (Pretoria); LLM (Pretoria); LLD (Pretoria); PhD; Diploma in Datametrics (UNISA)
Prof L M Ntlhe	MBChB(Natal); FCS(SA)
Mrs M C Nzeku	(Female) BSc(NUL); MSc Biochem(UCL,UK)
Snr Sr J. Phatoli	(Female) BCur (Et.Al); BTech Oncology
Dr R Reynders	MBChB (Pret), FCPaed (CMSA) MRCPCH (Lon) Cert Med. Onc (CMSA)
Dr T Rossouw	(Female) MBChB.(cum laude); M.Phil (Applied Ethics) (cum laude), MPH (Biostatistics and Epidemiology (cum laude), D.Phil
Mr Y Sikweyiya	MPH (Umea University Umea, Sweden); Master Level Fellowship (Research Ethics) (Pretoria and UKZN); Post Grad. Diploma in Health Promotion (Unitra); BSc in Health Promotion (Unitra)
Dr L Schoeman	(Female) BPharm (NWU); BAHons (Psychology)(UP); PhD (UKZN); International Diploma in Research Ethics (UCT)
Dr R Sommers	**Vice-Chair** (Female) - MBChB; MMed (Int); MPharMed.
Prof T J P Swart	BChD, MSc (Odont), MChD (Oral Path), PGCHE
Prof C W van Staden	**Chairperson** - MBChB; MMed (Psych); MD; FCPsych; FTCL; UPLM; Dept of Psychiatry

Student Ethics Sub-Committee

Prof R S K Apatu	MBChB (Legon,UG); PhD (Cantab); PGDip International Research Ethics (UCT)
Mrs N Briers	(female) BSc (Stell); BSc Hons (Pretoria); MSc (Pretoria); DHETP (Pretoria)
Prof M M Ehlers	(female) BSc (Agric) Microbiology (Pret); BSc (Agric) Hons Microbiology (Pret); MSc (Agric) Microbiology (Pret); PhD Microbiology (Pret); Post Doctoral Fellow (Pret)
Dr R Leech	(female) B.Art et Scien; BA Cur; BA (Hons); M (ECI); PhD Nursing Science
Dr S A S Olorunju	BSc (Hons). Stats (Ahmadu Bello University –Nigeria); MSc (Applied Statistics (UKC United Kingdom); PhD (Ahmadu Bello University – Nigeria)
Dr L Schoeman	CHAIRPERSON: (female) BPharm (North West); BAHons (Psychology)(Pretoria); PhD (KwaZulu-Natal); International Diploma in Research Ethics (UCT)
Dr R Sommers	**Vice-Chair** (Female) MBChB; M.Med (Int); MPhar.Med
Prof L Sykes	(female) BSc, BDS, MDent (Pros)

DR L SCHOEMAN; BPharm, BA Hons (Psy), PhD;
Dip. International Research Ethics
CHAIRPERSON of the Faculty of Health Sciences
Student Research Ethics Committee, University of Pretoria

DR R SOMMERS; MBChB; M.Med (Int); MPhar.Med.
VICE-CHAIR of the Faculty of Health Sciences Research Ethics Committee, University of Pretoria

012 354 1677 0866516047 deepeka.behari@up.ac.za http://www.healthethics-up.co.za
Private Bag X323, Arcadia, 0007 - 31 Bophelo Road, HW Snyman South Building, Level 2, Room 2.33, Gezina, Pretoria

Appendix 4: Approval letter from Steve Biko Academic Hospital

Updated 28-02-2007

Permission to access Records / Files / Data base at
......STEVE BIKO ACADEMIC HOSPITAL
[Type in name of hospital / government department / hospital / school / company / NGO / etc][1]

TO: .... **[Name]**[1]
Chief Executive Officer/Information Officer

....
[Name of hospital / government dept. / hospital / school / company / NGO / etc][1]

FROM : ...NICOLENE FOURIE.......... **[Name]**[1]
Investigator

....
[Name of hospital / government dept. / hospital / school / company / NGO / etc OR investigator's home address][1]

Re: Permission to do research at ...STEVE BIKO ACADEMIC HOSPITAL.......
[Name of hospital / government department / hospital / school / company / NGO / etc][1]

TITLE OF STUDY: THE OUTCOMES OF MECHANICAL TRACTION VS. MANIPULATION AND/OR MOBILISATION IN THE TREATMENT OF NON-SPECIFIC NECK PAIN IN ADULT PATIENTS

This request is lodged with you in terms of the requirements of the Promotion of Access to Information Act. No. 2 of 2000.

I am a researcher / ~~student~~[2] at the Department of ...PHYSIOTHERAPY... at the University of Pretoria / .... Hospital. I am working with ...ELZETTE KORKIE........................ [Title(s) and surname(s) of co-investigator(s) / supervisor(s)][1]. I herewith request permission on behalf of all of us to conduct a study on the above topic on the hospital ~~grounds / at your~~ facility / ...PHYSIOTHERAPY DEPT...[2] This study involves access to patient / ~~client / learner / student /~~ ....[2] records.

The researchers request access to the following information: patient / ~~client / learner / student /~~ ....[2] files, record books and data bases.

We intend to publish the findings of the study in a professional journal and/ or to present them at professional meetings like symposia, congresses, or other meetings of such a nature.

We intend to protect the personal identity of the patients / ~~clients / learners / students /~~ ....[2] by assigning each individual a random code number.

We undertake not to proceed with the study until we have received approval from the Faculty of Health Sciences Research Ethics Committee, University of Pretoria.

Yours sincerely

[signature]
Signature of the Principal Investigator

Permission to do the research study at this institution / facility and to access the information as requested, is hereby approved.

Title and name of Chief Executive Officer: Dr AP van der Walt

Name of institution: Steve Biko Academic Hospital

Signature: [signature]

Date: 21/9/2011

STEVE BIKO
PRIVATE BAG X169
Official Stamp
2011 -09- 21
PRETORIA 0001
ACADEMIC HOSPITAL

[1] Delete all highlighted instructions before submitting the form for a signature. Also delete this footnote.
[2] Delete which is not applicable and or add a more appropriate description.

Appendix 5: Letter from Language Editor

Mandy Engelbrecht

Translator and copyeditor

Roodepoort

mandy.engelbrecht@gmail.com

072 199 2120

19 July 2013

To whom it may concern

RE: Editing of Nicolene Breed's Dissertation

I, Mandy Reneé Engelbrecht, herewith confirm that I edited Nicolene Breed's dissertation entitled "Mechanical Traction Versus Joint mobilisation in the Treatment of Non-Specific Neck Pain in Adult Patients".

Regards,

Mandy Engelbrecht

Appendix 6: Approval letter from Steve Biko Hospital Physiotherapy Outpatient Department

INITIAL CONSENT BY DEPARTMENTAL HEAD

I E-von Niekerk head of Physiotherapy

department of Steve Biko Academic Hospital hospital in consultation with the Chief Executive Officer / Superintendent of this Hospital grant permission to submit an application to conduct a clinical trial/evaluation to the Chairperson (s) of the relevant Ethics, Research and Therapeutic Committees of this Hospital.

The officer conducting the trial/evaluation will be N. Botha

Designation / Rank Assistant Director Physiotherapy

THE HEAD OF THE DEPARTMENT MUST SIGN HERE!

HEAD OF DEPARTMENT			DATE		
Signature	Initial(s)	Surname	Day	Month	Year
[signature]	E.	Von Niekerk.	09	09	2011

THE APPLICANT MUST SIGN HERE

TRIALIST-INVESTIGATOR			DATE		
Signature	Initial(s)	Surname	Day	Month	Year
[signature]	N	Botha	19	07	2011

THE APPLICANT THAT APPLY FOR THIS STUDY MUST SEE TO IT THAT THE SUPERINTENDENT / C.E.O. OF THE HOSPITAL WHERE THE STUDY WILL BE DONE - SIGN HERE BEFORE THE ETHICAL COMMITTEE RECEIVE THIS APPLICATION FORM.

APPROVAL BY HOSPITAL CHIEF EXECUTIVE OFFICER:

I Dr AP van der Walt Chief Executive Officer / superintendent of

Steve Biko Academic Hospital, hereby agree that this trial / evaluation be conducted in the Physiotherapy Department of this hospital.

The officer conducting the trial will be : N. Botha

The officer controlling supplies will be: E. van Niekerk

HOSPITAL C.E.O. / Superintendent			DATE		
Signature	Initial(s)	Surname	Day	Month	Year
[signature]	DR AP VAN DER WALT DIRECTOR CLINICAL SERVICES				

STEVE BIKO
PRIVATE BAG X169
2011 -09- 14
PRETORIA 0001
ACADEMIC HOSPITAL

Page 4 of 4