# QUALITY OF LIFE MEASURED 12 MONTHS POSTOPERATIVELY IN SUBJECTS WHO HAD AN ANTERIOR NECK FUSION

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# DECLARATION

I, Louise De Jonge, declare that this research report is my own work. It is submitted for the degree of Masters of Science in Physiotherapy in the University of the Witwatersrand, Johannesburg. It was not submitted before for any degree or examination at this or any other University.

Signature of the Candidate.....

.....day of.....2009

# ABSTRACT

**Background Data**

The cervical spine is subjected to wear and tear as well as trauma. This increases the occurrence of degeneration of intervertebral discs and facet joints. Degeneration will result in loss of disc height and the formation of osteophytes on adjacent vertebrae. Nerve roots can be irritated or compressed by this pathology and patients can possibly develop neurological signs and symptoms as well as pain. An anterior neck fusion is a surgical procedure that is frequently used to manage cervical pathologies such as degeneration, spinal stenosis, disc herniation, or trauma. Cervical pathologies can become severe and neural compression may develop. Compression of neural components can present with symptoms such as muscle weakness, numbness, tingling or radicular pain. The main aim of the surgery is to decompress the neural structures, permanently stabilize the vertebrae, to maintain a cervical lordosis and to hold an anatomical disc space.

Chronic spinal disorders, including cervical and lumbar conditions, are considered the most expensive benign condition to manage. Previous research demonstrated poor functional outcomes especially in the lumbar area. Little evidence is available regarding the functional outcomes of patients after anterior neck fusion surgery. The aim of this study was to investigate the levels of pain and the quality of life experienced by patients who had an anterior neck fusion one year ago.

**Methods**

A cross – sectional survey was conducted. Neurosurgeons in the Johannesburg region were contacted telephonically to establish whether they performed anterior neck fusion surgery. Potential subjects were then identified and contacted to establish whether they suited the inclusion criteria for the study. Pain was assessed using the Visual Analogue Scale. The Neck Disability Index, Fear Avoidance Beliefs and Short Form-36 questionnaires were completed to determine the levels of dysfunction, anxiety and depression as well as health related quality of life in subjects who had an anterior neck fusion one year ago. The quality of life of these subjects was then compared to that of a healthy baseline group.

**Results and Discussion**

Forty-two (n = 42) subjects were telephonically identified from the neurosurgeons' records. Thirty-five (n = 35) subjects met the inclusion criteria and participated in the study. Twenty-six subjects were female (n = 26) with an average age of 54 years and nine (n = 9) were male with an average age of 53 years. The demographic questionnaire demonstrated a high prevalence

for the use of pain- and anti-inflammatory medication (81.3%). According to the demographic questionnaire, the subjects received on average six physiotherapy treatments postoperatively. Most of the subjects (n = 22) demonstrated pain over the upper shoulder area as well as posterior regions of the neck on the body chart. At the time of assessment, the subjects indicated their level of pain using a VAS scale and had an average score of 35.48mm (SD ± 24.11) which indicated a low level of pain. Results obtained from the NDI questionnaire indicated that the subjects had moderate disability one year postoperatively. The mean score on the NDI for subjects was 31.10 (SD ± 11.96). Subjects did not demonstrate high scores on the FABQ and had a mean score of 54.09 (SD ± 0.99). There were no significant differences between the male and female groups for the FABQ. On the SF-36, the subjects had a moderate reduction in mental health components of QoL [MCS = 42.19 (SD ± 13.31)] as well as the physical health components of QoL [PCS = 46.78 (9.44)]. QoL of these subjects was compared to a baseline group. Results showed a statistically significant difference between the groups for all eight domains (p- values ranged between 0.0001 and 0.012). The mental health component score (MCS) was not significantly different between the groups but subjects with anterior neck fusion had a significantly lower score on the physical health component (PCS) than the baseline group (p = 0.001).

**Conclusion**

This paper concluded that subjects who had an anterior neck fusion 12 months ago still suffered from low levels of pain and moderate dysfunction. They reported low levels of QoL related to physical health one year postoperatively.

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| | | |
|---|---|---|
| ACDF | - | Anterior Cervical Discectomy and Fusion |
| ADL | - | Activities of daily living |
| BP | - | Bodily Pain |
| CNS | - | Central nervous system |
| DRAM | - | Distress and risk assessment method |
| FABQ | - | Fear Avoidance Beliefs Questionnaire |
| FABQ-P | - | Fear Avoidance Beliefs Questionnaire Physical Activities |
| FABQ-W | - | Fear Avoidance Beliefs Questionnaire Work |
| GH | - | General Health |
| HIV | - | Human Immunodeficiency Virus |
| LOS | - | Length of Stay |
| MCS | - | Mental Health Component Score |
| MH | - | Mental Health |
| MRI | - | Magnetic Resonance Imaging |
| n/a | - | not applicable |
| NDI | - | Neck Disability Index |
| PCS | - | Physical Health Component Score |
| PF | - | Physical Function |
| PLL | - | Posterior Longitudinal Ligament |
| QoL | - | Quality of Life |
| RA | - | Rheumatoid Arthritis |
| RE | - | Role Emotional |
| RP | - | Role Physical |
| SF | - | Social Functioning |
| SF-36 | - | Short Form-36 |
| SLE | - | Systemic Lupus Erythematosus |
| VAS | - | Visual Analogue Scale |
| VT | - | Vitality |
| WAD | - | Whiplash Associated Disorders |
| WRD | - | Wide Range Dynamic |

# CHAPTER 1

## INTRODUCTION

### 1.1 BACKGROUND

The cervical spine is subjected to wear and tear due to the aging process or trauma (Persson et al 2001). This is common in the middle age and older population (McCormack et al 1996). Wear and tear as well as predisposing trauma can result in a process of pathological changes such as progressive disc degeneration, osteophyte formation and facet joint hypertrophy (Sampath et al 1999).

The vertebral column consists of a series of 33 uneven bones called vertebrae (Van De Graaff 2002). There are seven cervical, 12 thoracic, five lumbar, three to five fused sacral and four or five fused coccygeal vertebrae (Van De Graaff 2002; Saunders et al 1995). Four curvatures can be seen from the side namely the cervical curve (concaving to posterior) thoracic curve (convex to posterior) and the lumbar curve (concave to posterior). The fourth curve is the pelvic curve and is formed by the shape of the sacrum and coccyx and is convex posterior (Saunders et al 1995).

According to Van De Graaff (2002), the vertebral curves play an important role in strength and maintaining the balance of the body. Vertebrae enclose and protect the spinal cord, support the skull and allow for its movement. The entire spinal column is joined together by ligaments that allow the spine to bend and rotate. Many muscles attach to the spinal column for optimal stabilization and functional movements (Falla et al 2004; Van De Graaff 2002).

The cervical spine starts below the skull and has seven vertebrae referred to as C1 to C7 (Van De Graaff 2002; Saunders et al 1995). These vertebrae are much more mobile than the rest of the spinal column (Van De Graaff 2002). A typical cervical vertebra consists of an oval vertebral body, a short spinous process and round transverse foramina bilaterally in the transverse processes. In these foramina lie the vertebral arteries (Van De Graaff 2002). The vertebral arteries become the basilar artery when exiting C1 (Van De Graaff 2002). The function of the vertebral arteries is to supply the brain of oxygen and glucose via blood (Van De Graaff 2002).

Ligaments that connect the vertebral bones surround the cervical spine (Van De Graaff 2002). Ligaments are composed of dense regular connective tissue and are

flexible. Ligaments do not have a good blood supply and do not heal well after injury (Van de Graaff 2002). Ligamentum nuchae is palpable with neck flexion and stretches from the external occipital protuberance of the scull to C7. The anterior longitudinal ligament is connected to the anterior atlanto-occipital and atlanto-axial membranes and provides a mechanical continuity between the head and the cervical spine (Van De Graaff 2002). An important fact is that the anterior longitudinal ligament is a site for ossification when it sustains an injury, leading to decreased stress compliance that will reduce the strength in this ligament (Sizer et al 2004).

The anterior longitudinal ligament is much stronger than the posterior longitudinal ligament (PLL) (Sizer et al 2004; Saunders et al 1995). The PLL attaches to the tectorial membrane and has a tight connection to the intervertebral discs (Sizer et al 2004). The PLL has rich innervations of nociceptors and is a strong pain generator when strained (Maitland et al 2005).

Muscles of the neck will not be discussed individually but will briefly be considered in their functional classification (Falla et al 2004; Falla et al 2007; Richardson et al 1995). All the muscles in the body can be classified according to their function such as local stabilisers, global stabilisers and global mobilisers (Falla et al 2004).The stabilising muscles are deep and insert directly on the vertebrae (Falla et al 2007; Hodges et al 1996). The purpose of the cervical stabilising muscles (deep) is to stabilise the vertebrae before cervical movements such as flexion, extention or rotation. Global stabilisers (more superficial) stabilise the vertebrae while moving the neck and/or shoulders (Falla et al 2004). The global mobilisers (superficial muscles) are muscles doing the active movements of the neck/shoulders. Falla et al (2004) found in their literature review that there is a definite relationship in chronic pain and cervical muscle dysfunction. This dysfunction of muscles will eventually develop abnormal biomechanics and overload the structures such as joints and ligaments (Falla et al 2007). The abnormal, overloaded structures will contribute to more pain (Falla et al 2007).

Intervertebral discs lie between each vertebra with exception between the skull and the first vertebra (C1) (Van De Graaff 2002). A disc is flexible and allows motion in all directions, as well as acting as a shock absorber (Van De Graaff 2002; Saunders et al 1995). Each disc has a strong outer layer of fibrocartilage that attaches the disc to adjacent vertebrae (Saunders et al 1995). The fibrocartilage surrounds a soft, elastic nucleus and prevents bone-to-bone contact. The aging process, some diseases, and injuries to the spine can damage the intervertebral discs (Sizer et al 2004; Van De

Graaff 2002). This will cause a reduction of the disc elasticity. Eventually the inner nucleus can push through the outer layer and press on a nerve at the level of fault and this condition is called a disc herniation (Saunders et al 1995). Cervical disc herniation occurs less often than herniation of the discs in the lumbar spine (Saunders et al 1995). The reasons are the anatomical differences between the cervical and lumbar discs (Van De Graaff 2002; Saal et al 1996). An interesting fact with cervical discs is that the central gel changes to fibrocartilage over time (Saunders et al 1996; Van De Graaff 2002). Another reason is that neurocentral joints occupy the posterolateral vertebral edges and then the cervical disc cannot extend so far posterior than the lumbar discs (Saunders et al 1996; Van De Graaff 2002). The cervical PLL is also much stronger than the PLL of the lumbar spine (Saunders et al 1995). The following paragraph will give the reader more insight of the nervous system focusing on the cervical nerves.

There are 31 pairs of spinal nerves divided into groups as follow: eight cervical, 12 thoracic, five lumbar, five fused sacral and one coccygeal spinal nerve (Van De Graaff 2002; Saunders et al 1995). A spinal nerve exits the spinal cord through the intervertebral foramina of the vertebrae (Van De Graaff 2002). The first pair of cervical nerves is the only nerves that emerge between the occipital bone of the skull and atlas and not through the intervertebral foramen (Van De Graaff 2002).

A spinal nerve is a mixed nerve emerging from the spinal cord that is protected by the vertebrae (Van De Graaff 2002). The spinal nerve is attached to the spinal cord by posterior (composed of sensory fibres), and anterior roots (composed of motor fibres) (Kandel et al 2000). The posterior root contains a ganglion where the cell bodies of the sensory neurons are located. Sensory neurons transport sensory impulses from the human body through the posterior root into the spinal cord. The anterior root transmits motor impulses from the central nervous system (CNS) towards the human body (Kandel et al 2000).

As soon as the spinal nerve exits the intervertebral foramen, it divides into a small meningeal nerve, large posterior ramus, and rami communicantes (sympathetic trunk). The spinal nerves combine and split further into a network of nerve fibres, referred to as plexuses with the exception of the second and 12th thoracic nerves. In the current paper, the author will in short discuss the cervical and brachial plexus due to its association with subjects with an anterior neck fusion (Kandel et al 2000).

The cervical plexus is positioned bilaterally of the neck next to the first to fourth cervical vertebra (Van De Graaff 2002). Branches of the cervical plexus innervate the

skin and muscles of the head and shoulders (Van De Graaff 2002). The brachial plexus lies next to the fourth to seventh cervical vertebra as well as the first thoracic vertebra. The brachial plexus extends downwards over the first rib, behind the clavicle to enter the axilla (Van De Graaff 2002). The entire upper extremity as well as a number of shoulder and neck muscles is innervated by the brachial plexus.

Each cervical spinal nerve forms a cutaneous cervical neuron. These neurons innervate a certain area of the skin on the neck/arm area and called a dermatome (Van De Graaff 2002; Saunders et al 1995). Dermatomes can overlap with each other. Clinicians use sensation testing over the different dermatomes to evaluate for any abnormalities due to neural compression (See Appendix VIII for picture of dermatomes). Another method clinician's use is to test reflexes. The biceps reflex tests the spinal segment of cervical nerve 5/6 and the triceps reflex tests the spinal segment cervical nerve 7/8 (Van De Graaff 2002). A patient that suffers with severe neural damage at the neck will have deficits in their sensation as well as reflexes and can receive surgery if conservative management does not clear the neurological symptoms and signs (Maitland et al 2005). The following paragraph will introduce the reader to neck surgery.

An anterior cervical discectomy and fusion (ACDF) is a surgical procedure and is commonly used to manage cervical pathologies such as degeneration, spinal stenosis, disc herniation, or trauma (Lindt et al 2007). Based on experience, approximately 20 ACDF procedures are performed weekly in the Johannesburg area. Cloward (1958) as well as Robinson et al (1955) introduced ACDF and cervical decompression procedures with good results towards relieving neurological symptoms in patients who suffered from disc herniation. The ACDF is performed through a small incision in the front of the neck (Hauerberg et al 2008). A bone graft and cage is generally part of a fusion and provides support between the vertebrae where the diseased disc was removed (Hauerberg et al 2008). A graft can be obtained from the patient's iliac bone or from a bone bank. Titanium plates are also screwed into the cervical vertebrae to provide optimal support (Hauerberg et al 2008). The surgical procedure is discussed in more detail in the literature review.

According to literature postoperative care normally involves wearing a neck brace for three to six weeks. Wearing the neck brace depends on the decision of the neurosurgeon (Lindet al 2007; Mannion et al 2007; Mummaneni et al 2007; Peolsson 2007; A home program is explained to the patient prior to discharge and consists of advise to walk/move around and back care (Peolsson et al 2007). The reasons for the

above mentioned were due to the fact that the wound must heal and the fusion needs to form unification (Mannion et al 2007; Mummaneni et al 2007; Peolsson 2007). After six weeks, postoperative physiotherapy management includes active range of motion exercises of the neck (Peolsson 2007; Persson et al 1997). Between two to three months, patients need to visit the neurosurgeon to evaluate the success and strength of the fusion. If the union is good, the patient can start low force strengthening exercises (Peolsson 2007; Persson et al 1997).

## 1.2 STATEMENT OF PROBLEM AND JUSTIFICATION FOR RESEARCH

Based on clinical experience, an anterior neck fusion is often performed in South African hospitals. There is little evidence available regarding functional outcomes after surgery on national as well as international level. There is a need to establish the extent and impact of long-term problems that patients present with after neck surgery in order to implement evidence-based rehabilitation programs and follow ups (Peolsson et al 2006; Peolsson et al 2002; Persson et al 2001). More research is needed to underline the potential role of physiotherapy in the long-term management of this patient population (Peolsson et al 2006; Mayer et al 2002).

## 1.3 RESEARCH QUESTIONS

What is the current level of pain experienced by subjects who had an anterior neck fusion 12 months ago? What is the QoL of these subjects 12 months postoperatively?

## 1.4 RESEARCH AIMS

To establish the level of pain experienced by subjects 12 months after anterior neck fusion surgery. To establish the QoL of subjects 12 months after anterior neck fusion surgery.

## 1.5 RESEARCH OBJECTIVES

1. To determine the level of pain experienced by subjects 12 months after anterior neck fusion surgery.
2. To determine the QoL, related to physical and mental health, of subjects 12 months after anterior neck fusion surgery.
3. To establish the level of anxiety and depression that subjects experience 12 months after anterior neck fusion surgery.
4. To establish the level of dysfunction due to pain that subjects experience 12 months after anterior neck fusion surgery.
5. To compare QoL between subjects who had an anterior neck fusion and a healthy baseline group.

## 1.6 TYPE OF STUDY

A cross - sectional survey was conducted.

### SUMMARY

The cervical spine is subjected to wear and tear as well as trauma. This eventually can develop into pathology such as degeneration of the cervical spine. This degeneration can lead to neurological symptoms due to neural pressure. Surgery relieves the pressure on the nerves through decompressing and fusing the affected levels together.

Chapter 2 consists of an in-depth discussion of the literature on cervical pathology, QoL of subjects who had an anterior neck fusion and an overview of the different questionnaires used in this study.

# CHAPTER 2

## LITERATURE REVIEW

Search engines used were Pedro, Pubmed, Medline and Wits e-portal. The keywords used to identify suitable articles were anterior neck fusion, outcome measures, patient expectations, neck, pain, cervical pain, lumbar pain, lumbar fusion, rehabilitation, postoperative fusions, NDI, FABQ, VAS, and SF 36. Lumbar pain/fusion, outcome measures, and quality of life were also used as keywords.

## 2.1 CERVICAL PATHOLOGIES

### 2.1.1 Degeneration

Intervertebral disc degeneration is caused by cumulative wear and tear as well as trauma (Sizer et al 2004). This process can result in a series of pathological processes such as soft disc herniation, progressive disc degeneration, osteophytes, and facet joint hypertrophy, increasing the load on the facet joints, capsules, ligaments and surrounding muscles (Sampath et al 1999). The intervertebral disc will loose the ability to absorb water and the disc space will narrow (Van De Graaff 2002). The reduced intervertebral space and osteophytes can impinge neural tissue at adjacent nerve roots (Van De Graaff 2002).

Disc degeneration results in narrowing of disc spaces and causes increased mechanical stress at the vertebral joints (Persson et al 2001). The increased mechanical stress can result in bone formation called osteophytes (Van De Graaf 2002). These osteophytes can impinge on the nerve roots and in some cases cause sensation changes such as pins and needles into one or both arms or even numbness/ weakness (Persson et al 2001). The most affected levels are between the third and seventh cervical vertebrae (McCormack et al 1996).

Degeneration of the cervical spine also named cervical spondylosis, is the most common acquired cause of myelopathy and radiculopathy in the cervical spine and is a disabling, nonfatal symptom (Gok et al 2008). Degenerative changes with osteophytes in middle age and older are almost a universal manifestation (Persson et al 1997). In 15% to 40% of patients, degeneration occurs at a single disc space level and at multiple levels in 60% to 80% of patients (McCormack et al 1996).

Repeated trauma at work may contribute to the development of cervical spondylosis. According to McCormack et al (1996), cervical spondylosis has been noticed in patients who carry heavy overhead loads, dancers, gymnasts as well as in patients with spasmodic torticollis.

Radiculopathy is possibly the result of mechanical pressure on the nerve root applied by disc protrusion, spurring or a combination associated with an inflammatory component (Persson et al 2001). In general, radicular symptoms resolve in most patients with conservative treatment or with no treatment (Sampath et al 1999). Myelopathy occurs when the pathology/trauma is so severe that it damages the spinal cord (Persson et al 2001; Van De Graaff 2002). Neurological symptoms will become more widely distributed (Saunders et al 1995).

There remain many unanswered questions, regarding what constitutes the optimal management for many of these patients with radiculopathy due to cervical pathology (Sampath et al 1999). A comparison of results of medical and surgical treatment for cervical radiculopathy has received limited attention (Hauerberg et al 2008; Vavruch et al 2002; Persson et al 2001; Sampath et al 1999). The possibility of extrinsic factors cannot be ruled out for example, muscular pain, connective tissue pathology, pain from cervical facet joints and discs. This can give an indistinct clinical picture (Peolsson et al 2003; Sampath et al 1999).

Other factors that need to be looked at are poor posture, poor muscle endurance, sustained working positions, psychological and social factors (Persson et al 2001). In a study by Falla and colleagues (2004), the authors demonstrated increased superficial muscle activity in patients with neck pain. This can lead to a greater altered motor strategy with reduced deep muscle activation and again contribute to pain and disability or poor QoL (Falla et al 2004). The conservative and surgical management will be discussed later in this chapter and brings the researcher to the next point of trauma such as whiplash and the possible relationship with an anterior neck fusion.

### 2.1.2 **Whiplash**

According to Sizer et al (2004), the term “whiplash” is the most common word in the scientific literature to describe neck injuries that are associated with a motor vehicle accident. Motor vehicle accidents involve a whole cascade of biomechanical changes that can damage structures in the spine and the cervical spine undergoes significant strain without sustaining any direct contact (Poorbaugh et al 2008; Sizer et al 2004).

Sizer et al (2004) described in their study that the typical mechanism of a whiplash injury involves acceleration and hyperextension of the cervical spine in a front to rear or side-impact motor vehicle collision. The occupant's trunk is forced forward and the head will remain relatively stationary for the first 150 milliseconds of the movement. This is followed by a momentary change of the cervical spine into a physiologic motion of extension in the lower cervical segments and flexion in the upper cervical segments. It was previously believed that a whiplash is an extension/flexion injury but the latest research has demonstrated that it is rather a compression injury (Sizer et al 2004). The compression is caused by the upwards thrust by the trunk. Trauma from a whiplash injury creates joint compression instead of a glide of the cervical articular surfaces because they are orientated in a 45° plane. Articular surface compression appears to be greatest at C4, 5 and capsular strain at C6, 7 levels (Poorbaugh et al 2008; Sizer et al 2004). The zygapophyseal joints are thinly lined with cartilage and undergo severe strain with the compression (Van De Graaff 2002). This forced motion can lead to injuries of capsules, ligaments, facets or discs (Sizer et al 2004). At least 50% of whiplash injuries have pain due to damaged zygapophyseal joints (Bogduk et al 2001).

Whiplash injuries can produce excessive damage on discs. The surrounding soft tissues also sustain injury and will contribute to reduced spinal stability due to reduced neuromuscular control (Poorbaugh et al 2008). The discs of the cervical spine are innervated via the ventral primary ramus of the sinuvertebral nerves. The posterolateral region of the discs contains receptors resembling Pacinian corpuscles and Golgi tendon organs demonstrating a mechanoreceptive function. Irritation of these nerves could give persistent pain (Kandel et al 2000). Disc lesions were thought to contribute to the development of chronic neck pain after a whiplash injury in 33% of patients (Persson et al 1997). Disc and zygapophyseal joints are extensively innervated and could serve as primary pain generators in patients with whiplash injuries (Poorbaugh et al 2008). The literature shows that even minor injuries to a disc result in dramatic degenerative changes in the months that follow. Discs do not heel once they are injured due to poor vascularisation (Sizer et al 2004).

According to Jull and colleagues (2004), previous studies indicated that there is an association between neck flexor muscle strength, whiplash associated disorders (WAD) and insidious neck pain (Jull et al 2004). There is an anterior to posterior muscle imbalance in patients with neck pain and apparently patients with WAD have poor muscle strength compared to those with neck pain alone (Jull et al 2004). WAD

can contribute to cervical pathology leading to chronic pain and the need for neck surgery (Sizer et al 2004).

#### 2.1.2.1 **Physiotherapy Management of Whiplash Injuries**

Conservative physiotherapy treatment for a patient with a whiplash injury needs to be managed with great care. These patients can have much more damage that cannot always be seen on magnetic resonance imaging (MRI) or x-rays (Sizer et al 2004). Previous research demonstrated that MRI as well as x-rays could not always be reliable (Sizer et al 2004; Sterling et al 2004). The x-rays are usually taken after an accident involving the neck to exclude cervical fractures or dislocations. The MRI needs to establish more detailed information about the discs, facet joints and surrounding ligaments and muscles (Sizer et al 2004).

The basic intervention in the literature according to Sizer et al (2004), is pain management, reducing inflammation, cervical joint mobilization, return to normal functional activities and work and stabilizing exercises of neck muscles. Unfortunately clinicians prescribe cervical collars but there is not enough evidence that it is effective (Sizer et al 2004). Sizer et al (2004) suggests the use of a soft collar for the acute stage only and it must not be worn long term. The reason for this is to allow active movements of the neck to prevent stiffness and weakening of the surrounding muscles (Sizer et al 2004).

### 2.1.3 **PAIN**

Background information about pain mechanisms will allow a better understanding of pain in patients with an ACDF and is discussed in this section.

In the event of an injury such as surgery, patients who had an anterior neck fusion experience pain (Peolsson et al 2002). Based on clinical experience, it is evident that clinicians are daily challenged with management of pain. Pain can become the central focus of existence in patients who experiences longstanding pain (Wright et al 1999). In physiotherapy pain can be evaluated through input (nociceptive, peripheral neurogenic, central neurogenic) processing (cognitive, affective neuroendocrine) and output (cognitive, neuroendocrine, autonomic, immune, motor) mechanisms.

According to Ader et al (1995), ongoing pain can often weaken the immune system. This can eventually lead to chronic diseases that can increase a financial burden on the patient and medical aids (Ader et al 1995). Pain is classified as chronic when the duration of pain is lasting longer than three months or if patients experience pain far

beyond the expected healing time (O'Sullivan 2005). It is thus important to try to reduce pain in patients to prevent chronic cervical problems.

#### 2.1.3.1 **Pain Pathways**

The somatosensory system is a sensory pathway and contains approximately 10 million sensory neurons. This system transmits information from sensory receptors in the skin, muscle, joints and viscera to the cerebral cortex (Kandel et al 2000). First-order neurons are the primary afferent neurons and detect information arising from sensory receptors and travels to the spinal cord where it terminates primarily in the dorsal horn. There are six distinct laminae in the dorsal horn and the nociceptor specific cells are located in the superficial lamina I and II. Lamina I and II only receives input from C and A delta nociceptor fibres. Some deeper laminae, mainly V, consist of wide range dynamic (WRD) cells that respond to a variety of non-noxious and noxious stimuli. Information about tissue injury such as surgery is mainly carried from the spinal cord to the brain through five ascending pathways from which the spinothalamic tract is the most prominent pathway (first-order neurones). The second-order neurones receive synaptic input from the first-order neurones and are located in the dorsal column nuclei of the caudal medulla (brainstem). These neurons project the axons across the midline and travel through the medial lemniscus to the contra-lateral thalamus. The third-order neurones are located in the thalamus which project to the somatosensory areas of the cerebral cortex (Kandel et al 2000).

#### 2.1.3.2 **Peripheral Sensitisation**

Peripheral sensitisation occurs when there is tissue damage and the body forms an inflammatory "soup "(discussed below). The "soup" will lower the pain threshold of the nociceptors (Main et al 1999).

Pain is a complex, unpleasant sensory and emotional experience associated with actual or potential damage to the human body (Main et al 1999). Pain is dependant on experience and therefore varies between patients. Most tissues have specialized sensory receptors and called nociceptors (Kandel et al 2000). Not all the nociceptors give the sensation of pain. There is a great number of inactive nociceptors and will only be activated by tissue damage (Kandel et al 2000). These nociceptors are called "silent" nociceptors (Wright 1999). Nociceptors are free nerve endings and the mechanism by which the noxious stimulus depolarise free sensory endings to generate an action potential is not fully understood (Kandel et al 2000). Nociceptors are polymodal and this means that the nociceptors can react on chemical, mechanical and thermal nociceptive stimulation (Wright 1999).

Tissue damage such as surgery releases chemical mediators into the tissues that promote sensitisation of the peripheral nociceptors (Kandel et al 2000). Mediators that have been identified are bradykinin, serotonin, histamine, potassium, adenosine, protons, prostaglandin, leukotrienes and cytokines and are sometimes called the "inflammatory soup" (Wright 1999; Kandel et al 2000). It is thought that the nociceptors contain proteins in their cell membranes that are activated via "inflammatory soup" to convert thermal, mechanical or chemical energy of a noxious stimulus into an electrical potential to depolarise the membrane. Another trigger of the nociceptive system is the pH of the surrounding tissue. Inflammation that occurs in injuries or surgery lowers the pH and will stimulate the nociceptive system (Wright et al 1999). Nociception does not necessarily lead to the development of pain but rather the perception of pain and is the brain's thought and expansion of the sensory input (Kandel et al 2000). Only the C-fibres will respond to all noxious stimuli (Wright 1999) but A-Delta fibres respond to mechanical and thermal stimuli. Neuropathic pain and develops when the peripheral nerves or central nervous system (CNS) are directly injured (Kandel et al 2000). This type of pain is often described as a burning or electric sensation (Kandel et al 2000).

#### 2.1.3.3 **Central Sensitisation**

Central sensitisation is when the WRD cells and nociceptive specific cells in the dorsal horn becomes more sensitive due to an overload of painful stimuli ( Kandel et al 2000) and will be discussed in more detail.

Chronic pain is the result of central sensitisation and is an umbrella term used for a variety of processes to produce a state of hyper excitability of the dorsal horn, for instance stimulation that normally does not produce pain, will produce pain. Chronic pain is classified as pain that lasts for a period beyond healing of injury and does not serve any purpose (Main et al 1999). In chronic pain, the WRD cells become more sensitive to any stimuli. The receptor field in the brain will enlarge because all the stimuli are able to fire the cells and send messages through to the brain resulting in the sensation of pain (Kandel et al 2000). The brain creates a "memory tag" and the pain threshold level for pain is lowered. Allodynia, the reduction of pain threshold, and hyperalgesia, exaggerated response to a noxious stimulus, is associated with chronic pain. The reason is a dysfunctional nociceptive system (Kandel et al 2000).

2.1.3.4 **Peripheral Neurogenic Pain**

Nerve root irritation or compression is classified as peripheral neurogenic pain (Kandel et al 2000) and all the above paragraphs discussed involve the nerve. If any nerves are involved, the pain will follow a dermatomal pattern and can be accompanied by reduced or increased reflexes as discussed before. Clinicians use the testing of sensation, reflexes and muscle strength/atrophy to decide the amount of nerve damage (Persson et al 1997; Kandel et al 2000).

2.1.3.5 **Chronic Pain and Distress**

Pain has a primitive quality and serves as a protective mechanism but can become maladaptive in chronic pain conditions. Chronic pain serves no useful function and only makes a patient despondent (Kandel et al 2000). Psychological variables play an important role in the development of chronic pain (Lee et al 2006). Pain has a powerful impact on the life and happiness of a patient (Main et al 1999). It causes distress, loss of physical confidence, self-esteem, sense of hopelessness and despair. Psychological distress is anticipated to be a consequence of ongoing pain and disability (Sterling et al 2004). Weiss and colleagues (2006) found that most patients with chronic pain become clinically depressed or demonstrated signs of depression (Weiss et al 2006). Psychological factors such as fear and anxiety have been shown to affect measures of both pain threshold and pain tolerance (Sterling et al 2004).

The most important and powerful cognitive variables in predicting disability in patients with low back pain were pain and fear to move (Lee et al 2006). Pain related fears can present with avoidance such as resting, sustained posture, limping or avoiding painful movements in order to reduce pain. Avoidance beyond the expected tissue healing time will prolong the pain and fear, causing harmful effects to the patient both physically and psychosocially. Patients will then become incapable to perform normal movements or participate in activity due to fear of re-injury or pain. Subsequently this behaviour will lead to disuse atrophy and even withdrawal from social activities (Lee et al 2006).

Persson et al (2001) investigated the relationship between pain, emotional state and coping strategies in patients with chronic radicular neck pain before and after surgery or conservative treatments. They found that patients who had a neck fusion and reported pain postoperatively had the highest depression rate. According to Peolsson (2007), it is most important to inform patients of the outcome of different treatment interventions and of what to expect after the surgical procedure. Peolsson (2007)

suggested that patients must be informed before surgery that they have only a 50% chance of achieving pain relief and slight chance of functional recovery. He found that 71% of subjects with ACDF had high pain intensity on the VAS at the six year follow-up. Different cut-off points were used to make the conclusion of a 50% recovery rate. A 50% change in pain intensity is commonly used in pharmaceutical examination of new painkillers and that is why Peolsson feels 50% recovery rate could be used for ACDF (Peolsson 2007). Peolsson (2007) found that approximately one third of the study patients had lingering disabilities in objective variables such as strength and range of motion one year after ACDF with a cervical intervertebral fusion cage. Furthermore, two thirds of those patients had residual problems according to subjective variables such as pain, NDI and distress and DRAM at a three year follow-up. There are no reports addressing the degree of deficit more than three years after ACDF (Peolsson 2007). The mentioned study demonstrates that patients can suffer from depression due to pain postoperatively and the lack of research in patients who underwent an ACDF.

#### 2.1.3.4 **Visual Analogue Scale**

The VAS scale is a tool that was used in the current study to evaluate the level of pain in patients with an ACDF one year postoperatively (Mannion et al 2007). The VAS scale is a 100mm straight line where the patient indicates his/her level of pain (0mm = no pain, 100mm = worst imaginable pain). The clinician can decide if the pain measurement is for that day, the past week/month/year (Mannion et al 2007). The ends of the VAS line are usually labelled as the extremes (no pain and most severe pain). The distance between the mark of the patient and the origin is measured in millimetres and used as the score. The VAS scale is commonly used and is reliable (Persson et al 2001) and valid (Carlsson 1983).

## 2. 2 **NECK MUSCLE STRENGTH AND PROPRIOCEPTION**

Research has revealed that in the painful lumbar spine the most important thing to consider is the activation pattern (Hodges & Richardson 1996) of muscles. According to Peolsson et al (2007), patients with neck pain have poor neck proprioception compared to healthy subjects. Another contribution according to Peolsson et al (2007) is that patients with greater neck muscle fatigability had poorer proprioception and altered activation patterns that were associated with neck pain.

It has been reported that chronic neck pain reduces muscle strength with 20% - 50% (Van Wilgren et al 2003) and people who interpret pain as catastrophic will have kinesiophobia (fear of movement) that develops into disability (Nederhand et al

2004).This can lead to time off work, depression, anxiety and functional problems. Peolsson and colleagues reported that improved neck strength in patients with chronic neck pain, reduced their pain, disability and duration of sick leave (Peolsson et al 2002).

## 2.3 MANAGEMENT OF CERVICAL PATHOLOGIES

### 2.3.1 Conservative Management

The physiotherapy management of non specific neck pain is well described in the literature and there is strong evidence that physiotherapy exercise reduces the pain levels in non specific neck pain patients (Philadelphia Panel 2001). Another finding was that there was not enough evidence for modalities such as traction, thermo therapy, therapeutic ultrasound, trans cutaneous stimulation and electrical stimulation. Persson et al (2001) was one study that compared three groups of patients with radicular pain and will be described in the following paragraphs.

Persson et al (2001) conducted a randomised controlled study comparing physiotherapy interventions with neck surgery and a group wearing a collar. They randomised 81 subjects with radicular pain into three groups (physiotherapy group, collar group and neck surgery group). The outcomes measures they used for the emotional state where the Mood Adjective Check List, Hospital Anxiety, and Depression Scale with a Coping Strategies Questionnaire. The pain was measured with VAS and function with Disability Index Rating. The aims for the physiotherapy interventions were to relieve pain with trans-cutaneous electrical nerve stimulation, heat (moist heat packs and ultrasound), or cold and massage. This was combined with manual traction and gentle cervical mobilization. Relaxation, neck/shoulder stretches, isometric strengthening, and aerobic exercises were added to increase the oxygen consumption of the physiotherapy group. This group also received advice on ergonomics, posture, and were encourage reducing the workload on the cervical spine. The cervical collar group had to wear a rigid collar during the day and a softer collar at night for three months. The purpose of the collar was to reduce neck movements and remind the patients to protect the neck from painful movements. The results demonstrated that the physiotherapy and surgery group had the same results one year later. Persson et al (2001) remarked that their literature review revealed the clinical outcomes of surgery reported to be between 72% -94% but most articles are retrospective, patient selection and follow up times differed extensively. Another problem that Persson and colleagues (2001) mentioned is that postoperative treatment was barely described and not always done by a blinded observer.

### 2.3.2 **Surgical Management**

An anterior neck fusion is an accepted surgical procedure that is often used to manage cervical degenerative disc disease that causes radiculopathy and/or myelopathy (Lindt et al 2007). Patients with significant neurological deficits and failed conservative treatment are good candidates for neck surgery. The surgical goal is to decompress the spinal cord while maintaining the stability and sagittal alignment of the cervical spine (Gok et al 2008). ACDF, with or without a plate or cage fixation, is still the method of choice for a fusion (Hauerberg et al 2008) and several reports support this approach as effective (Clements et al 1990).

ACDF is usually performed through a small, transverse incision in the antero lateral side of the neck. The surgeon cuts through the platysma muscle and divides the platysma muscle into two. The anterior aspect of the spine is reached when the surgeon does a blunt dissection between the trachea and oesophagus. The vascular bundle lies laterally from the blunt dissection and contains the jugular vein, common carotid artery and vagus nerve. The vascular bundle is covered with the carotid sheath and the surgeon does not cut through the sheath (Van De Graaff 2002). The next step is to release the longus colli muscle, the anterior longitudinal ligament as well as the vertebral bodies. A fluoroscopy is done to detect the correct levels of the vertebrae that need to be fused (Hauerbeg et al 2008). A discectomy and decompression are standard procedures before inserting any bone and a cage. The discectomy is the removal of the fragment or the whole protruded disc and a decompression is the removal of osteophytes that encroached on the peripheral nerve root (Persson 2001). An intervertebral bone graft with a cage is generally part of a fusion to restore disc height and provide stability between the vertebrae where the diseased disc was removed. A donor graft can be derived from the patient's unicortical iliac crest bone or from a bone bank. Bone material and a titanium cage are placed in the intervertebral space. Cage position is confirmed with a fluoroscope in the frontal and lateral plane. A drainage tube is placed before closure of the wound (Wilke et al 2000). Despite broad clinical use of these cages, the numbers of randomised studies comparing clinical outcome measures of the anterior fusions with cages are still limited (Bärlocher et al 2002; Lind et al 2007).

#### 2.3.2.1 **Postoperative management**

In the literature search from 1995 to 2008, there was little evidence for physiotherapy management after ACDF (Hauerberg et al 2008; Peolsson et al 2007; Kienapfel et al 2004; Mayer et al 2002; Peolsson et al 2002; Vendrig et al 2002; Wilke et al 2000;

Sampath et al 1999; Wright et al 1999). Persson et al (2001) and Peolsson et al (2007 & 2003) are the only researchers that actually describe the physiotherapy management in detail and the focus will be on these three studies.

Patients were mobilized on the first postoperative day (walking), and depending on the neurosurgeon, a Philadelphia collar was used for three to six weeks postoperatively (Peolsson et al 2007; Peolsson et al 2003; Persson et al 2001). Based on clinical experience a home program is explained to the patient prior to discharge and consists of mobilizing exercises, such as walking and back care. There is not supporting evidence or literature for the postoperative care in hospital or the mobilizing exercises and advice given with discharge (Philadelphia Panel 2001).

Peolsson et al (2006) mentioned in their study that the instructions were to mobilize patients on the first postoperative day. Patients can walk and move around but are not aloud to do any resisted neck muscle strengthening for the fusion needs to heal (Peolsson et al 2006). After six weeks postoperatively, instructions were given to the patient by a physiotherapist to do active range of motion exercises. The patients had to consult the neurosurgeon two to three months postoperatively to evaluate the state of the fusion (Peolsson et al 2006). Thereafter patients began with low force exercises to gain neck muscle strength and endurance (Peolsson et al 2006). Unfortunately, the type of strengthening for neck muscles is not well researched or described (Peolsson et al 2006; Persson et al 2001). According to Peolsson (2007) six months postoperatively there are generally no contraindications for any activities except extreme sports such as wrestling until the fusion is healed.

In the study of Peolsson (2007), they compared neck muscle endurance of an ACDF and non-specific neck pain subjects. The neck muscle endurance increased significantly with the exercises that the researcher used. The exercises were based on the Philadelphia Panel evidence rehabilitation for non-specific neck pain. The Philadelphia Panel used literature of 1962 – 2000 according to the Cochrane methodology to identify randomised controlled studies. The authors discovered that only therapeutic exercise showed the best outcome. The specific exercises were not described in detail (Philadelphia Panel 2001).

In two other studies by Persson et al (1997) and Persson et al (2001), they used patients with radicular neck pain and compared pain, coping, emotional state and physical function in patients treated with surgery (group 1), physiotherapy (group 2) and subjects wearing a neck collar (group 3). Both these studies were done in the

same manner. The patients included suffered with chronic radicular neck pain. Group 2 received treatment by experienced physiotherapists that extended over a period of three months. The therapy was divided into 15 sessions, with one to two sessions per week and the duration of each session was 30 – 45 minutes. The passive physiotherapy treatment for pain relieve included trans-cutaneous electrical nerve stimulation, heat/cold packs, ultrasound, massage, manual traction and gentle cervical mobilization. The active treatment consisted of exercises that included isometric neck exercises to increase neck muscle strength and endurance as well as neck and shoulder stretches for flexibility. The advice included ergonomic instructions and posture correction to reduce sustained static working/leisure positions. This group was compared to the neck surgery group and collar group. In both studies at 12 months there was no significant difference between the surgical treated patients and the physiotherapy group (Persson et al 1997; Persson et al 2001).

Unfortunately, clinical outcomes after neck surgery are not well described in literature because the postoperative treatments are not always described as well as the fact that the observer was not always blinded (Persson et al 2001). According to the Philadelphia Panel (2001), outcomes measures was accepted as clinically relevant if it measured one of the following: quote “pain, function, strength, range of motion, return to work, patient satisfaction, activities of daily living or QoL These keywords are relating to function of patients and is needed to return patients back to their daily activities.

## 2.4 QUALITY OF LIFE IN PATIENTS WITH AN ANTERIOR NECK FUSION

A study by Peolsson and colleagues (2006) reported that ACDF is an accepted surgical method and that some studies demonstrate a reduction in pain intensity, improvement of neurological signs and better Odom’s criteria ratings. When the same subjects were measured with more outcome measures that included function, the results of surgery were actually worse (Peolsson et al 2006). Patients who had ACDF demonstrated insufficient life quality outcomes long-term. In this specific study by Peolsson and colleagues (2006), post-operative rehabilitation was not specially designed for the study and the patients received passive rehabilitation or non-specific exercises for the neck. There were also patients who received no physiotherapy (Peolsson et al 2006). However, there is not any evidence whether structured pre-or postoperative rehabilitation improves the outcomes after neck surgery (Peolsson et al 2006; Peolsson et al 2003; Peolsson et al 2002; Fouyas et al 2002). According to Peolsson and colleagues (2003) one year after ACDF with a cervical carbon-fibre

intervertebral fusion cage, 82% of patients reported >10mm average pain on VAS and more than 20% reported disability on the Neck Disability Index (NDI).

Patients who undergo an anterior neck fusion present with pain and poor QoL postoperatively (Peolsson et al 2007). Research has demonstrated that functional outcome measures taken at six months postoperatively after cervical fusions can predict the results of the same outcome measures in these patients' long term (Peolsson et al 2006). Peolsson et al (2006) measured VAS, NDI, distress and risk assessment method (DRAM) as well as general health outcomes in ACDF patients at six months, one, two and six years. Deficits in these outcome measures were present throughout the data collection at six months, one, two, and six years confirming the poor well-being of subjects postoperatively (Peolsson et al 2006; Peolsson et al 2003).

The success of ACDF surgery is usually confirmed postoperatively with improvement in neurological symptoms and bone formation with MRI. The success of surgery is rarely measured with questionnaires to establish the patient's subjective perception of QoL (Kienapfel et al 2004; Fouyas et al 2002).

Patients who underwent orthopedic surgery for other joints benefited from postoperative rehabilitation as they had an improvement in functional outcomes and reported good QoL postoperatively (Mannion et al 2007). According to these authors the postoperative rehabilitation of patients who had decompression surgery is not well described.

Patients suffering from severe long lasting symptoms, even if they benefit from surgery, might still have pain. Pain can result in an extreme response such as avoidance, anxiety, depression, low mood and anger (Main et al 1999). According to Persson et al (2001), they found that patients who had surgery had high expectations and if they still had pain, they suffered from disappointment and poor outcomes. Patients who were surgically treated viewed surgery as the ultimate treatment and became more passive which can explain why these subjects still have pain and poor QoL (Peolsson et al 2007). Some literature did demonstrate that if pre- and postoperative outcome measures such as SF-36 were compared, there was an improvement of results postoperatively (Ipsen et al 2007; Epstein et al 2006). In the study by Ipsen et al (2007), 200 patients were included that received an ACDF on one, two or three levels. The main aim of the study was to evaluate the association between the position of the plate and the short-term clinical outcomes. Ipsen et al

(2007) used the following outcome measures: VAS for neck and arm pain, SF-36, and plain radiographs. There was not any association between plate position and the clinical outcomes. All their patients did improve on SF-36 and the VAS (Ipsen et al 2007). Epstein and colleagues (2006) used the SF-36 to assess the QoL in subjects with cervical decompression and multilevel fusion. The authors demonstrated that there was an improvement in QoL reported with the SF-36 postoperatively. Unfortunately, only 14 patients were used and the patients were not randomly selected. Other literature demonstrated that the evidence of the QoL postoperatively ACDF is scanty and the studies are not of good quality (Fouyas et al 2002; Peolsson et al 2002).

## 2.5 INTRODUCTION OF QUESTIONNAIRES

The use of questionnaires is an accepted method to assess the outcomes of different treatment and rehabilitative interventions. Risk factors for a poor outcome can be detected via questionnaires. Most questionnaires are standardized and clinicians use the same questionnaires worldwide (McCarthy et al 2007). Questionnaires must be both valid (measure what it is intended to measure) and reliable (the measurements must be consistent and reproducible) (Vernon & Mior 1991). Several questionnaires have been used as outcome measures in previous studies conducted on subjects after neck fusion surgery and the following are discussed in this section: Short Form-36 (SF-36) questionnaire, 10 point Neck Disability Index (NDI), and Fear Avoidance Beliefs Questionnaire (FABQ). The questionnaires that were used as outcome measures in this particular study were SF-36, FABQ and NDI.

### 2.5.1 Short-Form 36

The SF-36 questionnaire is a well-known, multipurpose tool to assess health-related QoL in subjects from a diverse background (McCarthy et al 2007). The SF-36 consists of eight domains and 36 items. Thirty-five items are combined into eight subscales that are grouped together to form two higher–order scales, namely the Physical Health Component Score (PCS) and Mental Health Component Score (MCS). Each domain is scored from 0-100 (100 is the maximum score). The PCS is based on Physical Function (PF), Role Physical (RP), Bodily Pain (BP) and General Health (GH) where MCS includes Vitality (V), Social Functioning (SF), Role Emotional (RE) and Mental health scales (MH) (McCarthy et al 2007).

In contrast with other generic health status instruments, the SF-36 demonstrated better viability, internal uniformity, content validity, discriminative ability and has been tested more than most other questionnaires (McCarthy et al 2007).

The SF-36 English (UK- version) questionnaire was used in some studies conducted in South Africa and was found to be a valid and reliable research tool (O'Keefe & Wood 1996; Benitha & Tikly 2007). Benitha & Tikly (2007) compared Black South Africans with Rheumatoid Arthritis (RA) (n=50) and Systemic Lupus Erythematosus (SLE) (n=50) with a control group that matched the subjects geographically and ethnically in South Africa. The RA and SLE groups had significant lower scores on all the domains of SF-36 compared to the control group. The authors (Benitha & Tikly 2007) found that the SF-36 was a reliable and valid measurement tool. O'Keefe & Wood (1996) researched the QoL in 134 patients (42 White,49 Mixed Race, 43 Black) with Human Immunodeficiency Virus (HIV) to see if the SF-36 questionnaire was influenced (validity and reliability) by race, gender or the clinical stage of the disease. The HIV group was compared with healthy, non-medical personal that worked in a hospital (36 White, 37 Mixed Race, and 42 Black). The authors demonstrated that the SF-36 was reliable/valid and not influenced by race, gender or the stage of the disease and those patients in the early stage of HIV had a reduced QoL.

Mummaneni et al (2007) used the SF-36 successfully in their study with 540 patients comparing cervical disc arthroplasty and an allograft fusion. The investigation group was the subjects receiving an artificial cervical disc and the control group received an ACDF. The cervical disc arthroplasty had much better long-term outcomes and better scores on SF-36 than the ACDF group (Mummaneni et al 2007). According to Mummaneni et al (2007), the mean improvement score of PCS at 12 months for the intervention group postoperative was 12.8 (11.2) and for MCS was 7.7(6.1). Scores for the ACDF is in brackets.

Epstein et al (2006) used the SF-36 to measure outcomes of a cervical laminectomy together with an instrumental fusion. The measurements was taken pre- and postoperatively (Epstein et al 2006) in 14 patients. Preoperative SF-36 data were gathered for the eight health scales namely physical function (36.6), role physical (-18.75), bodily pain (32.3), general health (53.8), vitality (38.3), social function (39.5), emotional (36) and mental health (58). Epstein et al (2006) took measurements of the SF 36 at six weeks, three months, six months and one year postoperatively. Only the one year postoperative scores will be displayed. The subjects improved continuously on all eight health scales over the first postoperative year and their scores were PF

(42.1), RP (-7.1), BP (56.4), GH (65), V (68.6), SF (55.4, RE (57.1), MH (72) (Epstein et al 2006). Unfortunately, not many studies evaluated the functional outcomes of an anterior neck fusion or post traumatic neck pain and more research is needed in this area (Mayer et al 2002).

### 2.5.2 **Fear Avoidance Beliefs Questionnaire**

Examination of fear avoidance Beliefs serves as a useful tool to screen patients who are at risk for prolonged work disability and to detect pain-related fear in patients (Fritz et al 2002).The FABQ consists of 16 questions and is a valid and reliable tool (Lee et al 2006; Grotle & Vøllestad 2006; Pfingsten et al 2000). This questionnaire was developed originally for subjects with low back pain but on the questionnaire is a note that states that this scale can be applied to patients with other types of chronic pain. Only items 3 and 11 mention" back". This questionnaire could be modified to evaluate subjects with neck pain (Lee et al 2006).

There are two subscales in the FABQ namely fear avoidance beliefs about physical activity (FABQ-PA) with five items, and fear avoidance in work related disability (FABQ-W) with 11 items. The items are scored on a 7-point Likert scale (strongly agree to strongly disagree). Each subscale score is calculated independently: FABQ-W (range 0-42) is calculated by adding items 6, 7, 9-12, 15 together and the FABQ-PA (range 0-24) by adding items 2-5. The five remaining questions are used as delusive items as proposed by Waddell et al (1993).

Some patients experience pain as threatening and avoid activities such as turning and moving of the affected area. Fear avoidance can be clarified as a maladaptive response and increases the risk of catastrophic thoughts. It creates fear to move the affected area (Huis in't Veldt et al 2007).

Literature suggests that factors such as fear, depression and muscle weakness may influence the outcome of subjects who had an anterior neck fusion (Peolsson et al 2003; Persson et al 2001). Avoidance is a maladaptive reaction that leads to the withdrawal from social activities (Cleland et al 2007). Patients with fear avoidance display distress that is more psychological than physical. There is a dearth of evidence regarding fear avoidance in patients with neck pain (Cleland et al 2007).

### 2.5.3 **Neck Disability Index Questionnaire**

The 10 point NDI questionnaire is reliable, valid (Gulsah et al 2007; McCarthy et al 2007) and enables the professional to understand the effect of neck pain on daily

activities in subjects. Vernon (1989) designed the NDI that is a modification of the Oswestry Low Back Pain Disability Index. The NDI contains 10 items (pain intensity, personal care, lifting, reading, headaches, concentration, work, driving, sleeping and recreation) each with six possible answers. Seven questions are related to activities of daily living, two related to pain and one item related to concentration. Each item is scored from zero to five and the total score is expressed as a percentage, with higher scores corresponding with greater disability (0-20 normal, 21-40 mild disability, 41-60 moderate, 61-80 disability, severe and 80+ complete disability). McCarthy et al (2007) established that the NDI is reliable and valid and can be used for out patients with spinal surgery. Peolsson (2006) used the NDI and VAS scale together, to determine the clinical benefit of an ACDF. They found the scales reliable and valid and their patient group demonstrated deficits in 83%-100% of cases (Peolsson et al 2006).

## 2.6 CONCLUSION

According to the literature review ACDF is a frequently used method for cervical pathology especially when there is neurological deficits such as pins/needles, and/or muscle weakness. The aging process as well as trauma is part of life and this can predispose the pathological changes in the neck.

Most studies relied on radiographic images to confirm the fusion rate as well as new bone formation. Literature demonstrated that the studies were not always randomised controlled, blinded, or lacked big enough sample sizes. This makes the evidence poor for the QoL and pain levels of patients who had an ACDF short and long-term.

In the literature, there is a lack of evidence about physiotherapy rehabilitation programs after ACDF and not any evidence for the recommended management in the first six weeks postoperative period. Fortunately, there is good evidence to suggest that exercises for the neck does improve patients' symptoms and lowers the pain level experienced in non-specific neck pain. Unfortunately, precise exercises (patient position, method, aim of specific exercise and patient expectations) are not well described.

There is not enough supporting evidence for the QoL and levels of pain experienced in patients with an ACDF (Peolsson et al 2006). There is a need to establish patient QoL postoperatively although some studies did demonstrate improvement postoperatively if compared with preoperative QoL (Epstein et al 2006). Therefore,

the question remains as to whether this reported QoL is acceptable for patients after an ACDF.

In summary, the conclusion is that the level of pain as well as the QoL in subjects who underwent an ACDF needs to be established. The results of this research report can form a baseline from which new evidence-based physiotherapy approaches and interventions could be developed.

# CHAPTER 3

**METHODOLOGY**

The methodology discussed in this chapter is based on the findings of the literature review discussed in chapter 2. The study design, sample population, hypothesis, data collection procedure and instruments used are discussed in detail. The methods used for data analysis are given. Ethical considerations are addressed towards the end of this chapter.

## 3.1 STUDY DESIGN

A cross - sectional survey was performed on a cohort of subjects that had an anterior neck fusion one year ago and fitted the inclusion and exclusion criteria of this study.

## 3.2 HYPOTHESIS

The alternative hypothesis ($H_1$) was that subjects who underwent an ACDF would suffer from pain and poor health related QoL one year postoperatively. The null hypothesis ($H_0$) was that subjects who had an ACDF would not suffer from pain and a reduction in health related QoL one year after surgery.

## 3.3 SAMPLE SELECTION

A sample of convenience was selected from private practices of neuro- and orthopaedic surgeons in the Johannesburg area who completed a letter of permission (Appendix VII). Subject recruitment started in June 2008 and finished in August 2008. All subjects were one year postoperative at the time of recruitment.

## 3.4 SAMPLE SIZE

From nQuery Advisor 6.0, a sample size consisting of 35 subjects (n = 35) would yield a 95% confidence interval for pain and these confidence limits would be within 5% of the mean pain. The sample size calculation was done in consultation with a biostatistician from the Medical Research Council. The sample size was determined using pain intensity one year postoperatively as measured with the VAS scale (Appendix V). The population of patients seeking treatment because of pain were based on clinical experience and patients were expected to report levels of pain between 40% and 100% on the VAS scale. The standard deviation was estimated to be 15%.

## 3.5 INCLUSION CRITERIA

The following patients were included in this study:

- Subjects who had an anterior neck fusion 12 months ago due to degenerative diseases.
- Aged between 30-60 years.
- Subjects who were resident in and around Johannesburg.

## 3.6 EXCLUSION CRITERIA

The following conditions were excluded from this study:

- Rheumatoid arthritis
- Previous spinal surgery
- Spinal tumours
- Spinal fractures
- Cancer

## 3.7 DATA COLLECTION PROCEDURE

### 3.7.1 Subjects with Anterior Neck Fusion

Thirty-five subjects (n = 35) were recruited from private practices of neuro- and orthopaedic surgeons between June 2008 to August 2008. All the hospitals were contacted telephonically to gain the telephone numbers of the surgeons that operated in the hospitals. The different private practices were phoned and asked if the surgeon did ACDF procedures. The receptionists could always assist in the answer. The doctors that did ACDF were contacted and the purpose of the study was explained telephonically. An informed consent (Appendix VII) was either faxed or e-mailed to them and their receptionists either faxed or e-mailed it back after completion. Contact details of 43 patients who had an anterior neck fusion in 2007 were obtained. The date of surgery was confirmed with the possible subjects and the inclusion criteria were used as screening method telephonically by the researcher.

The researcher made an appointment telephonically with 35 selected subjects. The meeting was either at the subject's home or at the researchers practice. The researcher explained the purpose of the study to selected subjects at place of meeting. Each subject received a subject information sheet and consent form that had to be signed (Appendix I). The subject received four questionnaires [demographic (appendix II); SF-36 (appendix IV); NDI (appendix V) and FABQ (appendix VI)] to complete. The researcher waited for the subject to complete the

questionnaires and assisted if needed. The demographic questionnaire contained questions about age, gender, sport, hobbies, surgery date, and days of hospitalisation, specific physiotherapy treatment received as well as the amount of treatments received and the use of medication. Each subject indicated their perceived level of pain on the VAS (Appendix V) and marked any symptoms such as pins and needles, on the body chart (Appendix II). Each subject completed all questionnaires by themselves.

### 3.7.2 **Pilot Study**

A pilot study was conducted on six healthy individuals to establish the approximate time needed to complete all the questionnaires and the average time was 45 minutes. The researcher used a stopwatch to time the participants while they filled the questionnaires in. When the participant had finished all the questionnaires, the researcher wrote the time down. The six different times were added and divided by six to give the average time of 45 minutes.

### 2.7.3 **Body Chart**

A body chart picture was used as part of the questionnaire for each subject to mark the areas of pain. The subjects could indicate the type of pain such as throbbing, burning, stabbing, pins and needles, numbness or other. This body chart is used in the researcher's private practice and has not been validated.

## 3.8 **DATA ANALYSIS**

Data summary primarily included mean, standard deviation and 95% confidence intervals for continuous data for pain on VAS, composite scores from SF-36, NDI, FABQ and demographic variables such as age. Data of the NDI and FABQ were analysed using the t-test. Demographic questionnaire data was summarized using cross-tables.

The NDI, FABQ and VAS had instructions on how to add the totals of the questionnaires and whether the subject scored high, medium or low as well as the interpretation of the scores. The SF 36 software was used to calculate domain scores from subjects' responses. The results were compared with other studies using the t-test.

## 3.9 **ETHICAL CONSIDERATIONS**

Permission was obtained from the Committee for Research on Human Subjects at the University of the Witwatersrand to conduct this study (M080415 See Appendix III).

Permission was also obtained from the relevant neuro- and orthopaedic surgeons at private practices participating in the study to access contact details of subjects (Appendix VII). Informed consent from the specific subjects approached to participate in the study was obtained (Appendix I). Subjects were allowed to withdraw from this study at any time.

The results obtained through the above mentioned methodological process are described in chapter 4.

# CHAPTER 4

**RESULTS**

This chapter describes the results obtained from the cross-sectional study that was described in the previous chapter.

## 4.1 DEMOGRAPHIC CHARACTERISTICS

A total of 35 subjects (n = 35) participated in this study. The mean age for female subjects was 54 (SD ± 5.34) years and for male subjects 53 (SD ± 6.12) years. Twenty six subjects were female (n = 26) and nine (n = 9) were male (See table 4.1 below). Twenty of the female subjects enjoyed hobbies /sport activities such as knitting, baking, reading, gardening and walking. Male subjects had hobbies such as golf, gardening and reading.

**Table 4.1: Demographic Data of Subjects (n = 35)**

| Variable | Male | Percentage | Female | Percentage |
|---|---|---|---|---|
| **Age (years)** | 53 (6.12) | n/a | 54 (5.34) | n/a |
| **Gender** | 9 | 25,7 % | 26 | 74,3 % |
| **Hospital LOS (days)** | 5 | n/a | 5 | n/a |
| **Use of anti-inflammatory medication** | 6 | 67% | 22 | 85% |
| **Use of pain medication** | 7 | 77% | 25 | 96% |
| **Use of other medication** | 3 | 33% | 12 | 46% |
| **Number of levels fused** | 2 | n/a | 2 | n/a |

**Data expressed as mean (SD). LOS = length of stay*

**n/a - not applicable*

There was no difference in the average age and hospital LOS between male and female subjects. The numbers for the use of medication was high. There were 67% (6) male subjects that used anti-inflammatory medication and 77% (7) that used pain medication. Only 33% (3) male subjects used “other” medication. The percentage of female subjects still using anti-inflammatory and pain medication was 85% (22) and 96% (25) respectively. The use of other medication for the female subjects was 46% (12). The average number of cervical levels fused in both the male and female subjects was two levels. The subjects indicated on the demographic questionnaire if they had one or more levels fused. There were 19 subjects who had one level fused, 12 subjects had two levels fused, two had three levels fused and one had four levels

fused. The amount of fusion levels were calculated and divided with 35. This came to an average of two fused levels. Patients who had previous spinal surgery were not part of the study.

**Table 4.2: Physiotherapy Treatment Modalities (n=35)**

| | Male | Percentage | Female | Percentage |
|---|---|---|---|---|
| **Massage** | 7 | 78 % | 17 | 73 % |
| **Electrotherapy** | 2 | 22 % | 9 | 35 % |
| **Exercise** | 6 | 67 % | 18 | 69 % |
| **Advice** | 7 | 78 % | 18 | 69 % |
| **Home Program** | 7 | 78 % | 18 | 69 % |

The average number of physiotherapy treatments given postoperatively was six. According to the demographic questionnaire 78% (7) male subjects received massage, 22% (2) received electrotherapy, 67% (6) received exercises, 78% (7) advice and a home program. The female subjects documented that 73% (17) received massage, 35% (9) received electrotherapy and 69% (18) received exercises, advice and a home program. Thirty-one percent (31%) of subjects did not receive any physiotherapy intervention.

## 4.2 CHARACTERISTICS OF SUBJECTS ONE YEAR POST OPERATIVELY

### 4.2.1 Area of Pain and VAS Scale

Most of the subjects (n = 22) demonstrated pain over the upper shoulder area as well as posterior regions of the neck. One patient experienced pins and needles in the left arm. Three patients did not indicate any abnormalities on the body chart at the time of assessment; the rest of the subjects (n =23) still experienced symptoms (burning pain, weakness and discomfort) in the upper quarter.

At the time of assessment subjects indicated their level of pain using a VAS scale. An average score of 35.48mm (SD ± 24.11) was obtained.

### 4.2.2 Quality of Life

The SF-36 questionnaire was self-administered 12 months after discharge and help was only provided if the subject did not understand what was being asked. No attempt was made by the researcher to influence the subject's responses to the questions asked. Each domain scored out of 100 that have the implication the higher the score the better the QoL in subjects. Lower scores indicated worse QoL.

The results are demonstrated in table 4.2.1 below.

**Table 4.2.1: Short Form-36 Scores of Subjects with Anterior Neck Fusion**

| Domains | Mean (SD) (n=35) |
|---|---|
| Physical Function (PF) | 74.86(20.53 |
| Role Physical (RP) | 47.06 (34.69) |
| Bodily Pain (BP) | 65.40 (25.93 |
| General Health (GH) | 59.71 (28.04) |
| Vitality (V) | 53.14 (25.81) |
| Social Functioning (SF) | 66.43 (30.88) |
| Role Emotional (RE) | 59.05 (28.11) |
| Mental Health (MH) | 60.00 (26.96) |
| Mental Health Component Score (MCS) | 42.19 (13.31) |
| Physical Health Component Score (PCS) | 46.78 (9.44) |

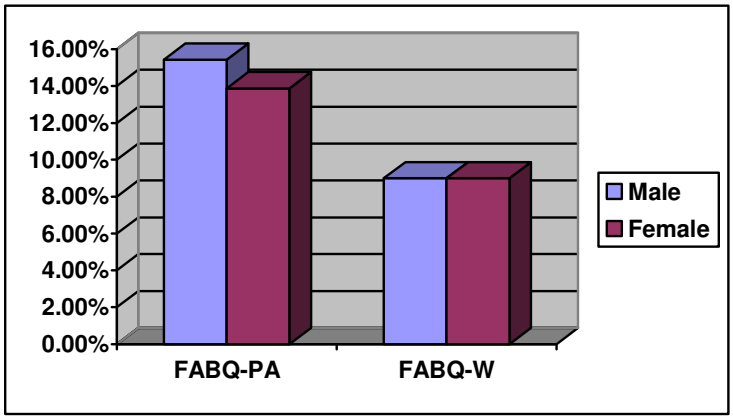
*Values are expressed as mean (SD).*

According to the values in the above mentioned table, moderately high scores were detected in the PF, BP and SF domains (between 60 and 75), where as subjects reported lower values for the MH, GH, VT and RE domains. Subjects scored below 50 in the RP domain and the MCS.

### 4.2.3 Levels of Anxiety and Depression due to Pain as measured with FABQ

Results obtained from the FABQ- PA showed that subjects experienced low fear avoidance related to physical activity [mean = 14.30 (SD ± 10.75)] one year postoperatively. Subjects also reported low fear avoidance related to work (FABQ – W). The mean score was 9.06(SD ± 7.26). In figure 4.1 below the results for FABQ-PA and FABQ-W are summarized.

**Figure 4.1: FABQ Domain Results (n = 35)**



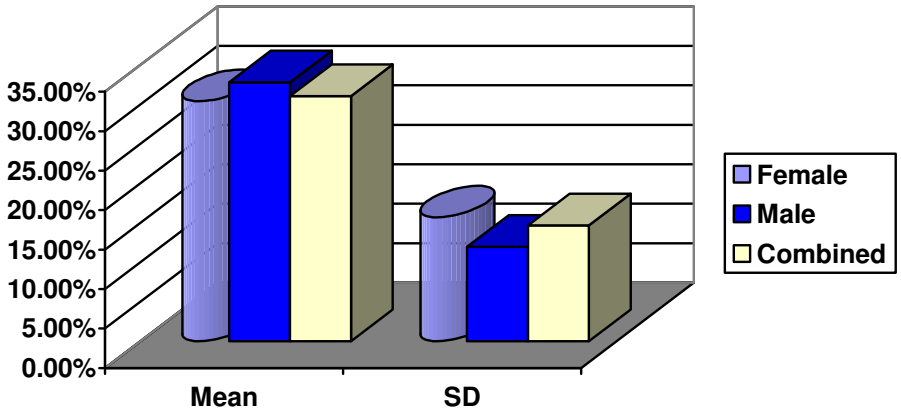

**Data expressed as means (%). FABQ-PA = Fear Avoidance Beliefs Questionnaire – Physical Activity; FABQ-W = Fear Avoidance Beliefs Questionnaire – Work*

There was no statistically significant difference in fear avoidance between male and female subjects for the two domains of the FABQ (p = 0.715 FABQ–PA; p = 0.977 FABQ–W).

### 4.2.4 Levels of Dysfunction due to Pain as measured with the NDI

Results obtained from the NDI questionnaire indicated that subjects had moderate disability when assessed one year postoperatively (0% is no disability and 100% is total disable). According to the NDI questionnaires, a score between 0-20% is normal, 21-40% is mild disability, 41-60% moderate, 61-80% severe and 80+% is completely disabled. The mean NDI score was 31.10 % (SD ± 11.96) and falls under mild disability. Average scores for the pain, ADL and concentration domains of the NDI were 23.76%; 11.61% and 8.53% respectively. There was no statistically significant difference for the NDI score between males and females (p = 0.687). A summary is below in figure 4.2

**Figure 4.2.4 Summary of NDI Scores**




**SD = Standard Deviation; Mean is presented in %.*

## 4.3 Comparison of QoL between Patients with Anterior Neck Fusion and Baseline Data

A cross-sectional survey was conducted by a PhD candidate in the Physiotherapy Department of the University of the Witwatersrand (March – June 2006) prior to the commencement of the current study. In that study the health-related QoL of 175 (n = 175) people resident in Gauteng and the Free State was assessed with the SF-36 UK-English questionnaire. This was a postal survey and none of the participants reported any illness/surgery in the 12 months prior to completion of the questionnaire. The mean age of the participants was 28.8 years. The original purpose of this survey was to establish baseline QoL data for a group of healthy South African residents from various ethnic origins. The results of this survey have not been published and permission was orally obtained to use the data. The baseline group received SF-36 Questionnaires via post. Only 137 questionnaires were returned and the results were used to compare the QoL in patients with an anterior neck fusion.

A comparison of reported QOL was made between patients who had an anterior neck fusion (n = 35) and the baseline group (n = 137) (See Table 4.3).

**Table 4.3: Short Form-36 Score Comparison between Subjects with Anterior Neck Fusion and Baseline Data**

| Domains | Neck Fusion Subjects (n=35) | Baseline Group (n=137) | p- Value |
|---|---|---|---|
| PF | 74.86(20.53) | 92. 87(13.92) | 0.0001 |
| RP | 47.06 (34.69) | 88.64 (25.47) | 0.0001 |
| BP | 65.40 (25.93) | 80.69 (20.05) | 0.002 |

| | | | |
|---|---|---|---|
| GH | 59.71 (28.04) | 79.13 (18.55) | 0.0003 |
| VT | 53.14 (25.81) | 60.99 (21.25) | 0.098 |
| SF | 66.43 (30.88) | 83.45 (22.21) | 0.003 |
| RE | 59.05 (28.11) | 73.33 (37.65) | 0.012 |
| MH | 60.00 (26.96) | 72.99(18.02) | 0.009 |
| MCS | 42.19 (13.31) | 46.58 (11.86) | 0.08 |
| PCS | 46.78 (9.44) | 56.26 (9.31) | 0.001 |

**Values are expressed as mean (SD). MCS = mental health summary scale; PCS = physical health summary scale. PF = Physical Function; RP = Role Physical; BP = Bodily Pain; GH = General Health; VT = Vitality; RE = Role Emotional; SF = Social Functioning; MH = Mental Health*

QoL related to physical health (PF, RP, BP and GH) was significantly different between subjects with anterior neck fusion and the baseline data one year postoperatively. The SF ($p = 0.003$) and MH domains ($p = 0.009$) were also significantly different between the two groups. There were no significant differences between the two groups for the RE and VT domains. The PCS score ($p = 0.001$) was significantly different between subjects and the baseline data however there was no significant difference in the MCS score.

The results described in this chapter will be compared to that of other researchers and discussed in the next chapter.

# CHAPTER 5

## DISCUSSION

### 5.1 INTRODUCTION

This study is the first research report of its kind to be conducted in Johannesburg to evaluate the level of pain and QoL in subjects who had an anterior neck fusion one year postoperatively. The results confirmed that patients who had an anterior neck fusion one year ago still presented with pain, moderate level of neck disability, low levels of fear avoidance and poor QoL related to physical function.

### 5.2 DEMOGRAPHIC CHARACTERISTICS

According to the demographic questionnaire 69% subjects in this study received on average six physiotherapy treatments after discharge from the hospital. No definite reason could be established from the data why 31% of subjects did not receive any physiotherapy treatment. Unfortunately there is not evidence on the recommended number of physiotherapy treatments postoperatively after an ACDF and the researcher of this current paper could not establish any other researchers that questioned the appropriate amount of physiotherapy sessions postoperative ACDF. There is a possibility that physiotherapy was not requested postoperatively by the surgeon or patient, patient refused therapy, lived too far from the physiotherapy practice or had insufficient funds for physiotherapy treatment after discharge.

According to Peolsson (2007) there is not enough evidence available about the content of rehabilitation programs given postoperatively and whether physiotherapy could influence surgical outcomes of subjects with an ACDF. There is no evidence for the recommended amount of treatment sessions postoperatively and there is a possibility that six treatment sessions was not sufficient intervention to prevent further complications. A lack of evidence for postoperative physiotherapy management in the research literature may have led some clinicians not to request physiotherapy treatment postoperatively. The question remains what is enough physiotherapy and what is the best rehabilitation program if any, for patients with ACDF?

In this study, most of the subjects received massage, exercises and a home program. Interestingly, the use of electrotherapy treatment was not a major part of the treatment received postoperatively. A reason could be the fact that patients need the inflammation process postoperatively to help with the healing of the fusion or that there is not sufficient evidence about the long term effect of electrotherapy on patient

outcomes (Poitros et al 2008). According to Poitros & Brosseau (2008), there is little evidence available for the use of electrical modalities although it is still frequently used as part of a passive physiotherapy program. It is obvious that physiotherapy treatment does give pain relief (Persson et al 2001; Persson et al 1997). It would be interesting to combine the same physiotherapy treatment plan of Persson et al (2001) for patients with an ACDF postoperatively to capture the results. This can help to fill the gap in evidence based research.

Another possible problem is that patients are much more passive postoperatively (Peolsson 2007) with the thought that surgery is the ultimate resolution of all problems. It can be suspected that this specific group of subjects who participated in our study might have been passive towards rehabilitation postoperatively. An assumption can be made that insufficient postoperative exercises had the consequence of poor neck muscle endurance, poor proprioception and muscle weakness. Patients probably are not always as compliant towards exercise as they should be. Pain is after all the reason why patients seek medical help and subjects could have been in a habit of not doing exercise.

The duration of neck symptoms before the surgery can be an important predictor of muscle weakness, poor proprioception and endurance postoperatively (Peolsson et al 2003). Previous research demonstrated a direct link between long duration of pain and the high level of pain intensity pre- and postoperatively (Persson et al 2001). There is a possibility that subjects in the current study already presented with chronic pain and weak stabilizing muscles preoperatively that contributed to their pain that cannot always be fixed with surgery. In a study by Falla et al (2004), cervical muscle dysfunction was a marked sign in chronic neck pain syndromes. Falla et al (2007) also revealed impaired activation of the deep cervical flexors in people with chronic neck pain indicating that coordination of muscle activation alters during dynamic tasks. Daily activities consist of dynamic tasks and in a neck with poor muscle strength and endurance, cervical joints and structures are overloaded and contribute to pain (Falla et al 2007). The overload of neck structures (facet joints) can generate pain (Sizer et al 2004). This can be a possible reason why subjects in the current study still used pain medication after surgery for such a long period of time.

## 5.3 AREA OF PAIN AND PAIN INTENSITY

Subjects indicated on the provided body chart the areas of throbbing/burning/stabbing pain, numbness, pins and needles or other complaints. Three patients (8.6%) did not experience any of the above mentioned symptoms. Twenty-three (n = 23) (65.7%)

subjects marked areas of the upper quarter on the chart. The biggest complaint was a burning sensation as well as a tired “heavy” head. This can be attributed to muscle weakness that did not gain proper strength and endurance postoperatively.

Based on clinical experience the researcher expected subjects to report VAS scale scores between 40% and 100%. This study had a lower mean score of 35.48 mm and in a study by Kjellman et al (2002) the subjects with ACDF reported a mean VAS score of 35 mm one year later. A possible reason for a lower outcome on the VAS scale in this report is that a vast percentage of subjects included in our study used pain (80%) and/or anti-inflammatory (91%) medication at the time of assessment. In a study by Peolsson et al (2002) subjects reported pain to be the main problem after a neck fusion. Their subjects had a mean VAS score of 34mm (n = 26) for current pain 12 months postoperatively and this correlated well with our results. Peolsson et al (2002) and Kjellman et al (2002) reported that the duration of pain preoperatively is an important predictor for having pain postoperatively and this may be why subjects still indicated some pain on the VAS scale postoperatively although the pain intensity was not extremely high. The duration of pain for a long period of time is an indicator to subjects that something must be wrong and according to Persson et al (2001), longstanding pain can produce symptoms such as hopelessness, depression, social withdrawal and the constant seeking of medical help. This can direct patients to continuous medical consultation, the use of medication and increase the medical financial burden.

Another suggestion is that the pain mechanisms of humans can influence the outcomes of pain assessment with questionnaires. Patients with long standing pain become chronic and this will stimulate the central sensitizing pain mechanism in the CNS as discussed in the literature review. Surgery forms an acute injury on muscle, ligaments and strains the facet joints that are richly innervated via nociceptors. The patients with chronic pain already have a “memory tag” of pain which is maladaptive and more pain due to surgery leads to further CNS activation. Physiotherapists are well trained to manage this type of patient effectively via the correct passive and active interventions as well as education. Education of patients about pain mechanisms is crucial and they need to understand that not all pain is harmful (Main et al 1999). According to Main et al (1999) they mentioned in their study that patients need to be in control of their pain and passive therapies do not allow the patient to establish that exercise is beneficial. As we all know, people relate pain with major damage done to the body and the perception of pain needs to be understood because not all pain is “bad” (Main et al 1999).

## 5.4 FEAR AVOIDANCE

In the current study the subjects reported to be moderate fear avoidant that was an interesting finding. According to Waddell et al (1993), who developed this questionnaire gave the indication that the higher the score, the worst the fear. Apparently, the maximum score for all 16 items is 96 (Waddell et al 1993). The combined (male and female) mean score for the FABQ-PA was 14.30 (SD ± 10.75) and for FABQ-W was 9.06 (SD ± 7.26). Cleland et al (2007) measured the psychometric properties of the FABQ and the Tampa Scale of Kinesiophobia in patients with neck pain. Results in the study of Cleland et al (2007) compared well with the results from the current study as they reported scores of 12.6 (FABQ-PA) and 13 (FABQ-W).

According to Huis in't Veldt et al (2007), patients with neck pain were not always as avoidant as patients with low back pain. The results from the current study were low and the reason could be that the FABQ was developed for patients with low back. According to Huis in't Veldt et al (2007) patients with low back pain is somehow more fear avoidant than patients with neck pain. The results of Huis in't Veldt's et al (2007) study [FABQ-W 6.29 (SD ± 5.25); FABQ-PA 12.57 (SD ± 10.10); n = 58] compared well with our results [FABQ-W 9.29 (SD ± 7.26); FABQ-PA 14.10 (SD ± 10.75). It would have been of value to clarify from the subjects whether the medication was for neck pain or pain from other parts of the body. Another reason for the low the FABQ is that the questionnaire is more relevant in a working population and in our study 67% of subjects were retired or not working.

Pain can contribute to the fear of movement but in our study a big percentage subjects (81,3%) used pain and/ or anti-inflammatory medication. The use of medication could probably be part of a coping strategy and will apparently influence the results of the FABQ. Cleland et al (2007) mentioned in their study that pain related fear and chronic disability have a strong correlation with low back pain. Unfortunately there is not enough research regarding the effect of fear related pain and disability in patients with neck pain (Cleland et al 2007). In their study, Cleland et al (2007) revealed that there was not a significant correlation between FABQ-PA, pain and disability but FABQ-W was well correlated with patients with neck pain and disability. Cleland et al (2007) mentioned in their literature review that higher levels of fear were found in patients with sudden onset of neck pain. Most of the subjects in the current study possibly had longstanding pain and this could explain why this report did not demonstrate high FABQ scores.

Subjects in this study may obviously be less fearful if they do not have pain and at the time of evaluation pain was not excruciating. The subjects were not advised to stop the use of any pain and/or anti-inflammatory medications before the assessment. Another explanation for our results could be the type of subject used in this study as they might not have been a fear avoidant group.

## 5.5 NECK DISABILITY

The neck disability index (NDI) is a more complex parameter due to the type of questions asked and therefore influenced by other problems such as back pain and distress (Peolsson 2007). In this study, subjects had a moderate mean score of disability (> 30%) on the NDI. Peolsson (2007) found that 70% of patients in their study still had a deficit on the NDI (mean score ± 30%) measured at six months, two and six years post anterior neck fusion. Peolsson et al (2002) felt that the pain experienced by subjects originated from other factors and was therefore not solved by neck surgery alone. The reason could be that patients might have specific and non-specific neck problems. The subjects in this study possibly had other contributing pain generators and not only the mechanical problem that was surgically removed.

## 5.6 QUALITY OF LIFE IN SUBJECTS AFTER ANTERIOR NECK FUSION

QoL related to PCS [47.78(9.44)] in this specific group was significantly lower in comparison with a healthy baseline group [56.26(9.31)]. The expectation is that after surgery the subjects should have a better QoL. Comparing results with Epstein et al (2006), the following were reported for the eight domains of the SF-36: PF (42.1), RP (- 7.1), BP (56.4), GH (65), VT (68.6), SF (55.4), RE (57) and MH (72) one year postoperatively. Their results compared well to the results of the current study except for RP and MH domains. All the domains except VT (68.6) had a lower score than the baseline data demonstrating that although the results of Epstein et al subjects (2006) improved, it still did not match the baseline data reported in the current study. A possible contributing factor can be the differences in demographic data such as age. In Epstein et al's study (2006), the subjects had an average age of 64 years. In the current study the subjects had an average age of 53.5 years and of the baseline group 28.8 years. Demographic differences can explain the difference in VT scores. The MH (58) reported in Epstein's study preoperatively compared well with these subjects postoperatively MH (60.00). The baseline data for MH (72.99) in the current study compared well with Epstein's study MH (72) postoperatively. A comparison of preoperative values for RP and MH between patient's in Epstein et al's (2006) study and the baseline data, illustrated that preoperative pain already influenced their subjects mental QoL and a component of their physical QoL. The results from the

current study suggest that pain still had a significant influence on physical components of QoL even at 12 months after surgery.

The MCS between the current study group and baseline data did not differ significantly ($p = 0.08$). According to Peolsson et al (2003) postoperative success can be influenced by the duration and intensity of pain and there is also a direct relationship between pain and the mental state of patients (Peolsson et al 2003). Subjects in our study did not demonstrate high pain scores but could possibly be influenced by the use of medication. The subjects did use medication and 42% used "other" medication that could have influenced the data. Lower pain levels as well as the possible use of anti-depressants might have contributed to a better MCS score.

## 5.7 SUMMARY

The results obtained from this cross-sectional survey confirmed our hypothesis which stated that subjects who had an anterior neck fusion still suffer from pain which leads to a reduction in health related QoL one year after surgery.

# CHAPTER 6

## LIMITATIONS AND RECOMMENDATIONS

In the current study there was no baseline against which we could measure the postoperative results of our subjects because the subjects were not evaluated preoperatively by the researcher. The only baseline was the subjects' retrospective answers in the demographic questionnaire and on the SF-36 as to whether they were better or worse than one year ago. Most of the subjects reported the use of medication but the questionnaire did not contain a question to clarify the reason for the use of medication. It would have been valuable to determine whether the subjects used prescribed pain and/or anti-inflammatory medication or whether it was medication that was bought over the counter. It would have been of great value to obtain information of the exact dosage and frequency for the use of medication. A question about whether subjects were using anti-depressants would have assisted with the interpretation of the results obtained for mental QoL.

The demographic questionnaire did not have a question about the duration of preoperative cervical pain which could actually give the researcher insight for the success rate on surgery and physiotherapy intervention. Peolsson et al (2003) mentioned that the preoperative duration of pain will influence the surgical outcomes as well as the physiotherapy treatment.

Questions about the physiotherapy interventions should preferably state physiotherapy treatment "in hospital" and physiotherapy "out of hospital" with subtitles of different detailed modalities such as walking, massage, transcutaneous stimulation, interferential current, ultrasound, heat/cold packs and joint mobilization. The subjects need to be asked to describe the exercises in more detail and their adherence to exercise should be assessed. If not, another question must follow why they did not do the exercises. The reasons given would assist to develop treatment plans around patient's behavior. More insight into the advice given to patients postoperatively would have been useful.

The FABQ used in this study might be less appropriate for patients with a neck fusion because the FABQ was originally developed for patients with low back pain; however it has been used in other pain conditions with success (Huis in't Veld et al 2007). There were questions that most probably did not relate well with this sample of patients due to the fact that 63% were retired or not working. The second part of the FABQ-W is specifically related to work. Question 15 for instance asks whether the patient would be able to return to work after three months. Most of the subjects in the current study scored zero because 67% of the

subjects were either retired or unemployed. This could have lowered the overall score of the FABQ.

The researcher puts forward the following ideas for future research:

a) Evaluation of the association between WAD and neck fusions as there is not enough evidence as to whether predisposing trauma increases the risk of cervical damage.

b) Evaluation of specific postoperative rehabilitation programs for patients who had anterior neck fusion to further define the role of physiotherapy in the management of this patient population postoperatively.

c) This study to be repeated on subjects that are still employed in order to verify the results of the current study.

# CHAPTER 7

## CONCLUSION

This paper concluded that subjects who had an anterior neck fusion 12 months ago still suffered from moderate pain and low QoL related to physical health postoperatively. They presented with SF-36 scores which were much lower (physical health) than that of the baseline group.

Patients who decide to undergo surgery must be informed that the operation will remove the mechanical cause of the pain but other factors such as nociceptive pain, muscle spasm, poor muscle endurance and poor proprioception which can contribute to pain and discomfort will still be present if not treated effectively and long enough after surgery. According to the Philadelphia Panel (Philadelphia Panel 2001) the best results (less pain and increased QoL) for patients with non specific neck pain were obtained through neck exercises. Patients must realize the importance of regular exercise postoperatively for a successful outcome after neck fusion. Clinician and patient education towards an active approach postoperatively such as neck exercises must be part of the treatment goal so that patients can have a better QoL and less pain postoperatively. The exercises will allow the patients to use their necks and realize “hurt does not always equal harm” (Main et al 1999).

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# APPENDIX I

- Subject Information Sheet

**SUBJECT INFORMATION SHEET**

Dear Participant

Good day, my name is Louise De Jonge; I am registered as a postgraduate student at the University of the Witwatersrand. I am investigating the quality of life of people who had an anterior neck fusion 12 months ago.

In the medical literature, anterior neck fusions are the most frequently used surgical procedure for cervical degenerative disc disease. Research indicates that functional outcomes are poor after surgery and that patients need to have more intensive rehabilitation pre- and postoperatively.

The aim of this study is to establish the quality of life in people who had an anterior neck fusion 12 months ago and to detect the functional problems and disability that they might still be suffering from.

The physiotherapist, who cared for you postoperatively during your stay in hospital, has referred you to me for possible participation in this study.

There are not any risks involved with this study. Questionnaires will be used in this study that you will need to fill in.

All the information obtained from you will remain confidential. If you participate in this study, a specific number will be assigned to your form. All the data collected from your questionnaires will be entered into the computer under your specific number so that your name remains unknown to the researcher.

If you decide to participate in this study, you need to sign this letter as indication of your consent. You will only be seen once for an hour at a venue of your choice by the researcher. This consultation will not cost you anything because of your participation in a research project.

This consent form may contain words that you do not understand. Please feel free to ask me to explain any words or information that you do not clearly understand. You may take an unsigned copy of this consent form home to discuss with family or friends and think about it before making your decision. You can contact me for further information about the study or if any of the above information is unclear to you.

**Contact person** : Louise De Jonge

**Contact number** : (011) 826 2824 or 083 254 7372

**Email** : louisedj@vodmail.co.za

**CONSENT**

I fully understand the nature of this study that investigates my quality of life 12 months after surgery.

I agree to participate in this study and the researcher will see me only once in order to complete the relevant documentation.

**Printed name :** _____

**Signature :** _____

**Date and time:** _____

I, Louise De Jonge, herewith confirm that the above participant has been fully informed about the nature and conduct of the above study. There are not any risks involved.

**Signature :** _____

# APPENDIX II

- Demographic Questionnaire
- Body Chart

# DEMOGRAPHIC QUESTIONNAIRE

INSTRUCTIONS PLEASE TICK RELEVANT ANSWERS

SEX F [ ] M [ ]

AGE [ ]

SPORT/HOBBIES [ ]

CURRENT EMPLOYMENT STATUS

| RETIRED | YES | NO | EMPLOYED | YES | NO |
|---|---|---|---|---|---|
| | | | | | |

DATE OF SURGERY [ ]

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| AMOUNT OF DAYS IN ICU | 2 | 3 | 4 | 5 | 6 | 7 | MORE |
| AMOUNT DAYS OF HOSPITILIZATION TIME | 2 | 3 | 4 | 5 | 6 | 7 | MORE |
| AMOUNT OF LEVELS FUSED | 2 | 3 | 4 | | | | MORE |

| | | | |
|---|---|---|---|
| DID YOU RECEIVE | PHYSIOTHERAPY | YES | NO |
| | | | |
| TYPE OF TREATMENT | MASSAGE | YES | NO |
| | ELECTROTHERAPY | YES | NO |
| | EXERCISES | YES | NO |
| | ADVISE | YES | NO |
| | HOME PROGRAM | YES | NO |

| | | |
|---|---|---|
| DID YOU HAVE PHYSIOTHERAPY AFTER DISCHARGE | YES | NO |

| | | | | | | |
|---|---|---|---|---|---|---|
| IF YES,NUMBER OF PHYSIOTHERAPY SESSIONS | 2 | 3 | 4 | 5 | 6 | MORE |

| | | |
|---|---|---|
| DO YOU TAKE MEDICATION AT PRESENT | YES | NO |

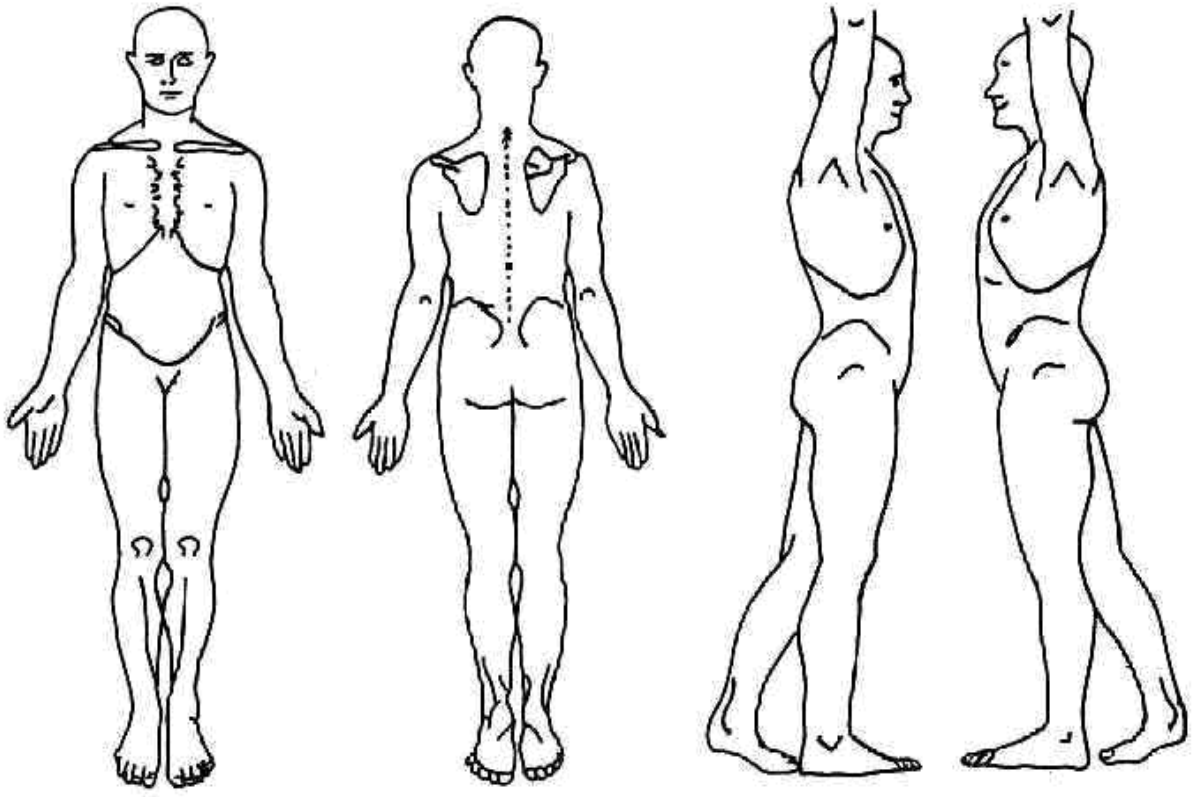
| | | | |
|---|---|---|---|
| ANTI-INFLAMMATORY | YES | NO | |
| | | | |
| PAIN KILLERS | YES | NO | |
| OTHER MEDICATION | YES | NO | FILE NUMBER |

# BODY CHART

Please indicate on the diagram below where you experience any of the following symptoms.

**T** = THROBBING **P** = PINS & NEEDLES **B** = BURNING **S** = STABBING

**N** = NUMBNESS **O** = OTHER



File number: _____

# APPENDIX III

- Ethical Clearance Certificate

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 De Jonge

| | |
|---|---|
| CLEARANCE CERTIFICATE | PROTOCOL NUMBER M080415 |
| PROJECT | Quality of life measured 12 months post operatively in subjects who had an anterior neck fusion |
| INVESTIGATORS | Ms L De Jonge |
| DEPARTMENT | School of Physiology |
| DATE CONSIDERED | 08.04.25 |
| DECISION OF THE COMMITTEE* | Approved unconditionally |

**Unless otherwise specified this ethical clearance is valid for 5 years and may be renewed upon application.**

DATE 08.06.09 CHAIRPERSON .....
(Professor P E Cleaton Jones)

*Guidelines for written 'informed consent' attached where applicable

cc: Supervisor : Ms H van Aswegen

---

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10004, 10th Floor, Senate House, University.
I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

# APPENDIX IV

- SF-36 Health Survey

# SF-36 HEALTH SURVEY

**INSTRUCTIONS:** This survey asks for your views about your health. This information will help keep track of how you feel and how well you are able to do your usual activities.

Answer every question by marking the answer as indicated. If you are unsure about how to answer a question, please give the best answer you can.

1. In general, would you say your health is:

(circle one)

| | |
|---|---|
| Excellent | 1 |
| Very good | 2 |
| Good | 3 |
| Fair | 4 |
| Poor | 5 |

2. Compared to one year ago, how would you rate your health in general now?

(circle one)

| | |
|---|---|
| Much better now than one year ago | 1 |
| Somewhat better now than one year ago | 2 |
| About the same as one year ago | 3 |
| Somewhat worse now than one year ago | 4 |
| Much worse now than one year ago | 5 |

3. The following questions are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?

(circle one number on each line)

| ACTIVITIES | Yes, Limited A Lot | Yes, Limited A Little | No, Not Limited At All |
|---|---|---|---|
| a. **Vigorous activities**, such as running, lifting heavy objects, participating in strenuous sports | 1 | 2 | 3 |
| b. **Moderate activities**, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf | 1 | 2 | 3 |
| c. Lifting or carrying groceries | 1 | 2 | 3 |
| d. Climbing **several** flights of stairs | 1 | 2 | 3 |
| e. Climbing **one** flight of stairs | 1 | 2 | 3 |
| f. Bending, kneeling, or stooping | 1 | 2 | 3 |
| g. Walking **more than a mile** | 1 | 2 | 3 |
| h Walking **half a mile** | 1 | 2 | 3 |
| i. Walking **one hundred yards** | 1 | 2 | 3 |
| j. Bathing or dressing yourself | 1 | 2 | 3 |

4. During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?

(circle one number on each line)

| | YES | NO |
|---|---|---|
| a. Cut down on the **amount of time** you spent on work or other activities | 1 | 2 |
| b. **Accomplished less** than you would like | 1 | 2 |
| c. Were limited in the **kind** of work or other activities | 1 | 2 |
| d. Had **difficulty** performing the work or other activities (for example, it took extra effort) | 1 | 2 |

5. During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?

(circle one number on each line)

| | YES | NO |
|---|---|---|
| a. Cut down on the **amount of time** you spent on work or other activities | 1 | 2 |
| b. **Accomplished less** than you would like | 1 | 2 |
| c. Didn't do work or other activities as **carefully** as usual | 1 | 2 |

6. During the past 4 weeks, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbours, or groups?

(circle one)

Not at all ..... 1

Slightly ..... 2

Moderately ..... 3

Quite a bit ..... 4

Extremely ..... 5

7. How much bodily pain have you had during the past 4 weeks?

(circle one)

None ..... 1

Very mild ..... 2

Mild ..... 3

Moderate ..... 4

Severe ..... 5

Very severe ..... 6

8. During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?

(circle one)

Not at all ..... 1

A little bit ..... 2

Moderately ..... 3

Quite a bit ..... 4

Extremely ..... 5

9. These questions are about how you feel and how things have been with you during the past 4 weeks. For each question, please give the one answer that comes closest to the way you have been feeling. How much of the time during the past 4 weeks -

(circle one number on each line)

| | All of the Time | Most of the Time | A Good Bit of the Time | Some of the Time | A Little of the Time | None of the Time |
|---|---|---|---|---|---|---|
| a. Did you feel full of life? | 1 | 2 | 3 | 4 | 5 | 6 |
| b. Have you been a very nervous person? | 1 | 2 | 3 | 4 | 5 | 6 |
| c. Have you felt so down in the dumps that nothing could cheer you up? | 1 | 2 | 3 | 4 | 5 | 6 |
| d. Have you felt calm and peaceful? | 1 | 2 | 3 | 4 | 5 | 6 |
| e. Did you have a lot of energy? | 1 | 2 | 3 | 4 | 5 | 6 |
| f. Have you felt downhearted and low? | 1 | 2 | 3 | 4 | 5 | 6 |
| g. Did you feel worn out? | 1 | 2 | 3 | 4 | 5 | 6 |
| h. Have you been a happy person? | 1 | 2 | 3 | 4 | 5 | 6 |
| i. Did you feel tired? | 1 | 2 | 3 | 4 | 5 | 6 |

10. During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting with friends, relatives, etc.)?

(circle one)

All of the time ..... 1

Most of the time ..... 2

Some of the time ..... 3

A little of the time ..... 4

None of the time ..... 5

11. How TRUE or FALSE is each of the following statements for you?

(circle one number on each line)

| | Definitely True | Mostly True | Don't Know | Mostly False | Definitely False |
|---|---|---|---|---|---|
| a. I seem to get ill more easily than other people | 1 | 2 | 3 | 4 | 5 |
| b. I am as healthy as anybody I know | 1 | 2 | 3 | 4 | 5 |
| c. I expect my health to get worse | 1 | 2 | 3 | 4 | 5 |
| d. My health is excellent | 1 | 2 | 3 | 4 | 5 |

# APPENDIX V

- NDI – Neck questionnaire
- VAS Scale

# VISUAL ANALOGUE SCALE

Make a mark on line to present your level of pain now

No pain _____ Extreme pain

**APPENDIX VI**

- Fear Avoidance Physiotherapy Evaluation Form

**FEAR AVOIDANCE PHYSIOTHERAPY EVALUATION FORM**

**To be completed by the patient as part of research. Please complete the form and give to your therapist.**

**File number: _____**

For each statement please circle any number from 0 to 6 to say how much physical activity such as bending, lifting, walking or driving affect or would affect your neck.

| | | **Completely Disagree** | | | **Unsure** | | **Completely Agree** | |
|---|---|---|---|---|---|---|---|---|
| 1. | My pain was caused by physical activity | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 2. | Physical activity makes my pain worse | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 3. | Physical activity might harm to my neck | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 4. | I should not do any physical activities which (might) make my pain worse | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 5. | I cannot do physical activities which (might) make my pain worse | 0 | 1 | 2 | 3 | 4 | 5 | 6 |

The following statements are about how your normal work affects your neck pain.

| | | **Completely Disagree** | | | **Unsure** | | **Completely Agree** | |
|---|---|---|---|---|---|---|---|---|
| 6. | My pain was caused by my work or by an accident at work | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 7. | My work aggravate my pain | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 8. | I have a claim for compensation for my pain | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 9. | My work is to heavy for me | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 10. | My work makes or would make my pain worse | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 11. | My work might harm my neck | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 12. | I should not do my normal work with my present pain | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 13. | I cannot do my normal work with my present pain | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 14. | I cannot do my normal work until my pain is treated | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 15. | I do not think that I will be back to my normal work within 3 months | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 16. | I do not think that I will ever be able to go back to that work | 0 | 1 | 2 | 3 | 4 | 5 | 6 |

# APPENDIX VII

- Letter to Surgeons

\Dear colleague

Good day, I am Louise De Jonge and am registered as a postgraduate student at the Physiotherapy department of the University of the Witwatersrand. I am investigating the quality of life of subjects who had an anterior neck fusion 12 months ago as part of a master's degree.

In order to collect the correct amount of data for this study, I would like to contact patients who had an anterior neck fusion between April 2007 and June 2007 at your hospital. Therefore, I would need your permission to access contact details from these patients so that I can contact potential subjects for this study telephonically.

I will then see subjects who consent once off while they complete four questionnaires relating to this study. These subjects will not receive any treatment from me. I would see the patients only once.

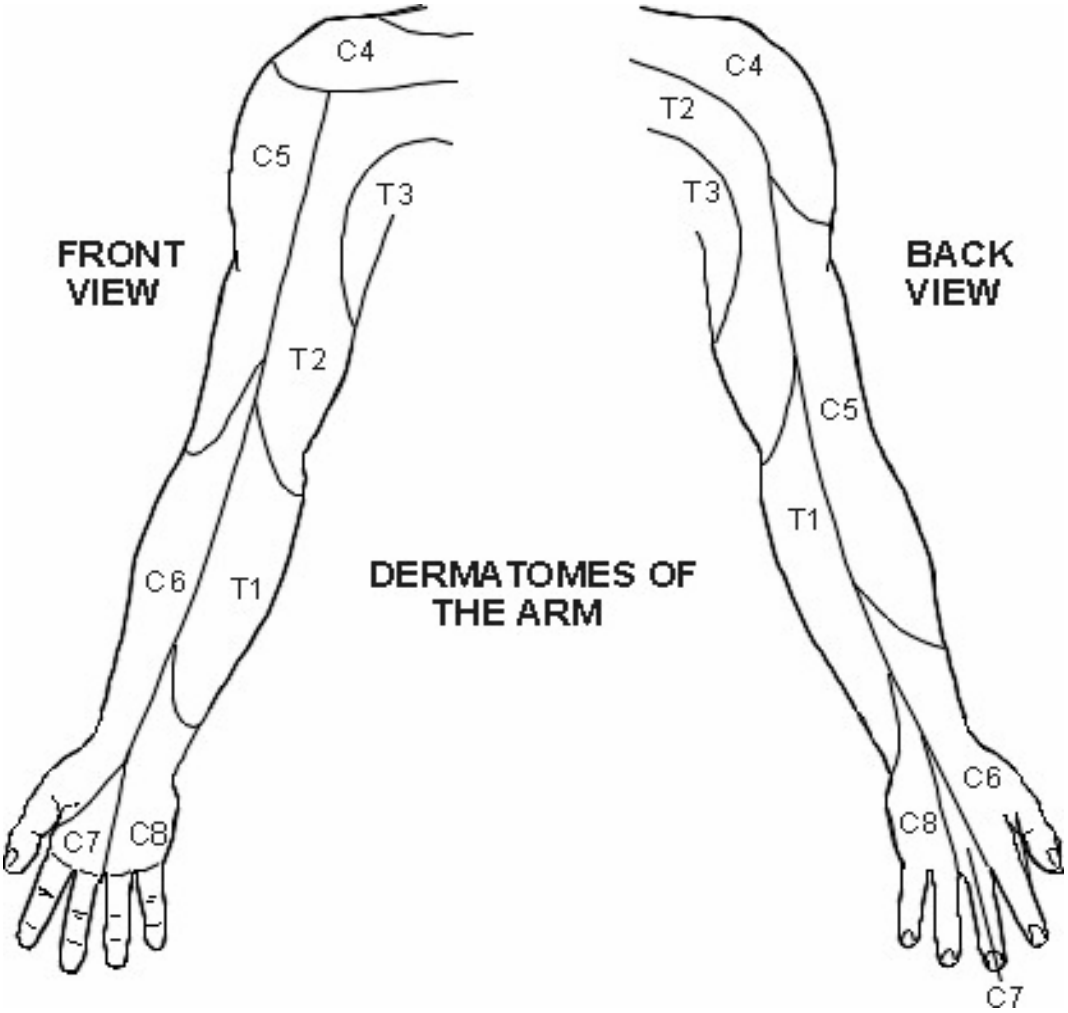
Please be so kind to sign this letter and send it back.

**Surgeon** :
**Hospital** :
**Sign** :
**Date** :

Louise De Jonge
E-mail: louisedj@vodamail.co.za
louisedjonge@mweb.co.za
Tel: 011-826 2824
Fax: 011-8262824
Cell: 083 254 7372

**APPENDIX VIII**

Picture of Dermatomes


FRONT
VIEW
C4
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C7
C8
DERMATOMES OF
THE ARM
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VIEW
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T3
C5
T1
C6
C8
C7