Mechanical neck pain

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CHAPTER CONTENTS

| Mechanical neck pain definition | 94 |
| Prevalence of mechanical neck pain | 95 |
| Financial impact of mechanical neck pain | 96 |
| Risk factors and prognosis in mechanical neck pain | 97 |
| Prevalence of neck pain in working individuals | 97 |
| Prognostic factors of neck pain in working individuals | 97 |
| Prevalence of neck pain in the general population | 98 |
| Prognostic factors of neck pain in the general population | 98 |
| Review of anatomy specific to mechanical neck pain | 99 |
| Causes of mechanical neck pain | 99 |
| Clinical presentation of neck pain | 99 |
| Proposed management of mechanical neck pain | 100 |
| First level of classification | 100 |
| Red flag screening | 101 |
| Spinal fractures | 102 |
| Cervical myelopathy | 102 |
| Primary neoplastic conditions | 103 |
| Cervical arterial dysfunction | 103 |
| Clinical cervical spine instability (CCSI) | 103 |
| Yellow flag screening | 104 |
| Second level of classification | 104 |
| Mechanical neck pain classification | 104 |
| Treatment based classification | 106 |
| Classification categories | 106 |
| Cervical spine self-report measures of pain and function | 107 |
| Numerical pain rating scale | 107 |
| Neck disability index | 107 |
| Patient specific functional scale | 108 |
| Fear avoidance belief questionnaire | 108 |
| Global rating of change scale | 108 |
| Conclusion | 108 |

MECHANICAL NECK PAIN DEFINITION

Neck pain is a common problem affecting individuals worldwide. Prevalence data suggests that neck pain can span the ages, affecting children and the elderly alike, without gender discrimination. Similar to low back pain, neck pain is episodic in nature (Hogg-Johnson et al 2009) with complete resolution of symptoms evading the majority of neck pain sufferers (Carroll et al 2009) resulting in quality of life and economic impacts (Borghouts et al 1999, Wright et al 1999).

Despite its common presence, there is wide variability in defining neck pain (Fejer et al 2006). This is due, in part, to the presence of both physical and psychosocial contributors to cervical spine pain. As a result of the multifactorial presentation of neck pain and the inability to identify the exact source of presenting cervical spine symptoms (Borghouts et al 1998), the label non-specific neck pain has been assigned to any un-diagnosable symptomatic disorder of the cervical spine. The vagueness of this descriptive term has resulted in further variance of what compromises non-specific neck pain. As such, terms like occupational cervico-brachial disorder, tension neck...
syndrome, cervical spondylosis, thoracic outlet syndrome, cervical osteoarthritis and mechanical neck pain have been synonymously applied to non-specific neck pain (Koes & Hoving 2002). Contributing to this terminology confusion is the reality that specific, valid and reproducible diagnostic criteria are absent (Buchbinder et al 1996a; Buchbinder et al 1996b).

In an effort to standardize a working definition of neck pain, steps have been taken to identify the symptomatic boundaries that comprise the neck pain experience. The following definition for neck pain or cervical spinal pain was proposed (Fig 7.1):

‘Pain perceived as arising from anywhere within the region bounded superiorly by the superior nuchal line, inferiorly by an imaginary transverse line through the tip of the first thoracic spinous process, and laterally by the sagittal planes tangential to the lateral borders of the neck.’

(Merskey & Bogduk 1994)

In 2009, The Neck Pain Task Force put forth its working definition for neck symptoms covering non-descript terms such as non-specific, soft tissue and mechanical neck pain. The Task Force excluded neck pain associated with systemic or pathologic disease or neck pain as a result of ‘skin lesions, throat disorders, tumour, infections, fractures and dislocations’ (Guzman et al 2009). They defined neck pain as symptoms ‘located in the anatomic region of the neck as outlined (Fig 7.2), with or without radiation to the head, trunk and upper limbs’ (Guzman et al 2009).

The definitions above are intended to provide a uniform definition for neck pain. However, the following operational definitions have been used in research to define mechanical neck pain. Cleland et al (2005) defined mechanical neck pain as ‘non-specific pain in the area of the cervico–thoracic junction that is exacerbated by neck movements’. Others (Martinez-Segura et al 2006, Fernandez-de-las-Peñas et al 2007b, Gonzalez-Iglesias et al 2009a,b, Mansilla-Ferragut et al 2009) have used the following definition of mechanical neck pain by Fernandez-de-las-Peñas et al (2007a), or a slight variation thereof: ‘generalized neck and/or shoulder pain with mechanical characteristics including: symptoms provoked by maintained neck postures or by movement, or by palpation of the cervical muscles’. Still others have grouped symptoms like headache of cervical origin, mechanical neck disorder with radicular signs and symptoms, neck disorder associated with whiplash and neck disorder associated with degenerative changes as subsets of mechanical neck disorders (Gross et al 2002). Kanlayanaphotporn et al (2009) used the following definition of neck pain: ‘pain primarily confined in the area on the posterior aspect of the neck that can be exacerbated by neck movements or by sustained postures.’ These operational definitions of neck pain denote the location of and potential provocative manoeuvres for the patient’s symptoms but do not infer causation of the patient’s perceived symptoms. This dilemma has led to efforts being made in current research to explain the neck pain experience and guide effective interventions.

**PREVALENCE OF MECHANICAL NECK PAIN**

Neck pain presents a global healthcare challenge to the medical profession with personal and economic impact. Prevalence estimates are of interest to researchers in order
to help assess the population impact of neck pain and direct future investigations into the etiology and management of this phenomenon. This ability to accurately analyse the worldwide impact of neck pain is challenged by the immense variation in the results and quality of the research to date.

A recent systematic review by Fejer et al (2006) investigated the worldwide prevalence of neck pain as reported in the literature from 1980–2002. Their search resulted in 56 papers meeting their inclusion criteria from Scandinavia (46%), the rest of Europe (23%), Asia (16%) and North America (11%). Australia (two papers) and Israel (one paper) also made contributions investigating the prevalence of neck pain in their respective countries. Variation in the investigated studies was obvious. Various sample sizes were seen ranging from 300 to 51,050 subjects. Variation as to what constituted neck pain, both in terms of anatomical location and an operational definition, was present as well. However, in 79% of the studies investigated, unbiased and randomized population samples were used. Over half of the studies critiqued had sample sizes of over 1000 subjects. The most common categories of prevalence periods investigated and their collective results are shared below.

The point prevalence of neck pain was investigated in 8 studies (13%) ranging from 5.9–38.7%. This data was further broken down by age categories resulting in prevalence ranges of 5.9–22.2% for individuals age 15–74 years, and 38.7% for individuals specifically over the age of 65.

One-week prevalence data was investigated in six studies (10%) with a range of 1.4–36%. However, one study used a unique definition of neck pain not used anywhere else. Excluding this study resulted in five remaining studies with a range of 1.4% to 19.5% of individuals 15–90 years of age reporting a one-week prevalence of neck pain.

One-month prevalence statistics were investigated in six studies (10%) resulting in a range of 15.4% to 41.1% for individuals between 16–79 years of age. One study by Wedderkopp et al (2001) investigated children (ages 8–10) and adolescents (ages 14–16) and reported a one-month prevalence rate of neck pain at 6.9%.

Seven studies (11%) reported 6-month prevalence data for adults 18–80 years of age ranging from 6.9% to 54.2%. Three of these studies reported ranges from 6% to 45% for 12-year-old males and 18-year-old females respectively.

The largest reported prevalence rate was in the one-year category. Twenty-two studies (39%) reported ranges of 16.7% to 75.1% for individuals aged 17–70 years old. Two studies reported ranges for adolescents. Niemi et al (1997) reported a one-year prevalence rate of 15.8% for 714 (408 girls, 306 boys – age ranges not specified) high school students. A second study by Holmen et al (2000) reported one-year prevalence data for 4279 junior high and high school students aged 13–18 years. In this population, adolescents reported a 22.1% one-year prevalence of neck and shoulder pain. In addition, the systematic critical review by Fejer et al (2006) goes on to delineate a range of 8.8–11.6% one-year prevalence as reported by three studies (Woo et al 1994, Isacsson et al 1995, Brochet et al 1998) of the elderly population (age > 65, 68 years of age, and age > 70 respectively).

Life-time prevalence rates were reported in eight studies (13%), two of which were gathered from the Tokelau Islands in the South Pacific Ocean. There, lifetime prevalence rates ranged from 0.2–2.1%. The remaining six studies reported prevalence rates of 14.2–71% for individuals 18–84 years of age. One study (Aoyagi et al 1999) focused on 860 women ages 60–79 years living in Japan or Hawaii. The results of this study reported 14.8% lifetime prevalence (‘which of your joints have ever been painful...’) of neck joint pain in the combined populations. However, in the systematic critical review by Fejer et al (2006), one of their inclusion criteria was to look at populations that were representative of the general population. In light of this, the Hawaiian–Japanese cohort was not considered representative of the Hawaiian population. Therefore, only the Japanese data was included, resulting in a lifetime prevalence for this group (n = 222) of 17.1%.

In summary, the literature has revealed varying descriptors of neck pain which can affect the quality of the studies. Interestingly, Fejer et al (2006) did not find a correlation between the variation in the studies they reviewed and prevalence estimates. This suggests that the quality of the studies (presence of heterogeneity) reviewed may not be a factor in neck pain prevalence estimates. In addition, the longer duration of the prevalence period the higher the reported prevalence estimates (i.e. one-year prevalence estimates where higher than one-month prevalence estimates). Gender differences were also seen. Women consistently reported neck pain 83% more than men (25 out of 30 studies; see Table 7.1).

Financial impact of mechanical neck pain

In addition to disability, neck pain carries significant economic impact as well. In the Netherlands, total costs of neck pain were estimated to be $686.2 million comprising about 1% of the 1996 total health care expenditures in the Netherlands. Health service costs for patients with neck pain, denoted as ‘direct (medical) costs’, comprised $159.6 million of the $686.2 million total cost. The remaining $526.5 million represented ‘wealth lost to society’ or ‘indirect (non-medical) costs’ (Koopmanschap & Rutten 1996) as a result of neck pain (Borghouts et al 1999). In the US, cervical spine disorders present challenges to the health care system, accounting for billions of dollars spent on indemnity and medical costs in the...
worker’s compensation system, which are second only to worker’s compensation costs associated with lumbar spine disorders (Wright et al 1999).

### Risk factors and prognosis in mechanical neck pain

In light of current evidence, neck pain cannot be looked at in isolation. Rather this phenomenon is generally non-traumatic and multifactorial with evidence supporting the dual interaction of the physical and psychosocial arenas (Ariens et al 2001, Croft et al 2001, Guzman et al 2009, Cote et al 2009, Jull & Sterling 2009, Sterling 2009) as contributors to the pain experience. Identifying risk factors for, or predictors of, neck pain is useful at helping direct measures to prevent initial neck injury (primary prevention) or interventions for addressing factors that contribute to persistent symptoms and/or recurrent neck pain (secondary prevention) (Hill et al 2004).

Historically, risk factors for neck pain have been broken down into categories. These categories have been identified as work-related or non-work-related risk factors. These categories can further be broken down into three basic sub-groups: (1) physical risk factors, (2) psychosocial risk factors and (3) individual risk factors (i.e. coping behaviour) (Ariens et al 2000, 2001).

Early research (1966–1997) into risk factors (Ariens et al 2000, 2001), both physical and psychological, has consisted primarily of methodology using cross-sectional study designs. However, this style of research inquiry limits the ability to establish cause and affect relationships (Croft et al 2001, Carroll et al 2009). Research has evolved in the last 10 years, improving upon this methodological dilemma, by contributing larger numbers of prospective studies (Cote et al 2009). Prospective study designs allow a more confident establishment of relationships and, thus, contribute more deeply to the systematic review process.

#### Table 7.1 Prevalence of mechanical neck pain

<table>
<thead>
<tr>
<th>Neck pain</th>
<th>Age (years)</th>
<th>World population (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point Prevalence</td>
<td>15–74</td>
<td>5.9–22.2</td>
</tr>
<tr>
<td></td>
<td>65+</td>
<td>38.7</td>
</tr>
<tr>
<td>One-Week Prevalence</td>
<td>15–90</td>
<td>1.4–19.5</td>
</tr>
<tr>
<td>One-Month Prevalence</td>
<td>16–79</td>
<td>15.4–41.1</td>
</tr>
<tr>
<td></td>
<td>8–10 &amp; 14–16</td>
<td>6.9</td>
</tr>
<tr>
<td>Six-Month Prevalence</td>
<td>18–80</td>
<td>6.9–54.2</td>
</tr>
<tr>
<td></td>
<td>18 (female population)</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>12 (male population)</td>
<td>6</td>
</tr>
<tr>
<td>One-Year Prevalence</td>
<td>17–70</td>
<td>16.7–75.1</td>
</tr>
<tr>
<td></td>
<td>high school &amp;</td>
<td>15.8–22.1</td>
</tr>
<tr>
<td></td>
<td>13–18</td>
<td>8.8–11.6</td>
</tr>
<tr>
<td>65+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lifetime Prevalence</td>
<td>18–84</td>
<td>14.2–71</td>
</tr>
<tr>
<td></td>
<td>60–79</td>
<td>17.1</td>
</tr>
</tbody>
</table>

#### Prevalence of neck pain in working individuals

A recent systematic review (Cote et al 2009) sought to investigate the prevalence of neck pain risk factors for working individuals. They found frequent or persistent neck disorders can develop in at least 5% of the workforce with 10%, of those that develop neck pain, succumbing to activity limitation (due to neck pain) at least one time. Over half of those workers (50%) who develop neck pain will go on to report neck pain one year later (Carroll et al 2009). Identifying the contributors of neck pain has pointed researchers away from single risk factors and towards complex relationships involving interactions among individual, cultural and work-related variables. Furthermore, age, previous musculoskeletal pain, quantitative job demands, social support at work, job insecurity, low physical capacity, poor computer workstation design and work posture, sedentary work position, repetitive work, and precision work suggest an episode of neck pain. Contributors to the development of neck pain included variables of gender, a history of headache, emotional problems, smoking, awkward work postures, physical work environment and ethnicity (Box 7.1).

#### Prognostic factors of neck pain in working individuals

Prognostic factors for workers with neck pain have also been investigated (Carroll et al 2009) revealing 60% of workers noting persistent or recurrent neck pain one year later after an onset of symptoms. Gender also played a role in neck pain with women more likely than men to report persistent or recurrent pain. Outcomes such as prior musculoskeletal pain, prior sick leave and occupational type (blue-collar versus white-collar) were associated with poor neck pain prognostics. The only psychosocial variable that demonstrated a prognostic role was a report of having little self-perceived influence over one’s own work situation. This was associated with another report of neck pain 4 years later. A challenge after identification of these poor prognosticators is the
realization of the limited ability to modify these variables. But, improved outcomes were noted with changing jobs (for sewing machine operators) and exercise (Box 7.2).

Prevalence of neck pain in the general population

Hogg-Johnson et al (2009) reviewed the literature for risk factors in the general population. Their review revealed equivocal findings regarding age as a risk factor. The incidence of neck pain occurs across all ages, increasing in its prevalence as the years pass. There appears to be a peak in the prevalence of neck pain in the middle years and less prevalent in the later years of life.

Evidence has suggested a multifactorial presentation of neck pain. This includes additional health complaints (i.e. headache, low back pain, poorer self-rated health) that accompany neck pain complaints. Contrary to popular assumptions in medicine, cervical spine disc degeneration failed to be a risk factor for neck pain. In addition to physical risk factors, psychological factors predicted and presented with neck pain complaints (Box 7.3).

Prognostic factors of neck pain in the general population

Carroll et al (2008) investigated prognostic factors in the general population. Neck pain affects each sex with higher reports among women than men. However, gender only weakly predicted neck pain recovery. Younger age is associated with a more favourable prognosis. In contrast, old age is a predictor of poorer prognosis and a weak predictor of recovery. But, middle age individuals (45–59 years of age) were the highest risk and carried the poorest prognosis for neck pain.

In studies of neck pain, physical activity and exercise are assessed by self-reported questionnaires. This poses challenges to the conclusions that are able to be drawn from this data. Regular physical activity is favourable for a number of musculoskeletal issues from a prophylactic perspective, including being a component of neck pain management. However, prognostic studies evaluating its effect provided no relationships between the persistence or recurrence of neck pain when compared at the start and end of the studies.

Psychosocial health plays a factor in the prognosis of neck pain. For individuals that utilize a passive coping mechanism, their outcomes were worse than those with greater social support and better psychological health. In contrast, neck pain is associated with poorer psychological health which was also a risk factor for a new episode of neck pain (Box 7.4).
Any innervated structure in the cervical spine can be a pain generator, e.g. the posterior musculature, cervical zygapophyseal joints, lateral atlanto-occipital joint, atlanto-occipital joint, median atlanto-axial joint, dura mater of the spinal cord, pre-vertebral and lateral muscles of the neck, inter-vertebral discs, vertebral artery, synovial joints, anterior and posterior longitudinal ligaments, atlanto-axial ligaments, and internal carotid artery (Bogduk 2003). The reader is referred elsewhere for more detailed discussions of the cervical spine anatomy and its associated innervations (Bogduk 2002, 2003, Bogduk & McGuirk 2006). It is important to note that while these innervated structures can certainly be credited with the pain experience, the presence of innervation alone does not confirm the structure as the source of symptoms (Bogduk 2003).

Similar to low back pain, identifying exact sources of neck pain is challenging, if not impossible. The ability of any innervated structure in the cervical spine to act as a pain generator makes identification of the source of neck pain a challenge (Bogduk 2002). Further, pathological conditions (i.e. malignancy, cervical myelopathy, fracture, systemic disease and arterial dysfunction) can also cause neck pain.

Current spine research, both in low back and cervical spine regions, is encouraging a shift in clinical decision making away from previously emphasized tissue-based models of pain towards multifactorial causes (Ariens et al 2000, Guzman et al 2009). The biomedical model is repeatedly found to account for only part of the pain experience in certain spinal conditions. The International Association for the Study of Pain (IASP) has encouraged a broader clinical reasoning framework when working with patients in pain. Specifically, they have encouraged clinicians to consider possible hypotheses beyond tissue-based sources. Assisting clinicians to move beyond simple tissue-based sources, the IASP provided the following definition of pain: ‘An unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage’ (Merskey & Bogduk 1994). Based on current evidence suggesting the failure of tissue-based models to accurately explain all types of neck pain, today’s clinician must be aware of both ‘actual’ and ‘potential’ sources of neck pain. Thus, a bio-psychosocial model is now being looked to as a more comprehensive model of spine pain. This model provides a combination of biomedical, psychological and social contributors to neck pain. It has been introduced in an attempt to more accurately account for the multidimensional aspect of neck pain (Jull & Sterling 2009, Sterling 2009).

Neck pain and cervical radicular pain are two categories that have been identified for spinal related pain of the cervical region. Cervical radicular pain, pain that is perceived in the upper limb (Slipman et al 1998, Bogduk 2003) emanates from the cervical spine. Due to the ability of the cervical spine to create pain locally in the neck as well as distally in the upper extremity, the terms ‘cervical radicular pain’ and ‘neck pain’ are used interchangeably. This association, however, is incorrect. Despite the commonality of the cervical anatomic region responsible for creating symptoms, neck pain and cervical radicular pain are not interchangeable terms. Adding to this confusion is the use of the term ‘cervical radiculopathy’ as a synonym for cervical radicular pain. Briefly, cervical radiculopathy is a ‘neurologic condition, characterized by objective signs of loss of neurologic function, that is, some combination of sensory loss, motor loss, or impaired reflexes in a segmental distribution’ (Bogduk 2003). This is a result of pathology involving compression or compromise of the spinal nerve roots or the spinal nerve itself. This is objectively assessed as a loss of function and not pain. If pain is involved in a compressive condition in the cervical spine, it is due to compression of the dorsal root ganglion (see Chapter 8). Compression of nerve roots does not cause illicit nociceptive activity (Howe et al 1977). Compression of the dorsal root ganglion evokes activity in the Aβ and C fibers (Howe et al 1977). This neural behaviour is more than nociceptive activity (which is predominantly Aβ and C fiber transmission). Because of the involvement of the Aβ fibres with dorsal root ganglion compression, this establishes a distinction between radiculopathy (a reflection of a loss nerve function and not necessarily pain) and radicular pain (a reflection of dorsal root ganglion involvement beyond simple nociceptive function). Paraesthesia is associated with radicular pain which reflects involvement of Aβ fibres (Bogduk 2003). From this perspective, the seemingly intuitive thought that pain results from ‘pinched’ or ‘compressed’ nerves does not hold true unless the dorsal root ganglion is involved in that compression.

Within a sound clinical reasoning framework, it is still important for physical therapists to have an appreciation for potential tissue-based sources of neck pain. Epidemiological studies have provided support for prevalence rates of neck pain from around the world. This information is useful for helping clinicians and prognosticate direct research and prognosticates about this subgroup of patients. However, these studies are not useful in providing insight into the sources
of neck pain (Yin & Bogduk 2008). Having an appreciation for possible causes of neck pain can assist the clinician in identifying pre-test probabilities for neck conditions, which then allows the clinician to prioritize their evaluation and match the patient to interventions that are associated with a higher level of success (Yin & Bogduk 2008).

The patient with neck pain creates a clinical reasoning challenge due to the vast possible causes behind the patient’s chief complaint. Clinicians commonly evaluate their patients looking for a familiar pattern of symptoms that will then lead the clinician to hypothesize about a particular tissue-based source of the patient’s chief complaint. In this regard, research on normal and symptomatic patients has provided identifiable referral patterns for the cervical spine zygapophyseal joints (Fig 7.3 and Fig 7.4) and intervertebral discs (Fig 7.3), spinal nerves (Fig 7.5) and soft tissue (Fig 7.6). Nociceptive stimulation of the cervical spine, without involvement of cervical nerves or nerve roots, can refer symptoms to the upper limb, anterior chest wall, interscapular region and head (Bogduk 2002, 2003, 2006, Grubb & Kelly 2000) (Fig 7.7).

**PROPOSED MANAGEMENT OF MECHANICAL NECK PAIN**

Current best evidence has advocated a treatment-based classification approach for the management of patients with neck pain. Emphasis has been placed on matching the patient to optimal interventions based on the identification of signs and symptoms collected during the patient interview and physical examination (Childs et al 2004, Cleland et al 2006, Fritz & Brennan 2007, Childs et al 2008). The clinical decision-making process involved in applying this treatment-based classification strategy consists of two distinct levels (Cleland et al 2006). The first level requires that the therapist determine if the patient is appropriate for physical therapy services through a comprehensive medical screen including red and yellow flag assessments. The second level of the classification schema involves directing the patient to their matched intervention(s) or subgroup based on presenting signs and symptoms as well as their respective physical examination findings (Cleland et al 2006, Fritz & Brennan 2007).

**First level of classification**

Step one of this classification approach begins with a comprehensive review of the patient’s medical history and a medical screen encompassing both a review of
general health and specific systems (Boissonnault 2005). General health questions should be asked of all patients inquiring about the following: (1) fatigue, (2) malaise, (3) weakness, (4) unexplained weight loss/gain, (5) nausea, (6) paraesthesia or numbness, (7) dizziness or light-headedness, (8) change in mentation or cognition, and (9) chills, sweats, or fever.

Patient self-administered questionnaires can assist with this data collection. They have been shown to be accurate for reporting important health history information and in assisting the clinician in deciding whether or not to proceed further to the second level of classification (Pecoraro et al 1979, Boissonnault 2005).

A specific system screen (Cardiovascular, Pulmonary, Gastrointestinal, Urogenital Endocrine, Nervous system, Integumentary) follows based on the initial information gathered from the general health questions review including the body chart and self-administered questionnaires. The patient interview is a key component in attempting to recognize serious spinal pathology that may warrant additional concern including appropriate medical follow-up with a primary care practitioner (Greene 2001, Greenhalgh & Selfe 2009).

**Red flag screening**

A screen for possible red flags (signs or symptoms that may suggest a more serious underlying pathology) is the first step in the classification process for determining if the patient is appropriate for physical therapy services (Nordin et al 2009). It has been suggested that the clinician needs to determine one of three potential courses of action after the initial medical screening is complete: treat the individual and proceed to the second level of classification; treat the patient and proceed to the second level of classification with notification to the individual’s physician regarding signs or symptoms that may warrant concern; or refer to a physician, without any form of treatment during the initial visit, for further diagnostic work-up due to patient interview/examination findings (Boissonnault 2005). There is a small
Spinal fractures

Spinal fractures usually occur with some type of mechanical trauma or injury. Typically fractures occur from a fall, blunt trauma, the application of compressive or axial load force, or the result of a motor vehicle collision. It has been shown that risk factors such as a patient’s age, as well as the height of the fall (>3 m), are risk factors that increase the risk of cervical spine fractures. Incidents involving axial loads, diving incidents, and collisions all raise the risk of potential cervical spine fracture. The highest occurrences take place with motor vehicle collisions at speeds >100 km/hr (Thompson et al. 2009). The Canadian Cervical Spine Rule is a clinical prediction rule used to determine if cervical spine radiography is needed for an alert and stable individual who has suffered a cervical spine injury (Stiell et al. 2001, 2003). The rule is based on various high and low risk criteria as well as the ability of the patient to rotate their neck. If the rule is positive and the patient has not had any radiographs performed, the therapist should ensure that the appropriate radiographic evaluation be undertaken prior to the initiation of formal physical therapy services (see Chapter 2 for the Canadian C-Spine Rule).

Cervical myelopathy

Cervical myelopathy is a disorder that involves compression of the spinal cord canal resulting in neurological compromise. Canal obstruction can be caused by a variety of factors including: degenerative changes of the

Fig 7.6 Referral patterns from inter-spinous muscles (from Bogduk & McGuirk 2006, with permission).

Fig 7.7 Referral patterns from nociceptive stimulation of the cervical spine.
intervertebral discs, hypertrophy of the ligamentum flavum, or osteophyte formation due to the degenerative processes occurring at the intervertebral disc level. Cervical myelopathy is reported as the most common form of spinal cord dysfunction in individuals over the age of 55, affecting 90% of individuals as they approach their seventies (Cook et al 2009). Common symptoms include sensory disturbances of the hands, gait disturbances or balance unsteadiness, decreased motor strength with associated muscle wasting in the upper extremities, as well as bowel and bladder disturbances. Current research reported only moderate to substantial reliability for the clinical tests for cervical spine myelopathy. Furthermore performing a cluster of commonly used tests for this disorder did not improve the diagnostic accuracy greater than the Babinski test alone (Cook et al 2009). Readers are referred to Chapter 8 for further information on cervical myelopathy.

**Primary neoplastic conditions**

Primary neoplastic conditions are rare in the cervical spine representing 0.4% of all tumours and accounting for less than 5% of tumours that occur above the sacrum (Abdu & Provencher 1998). A more common clinical presentation may be from a Pancoast tumour, which is a malignant tumour of the upper apices of the lungs or within the superior pulmonary sulcus of the lung. It has been estimated that Pancoast tumours account for 2–5% of all cancers of the lung (Kovach & Huslig 1984). A common clinical presentation will include shoulder pain that radiates into the arm and/or hand with or without the presence of neck pain. These individuals may or may not have pulmonary signs or symptoms. Often a patient may exhibit a clinical presentation similar to Horner’s syndrome or an ulnar nerve dermatomal pattern due to the close proximity of the tumour to the lower trunk of the brachial plexus (C8–T1). Pancoast tumours affect men more than women and typically show an increased incidence rate over the age of 50, especially with a history of tobacco usage. In the low back literature a systematic review looking at malignancy found a combination of age > 50, a previous history of cancer, unexplained weight loss (more than 5–10% of your body weight within a month), and failure to improve after 1 month, was 100% sensitive in diagnosing a primary metastasis (Henschke et al 2007). Given the fact that lung cancer leads the cause of death among active cancers and is the second most common cancer in men and women in the United States (Centers for Disease Control Resource page), it is important that clinicians screen for the disease appropriately.

**Cervical arterial dysfunction**

Cervical arterial dysfunction (CAD) is a recent term that describes the arterial events that can occur in both the anterior and posterior arterial systems of the cervical spine. The anterior system is composed of the internal carotid arteries (ICA) and provides blood flow to the eyes as well as the cerebral hemispheres. The posterior system is composed of the vertebo-basilar arteries (VBA) and provides blood flow to the hind-brain (Kerry & Taylor 2009). These pathologies can mimic cervico-cranial pain. The clinician must be able to differentially diagnosis a likely arterial presentation versus symptoms due to a musculoskeletal source based on physical examination findings encountered during a comprehensive screen and subsequent physical examination. The exact prevalence rate of spontaneous vertebral dissections and vertebo-basilar insufficiency is unknown. Therefore the clinician should have a high suspicion of CAD, especially in cases involving cervical spine trauma. Although the prevalence rate for these conditions is quite low, the clinician should be aware of the limitations surrounding the current objective examination for CAD. This awareness should lead to decreased clinical reasoning errors that occur when these tests are used in isolation during the differential diagnosis process.

This paradigm shift encourages the patient interview to include a thorough review of vascular risk factors such as hypertension, hypercholesterolaemia diabetes mellitus, a history of smoking, infection, coagulation abnormalities and direct vessel trauma. During the objective component of the evaluation, additional tests such as a cranial nerve and eye examination can be used to assist the clinician in a comprehensive perspective of the patient’s current haemodynamic status (Kerry & Taylor 2009). This comprehensive evaluation is extremely important as current literature is supporting the hypothesis that neck movements are not valid screening tools in determining who is at risk for a vertebo-basilar artery dissection (Haldeman et al 1999). The concept of pre-manipulative testing has also been discouraged when there is a strong suspicion of a vertebo-basilar artery dissection. It has also been suggested that pre-manipulative testing adds little clinical information needed for decision making. In light of this, clinicians should question whether or not provocation tests add any benefit to the patient screening process with a realization that a comprehensive approach to screening for cervical arterial disorders is the key to early identification (Thiel et al 2005).

**Clinical cervical spine instability (CCSI)**

CCSI can occur from a variety of traumatic and non-traumatic events. CCSI has been difficult to diagnose due to the subtle clinical features that are associated with this condition (Cook et al 2005), the relative low prevalence rate, and the lack of clinical tests that have been shown to be reliable and valid in assisting the clinician in their clinical decision making process (Mintken et al 2008). The clinician should undertake a screening process that looks at ruling out ligamentous instability after any injury to the cervical spine, especially after a fall, blunt
trauma, or a motor vehicle accident. There are a variety of non-traumatic diagnoses which should be aware of that carry the potential for ligamentous instability such as rheumatoid arthritis, Down syndrome, ankylosing spondylitis, as well as prolonged oral contraceptive or corticosteroid use (Boissonnault 2005). A combination of the application of the Canadian Cervical-Spine rules, and a thorough history and physical examination aimed at identifying ligamentous structures, are key components of the clinician’s examination process when attempting to rule out ligamentous instability. Despite the absence of strong empirical data for testing the integrity of the alar and transverse ligaments, they are considered essential components of the evaluation process, often performed due to potential medicolegal ramifications (Cleland et al 2006). From a clinical reasoning perspective, it is helpful to understand that due to the weak empirical evidence behind these tests, one must use caution when obtaining a negative result on either of these tests in terms of ruling out the diagnosis.

In addition to the physical examination findings, the patient interview may reveal statements that increase the probability of CCSI. A large Delphi study reported common subjective identifiers as noted by expert physical therapists (Board Certified Orthopaedic Clinical Specialists (OCS) and Fellows of the American Academy of Orthopaedic Manual Physical Therapists (FAAOMPT)). A consensus of common patient complaints were noted as follows: ‘intolerance to prolonged static postures’, ‘fatigue and inability to hold head up’, ‘better with external support, including hands or collar’, ‘frequent need for self-manipulation’, ‘feeling of instability, shaking, or lack of control’, ‘frequent episodes of acute attacks’, and ‘sharp pain, possibly with sudden movements’ (Cook et al 2005). These patient reports may assist the clinician in identifying patients with CCSI.

**Yellow flag screening**

After clinicians have completed the first level of classification and concluded that there are no red flags or systemic issues present, the next step in the evaluation process is to perform a yellow flags assessment. Yellow flags are defined as patient indicators that require further investigation by the clinician regarding the cognitive and behavioural aspects of the patient presentation (Pincus et al 2002). These psychosocial variables have been demonstrated in the research literature as a link between neck pain in both the acute and sub-acute tissue healing phases (Linton 2000, Bot et al 2005, Carroll et al 2008). Epidemiological studies have demonstrated that 47% of all individuals who experienced a neck pain episode had either continued persistent pain or a worsening of symptoms at an annual follow-up (Cote et al 2004).

Fear of movement has been identified in the research literature as a psychosocial indicator that can assist in predicting disability in the neck pain population. It may be a key variable in explaining why individuals continue to have pain up to a year after their initial episode. The Fear-avoidance Beliefs Questionnaire is a tool which the clinician can use to objectify the patient’s fear of movement. Although primarily studied in the low back pain population there is data to suggest similar prognostic capabilities, although with weaker statistical associations, for functional outcomes using this tool in the cervical spine population (George et al 2001). Once the clinician determines the presence of any yellow flags, they can adjust the treatment plan accordingly (Fear-Avoidance based model) including notification of the patient’s primary care physician or referring individual regarding the clinical findings which may affect the patient’s future prognosis. Once the red flag and yellow flag assessment has been completed the clinician can then move on to the second level of classification involving matching the patient to the most appropriate interventions for their clinical findings.

**Second level of classification**

Once the patient has been evaluated for any potential red and yellow flags and the decision is made that the individual is appropriate for physical therapy services, the clinician can then move to the second level of classification (Fig 7.8). Here the clinician can start to classify the patient in terms of key impairments, appropriately matching them to selected interventions. This current treatment-based classification system is based on presenting signs and symptoms obtained from the history and physical examination with subsequent decision-making using a clinical algorithm (Fritz & Brennan 2007). The individual is then matched accordingly to the most appropriate interventions most likely to benefit their current clinical presentation (Childs et al 2004, Fritz & Brennan 2007). Preliminary studies of this treatment-based classification have shown that individuals receiving matched interventions were found to have strong associations with greater improvements in neck disability scores (NDI), as well as pain ratings, than individuals receiving non-matched interventions (Fritz & Brennan 2007).

**Mechanical neck pain classification**

Mechanical neck pain is often managed with a conservative, non-surgical approach, which has traditionally been the mainstay of treatment interventions for this population. Historically physical therapists have used a variety of different interventions including modalities, joint mobilization and/or manipulation, therapeutic exercise, and cervical spine mechanical traction (Cleland et al 2007).
These interventions have largely been accepted as the standard practice of care although high-quality evidence describing their usage is often absent or inconclusive (Childs et al. 2004, Fritz & Brennan 2007). This individualized and personalized clinical decision-making approach to patient care has been described as professional uncertainty or Wennberg’s hypothesis. Wennberg’s hypothesis states that when a clinician is faced with diagnostic uncertainty, treatment options are based on idiosyncratic factors. This outcome can lead to differences amongst providers in terms of the evaluative methods of their patients as well as subsequent treatment options (Wennberg et al. 1982, Jette & Jette 1997). A previous critical appraisal revealed a scarcity of evidence for the treatment of individuals with neck pain. They concluded more decisive research was needed to support conclusions regarding the efficacy of physical therapy interventions for patients with neck pain (Hoving et al. 2001).

A series of reviews from the Cochrane Library reported exercise, mobilization, manipulation, and electrotherapy had limited evidence of efficacy, and it was unclear if there were any potential benefit of their usage. Suggestions for improving the validity and statistical strength of future trials included obtaining larger patient sample sizes as well as establishing a model for the standardization for treatment for this population (Gross et al. 2004, Kroeling et al. 2005). Variability in practice and the absence of uniform professional decision-making has
been reported as key potential causes for the lack of high quality studies within the neck pain population. Smaller effect sizes leading to a fair to moderate quality of evidence rating, combined with reported subsequent data with only moderate success in patient outcomes, could potentially be a result of this lack of standardization of care (Fritz & Brennan 2007).

**Treatment based classification**

Due to the lack of high quality evidence for the management of this population, a treatment-based classification system (TBC) was proposed that can assist the practitioner in their clinical decision-making process (Wang et al 2003, Childs et al 2004, Fritz & Brennan 2007). This is different from a patho-anatomical approach to patient care, which is influenced by the search for the correct ‘diagnosis’ or tissue source. The patho-anatomical approach has been shown to be a large failure based on the inadequacies of the medical model for low back pain (Fritz & Brennan 2007). Previous studies have shown that diagnostic uncertainty at the primary care level is as high as 85% in the low back population. One can therefore infer that this would be a similar statistic for the cervical spine population (Jarvik 2003). In the absence of using a treatment-based classification system, physical therapy interventions are applied to individuals with the perception that the patient has an equal chance of failure or success, which is largely based on a patho-anatomical model. The classification approach uses a clinical reasoning process that focuses on classifying clinical data into certain categories for the purpose of making clinical decisions regarding therapeutic management. This current treatment-based classification model therefore assists the clinician in sub-grouping larger groups of patients into smaller, similar homogeneous entities. The focus is less on the identification of a patho-anatomical source and more on recognizing key impairments gained from the patient history, self-report measures, and the results of the physical examination, to guide the treatment approach (Childs et al 2004, Fritz & Brennan 2007).

**Classification categories**

Although high quality evidence is absent, there have been a series of studies that help guide intervention strategies once the patient has been classified into a sub-group. These interventions are the product of current, best, available evidence. They are supplemented with expert opinion and common practice when necessary. The current treatment-based classification system for patients with neck pain is composed of five classification categories (Fritz & Brennan 2007). The classification categories are: mobility, centralization, exercise and conditioning, pain control, and headache. An algorithm is used to aid the clinician in determining which appropriate classification their patient should be assigned to (see Fig 7.1). Interventions are applied according to best current evidence and standard practice of care.

Patients in the mobility classification will often present with a recent onset of symptoms, rarely have upper quarter symptoms (active range of motion does not peripheralize symptoms and no signs of nerve root compression) and usually demonstrate active range of motion discrepancies. In the mobility classification, matched interventions will include mobilization/manipulation directed at the cervical or thoracic spine. Neuromuscular re-education and strengthening of the deep neck flexors are also included as interventions within this subgroup (Cleland et al 2005, 2007).

The centralization classification typically consists of patients presenting with a referral pattern of pain into the upper extremity and/or hands with or without concomitant neck pain. They may have pain in a radicular pattern, as well as peripheralization of symptoms with active range of motion. A test item cluster has been developed to assist the practitioner in determining if the patient’s presentation is cervical radiculopathy. The four items of this cluster are: ipsilateral cervical spine rotation < 60°, a positive upper limb median nerve neurodynamic test, manual distraction relieves their current symptoms and a positive Spurling’s test (Wainner et al 2003). Typical interventions may include: manual mechanical cervical traction and cervical retraction exercises based on the centralization phenomenon. Current research has also proposed a manual therapy approach including mobilization and manipulation techniques directed at the cervical and thoracic spine (Cleland et al 2007, Young et al 2009). Symptom response is then recorded for possible centralization or peripheralization of symptoms. This has been shown to assist in the clinician’s prognostic reasoning (Werneke et al 2003, 2008).

Within the exercise and conditioning classification patients will have lower pain and disability scores, a longer duration of symptoms (> 30 days), no signs of nerve root compression, and no signs of peripheralization or centralization. Common interventions will include both general strengthening for the upper quarter as well as motor control exercises focused on the deep neck flexor muscle area (Bronfort et al 2001). Individuals often begin in one specific classification and then move into this category as they start to improve.

The pain control classification includes individuals who have higher initial pain and disability scores, a recent onset of symptoms, which is usually due to trauma, concomitant cervicogenic headaches, referred pain into the upper quarter, as well as poor tolerance to participation in the physical examination. Interventions include pain relieving modalities and cervical spine range of motion exercises.

Finally, the headache classification has patients who present with a one-sided or unilateral headache pattern
with certain cervical spine motions exacerbating symptoms. The following interventions have been recommended for this population: cervical spine manipulation or mobilization, motor control exercises for the deep neck flexor muscles, and strengthening of the upper quarter musculature (Jull et al 2002).

CERVICAL SPINE SELF-REPORT MEASURES OF PAIN AND FUNCTION

The administration and collection of self-report measures is gaining increased awareness in physical therapy clinical practice and published research. These health status questionnaires look at a variety of variables such as general health, functional limitations and current levels of the individual’s self perceived disability. It has been advocated that the use of these measures can assist the practitioner in their clinical performance as well as their overall professional accountability to the patient in providing the best care possible (Delitto 2006).

Common measures in the cervical spine population include the Numeric Pain Rating Scale (NPRS), Neck Disability Index (NDI), Patient Specific Functional Scale (PSFS), Fear-avoidance Belief Questionnaire (FABQ), and the Global Rating of Change scale (GRC). When applying these measures to a specific patient population it is helpful to know the tool’s psychometric properties, especially the minimum detectable change (MDC) and the minimum clinically important difference (MCID). It is helpful to define MDC and MCID as their value is related to the clinical relevance of the measure used as well as determining if a clinical meaningful change had occurred based upon a certain treatment approach. The MDC is defined as the least amount of change that falls outside of the normal measurement error (Kovacs et al 2008). MCID is the smallest amount of change, or difference that the patient perceives as being beneficial (Jaeschke et al 1989).

Currently there is a lack of published evidence that suggests an optimal timeframe for an appropriate follow up when using self-report measures. The authors recommend that a numeric pain rating (NPRS) and change between sessions (GRC) be measured at each visit. Tools that look at perceived functional limitations (PSFS) should be measured weekly. Fear avoidance behaviour (FABQ) and self reported disability (NDI) should be evaluated at the initial evaluation and at time of discharge (Table 7.2). One may administer these tools more often based on the patient’s specific case presentation. These are general guidelines to assist the clinician in their preliminary usage of these tools in the clinical setting.

Numerical pain rating scale

The Numerical Pain Rating Scale (NPRS) is a subjective measure in which individuals rate their pain on an eleven-point numerical scale. The scale is composed of 0 (no pain at all) to 10 (worst imaginable pain). It has been shown that a composite scoring system including best, worst, and current level of pain over the last 24 hours was sufficient to pick up changes in pain intensity with maximal reliability (Jensen et al 1999). The MCID has been found to be a change in score of 1.3 points or higher in the mechanical neck pain population (Cleland et al 2008).

Neck disability index

The Neck Disability Index (NDI) is the most common region specific tool in use for measuring neck related disability. It has been shown to be a reliable and valid tool. In a recent study there was no difference in NDI scores in patients with or without unilateral arm pain suggesting that the NDI adequately accounts for UE symptoms in conjunction with neck pain (Young et al 2009). There are 10 questions each scored with a possible 0–5 value with the larger number indicating a higher self-reported disability status. The score on this questionnaire can range from 0–50. In order to calculate a percentage, simply multiply the final value by two. In a recent study the MCID was found to be 7.5 points and an MDC of 10 points.

<table>
<thead>
<tr>
<th>Table 7.2</th>
<th>Self reported measures for the cervical spine population</th>
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</thead>
<tbody>
<tr>
<td>Measure</td>
<td>Score</td>
</tr>
<tr>
<td>Numeric Pain Rating Scale (NPRS)</td>
<td>0–10</td>
</tr>
<tr>
<td>Patient Specific Functional Scale (PSFS)</td>
<td>0–10</td>
</tr>
<tr>
<td>Neck Disability Index (NDI)</td>
<td>0–50</td>
</tr>
<tr>
<td>Global Rate of Change (GROC)</td>
<td>–5 to +5</td>
</tr>
<tr>
<td>Fear Avoidance Belief Questionnaire (FABQ)</td>
<td>0–24 (PA)*</td>
</tr>
</tbody>
</table>

*PA: Physical activity subscale
It is recommended that the MDC be used as this exceeds the standard error of measurement that one would find with this tool if accepting the current MCID value (7.5 points) (Young et al. 2009).

Patient specific functional scale

The Patient Specific Functional Scale (PSFS) is an outcome measure that asks the patient to identify and rate limited functional activities. It is based on a 0–10 scale with score of 10 establishing their ability to perform the activity prior to injury and zero representing their current inability to perform the activity at all. The PSFS has been shown to be highly reliable in the neck pain population (Westaway et al. 1998). Currently there is a lack of evidence that supports an actual MCID for this tool in the mechanical neck pain population, but a study looking at individuals with suspected cervical spine radi-culopathy established an MCID of 2 points (Cleland et al. 2006).

Fear avoidance belief questionnaire

The Fear Avoidance Belief Questionnaire (FABQ) was originally developed in 1993 and was used to measure subjects’ beliefs and fears about how their physical activity or work activity may contribute to their current pain state (Waddell et al. 1993). The FABQ has a total of 66 points and consists of a total of 16 questions which can be scored from 0–6. Outlier questions are present resulting in the work subscale (FABQW) containing a total of 42 points (questions 6, 7, 9, 10, 11, 12, 15), while the physical activity subscale (FABQPA) has a total of 24 points (questions 2, 3, 4, 5). A recent study used this tool in the development of a clinical prediction rule for those individuals with neck pain that may benefit from thoracic spine manipulation, exercise, and patient education. They found that a score of < 12 on the FABQPA was one of the predictors of a successful outcome (Cleland et al. 2007). An additional study in 2007 showed that a chronic neck pain sub-sample total score of 41 for the FABQ (T), 19 for the FABQ (PA) and 19 for the FABQ (W) could identify prolonged disability 6 months later (Landers et al. 2008). There is no published data at this time that describes an MDC or MCID for this tool.

Global rating of change scale

The Global Rating of Change scale (GRC) is used to look at the patient’s self perceived progress during the course of their treatment. This tool adds objectivity to the frequently asked clinical question, ‘How are you feeling today – better, worse, or the same as compared to when you first started physical therapy?’. The GRC asks the patient to rate their progress from a previous point in their care (often the initial evaluation) to their current state. The most common version of this scale used in the physical therapy literature is a 15-point scale that has data points ranging from −7 (A great deal worse) to +7 (A great deal better). The original literature that had described this tool was based on a patient population that was diagnosed with chronic lung or heart disease (Jaeschke et al. 1989). The authors used the 15-point scale in defining treatment success using an arbitrary cut-off system. A recent review of the GRC found using an 11-point scale ranging from −5 (very much worse) to +5 (completely recovered) or a 15-point scale, as previously mentioned, yielded the same results in terms of responsiveness. Given the lack of empirical evidence for the arbitrary cut off points used in the 15-point scale, it is the author’s opinion that the 11-point scale be used with a corresponding MCID of 2 points (Kamper et al. 2009).

CONCLUSION

Neck pain is a common occurrence affecting individuals around the world. Similar to low back pain, it is difficult to identify exact sources of neck pain, strengthening the likelihood of a multifactorial presentation to this pain phenomenon. Epidemiologic studies provide data to guide future research with the goal of optimizing management strategies. Physical therapists must be aware of current best practice standards regarding neck pain. This includes screening patients for the appropriateness of physical therapy services prior to initiating treatment. Once the decision is made to proceed with physical therapy care, a treatment-based classification system is proposed as an ideal starting point for managing this population. Outcome measures provide objective data to support the clinical decision making process for individuals with cervical spine pain. Future research is needed to provide further insight into the management of patients with neck pain.

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