Cervicogenic Headache: A Manual Therapy Approach

Mollie Pharris
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CERVICOGENIC HEADACHE: A MANUAL THERAPY APPROACH

by

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An Independent Study
Submitted to the Graduate Faculty of the
Department of Physical Therapy
School of Medicine and Health Sciences
University of North Dakota
in partial fulfillment of the requirements
for the degree of
Master of Physical Therapy

Grand Forks, North Dakota
May
2000
This Independent Study, submitted by Mollie K. Pharris in partial fulfillment of the requirements for the Degree of Master of Physical Therapy from the University of North Dakota, has been read by the Faculty Preceptor, Advisor, and Chairperson of Physical Therapy under whom the work has been done and is hereby approved.

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(Faculty Preceptor)

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Title Cervicogenic Headache: A Manual Therapy Approach

Department Physical Therapy

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ABSTRACT

The cervical spine was first suggested as an origin for headache almost 200 years ago. Since then, the etiology of headaches arising from the cervical spine has remained controversial and confusing. Cervicogenic headache is often confused as tension or common migraine headache, therefore presenting a great diagnostic and therapeutic challenge for the physical therapist. The clinical physical therapist must have a strong background in anatomy and biomechanics of the cervical spine in order to assess and determine the involvement of the cervical spine as a primary or secondary factor in the individual's complaint of headache. This knowledge is also necessary for effective use of mobilization techniques on the cervical spine, which have been proven effective in the treatment of cervicogenic headache.

The purpose of this independent study was to review existing literature with focus on the anatomy, biomechanics, evaluation, and effective mobilization techniques for cervicogenic headache. Structures innervated by the C₁ - C₃ spinal nerves are implicated as sources of noxious stimuli converging on the trigeminocervical nucleus and causing cervicogenic headache. The neuroanatomical bases of cervicogenic headache, diagnostic criteria, evaluation strategies and appropriate mobilization techniques for relief of cervicogenic headache are discussed in this independent study.
CHAPTER I
INTRODUCTION

The cervical spine was first suggested as an origin for headache almost 200 years ago.\(^1\) Since then, the etiology of headaches, arising from the cervical spine has remained controversial and confusing.\(^2\) Only within the last 20 years has the role of the cervical spine as a source of headache begun to be more understood and less controversial. Headaches that originate from structures in the neck have been given various names, ranging from broad terms such as "cervical",\(^2,3,4,5,6\) "occipital",\(^7\) and "cervicogenic"\(^8,9,10\) to specific terms such as "third nerve occipital headache".\(^11\) "Cervical headache" and "cervicogenic headache" have come to refer to the same condition and the terms can be used interchangeably.\(^4\)

The literature supporting the involvement of the cervical spine in headaches is substantial.\(^2\) Recent studies suggest that cervicogenic headache, as defined by the International Headache Society (IHS), account for some 15-20% of all recurrent headaches.\(^12\) Turk and Ratkolb\(^13\) report that, about 40% of all headaches are of cervicogenous origin, while Boake\(^14\) and Frykholm\(^15\) feel that cervical headaches represent 70% of all headaches seen by general practitioners. Often confused as tension or common migraine headache, headache arising from the neck presents a great diagnostic and therapeutic challenge for healthcare professionals including, physical therapists.\(^2\)
Diagnosis of cervical headache is not always an easy task. The clinical physical therapist must have a strong background in anatomy and biomechanics of the cervical spine in order to assess and determine the involvement of the cervical spine as a primary or secondary factor in an individual's complaint of headache. This knowledge is also necessary for effective use of mobilization techniques on the cervical spine.

Although, the most effective form of treatment for cervical headache has not been specified, spinal mobilization and/or manipulation have been established as the most common forms of noninvasive treatment. Several studies have demonstrated that mobilization of the cervical spine can aid or reduce the occurrence of cervical headaches and in many cases, the patient's with the most severe and debilitation headaches appear to respond most significantly to this form of treatment.

The purpose of this independent study was to review existing literature with focus on the anatomy, biomechanics, evaluation, and effective mobilization techniques for cervicogenic headache. Structures innervated by the C1- C3 spinal nerves are implicated as sources of noxious stimuli converging on the trigeminocervical nucleus and causing cervicogenic headache. The neuroanatomical bases of cervicogenic headache, diagnostic criteria, evaluation strategies and appropriate mobilization techniques for relief of cervicogenic headache are discussed in this independent study.
CHAPTER II

ANATOMY OF THE CERVICAL SPINE

Osteology

Seven cervical vertebrae form the bony skeleton of the cervical vertebral column that protect and encase the spinal cord. The cervical vertebrae are relatively small bones and bear less weight than do the vertebrae in the rest of the spinal column. In terms of vertebral structure, the cervical spine is divided into the lower cervical spine that consists of typical vertebrae and the upper cervical spine that consists of two very distinctive atypical vertebrae, the atlas, and the axis.

**Lower Cervical Spine**

There is disagreement as to the vertebrae that make up the lower cervical spine. According to Pratt, the vertebrae included in the lower cervical spine are the inferior aspect of C2 through C7. Grant refers to the lower cervical spine as vertebrae C3 through T1 while, most other sources classify the lower cervical spine as vertebrae C3 through C7. For clarification, this study will regard the lower cervical spine as vertebrae C3 through C7. Vertebrae C3 through C6 are considered typical cervical vertebrae and their distinguishing characteristics are described in this section. C7 is a transitional vertebra between the cervical spine and thoracic spine, it has many of the same characteristics as C3-C6, but also differs in some aspects.
Vertebral Bodies and Uncinate Processes

The lower cervical vertebrae have the smallest bodies and the largest spinal foramina of any region of the vertebral column (Figure 1). The medial-lateral dimensions of the vertebral bodies exceeds the anterior-posterior dimensions. A unique characteristic of the lower cervical spine vertebral bodies is superiorly projecting processes on their superolateral aspects. These processes are called uncinate processes. The uncinate processes are shaped such that the inferior surface of the vertebral body above fits within them. This relationship forms the uncovertebral joints or "joints of Luschka". These joints limit lateral gliding and allow sagittal plane flexion and extension, as well as provide medial and lateral protection to the intervertebral discs that are found between the vertebral bodies. Another protective feature of the vertebral bodies is an inferior rim on the anterior surface of the body that extends downward over the anterior portion intervertebral disc.
Pedicles

The pedicles are located between the vertebral bodies and transverse processes of the lower cervical vertebra (Figure 1). The pedicles of the lower cervical spine project posterolaterally from the vertebral bodies as opposed to directly posterior as in the thoracic and lumbar spines. As a result, a triangular shaped vertebral foramen is formed. The vertebral foramen is where the spinal cord is housed. The apex of the vertebral foramen is directed posteriorly and the base is directed anteriorly. The vertebral foramen is comparatively large in the cervical spine because of the vital medullary contents are housed here.

Laminae

The paired laminae project posteriomedially from each articular mass and come together in midline to fuse with each other (Figure 1). The articular mass originates from the junction of the pedicle and lamina and is formed by the superior and inferior articular facets. The laminae form the apex of the vertebral foramen.

Transverse Processes

The transverse processes are the most unique feature of the lower cervical vertebrae. They are short and project anterolaterally and slightly inferiorly from the vertebral bodies and articular masses (Figure 1). Each transverse process in the cervical spine has two parts, an anterior and a posterior projection. The anterior or costal process projects from the vertebral body and ends laterally as the anterior tubercle. The posterior part is considered the true transverse process and projects from the articular mass and ends as the posterior tubercle. The anterior tubercle of C6 is particularly large and called the carotid tubercle because the carotid pulse is easily palpable at that
location. The transverse processes are concave or gutter shaped on their superior aspects to allow passage of the spinal nerves. The spinal nerves are firmly anchored in the gutters making the nerves vulnerable to injury with distraction of the cervical vertebra. The transverse processes of vertebra C3 through C6 have a round hole called the transverse foramina through which the vertebral artery passes. These transverse foramina are another distinguishing characteristic of the cervical spine.  

**Spinous Processes**

The spinous processes extend posteriorly from the junction of the fused laminae (Figure 1). The spinous processes of the lower cervical spine are relatively short, project slightly inferiorly and are typically bifid with the exception of C6 that is usually not bifid and is intermediate in length between C5 and C7. The C7 spinous process, called the vertebra prominens, is the longest of the cervical spine. It also serves as a prominent point of attachment for many cervical muscles. 

**Upper Cervical Spine**

Distinct anatomical features of the upper cervical spine (craniovertebral region) make it unique and structurally different from any other region in the vertebral column. The craniovertebral region consists of the portion of the occipital bone that surrounds the foramen magnum including the occipital condyles, C1 (axis) and C2 (atlas). 

**Atlas (C1)**

The atlas is a ringed shaped bone that supports the skull (Figure 2-A). It lacks a distinct vertebral body and consists of two lateral masses that are connected by the anterior arch and the longer curved posterior arch. The anterior arch is short, straight, and forms only a small portion of the atlas' ring. An anterior projecting tubercle arises
Superior facet for the (occipital condyle)

Transverse ligament of the atlas

Posterior arch

Posterior tubercle

Spinous process (bifid)

Figure 2. (A) The Atlas. (B) The Axis.

from the anterior arch in midline. The posterior surface of this anterior tubercle has a facet that articulates with anterior surface of the dens (odontoid process) of the axis (C2) (Figure 2).

Projecting laterally from the anterior arch are the paired lateral masses. On the superior aspect of the lateral masses are the large, kidney-shaped, concave articular facets. These superior facets articulate with the occipital condyles of the skull and are obliquely oriented and face superior and medially to support the occiput forming the atlanto-occipital joint. 18, 21, 22, 23 The slightly convex inferior facets are very different in shape, contour, and orientation from the superior facets. 18 The articular surfaces of these
facets are circular, relatively flat, and slope slightly upward from medial to lateral to transmit the weight of the skull onto the superior facet joints of the axis.\textsuperscript{22}

The posterior arch is much larger than the anterior arch. It is long, curved, and extends posteriomedially from the lateral masses.\textsuperscript{21} On the superior surface of the right and left sides of the posterior arch is a distinct groove that delineates the bony channel over which the vertebral artery and the first cervical nerve pass.\textsuperscript{19,21} A small posteriorly projecting tubercle is present in the midline of the posterior arch that replaces the elongated spinous process of the other cervical vertebrae.\textsuperscript{19} Since the atlas has no spinous process it has the shortest anterior to posterior dimension of any of the cervical vertebrae.\textsuperscript{18} It is however, the widest in the medial to lateral dimension of all the cervical vertebrae because of the prominent transverse processes.\textsuperscript{21} The long transverse processes extend laterally from the lateral masses; each transverse process is perforated by a laterally angled transverse foramen for the passage of vertebral artery.\textsuperscript{18,23}

Axis (C\textsubscript{2})

The axis is the strongest of the cervical vertebrae (Figure 2-B). Anatomically, its superior and inferior aspects are very different from the atlas. The major distinguishing feature of the axis is the blunt, tooth-like dens that extends superiorly just above the atlas. Functionally, the dens acts as a pivot on which the atlas and occipital bone rotate.\textsuperscript{18,19} The anterior aspect of the dens contains a small articular facet that articulates with a facet located on the posterior surface of the anterior arch of the atlas.\textsuperscript{21}

The axis has large oval superior facets that articulate with the atlas and are immediately lateral to the dens. These superior facets are large and either slightly convex or flat and slope inferiorly from medial to lateral.\textsuperscript{18,19,22,23} In comparison with the lower
cervical spine, the superior and inferior facets of the axis do not form an articular pillar; rather the superior facets are positioned anterior to their inferior facets.\textsuperscript{21}

The laminae of the axis are the thickest of all cervical vertebrae and the pedicles of this vertebra are heavy and strong.\textsuperscript{21} The axis also has a prominent spinous process, which is large and bifid. These strong bony components provide solid muscle attachment sites that allow the upper cervical spine to move independently of the lower cervical spine.\textsuperscript{19} The transverse processes of the axis are also thick but much shorter than those of the atlas.\textsuperscript{22, 23} Like the atlas and the lower cervical spine, the transverse process of the axis has a transverse foramen for the passage of the vertebral artery.

Arthrology

The joints of the cervical spine include the uncovertebral "joints" (of Luschka) between the uncinate processes of C\textsubscript{3} through C\textsubscript{6}, the apophyseal joints between the articular facets of the adjacent vertebra, the atlanto-occipital joints and the atlanto-axial joints.

Uncovertebral "Joints"

The uncovertebral "joints" are between the uncinate processes of C\textsubscript{3} through C\textsubscript{6} vertebrae. The uncovertebral "joints" are joint-like structures that are covered with cartilage and contain a capsule filled with fluid.\textsuperscript{17} They are considered to be degenerative spaces in the discs that are filled with extracellular fluid by some, but most anatomists consider them to be synovial joints.\textsuperscript{17} The uncovertebral "joints" are frequent sites of osteophyte (bone spur) formation which can cause neck and headache pain.\textsuperscript{5, 17}
Apophyseal Facet Joints

Each cervical vertebra in the lower cervical spine has four articular facets that can be subdivided into two superior articular facets and two inferior articular facets. The superior articular facets articulate with the inferior facets of the vertebra above to form the apophyseal facet joints not only in the cervical spine, but also throughout the entire vertebral column. The superior facets of the lower cervical vertebrae face posterior and superior and inferior facets face anterior and inferior. Each of these joints is a typical synovial joint with the articular facets surfaces lined with hyaline cartilage. Located about two centimeters lateral to the spinous processes, these cervical apophyseal joints can be palpated as small domes through the overlying trapezius and deeper cervical muscles. The vertical column of bone between the articular facets is called the articular pillar and is prominent laterally at the junction of the pedicle and lamina. It is this articular pillar between C₃ and C₇ that bears a significant proportion of the axial loading of the head.

The orientation of the cervical facets in the lower cervical spine is oblique and 45° to the horizontal plane. This inclination does however, gradually decrease with reference to the horizontal plane from 45° at C₃ to closer to 30° at C₇.

Atlanto-occipital Joints

The occipital condyles and the superior articular facets of the atlas form the atlanto-occipital synovial joints. These synovial articulations are the most superior apophyseal joints of the vertebral column and provide only minimal bony stability of this joint during movement. The joint capsules are loose to permit a high degree of motion. There is no intervertebral disc present between the atlanto-occipital articulation.
**Atlanto-axial Joints**

There are four synovial joints between the atlas and the axis. The lateral atlanto-axial joints are formed between the inferior facets of the atlas and the superior facets of the axis. The third synovial joint is formed between the anterior arch of the atlas and the dens and the fourth articulation is between the posterior aspect of the dens and the transverse ligament of the cruciate ligament complex (Figure 2).

The joint capsules of these four articulations are also very lax because of the amount of motion between the surfaces. Like the atlanto-occipital articulation, the atlanto-axial articulations lack bony congruency and, hence, are inherently unstable.

**Supporting Structures and Connective Tissue of the Cervical Spine**

The supporting structures and connective tissue of the cervical spine include the intervertebral discs and the ligaments both of which are extremely important to the stability and function of the upper cervical spine.

**Intervertebral Discs**

The intervertebral discs are the most important structures joining the bodies of the vertebrae together. The discs act as shock absorbers, and their varying shapes produce the secondary curvatures of the vertebral column. The cervical discs are wedge-shaped, being of greater height anteriorly than posteriorly, and are therefore, the primary reason for the anatomical structure of the cervical lordosis. The height of the discs in the cervical spine are also comparatively high in relation to their surface area this accounts for the large amount of motion present in the cervical spine.

Intervertebral discs are not present between the occiput and the atlas nor between the atlas and the axis. Intervertebral discs are found between the axis and C3 and between
the remaining adjacent vertebral bodies of the cervical spine. The discs of the cervical spine are considered to be similar to the discs located throughout the vertebral column in general composition and structure and play a leading role in weight bearing. They absorb compression forces and allow one vertebra to rock and rotate on another. The intervertebral discs consists of a soft inner core, the nucleus pulposus, which is surrounded by an outer ring of fibrous tissue and fibrocartilage called the annulus fibrosus.

Ligaments

Ligamentum Nuchae

The ligamentum nuchae is a large, thick ligament in the cervical region (Figure 3). It extends the entire cervical spine from external occipital protuberance to the

![Figure 3. Sagittal View of the Ligaments of the Upper Cervical Spine.](image-url)
C₇ or T₁ spinous processes. It is an extremely important supporting structure for the head and its importance as a posterior restraint is well accepted.²¹ The ligamentum nuchae limits flexion of the cervical spine.¹⁸

**Ligamentum Flavum**

The ligamentum flavum differs from all other ligaments of the cervical spine due to the presence of a large number of elastic fibers (Figure 3).¹⁸ In addition, it is in a position to serve as one of the posterior boundaries of the spinal canal.²¹ The ligamentum flavum extends from the inferior edge of one lamina to the superior edge of an adjacent lamina. The ligamentum flavum also blends with the anterior part of the apophyseal joint capsule to give added support to this structure.¹⁸,²¹ The ligamentum flavum is present between the laminae of the axis and C₃ and all the vertebral segments caudal to this level. Above the axis, the posterior atlanto-axial and atlanto-occipital membranes replace the ligamentum flavum. Because of the ligamentum flavum’s elastic qualities, it is stretched during flexion of the cervical spine and then shortens approximately 40% as the cervical spine moves into full extension.¹⁸,²¹ As extension occurs the ligament shortens and thickens (but does not fold or buckle) and consequently does not impinge on the spinal cord.

**Anterior Longitudinal Ligament**

The anterior longitudinal ligament covers and connects the anterior aspects of the bodies of the vertebra and intervertebral discs (Figure 3).¹⁸,²⁰ The anterior longitudinal ligament extends from the occipital bone of the skull and anterior tubercle of the atlas and courses the full length of the vertebral column down to the sacrum.²⁰,²¹ The anterior longitudinal ligament is thin in the cervical spine, thickest in the lumbar spine, and is
firmly fixed to the intervertebral discs and the vertebral bodies. The anterior longitudinal ligament is the only ligament that restricts extension.

**Posterior Longitudinal Ligament**

The posterior longitudinal ligament is weaker than the anterior longitudinal ligament. It courses along the posterior aspect of the vertebral bodies and intervertebral discs forming the anterior boundary of the vertebral canal. The posterior longitudinal ligament narrows as it passes over the vertebral bodies and expands laterally over the intervertebral discs. The posterior longitudinal ligament is broadest in the cervical region where it is continuous with the tectorial membrane. The tectorial membrane is broad, strong and covers the dens (Figure 3 & 4). The tectorial membrane attaches to the anterior rim of the foramen magnum and courses caudally as the posterior longitudinal ligament to insert on the sacrum. The width of the posterior longitudinal ligament in the cervical region allows the ligament to function as an excellent barrier against posterior
disc protrusions and offers protection to the spinal cord. The posterior longitudinal ligament tightens with flexion of the vertebral column.

**Ligaments of the Upper Cervical Spine**

**Cruciate Ligament Complex**

The cruciate ligament is an important stabilizer of the occiput-atlas-axis region (Figure 3 & 4). This ligament is immediately anterior to the tectorial membrane and is referred to as the cruciate ligament due to its cross-like shape. The ligament has two parts, the transverse ligament of the atlas and the longitudinal ligament. The most significant part being the transverse ligament of the atlas. This ligament lies between the lateral masses of the atlas and is considered to be the most important ligament in the upper cervical spine. The transverse ligament holds the dens of the axis against the posterior surface of the anterior arch of the atlas. The second part of the cruciate ligament are two vertically oriented bands that cross the transverse ligament and join the body of the axis to the occipital bone. These are called the superior and inferior longitudinal bands. The cruciate ligament's major responsibility is to limit anterior translation of the atlas on the axis this is extremely important in preventing the dens from compressing against the spinal cord.

**Alar Ligaments**

The alar ligaments lie immediately anterior to the cruciate ligament complex (Figure 4 & 5). The alar ligaments consist of two laterally directed portions that are strong, short, fibrous ligaments that link the top of the dens to the anterior margin of the foramen magnum. These ligaments are biomechanically important because they
stabilize the dens and limit flexion, side bending, and rotation of the atlas on the axis.\textsuperscript{18}

The alar ligaments also relax on extension of the head and become taut with flexion.\textsuperscript{21}

The left alar ligament limits rotation to the right and rotation to the left is prevented by the right alar ligament.

**Apical Ligament**

The apical ligament also lies immediately anterior to the cruciate ligament complex and extends from the apex of the dens to the anterior rim of the foramen magnum (Figure 5).\textsuperscript{18,21} This ligament is short but strong and works with the two alar ligaments to provide stability to the occipito-atlanto-axial complex.

**Myology**

The numerous muscles of the cervical spine are devoted to the support and movement of the head. The muscles can become shortened and lengthened with "unhealthy" postures, damaged through trauma or disease or become irritated by overuse through activities of daily living. All of the muscles described in this chapter can be
implicated as a source of headache due to their innervation from any one of the spinal nerves C<sub>1</sub>-C<sub>3</sub>.

**Extrinsic Back Muscles**

The extrinsic back muscles, also known as the superficial back muscles, connect the upper extremities to the trunk and their main actions are concerned with movements of the extremities. However, when the extremities are fixed the trapezius and levator scapulae muscles have a direct effect on cervical spine mobility and play a very important role in postural control and stability. Rhomboids major and minor and latissimus dorsi are also extrinsic back muscles but will not be included in this review as they do not directly effect the cervical spine. All the extrinsic back muscles are innervated by the ventral rami of the spinal nerves. The origin, insertion, innervation and major actions of the extrinsic back muscles can be found in Table 1.

**Trapezius**

The trapezius muscle is large, flat, and triangular in shape and is the most superficial of the extrinsic back muscles. It covers the posterior aspect of the neck and superior half of the trunk and is ensheathed in a layer of fascia that serves as an attachment for much of its muscle tissue. The trapezius is a muscle of the shoulder girdle, and a cervical muscle. The trapezius muscle connects the shoulder girdle to the skull and the vertebral column making it a very important muscle in postural stability and control. Because the trapezius is primarily a muscle of the shoulder girdle its main actions are at this joint but if the upper extremity is strongly fixed a bilateral contraction of the trapezius results in extension of the head on the cervical spine. A unilateral
<table>
<thead>
<tr>
<th>Muscle</th>
<th>Origin</th>
<th>Insertion</th>
<th>Innervation</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trapezius</td>
<td>Superior nuchal line, Occipital protuberance, Ligamentum nuchae, Spinous processes C&lt;sub&gt;7&lt;/sub&gt;- T&lt;sub&gt;12&lt;/sub&gt;</td>
<td>Lateral 1/3 of clavical (upper fibers), Acromion (middle fibers), Spine of scapula (lower fibers)</td>
<td>Cranial Nerve XI, Ventral rami C&lt;sub&gt;3&lt;/sub&gt; and C&lt;sub&gt;4&lt;/sub&gt;</td>
<td>Elevate scapula, Retract scapula, Upward rotation of scapula, Contralateral rotation of the head, Extension of the head and thorax</td>
</tr>
<tr>
<td>Levator Scapula</td>
<td>Transverse processes C&lt;sub&gt;1&lt;/sub&gt;-C&lt;sub&gt;4&lt;/sub&gt;</td>
<td>Superior angle of the scapula</td>
<td>Dorsal scapular, Nerve to levator scapula, Ventral rami of C&lt;sub&gt;3&lt;/sub&gt; and C&lt;sub&gt;4&lt;/sub&gt;</td>
<td>Elevate scapula, Downward rotation of scapula, Lateral flexion of the neck</td>
</tr>
</tbody>
</table>
contraction will produce ipsilateral side bending or contralateral rotation of the head and cervical spine.

The trapezius is often irritated by poor posture and fatigue making it very susceptible to injury and manifestation of trigger points, which are hypersensitive areas of muscle tissue. These trigger points can occur in many muscles of the cervical spine and back, but the upper trapezius has been implicated as the cervical spine muscle most often plagued by trigger points leading to cervical headache.\textsuperscript{25}

**Levator Scapulae**

The levator scapulae are rope-like muscles that have direct attachments to the cervical transverse processes. The levator scapulae are optimally aligned to direct a posterior shear force to the vertebrae of the cervical spine.\textsuperscript{21} This is important to people who have forward head posture because with this condition there is an increase in the anterior shear force of the cervical spine that is counterbalanced by the levator scapulae. This puts extra tension and stress on these muscles as they are subjected to maintain a continuous contractile state to minimize the anterior shear force. Thus they become fatigued and irritated.

**Intrinsic Back Muscles**

The intrinsic back muscles, also known as the deep back muscles, are concerned with the maintenance of posture and movements of the spine and head. They consist of a large number of individual muscles that together form a large muscle mass that extends from the sacrum to the occipital bone. The intrinsic back muscles are divided into three layers: 1) a superficial layer; 2) an intermediate layer; and 3) a deep layer. All the
intrinsic back muscles are innervated by dorsal rami. The origin, insertion, innervation and major actions of the intrinsic back muscles can be found in Table 2.

**Superficial Layer of the Intrinsic Back Muscles**

The splenius muscles make up the superficial layer of the intrinsic back muscles and they lie directly under the trapezius in the cervical spine. They are large, flat bandage-like muscles and each muscle is divided into a cranial portion, splenius capitis, and a cervical portion, splenius cervicis. The splenius cervicis is inferior to the splenius capitis although they appear to be continuous with one another.

**Intermediate Layer of the Intrinsic Back Muscles**

The erector spinae muscles make up the intermediate layer of the intrinsic back muscles and are arranged in three vertical columns: 1) Iliocostalis (lateral column); 2) Longissimus (intermediate column); and 3) Spinalis (medial column). They all have a common origin but separate insertions as they course up the vertebral column. The longissimus muscle will be the only muscle discussed because it is the only muscle of the erector spinae group that has its proximal attachment on the head and cervical spine and because of these attachments is the only one with a direct action on the head and neck.

The longissimus lies deep to the already described splenius capitis. The longissimus like the splenius muscles is divided into two parts, the longissimus cervicis and the longissimus capitis. Both of these divisions are structurally and functionally relevant to the cervical region because of the actions they have on the head and cervical spine. The longissimus capitis inserts into the mastoid process along with the splenius capitis and sternocleidomastoid. This can be clinically important because of the forces
Table 2. Intrinsic Back Muscles

<table>
<thead>
<tr>
<th>Muscles</th>
<th>Origin</th>
<th>Insertion</th>
<th>Innervation</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Superficial Layer:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Splenius Capitis</td>
<td>Inferior ligamentum nuchae and spinous process of T1 - T6</td>
<td>Superior nuchal line and mastoid process</td>
<td>Dorsal rami</td>
<td>Rotates head and neck to the same side, Laterally flexes neck, Extends head and neck</td>
</tr>
<tr>
<td>Splenius Cervicis</td>
<td>Inferior ligamentum nuchae and spinous process of T1- T6</td>
<td>Transverse processes C1-C4</td>
<td>Dorsal rami</td>
<td>Same as splenius capitis except does not extend head just neck</td>
</tr>
<tr>
<td><strong>Intermediate Layer:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Erector Spinae</td>
<td>Broad tendon from posterior part of iliac crest, posterior surface of sacrum, sacral and inferior lumbar spinous processes, and supraspinous ligament</td>
<td>Longissimus Cervicis-posterior tubercles of cervical transverse processes Longissimus Capitis-mastoid process</td>
<td>Dorsal rami</td>
<td>Acting bilaterally, they extend vertebral column and head; acting unilaterally, they laterally bend the neck Logissimus capitis extension and lateral bending of the atlanto-occipital joint</td>
</tr>
<tr>
<td>Iliocostalis Longissimus</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spinalis</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Deep Layer:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transversospinal Semispinalis</td>
<td>Transverse Processes: Semispinalis fibers run superiomedially to occipital bone and spinous processes in thoracic and cervical regions, span 4-6 segments</td>
<td>Spinous Processes: Multifidus-fibers run superiomedially to spinous processes of vertebrae above, spanning 2-4 segments</td>
<td>Dorsal rami</td>
<td>Extend head and thoracic and cervical regions of vertebral column, rotates them contralaterally Semispinalis capitis extension of the atlanto-occipital joint Stabilization of vertebrae function as organs of proprioception</td>
</tr>
</tbody>
</table>
that are transferred through the mastoid process by the actions of these three muscles, which makes this area vulnerable to pain and constant irritation.\textsuperscript{21}

**Deep Layer of the Intrinsic Back Muscles**

Beneath the erector spinae muscles lie several short muscles (semispinalis, multifidus, and rotatores) that make up the deep layer of the intrinsic back muscles. The small rotatores muscles will not be included in this review secondary to their non-involvement in cervical headache manifestation.

The semispinalis muscles lie deep to the splenius capitis and medial to the longissimus muscle group in the cervical spine. It is divided into three parts: 1) Semispinalis thoracic; 2) Semispinalis cervicis; and 3) Semispinalis capitis. Semispinalis thoracic is not active in cervical spine function and therefore will not be addressed. The semispinalis cervicis and capitis are large massive muscles of the cervical spine and both have extremely thick, broad tendons.\textsuperscript{21} The muscles have large cross sections, are well developed, and are perceived as being round in comparison to the flat splenius and trapezius muscles.\textsuperscript{18,21} The semispinalis capitis overlies the semispinalis cervicis. The insertions of semispinalis cervicis and capitis are well posterior to the center of rotation of cervical spine motion, providing a long lever arm for cervical spine extension. In addition, their muscle fibers are oriented to generate a line of force that results in nearly pure extension of the cervical spine and occiput making them the most important extensor muscles of the head and cervical spine.\textsuperscript{21}

The multifidus muscle is also part of the deep back layer of the intrinsic muscles and covers the laminae of S\textsubscript{4} to C\textsubscript{2} vertebrae.\textsuperscript{20} The multifidus plays a much more significant role in the lumbar spine than in the cervical spine because it is more highly
developed in the lumbar spine. In the cervical spine, it is best to consider the small multifidus muscles with the semispinalis group because they are similar in producing cervical spine motion.

**Suboccipitals**

The four suboccipital muscles (rectus capitis posterior major, rectus capitis posterior minor, superior oblique and inferior oblique) are the deepest of the intrinsic back muscles in the upper cervical spine and lie beneath the semispinalis capitis (Figure 6). They are important muscles of the craniovertebral segment. The suboccipitals are

![Figure 6. The Suboccipital Muscles](image-url)
small, short and are significantly involved with postural awareness and proprioception. They also help to move the head as they form a functionally working unit between the occiput, atlas and axis. The suboccipitals help to move the occiput-atlas-axis complex independently of the lower cervical spine. Three of the four suboccipitals also form the borders of the suboccipital triangle. They include the rectus capitis posterior minor, which forms the medial border, the superior oblique muscle, which forms the superiorlateral border of the triangle and the inferior oblique muscle, which forms the lateral border of the suboccipital triangle. The origin, insertion, innervation and actions of these muscles are found in Table 3.

Table 3. The Suboccipital Muscles

<table>
<thead>
<tr>
<th>Suboccipitals:</th>
<th>Origin</th>
<th>Insertion</th>
<th>Innervation</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rectus Capitis Posterior Major:</td>
<td>Spinous Process of C2</td>
<td>Lateral part of the inferior nuchal line and occipital bone</td>
<td>Suboccipital Nerve</td>
<td>As a group they can extend the head on C1 and rotate C1 on C2</td>
</tr>
<tr>
<td>Rectus Capitis Posterior Minor:</td>
<td>Posterior tubercle of the posterior arch of C1</td>
<td>Medial part of the inferior nuchal line</td>
<td></td>
<td>Most important in postural and proprioceptive feedback of the cervical spine</td>
</tr>
<tr>
<td>Inferior Oblique:</td>
<td>Spinous process of C2</td>
<td>Transverse process of C1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Superior Oblique:</td>
<td>Transverse process of C1</td>
<td>Occipital bone between the superior and inferior nuchal lines</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Located within the suboccipital triangle is the vertebral artery and first cervical nerve, also known as the suboccipital nerve (Figure 6). This is the nerve that innervates all four of the suboccipital muscles. The vertebral artery is a prominent structure and is
deep within the triangle. This artery is of great concern to physical therapist performing cervical mobilizations because of its course and relationship with the cervical ventral rami.\textsuperscript{18} It branches from the subclavian artery and ascends the neck through the transverse foramina of the upper six cervical vertebrae before entering the foramen magnum. The artery is affected greatly by motion between the axis and the occiput. Since the transverse foramen of the atlas is more lateral than that of the axis, the artery must incline laterally between the two vertebrae. After the artery passes through the foramen of the atlas, it makes an acute posterior bend around the superior articular process of the atlas.\textsuperscript{18} It then passes medially along the posterior arch of the atlas before ascending into the foramen magnum. The vertebral arteries are not freely movable at the atlas and axis transverse foramina, because they are fixed by fibrous tissue. A large excursion of axial rotation occurs between the atlas and axis during rotation of the head and the artery is stretched and susceptible to occlusion during this process. The artery most vulnerable during rotation is usually the one that is contralateral to the side of rotation. Meaning, a person turning their head to the right is putting the greatest amount of stress on the left vertebral artery. A section of the vertebral artery receives sensory innervation from the vertebral nerve that has branches from the C\textsubscript{1} and C\textsubscript{2} ventral rami.

**Anterior Cervical Muscles**

There are many anterior cervical muscles that serve important functions for the cervical spine, but most will not be reviewed secondary to not receiving innervation from any of the first three spinal nerves and therefore being ruled out as a source of cervicogenic headache. The sternocleidomastoid, longos colli and capitis and the rectus
capitis anterior and lateralis do however, receive innervation from the first three spinal nerves and will therefore be discussed.

**Sternocleidomastoid**

The sternocleidomastoid is the largest and most superficial muscle in the anterior neck. This broad, strap-like muscle has two heads and is a key muscular landmark in the neck because it divides each side of the neck into anterior and posterior triangles. It plays an important role in the integrity of the cervical spine and is quite complicated functionally. The sternocleidomastoid is easily visualized through the skin, making it an important indicator of the forward head posture. The greater the verticality of the sternocleidomastoid muscle when the neck is viewed from the side (in the sagittal plane), the greater the likelihood that a forward-head posture is present.

The sternocleidomastoid has multiple functions and affects the upper and lower cervical spines differently. It causes contralateral rotation and extension of the cervical spine when acting unilaterally. The rotation is a result of the entire cervical spine moving together while the extension component comes from extension of the upper cervical spine. The upper portion of the sternocleidomastoid is posterior to the center of rotation for flexion and extension of the cervical spine and the inferior portion of the muscle is anterior to this center of rotation. Therefore, when acting bilaterally it has the potential to extend the upper cervical segment, especially the occiput on the atlas and to produce flexion of the lower cervical segments.

**Longus Colli and Capitis**

The longus colli and capitis muscles cover the anterior aspect of the cervical vertebral bodies. Injury to these muscles is especially common with forced
hyperextension as seen in “whiplash” injuries. The forced hyperextension motion often
damages the longus colli and longus capitis because the violent cervical extension motion
is not checked until the occiput comes into contact with the posterior aspect of the lower
neck.21 The injury to these two muscles might offer an explanation to the headache pain
that is suffered by many that have sustained this type of injury, most commonly from a
motor vehicle accident.

These muscles are the truest flexors of the entire cervical spine because of their
anterior position.21 These muscles are located anterior to the center of rotation for flexion
and extension of the cervical spine. Consequently, bilaterally they produce flexion of the
cervical spine by causing anterior sagittal rotation of the cervical vertebrae.21 Contracting
unilaterally, they can cause some rotation and ipsilateral side bending.18 In addition,
compression forces between the cervical vertebral bodies are increased with contraction
of these muscles.

**Rectus Capitis Anterior and Lateralis**

The rectus capitis anterior and rectus capitis lateralis are both very short muscles
that extend from the anterior aspect of the atlas to just anterior to the occipital condyles
and just lateral to the occipital condyles, respectively. These two muscles have a minor
contribution to occipital flexion because of their location and lines of pull, but their
major contribution is proprioception for occipital motion rather than as prime movers.21
This continual source of proprioceptive data allows for continual adjustment of head the
and neck for postural positioning.
Innervation of Spinal Nerves C₁ - C₃

Dorsal Ramus of C₁

The dorsal ramus of spinal nerve C₁, the suboccipital nerve, is larger than the ventral ramus of C₁. The suboccipital nerve exists from the spinal canal between the posterior arch of the atlas and the vertebral artery (Figure 6).²⁶ It then enters the suboccipital triangle and, as previously stated, supplies the four suboccipital muscles. It typically has no cutaneous distribution.¹⁸

Dorsal Ramus of C₂

The dorsal ramus of spinal nerve C₂ has branches that supply motor innervation to the nearby splenius capitis, longus capitis and semispinalis capitis muscles but the largest part of the nerve forms the greater occipital nerve.²⁴ The greater occipital nerve is a cutaneous nerve and supplies most of the posterior aspect of the scalp,¹⁸,²⁴ up to the vertex of the skull.²⁴,²⁶ It arises dorsal to the lateral atlanto-axial joint passing between the posterior arch of the atlas and the lamina of the axis below the inferior oblique muscle.²⁶ This nerve is the largest of the cervical dorsal rami and is frequently implicated as a primary cause of cervicogenic headache because it is vulnerable to compression between the posterior arch of the atlas and the lamina of the axis. The small space between these two structures is reduced with extension of the upper cervical spine pointing towards the possible relationship between forward head posture and occipital headaches.¹⁸

Dorsal Ramus of C₃

The dorsal ramus of the C₃ spinal nerve is smaller than C₁ and C₂ and divides into an internal and external branch. The internal branch runs between the semispinalis capitis
and cervicis and pierces splenius to supply the skin over the trapezius muscle.\textsuperscript{26} The internal branch of the dorsal ramus of C\textsubscript{3} gives off another important branch called the third occipital nerve that supplies the skin of the lower and back part of the head.\textsuperscript{24,26} The third occipital nerve arises in the C\textsubscript{2}-C\textsubscript{3} intervertebral foramen and curves dorsally through the intertransverse space.\textsuperscript{27} The external branch joins with the dorsal ramus of C\textsubscript{2} to innervate the splenius, longissimus capitis, and semispinalis capitis.\textsuperscript{26} The internal branches of the posterior divisions of the C\textsubscript{2} and C\textsubscript{3} dorsal rami communicate with the posterior divisions of the suboccipital nerve referred to as the posterior cervical plexus.\textsuperscript{26}

**C\textsubscript{1} – C\textsubscript{4} Ventral Rami**

The ventral rami of C\textsubscript{1}–C\textsubscript{4} combine to form the cervical plexus. These rami have direct branches to upper anterior cervical muscles including, rectus capitis anterior and lateralis, longus capitis and colli, sternocleidomastoid as well as the trapezius. The plexus also has four cutaneous branches that supply the skin of the anterolateral neck, the posterior triangle, and the superior aspect of the shoulder but will not be discussed secondary to the fact that there are no known conditions affecting the skin that cause cervicogenic headache.\textsuperscript{27} The cervical plexus is situated opposite the upper four cervical vertebrae, in front of the levator scapulae, and covered by the sternocleidomastoid. Each nerve, except the first, divides into an upper and a lower branch, and the branches unite to form three loops.\textsuperscript{26} The cervical plexus branches into superficial and deep counterparts, which then branch further into specific peripheral nerves. These divisions are beyond the scope of this independent study.
The Trigeminocervical Nucleus

The trigeminocervical nucleus is the neuroanatomical basis for how a noxious stimulus, arising from the neck, can be perceived as a headache. The nucleus is formed between the caudal part of the trigeminal spinal nucleus and the upper three cervical spinal nerves (Figure 7).

Figure 7. The Trigeminocervical Nucleus.

The trigeminal nerve is the largest cranial nerve and is the great sensory nerve of the superficial and deep portions of the head and face. The three branches of the trigeminal nerve supply the sensation to the anterior scalp and face, with overlap between these branches and the branches of the upper cervical nerves. The trigeminal nerve is divided into a motor root and a sensory root. It is the sensory root that is important to the study of cervicogenic headache. The sensory root is divided into upper and lower roots. The upper root ends in the principle trigeminal nucleus and the lower root extends caudally from the principle trigeminal nucleus through the pons and medulla as far as the
substantia gelatinosa. It is this lower root that is named the spinal root of the trigeminal nerve and these lower root fibers terminate in the spinal trigeminal nucleus. The spinal trigeminal nucleus consists of three parts: oral, interpolar, and caudal (Figure 7). The oral and interpolar parts are associated with trigeminal reflexes. It is the caudal part of the spinal trigeminal nucleus that carries pain and temperature impulses from the face and head and converges with the spinal cord. No anatomical features demarcate where the spinal nucleus ends and the gray matter of the spinal cord begins, yet, within this continuous column a nucleus can be identify which is the trigeminocervical nucleus. It is thought that the trigeminocervical nucleus extends as far as the C₃ or C₄ spinal cord segments. Given the convergence between trigeminal afferents and afferents from the first three cervical spinal nerves, the possible sources of cervicogenic headache are any of the structures innervated by the C₁-C₃ nerves (Table 4).

Table 4. Distribution of the C₁-C₃ Spinal Nerves.

<table>
<thead>
<tr>
<th>C₁-C₃ Ventral rami</th>
<th>C₁-C₃ Sinuvertebral nerves</th>
<th>C₁-C₃ Dorsal rami</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Atlanto-occipital joint</td>
<td>• Median atlanto-axial joint</td>
<td>• C₂-C₃, C₃-C₄ apophysial joints</td>
</tr>
<tr>
<td>• Lateral atlanto-axial joint</td>
<td>• Transverse ligaments</td>
<td>• Suboccipital muscles</td>
</tr>
<tr>
<td>• Longus capitis</td>
<td>• Alar ligaments</td>
<td>• Semispinalis capitis</td>
</tr>
<tr>
<td>• Longus cervicis</td>
<td>• Dura mater of spinal cord</td>
<td>• Semispinalis cervicis</td>
</tr>
<tr>
<td>• Rectus capitis anterior</td>
<td>• C₂-C₃ intervertebral disc</td>
<td>• Multifidus</td>
</tr>
<tr>
<td>• Rectus capitis lateralis</td>
<td></td>
<td>• Longissimus capitis</td>
</tr>
<tr>
<td>• Trapezius</td>
<td></td>
<td>• Splenius capitis</td>
</tr>
<tr>
<td>• Sternocleidomastoid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Vertebral artery</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Adapted from Bogduk N. The anatomical basis for cervicogenic headache. J of Manipulative Physiol Ther. 1992;15:67-70.)

The trigeminocervical nucleus is a unique combination of the pain and temperature primary afferent nerve fibers that arise from both the trigeminal and cervical
nerves.\textsuperscript{21,30} To clarify, the trigeminocervical nucleus is defined as those cells in the upper three cervical segments that receive both trigeminal and peripheral input from the first three cervical spinal nerves.\textsuperscript{30} According to Bogduk,\textsuperscript{30} the nociceptive neurons of the trigeminocervical nucleus have large receptive fields that surround both the fields of the trigeminal nerve and the fields of the first three cervical nerves. Consequently, if a neuron that is used to receiving trigeminal input happens to receive a noxious input from an unexpected cervical source, the nociceptive information is relayed to the thalamus; however, the actual source of the information is unclear.\textsuperscript{30} The brain, relying on familiarity with the more expected input, interprets the pain as arising from the trigeminal field and not from the neck and the sensation is perceived as a headache.\textsuperscript{30} It is felt by many that this close anatomic relationship between the spinal cord of the cervical spine and the nucleus of the trigeminal nerve allows for pain to be referred to the suboccipital and frontal regions of the head.\textsuperscript{5,9,30,31} As such, the trigeminocervical nucleus is the essential nociceptive nucleus of the upper neck, head and throat.

A thorough understanding of the anatomy of the cervical spine is necessary in order to differentiate between the structures innervated by the $C_1$-$C_3$ spinal nerves. Equally important to the understanding of the cervical spine is knowledge of cervical spine kinematics. The integration of knowledge between the anatomy and kinematics of the cervical spine is essential to determining whether the headache is emanating from the cervical spine or if the headache is secondary to other pathological conditions. The following chapter will discuss the kinematics of both the upper and lower cervical spine.
CHAPTER III
CERVICAL SPINE KINEMATICS

In order to effectively assess and treat cervicogenic headaches an understanding of the normal structure and function of the cervical spine is a prerequisite for development of sound evaluation and treatment techniques. Therefore, a thorough knowledge of spinal kinematics (study of motion without the influences of force and mass) is helpful in understanding all aspects of the diagnosis and management of spinal pathology. This is especially true of the cervical spine, for it is the most mobile portion of the vertebral column. Flexion, extension, lateral flexion, and rotation occur in the cervical region. The range of motion (ROM) in lateral flexion and rotation are greater in the cervical region than in any other region. The motions available in the cervical spine occur through a combination of motions at the atlanto-occipital joints, atlanto-axial joints and the remaining apophyseal joints between the vertebrae of the lower cervical spine.

Atlanto-occipital Kinematics

The atlanto-occipital joint permits primarily a nodding motion of the head (flexion and extension in the sagittal plane around a frontal axis); however, limited axial rotation and lateral flexion is possible. There is disagreement on how much flexion and extension are available at this joint (Table 5). During flexion, the occipital condyles roll forward and glide backward on the superior facets of the atlas. Flexion of the occiput on the atlas is limited by the bony contact between the anterior rim of the
foramen magnum and the superior surface of the dens.\textsuperscript{21,33} During extension the opposite occurs, e.g., the occipital condyles roll backwards and slide forward on the facets. Extension is limited by the connective tissue restraints of the tectorial membrane.\textsuperscript{21}

### Atlanto-axial Kinematics

Motions available at the atlanto-axial joint are flexion, extension, lateral flexion, and rotation with rotation the predominant motion at this joint.\textsuperscript{21,33} It accounts for fifty percent of the total amount of rotation available in the cervical spine while the remaining fifty percent occurs between $C_3$ and $T_1$.\textsuperscript{21,32,33,34,35,36} Rotation at the atlanto-axial joint occurs prior to rotation in the rest of the cervical region.\textsuperscript{33} Rotation occurs when the inferior facets of the atlas move on the superior facets of the axis through a forward and medial movement of the contralateral facet of the atlas and a backward and medial movement of the ipsilateral facet of the atlas.\textsuperscript{34} For example, rotation of the atlas and subsequent head rotation to the left, results in forward and medial motion of the right facet and backward and medial motion of the left facet. Wide varieties of rotation range of motion measurements for the atlanto-axial have been published (Table 6).\textsuperscript{35,37,39,40}

The large degree of rotation available between the atlas and the axis is a result of the geometry of the articular surfaces. The surfaces are convex and have a horizontal orientation which allows maximum mobility.\textsuperscript{32} The anatomical dynamics associated with the atlas also contribute to the rotational ROM. The atlas is quite mobile; it is not bound

### Table 5.

<table>
<thead>
<tr>
<th></th>
<th>Penning\textsuperscript{38}</th>
<th>White &amp; Panjabi\textsuperscript{35}</th>
<th>Werne\textsuperscript{39}</th>
<th>Panjabi et al\textsuperscript{37}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atlanto-occipital Total Flexion and Extension Range of Motion</td>
<td>30°</td>
<td>13°</td>
<td>13°</td>
<td>24°</td>
</tr>
</tbody>
</table>
directly to the axis by any significant ligaments, and few muscles act directly on it to control its position or movements. Therefore, the atlas essentially lies like a passive washer between the skull and the axis. Because no extensor muscles insert onto the atlas its extension movements are purely passive and dependent on the forces acting on the skull. The position of the head and consequent line of gravity relative to the atlanto-axial joints will therefore influence the motion of the atlas.

A small degree of flexion and extension are available at the atlanto-axial joint, however strong ligaments support this region and limit these motions. The transverse ligament holds the dens of the axis tightly within a facet on the posterior side of the anterior arch of the atlas. This provides stability as well as the necessary checkreins against excessive flexion and extension of the atlanto-axial joint. During flexion of the atlas on the axis, the dens is pushed posteriorly against the strong transverse ligament, thus limiting flexion. The tectorial membrane also limits flexion and extension. As with rotation of the atlanto-axial joint, there is also a wide variation for flexion and extension ROM reported for this joint (Table 7).

Table 6.

<table>
<thead>
<tr>
<th>Atlanto-axial Rotation Range of Motion in One Direction</th>
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<tbody>
<tr>
<td>White &amp; Panjabi 35</td>
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<tr>
<td>47°</td>
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</table>

Table 7.

<table>
<thead>
<tr>
<th>Atlanto-axial Total Flexion and Extension Range of Motion</th>
</tr>
</thead>
<tbody>
<tr>
<td>White &amp; Panjabi 35</td>
</tr>
<tr>
<td>13°</td>
</tr>
</tbody>
</table>
Lower Cervical Spine Kinematics

The joints of the lower cervical spine are anatomically distinct therefore; the kinematics of this region are also unique. The movements that occur in this region of the spine are flexion, extension, lateral flexion and rotation, with flexion and extension being the predominant motions. Flexion and extension are uncoupled motions while lateral flexion and rotation and coupled (occur together). Similarly, rotation initiates lateral flexion because of the orientation of the articulating facets.

Flexion and extension motions in the lower cervical spine occur in the sagittal plane. The site of maximum motion of flexion and extension occurs between C4/C5 and C5/C6 segments and the C2/C3 segment has the least amount of motion (Table 8). During flexion of the cervical spine, the inferior facets of the superior cervical vertebra slide anterosuperiorly over the superior facets of the vertebra below. Pure anterior translation of a segment cannot occur because the inferior articular facet of the superior vertebrae would impact against the superior articular facet of the inferior vertebrae. Therefore, continued forward translation can only occur when the above-described process occurs. Flexion of the lower cervical spine is limited by the posterior longitudinal ligament, ligamentum nuchae, and ligamentum flavum.

Table 8.

| Lower Cervical Spine Total Flexion and Extension Range of Motion |
|-------------------------|-----------------|-----------------|-----------------|
|                         | White & Panjabi | Penning         | Dvorak et al    |
| C2-3                   | 8°              | 12°             | 10°             |
| C3-4                   | 13°             | 18°             | 15°             |
| C4-5                   | 12°             | 20°             | 19°             |
| C5-6                   | 17°             | 20°             | 20°             |
| C6-7                   | 16°             | 15°             | 19°             |
Extension of the cervical spine occurs when the pattern described for flexion reverses, with the inferior facets sliding downward and backward over the superior facets resulting in a posterior translation of the upper vertebra on the lower vertebra. The uncinate processes prevent excessive posterior translation of the vertebral bodies.\textsuperscript{33} Hyperextension is limited by the contact of the spinous processes and the anterior longitudinal ligament.

In the lower cervical spine, lateral flexion and rotation are coupled movements. Due to the orientation of the facets, rotation in either direction is always coupled with ipsilateral lateral flexion.\textsuperscript{34} The spinous processes of the vertebral bodies (C\textsubscript{2}–C\textsubscript{7}) move toward the convexity of the lateral flexion curve or opposite to the rotation of the vertebral body.\textsuperscript{32, 33} For example, during right lateral flexion, the spinous process moves to the left and vertebral body rotates right. This rotation happens when the left inferior facets slides up the left superior facet of the subadjacent vertebra and the right inferior facet slides down the right superior facet. The amount of rotation that is coupled with lateral flexion is not the same at each level of the cervical spine, it decreases from C\textsubscript{2} to C\textsubscript{7} (Table 9).\textsuperscript{33} The difference in rotation between segments is due to the change in the

<table>
<thead>
<tr>
<th>Lower Cervical Spine Rotation in One Direction</th>
</tr>
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<tbody>
<tr>
<td>White &amp; Panjabi\textsuperscript{35}</td>
</tr>
<tr>
<td>C\textsubscript{2-3}</td>
</tr>
<tr>
<td>C\textsubscript{3-4}</td>
</tr>
<tr>
<td>C\textsubscript{4-5}</td>
</tr>
<tr>
<td>C\textsubscript{5-6}</td>
</tr>
<tr>
<td>C\textsubscript{6-7}</td>
</tr>
</tbody>
</table>
orientation of the facets. In the midcervical region, the facets display a more horizontal orientation than in the more caudal segments. Therefore, more rotation is possible. Clinically, it is important to remember that there are large individual variations in range and distribution of rotational mobility in the lower cervical spine.

Understanding the normal kinematics of the cervical spine allows the clinician to determine when there is a dysfunction or restriction in the cervical spine. A restriction in movement at the neck is one of the diagnostic symptoms of cervical headache. Cervicogenic headache is complex in its symptomology and not always easy to discern from other forms of headache. Cervicogenic headache diagnostic criteria, pathophysiology, and diseases of the cervical spine that manifest as cervicogenic headache will be discussed in the following chapter in order to help differentiate these headaches from others.
CHAPTER IV

CERVICOGENIC HEADACHE

To date, vagueness and controversy cloud the concept of cervical headache. While most authors agree that headaches originate in the structures of the neck, there is dispute over how frequently this occurs. Some authors maintain that the majority of headaches encountered in clinical practice arise from the cervical spine; others hold that only a few are attributable to this source. There is also disagreement about how disorders of the cervical spine cause headaches, which diseases of the cervical spine produce headaches, and how these headaches may be identified. It is the intent of this chapter to summarize existing literature and provide insight into the diagnostic criteria, pathophysiology, and diseases associated with headaches of a cervical nature.

Diagnostic Criteria

Neck pain, which is thought to produce headaches, is a complex subject. It has taken years for formal diagnostic criteria of cervicogenic headache to be accepted. The first attempt at setting forth diagnostic criteria for cervicogenic headache was made in 1990. Eight years later, in the June 1998 journal Headache, formal diagnostic criteria for cervicogenic headache were published by the International Headache Society (IHS) (Table 10). For clinicians, this is an important event because it recognizes the disorder as a “legitimate” diagnosis. At present, cervicogenic headache can be differentiated
Table 10. Diagnostic Criteria for Cervicogenic Headache (IHS)

CERVICOGENIC HEADACHE (International Headache Society)

<table>
<thead>
<tr>
<th>Diagnostic Criteria</th>
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<tbody>
<tr>
<td>A. Pain localized to the neck and occipital regions. May project to forehead, orbit region, temples, vertex or ears.</td>
</tr>
<tr>
<td>B. Pain is precipitated or aggravated by special neck movements or sustained neck postures.</td>
</tr>
<tr>
<td>C. At least one of the following:</td>
</tr>
<tr>
<td>1. Resistance to or limitation of passive neck movements</td>
</tr>
<tr>
<td>2. Changes in neck muscle contour, texture tone or response to active and passive stretching and contraction</td>
</tr>
<tr>
<td>3. Abnormal tenderness of neck muscles</td>
</tr>
<tr>
<td>D. Radiological examination indicates at least one of the following:</td>
</tr>
<tr>
<td>1. Movement abnormalities in flexion or extension</td>
</tr>
<tr>
<td>2. Abnormal posture</td>
</tr>
<tr>
<td>3. Fractures, congenital abnormalities, bone tumors, RA or other distinct pathology</td>
</tr>
</tbody>
</table>

Clinically from other headaches with reasonable certainty. Cervical headaches are headaches whose causes are due to a dysfunction in the cervical region that is associated with movement abnormalities in cervical intervertebral segments. The dysfunction can be located in the joints, ligaments or other soft tissues of the neck, particularly those innervated by the upper three cervical nerves. A relationship has been established between headache symptoms and cervical joint trauma, arthropathy, and segmental hypo- and hypermobility. The joints of the upper cervical spine are implicated as primary sources of headaches.

The cardinal feature of cervicogenic headache is the presence of a movement abnormality in the neck, especially if aggravating that abnormality by active or passive movements reproduces the headache. Cervicogenic headache was first characterized as being strictly unilateral without any side shift, but most sources do not support this notion. Cervical headache can be felt unilaterally, unilaterally with spread, or
bilaterally. However, if the headache does present unilaterally it usually does not shift sides unlike in classic migraines where side shift occurs in ninety-five percent of cases.\textsuperscript{48} Traumatic cervical spine cases tend to have unilateral headaches, whereas cases with degenerative changes in the cervical spine tend to present with bilateral headaches.\textsuperscript{5} Cervical headache can be diagnosed by detecting movement abnormalities in the neck, but symptomology of cervical headache is somewhat ambiguous.

The diagnosis of cervicogenic headache is complicated by the fact that there can be symptomatic overlap between migraine, tension, vascular, and cervicogenic headaches.\textsuperscript{4, 6} Because of this overlap between symptoms of different types of headaches, diagnosis of cervicogenic headache cannot be placed on any one feature (e.g. associated neck pain) as indicative of a cervical origin for the headache.\textsuperscript{6} Many chronic forms of headache have similar areas of documented pain patterns. Cervicogenic pain is usually localized to the neck and/or suboccipital region, however the pain can project to the forehead, orbit region, temples, vertex, or ears.\textsuperscript{7, 8, 10, 11, 19, 45} The neck and/or suboccipital pain patterns are considered a characteristic feature of cervical headache, their presence being reported in almost all subjects in studies of cervical headache.\textsuperscript{6, 8, 11} However, neck pain and tenderness of the neck muscles occurs in virtually any form of headache and is not exclusive to only headaches of a cervical origin.\textsuperscript{11} It is the area of onset of pain that helps to differentiate cervical headache from other headaches. Sjaastad et al.\textsuperscript{49} concluded from studies of patients with migraine and cervical headaches that although both groups reported neck and head pain, the focal onset of pain in the patients with cervical headaches was in the neck and/or posterior area of the head, and eventually, the pain spread most commonly to the frontal area. In contrast, for patients with
migraines the onset of pain originated in the head, with subsequent spread to the neck. Solomon et al.\textsuperscript{7} found that while seventy percent of their group of 100 patients with cluster headache suffered concurrent neck pain, the origin of pain was in the neck only ten percent of the time.

Cervical headaches occur frequently or on a continual basis. Presenting either daily or follow a pattern of at least two to three headaches per week.\textsuperscript{4, 8, 10, 11, 19, 49} Bogduk et al.\textsuperscript{3} report that cervical headaches occur either daily or two to three times per week in over eighty percent of cases. The duration of a cervicogenic headache is variable. In the acute form of cervical headache such as those experienced by patients who have sustained a whiplash injury,\textsuperscript{48} the duration (length of time headache lasts) of the headache may be constant but fluctuant in intensity.\textsuperscript{6} On the other hand, the duration of pain is sporadic and unpredictable in those individuals who have not sustained a whiplash injury. It may last a few minutes to several days in duration\textsuperscript{9, 19} or may have a fluctuating long-term course with remissions and exacerbations.\textsuperscript{6, 46} The type of pain most commonly described in cervicogenic headache is a dull ache that is moderate to severe, non-throbbing, and non-lancinating and starts in the neck.\textsuperscript{3, 6, 7, 8, 9, 10, 19} The intensity of cervical headache pain is most often described as fluctuating and erratic.\textsuperscript{6, 9, 19} Headaches can be mild, moderate, or sometimes severe, depending on activity level, yet, the intensity of the headache usually does not prohibit participation in activities.\textsuperscript{19}

Headaches of a cervical origin rarely have a sudden onset. Patients with suspected cervicogenic headaches many times awaken in the morning with a headache and stiffness in the neck and feel that their sleeping position has been awkward.\textsuperscript{8, 10} Cervical headaches worsen with activity, progressively increase throughout the day, and may
worsen with stress. This is true of other chronic headaches as well, but with cervicogenic headache, there may be a warning of onset of headache via a pain or stiffness in the neck before build up of the headache. Moreover, between attacks, patients may feel stiffness and decreased mobility of the neck. There may also be crepitation and neck movements may be painful and restricted. Researches have also found that there is a decrease in range of motion of the neck especially rotation, and that during attacks, cervical headache sufferers try to minimize neck movements and resist passive range of motion to limit the pain.

Cervical headaches are typically precipitated or aggravated by sustained awkward neck postures, movements, and stressful situations. Aggravating neck movements most commonly involve extension or rotation of the upper cervical spine. The headache usually has a mechanical trigger and patients are able to provoke headache pain identical to the spontaneously occurring headache by certain movement of the head. Traumatic events, repetitive microtraumas, poor posture, osteoarthritis, and rheumatoid arthritis of the upper cervical spine are predisposing factors to cervicogenic headache. Factors that relieve cervicogenic headache are difficult to identify. Some patients may gain relief by changing posture, lying down, or applying direct pressure to the suboccipital area. Others find analgesics and anti-inflammatory drugs to be beneficial. However, cervical headaches do not benefit from medications used to treat migraines because the origin of headache is within the cervical spine.

A variety of associated symptoms occur with cervical headache that can either be part of the cervical headache pain pattern, another chronic headache pain pattern, or can provide warnings of pathology such as, intracranial bleeding, vertebral artery occlusion,
vestibular, or visual disturbances. Cervical headache is hard to distinguish from migraine in the fully developed conditions because it shares many of migraine's associated symptoms such as visual disturbances (usually blurred vision or flashing lights or spots moving before the eyes), dizziness, light-headedness, tinnitus, and nausea.\textsuperscript{3, 4, 6, 8, 9, 19, 45} Other associated symptoms that have been recorded during cervical headache attacks include the following ipsilateral phenomena: slight lacrimation, runny nose, erythema in the forehead and temporal region, diffuse flushing, and lower lid edema.\textsuperscript{8, 10} Furthermore, ipsilateral blurring and reduced vision occur fairly frequently and all visual symptoms seem to be ipsilateral if they occur with a unilateral cervical headache.\textsuperscript{10} An ipsilateral shoulder ache or a diffuse, non-radicular arm pain are also frequently associated with cervicogenic headache.\textsuperscript{48} Table 11 summarizes the symptomology associated with cervicogenic headache.

### Table 11. Cervicogenic Headache Signs and Symptoms

<table>
<thead>
<tr>
<th>Area of pain:</th>
<th>Frequency:</th>
<th>Duration:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Neck and/or suboccipitals</td>
<td>• Usually continual, either daily or two to three times per week</td>
<td>• Variable</td>
</tr>
<tr>
<td>• Forehead, orbit region, temples, vertex, or ears</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of pain:</th>
<th>Intensity:</th>
<th>Onset:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Dull ache</td>
<td>• Fluctuating and erratic</td>
<td>• Gradual</td>
</tr>
<tr>
<td>• Non-throbbing</td>
<td>• Mild, moderate or severe dependent on activity level</td>
<td>• Begins in neck moves to head</td>
</tr>
<tr>
<td>• Non-lancinating</td>
<td></td>
<td>• Increases through day</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Aggravated by:</th>
<th>Predisposing factors:</th>
<th>Associated symptoms:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Sustained awkward neck postures, movements</td>
<td>• Rheumatoid Arthritis</td>
<td>• Visual disturbances</td>
</tr>
<tr>
<td>• Stress</td>
<td>• Osteoarthritis</td>
<td>• Dizziness</td>
</tr>
<tr>
<td>• Poor posture</td>
<td>• Trauma to cervical spine</td>
<td>• Tinnitus</td>
</tr>
<tr>
<td></td>
<td>• Repetitive microtraumas</td>
<td>• Nausea</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Light-headedness</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Ipsilateral shoulder ache</td>
</tr>
</tbody>
</table>
The symptoms of headache arise from pathology in the cervical spine. The following section details the common ways structures of the cervical region become inflamed, irritated, compressed or damaged and thus produce headache pain through the convergence of the upper three cervical nerves and the trigeminal nerve (trigeminocervical nucleus).

Pathophysiology

In theory, there are structures, stimuli, and pathways through which neck lesions cause headaches. Clearly, many pain sensitive structures in and about the cervical spine are replete with nerve endings which, when stimulated, produce pain that may be referred to areas of the head.\textsuperscript{3, 4, 41} These include any structures innervated by the C\textsubscript{1}-C\textsubscript{3} spinal nerves (Table 4). Experiments in normal human volunteers have shown that noxious stimulation to any of these structures is capable of inducing pain referred to the head.\textsuperscript{3} The trigeminocervical nucleus is the neuroanatomical basis for cervicogenic headache and is described in Chapter II.

There are a variety of pathological causes of irritation or compression of these pain sensitive nerve structures in the neck. Dysfunction of the atlanto-occipital, atlanto-axial, and apophyseal joints are the most common pathogenic cause for cervicogenic headache. Dysfunction refers to the commonly seen conditions of hypo- or hypermobility of the cervical spine and results in movement restrictions (both general and segmental). Dysfunction of these synovial joints commonly result from inflammation and/or misalignment due to inflammatory joint diseases such as rheumatoid arthritis or ankylosing spondylitis, or by degenerative conditions such as cervical spondylosis, cervical disc degeneration, and osteoarthritis.\textsuperscript{3, 41} Trauma and prolonged occupational
postures also result in spine dysfunction. Hypomobility of the atlanto-axial joint can cause suboccipital head pain.\textsuperscript{31} The C\textsubscript{2}-C\textsubscript{3} joint is a common area of tenderness that reproduces headache symptoms.\textsuperscript{11} The joint is implicated as the most common area of hypomobility in the cervical spine\textsuperscript{6,7,50} The reason being, the joint between C\textsubscript{2}-C\textsubscript{3} represents a transitional area between the atlanto-axial joint that moves primarily in a horizontal plane and the C\textsubscript{3}-C\textsubscript{4} joint that moves primarily in a sagittal plane.\textsuperscript{50} Bogduk and associates\textsuperscript{47} conclude that disease of the C\textsubscript{2}-C\textsubscript{3} apophyseal joints produce headache through irritation or compression of the third occipital nerve. Cervical hypermobility also causes headaches when one or two isolated spinal segments have been damaged and pathology is present in the surrounding ligaments and muscles.\textsuperscript{3}

While Sjaastad et al.\textsuperscript{10} believe that cervicogenic headaches are “non-muscular” headaches of cervical origin; others report that lesions involving the neck muscles can cause headaches. The lesions cause a painful condition of the skeletal muscles referred to as myofascial pain and are characterized by hyperaesthetic areas, referred to as trigger-points. Trigger points can occur in any of the muscles of the cervical spine particularly those innervated by the upper three cervical nerves. Many of these spinal muscles arise from or insert into the base of the occipital bone and the development of myofasical pain and trigger points can refer pain to the head.\textsuperscript{3,4} These muscles include trapezius, sternocleidomastoid, semispinalis capitis, superior oblique, rectus capitis posterior major and minor, splenius capitis, longissimus capitis, and rectus capitis lateralis. Splenius capitis trigger points are often responsible for a complaint of dizziness.\textsuperscript{4} Although, trigger points are clinically recognizable and treatable, their cause is unknown.\textsuperscript{9}
These muscles of the cervical spine may be strained, stretched, torn, or inflamed by direct trauma, or they may be in painful spasm as a reflex attempt to splint an underlying lesion of the vertebral column. Through their fascial and aponeurotic connections, there is functional continuity between the shoulders, neck, and scalp muscles. Spasm or tension in the neck muscles produces myogenic head pain. Cervicogenic headaches due to cervical spine dysfunction can be augmented by myofacial pain.

The vertebral arteries are another pain sensitive structure in the cervical spine that have the potential to produce headache pain. They are innervated by the upper three cervical nerves therefore pain arising from the vertebral arteries is mediated by the same nerves and similar central connections that mediate upper cervical spine pain. Painful disorders of the vertebral artery are, therefore, capable of mimicking cervical headache. The close association of the arteries with the upper six cervical vertebrae predisposes them to compression and sometimes occlusion. Extension and/or rotation of the neck may compress one or both vertebral arteries as they transverse the lateral mass of the atlas and enter the foramen magnum; this may occur with neck trauma, chiropractic manipulation, and even movements within a physiologic range. The arteries may also be compressed by osteophytes as they ascend the transverse foramina. This occlusion and compression of the vertebral arteries by the cervical spine can be a cause of headache. This is a serious condition but is usually distinguishable by the patient's history and associated features from cervical headache of spinal origin, but in cases of doubt, the patient should be referred to the appropriate specialist.
Diseases and Conditions of the Cervical Spine That Produce Headache

Cervical Spondylosis and Cervical Disc Disease

Cervical spondylosis and cervical disc disease are “common and important causes of headache beginning in middle life or later”. This statement is regarded as controversial because most of the population over the age of 40 has radiologic changes of cervical spondylosis, but few have symptoms. However, in patients with symptomatic cervical disc disease and/or spondylosis, headache is a chief complaint in forty percent and a major symptom in twenty-five percent. Cervical spondylosis is one of the most common pathologically painful diseases of the neck that gives rise to headache. The headaches most likely originate in diseased upper cervical spine apophyseal joints, or from secondary myofacial pain. The headaches seen with these conditions are felt in the occipital or suboccipital regions. However, when severe, spread to involve the forehead, eye, or temple, and sometimes even the ipsilateral arm.

Rheumatoid Arthritis and Ankylosing Spondylitis

Thirty-five to eight-nine percent of patients with rheumatoid arthritis, and a smaller number of those with ankylosing spondylitis, have symptomatic involvement of the cervical spine. In both conditions, atlanto-axial subluxation is the most important cervical manifestation. Inflammation, stretching, and dissolution of the atlanto-axial ligaments cause subluxation of the atlas on the axis. Stretching of these pain sensitive upper cervical ligaments and nerve roots, produces suboccipital pain that may refer anteriorly to the forehead, temples, orbital region or vertex of the head. The pain is an intermittent or a persistent, deep suboccipital ache, which can become sharp and stabbing on flexing the head forward.
With ankylosing spondylitis, deformity of the craniocervical region is particularly evident. The head may be fixed in flexion as the atlas tilts forward on the axis; the occipital contour may be flattened as the head slides forward on the neck; and the head may be tilted and rotated as the facet joints slip asymmetrically.

Pain with these conditions may also arise from inflammation of the upper apophyseal joints; this type of pain tends not to be referred anteriorly, but rather is confined to the neck and occiput.

Anomalies of the Craniovertebral Junction

Anomalies of the craniovertebral junction are among the most solid examples of cervical lesions causing headaches. McRae reports neck pain as the chief complaint in thirteen percent of patients with bony craniovertebral anomalies while twenty-six percent of the patients with this same condition report occipital or suboccipital pain as their chief complaint. These anomalies include congenital atlanto-axial dislocation, separated dens, occipitalization of the atlas, and basilar invagination. The headache is believed to be due to stretching of the upper cervical nerve roots. The pain is usually described as bursting and it is made worse by bending the neck or stooping forward, and is relieved by lying down. Diagnosis of these anomalies is primarily via radiologic imaging studies.

Trauma to the Neck

Neck trauma is one of the most common causes of chronic headaches. The paradigm of “neck trauma headache” is the “whiplash” injury. Between eighty-five and ninety percent of cervical spine disorders are the result of trauma while the other fifteen percent are a result of non-traumatic joint and skeletal conditions. The mechanism behind a whiplash injury is usually a forceful hyperextension of the neck followed by
hyperflexion of the cervical spine. There is almost immediate diffuse muscular soreness in the neck followed within hours or a day of the accident by neck and head pain. The neck pain is a stiff ache and aggravated by neck movements while the head pain tends to be perceived as a continuation of the neck pain, spreading upwards through the suboccipital and occipital regions and often lodging in the forehead or eye, unilaterally or bilaterally. When severe, it can be associated with nausea, but vomiting is rare.

In most patients the pain subsides within days or weeks, but in some, the headache persists and results in full "whiplash syndrome." With this syndrome, the headache pain is described as severe. It is diffuse, though more marked posteriorly and sometimes more prominent on one side. The headache is usually worse in the morning and pressure on the suboccipital region may aggravate the frontal portion of the headache. The neck may be held stiffly, often with loss of the normal lordosis, and passive neck movements may be restricted. The neck muscles often are in palpable spasm. With "whiplash syndrome", there is little doubt that in most cases, stretching or tearing of the cervical muscles and ligaments produces the head and neck pain. The C2 sensory root or its extension, the greater occipital nerve, may be crushed between the atlas and axis as the head is forcibly extended and rotated by the accident; or the first and second cervical sensory roots may be compressed by swollen muscles in spasm. Whatever its source, the pain may be referred to the anterior part of the head, unilaterally or bilaterally, through the spinal trigeminal tract.

Knowledge of the anatomy and kinematics of the cervical spine together with the diagnostic criteria and pathophysiology of cervical headaches gives the clinician the tools necessary for determining whether or not a patient's headache is emanating from the
cervical spine. These tools utilized in an organized and logical evaluation procedure will provide the clinician the information needed to determine an appropriate treatment plan.

Chapter V outlines one of many evaluation procedures for the cervical spine that can be utilized with emphasis on cervical headache findings.
CHAPTER V
EVALUATION

The evaluation of the patient with complaints of headaches is not always an easy task. Not only is the cervical spine a complicated area to evaluate but the symptomology of cervical headaches tends to overlap with many other chronic headache conditions. The physical therapist must first decide whether cervical dysfunction is a primary cause, a partial cause, enhancing symptoms of other forms of headache, or has no role in the patient's headache. The characterization of headache is difficult due to the lack of laboratory tests and radiological examinations to assist in the positive medical diagnosis of many forms of headache. Therefore, as a clinician, it is important to perform a thorough evaluation in order to determine the source of headache and the appropriate treatment plan.

There are many evaluation procedures in existence. The following is but one of many cervical spine evaluations that the physical therapist can utilize. Whatever evaluation one chooses to use, it should include the basics of any orthopedic assessment: patient history, observation, physical examination, accessory motion testing, special tests, reflex and cutaneous distribution testing, palpation, and diagnostic imaging. The components of a cervical spine evaluation are listed in Table 12. This chapter will give an overview of the individual components of the evaluation with key emphasis on cervical headache findings. For a thorough description of the evaluation procedures, the
reader is encouraged to consult *Orthopedic Physical Assessment* and *Vertebral Manipulation*.16

Table 12. Components of the Cervical Spine Evaluation

| I. HISTORY |
| I. HISTORY |
| II. OBSERVATION |
| III. UPPER QUADRANT SCREENING (Peripheral Joint Scan) |
| IV. CERVICAL SPINE EVALUATION |
| 1. Active range of motion (sitting) |
| 2. Resisted isometric tests |
| 3. Axial compression/distraction |
| 4. Supine vertebral artery testing (supine) |
| 5. Passive range of motion and end feels |
| 6. Passive intervertebral movement testing (PPIVM) |
| 7. Passive accessory intervertebral movement testing (PAIVM) (prone) |
| 8. Special tests |
| 9. Palpation |
| V. DIAGNOSTIC IMAGING |

History

It is crucial to obtain a complete history, as many subtle findings will be identified at this point. The history is the first step in formulating a clinical hypothesis that is retested throughout the evaluation. It is not unusual for the skilled clinician to make a preliminary diagnosis from the history and utilize the rest of the evaluation to confirm or reject the hypothesis.60 General categories of information gathered during the history include: age, general state of health, etiological factors (onset of problem), specific pain behavior (very important for headache), previous management, and medications.

The cervical headache patient usually has no related medical history and the onset of cervical headache is independent of age, ranging from childhood to old age.6 Studies have shown that at least fifty percent of cervical headache patients will relate the onset of headache to neck or head trauma, or will have a past medical history of relevant neck
injury. However, the patient seldom relates trauma to their headache with initial questioning and the patient does not always know that headache can stem from the neck, whereas most people know that leg pain can come from the back. "How long have you had your headache?" is one of the most important questions to ask a patient suffering from headaches. It differentiates headaches into two categories: those that are primary complaints and those that are secondary to some other potentially serious condition. If the headache is longer than six months it is very unlikely that the headache is caused by a serious condition.

Observation

Observation should begin at first contact with the patient. The physical therapist should note the willingness of the patient to move and the pattern of movement demonstrated. Observation of the cervical region includes: head and neck postures, shoulder levels, muscle spasm or any asymmetry in facial expression, bony or soft tissue contours.

Posture is especially important to observe and pay attention to in the patient complaining of headache. Faulty posture is the most common precipitant of cervicogenic headache after stress. The worst posture in relation to cervicogenic headache is undoubtedly the chin-poke posture. The chin-poke posture is when the upper cervical spine is extended and the lower cervical spine is flexed. This posture, commonly referred to as forward head on rounded shoulders, affects the atlanto-occipital and atlanto-axial joints as well as leads to shortened suboccipital muscles.
Upper Quadrant Screening

The upper quadrant screening or peripheral joint scan is a quick evaluation consisting of mobility and neurological tests to rule out obvious pathology in the extremities or temporomandibular joints and to note areas that may need more detailed assessment. The upper quadrant screening evaluation should be performed on all patients demonstrating symptoms in the cervical spine, the upper extremities, or both. Range of motion, myotomes, dermatomes and reflex testing are included in the upper quadrant screening. The following joints are scanned bilaterally: temporomandibular joints, shoulder joints, elbow joints, and wrist and hand joints.

When examining a patient complaining of headache the temporomandibular joint is especially important to evaluate since, this joint can refer pain to the head. Any complaint of pain or tenderness associated with this joint should be carefully assessed as a possible cause of the patient's headache. For a complete evaluation of the temporomandibular joints refer to Orthopedic Physical Assessment.

Cervical Spine Evaluation

Active Range of Motion

Active range of motion of the cervical spine is performed first to determine limitations in motion, the willingness of the patient to move through the range, and where in the range the patient reports the pain. It is important to note the quantity and quality of movement, as well as provocation of the patient's complaints with each of the directions of movement of the cervical spine. Sitting, rather than standing, is the position most suitable for testing active cervical movements because the trunk is more stable. The following active movements should be examined: flexion, extension, right and left lateral
flexion, and right and left rotation. When flexion, extension or rotation produce pain it is usually desirable to discover whether the pain stems from the upper or lower cervical spine. The following tests will help in achieving this differentiation: Lower cervical flexion combined with upper cervical extension (patient's chin is protruded forward), upper cervical flexion combined with lower cervical extension (patient's chin is pulled in and back) and, upper cervical rotation left and right. Passive overpressure may be applied very carefully, but only if the movement is full and no pain is elicited. Overpressure is used to determine the end feel of the movement.

Patients with cervical headaches can present with restrictions in active range of motion, however it is not uncommon for the limitations in to be subtle. One reason is the large discrepancy of possible movements in flexion, extension, lateral flexion and rotation in the cervical spine. Another reason is it is difficult to identify landmarks from which to calculate base measurements. Lastly, active range of motion is a composite of multiple joint displacements, individual segmental motion is difficult to interpret. If a restriction is found in active range of motion, with accompanying pain in the head stemming from the suboccipital area and radiating up the occiput and over the vertex to the frontal area, a lesion is likely to be found at the atlanto-axial joint. This joint should be further evaluated to confirm or reject it as a cause of the headaches.

**Resisted Isometric Tests**

The same movements that were done actively are tested isometrically. Resisted isometric tests are done with the cervical spine in the neutral position, no motion should occur and painful movements are done last. Resisted isometrics test the contractile
structures, however any reproduction of pain is just as likely to be from compressive forces exerted by the muscles as from the muscles themselves.\textsuperscript{60}

\textbf{Axial Compression and Distraction}

Before the patient is placed in supine for further testing, the effect of axial compression and distraction on the patient's subjective complaint of headache should be evaluated. Axial compression and distraction are used to rule out neurological symptoms. Increased pain upon compression and decreased pain upon distraction can implicate weightbearing structures such as the disc or facets, or can be due to pressure on the nerve roots as the possible source of symptoms. On the other hand, decreased pain upon compression and increased pain upon distraction can infer ligamentous, or facet joint capsular involvement as they are placed in a slackened position upon compression and stretched with distraction.\textsuperscript{60} The facets and intervertebral discs can both be implicated as sources of headache, therefore it is possible to get a positive test with these two evaluation strategies.

\textbf{Supine Vertebral Artery Testing}

The vertebral artery has the potential to be occluded with movements of the cervical spine especially with rotation and combined extension of the neck.\textsuperscript{61} This is because of the relationship it has with $C_1$ and $C_2$ as it courses into the head through the foramen magnum. The integrity of the vertebral artery must be assessed before passive movement towards the extremes in extension, lateral flexion and/or rotation are performed. These positions can occlude the vertebral artery and cause the patient to become dizzy, nauseated, or lightheaded. The test can be performed in supine or in sitting. The patient's head and neck are passively taken into side flexion and extension.
After this movement is achieved, the physical therapist rotates the patient's neck to the same side and holds it for approximately thirty seconds.\textsuperscript{59, 60} This position decreases blood flow to both of the vertebral arteries but the occlusion is greater on the contralateral side.\textsuperscript{59} It is important to talk to the patient and watch for any signs of dizziness or nystagmus in the patient's eyes. The test is performed to both sides. A positive test would be any dizziness, nausea or nystagmus experienced by the patient.\textsuperscript{59} Positive findings should be reported to the physician immediately and extremes of extension or rotation, and other provocating positions must be avoided.\textsuperscript{60} Mobilizations that require the head to be put in combined extension and rotation are also contraindicated.

**Passive Range of Motion and EndFeels**

Passive range of motion is tested with the patient supine and compared to those directions that demonstrated restricted or painful motions with active movement. This allows the physical therapist to determine whether any differences in motion are due to weakness, restriction, or pain.\textsuperscript{60} End feels are also determined. The normal end feel in all directions for the cervical spine is tissue stretch. Abnormal end feels include muscle spasm, bony block or tissue tension and occur before the normal limits of motion.

In the patient with suspected cervical headache, care must be taken not to worsen a highly irritable joint or structure because of its influence on the rest of the evaluation. Restrictions in range of motion secondary to muscle tension, or facet hypomobility can be found during this part of the evaluation and should be assessed further to determine their involvement in the patient's complaint of headache.
Passive Physiological Intervertebral Movement Testing

Passive physiological intervertebral movements (PPIVM) are utilized to determine the amount of motion occurring at each spinal segment. It is possible for a patient's active range of motion to appear normal, yet PPIVMs may reveal symptomatic joint abnormalities.\textsuperscript{4,6} PPIVMs involve palpation of each motion segment in the cervical spine during passive physiological movement of the head and neck. The physical therapist tries to judge the movement at each level in an effort to determine any hypo- or hypermobility.\textsuperscript{60} The space between the spinous processes is palpated during flexion and extension. Laterally, the articular masses are palpated during side flexion and rotation. It is important to distinguish upper cervical spine pathology from lower cervical spine pathology in the patient with cervical headache because the upper craniocervical joints are most often implicated as the source of headache.\textsuperscript{4} It is possible to begin to make the distinction between the upper and lower cervical spines through the following PPIVMs: Atlanto-occipital flexion and extension, atlanto-axial rotation, C\textsubscript{2}-C\textsubscript{7} flexion, lateral flexion and rotation. If not familiar with the principles or performance of PPIVMs and/or PAIVMs (to be described next) the reader is referred to \textit{Vertebral Manipulation}\textsuperscript{16} or \textit{Manual Therapy for Chronic Headache}\textsuperscript{4} for a thorough description.

Passive Accessory Intervertebral Movement Testing

Accessory movements are necessary for normal physiological range of motion. Hypomobility in one or more planes of movement occurs with loss of accessory joint motion secondary to capsular or ligamentous tightness. Passive accessory intervertebral movements (PAIVM) test each vertebral segment in the cervical spine for mobility and the provocation or relieving of the patient's headache.\textsuperscript{60} PAIVMs can identify the joint to
be treated and the technique which is likely to be effective in treating the patient's headache. These movement tests are not only used for evaluation but also can be used as treatment techniques.

When performing PAIVMs the first pressures should be applied gently because even in conditions of normal mobility there is only a small amount of movement available at each segment. Being gentle is especially important for the headache patient due to their hypersensitivity. With these patients even the slightest pressure could set up an unacceptable exacerbation of symptoms. The joint that is responsible for the headache will quickly and easily be identified in most cases by its sharp pain response to gentle Grade I pressure (a tiny amplitude movement near the starting position of the range) and often by the appropriate referral of pain to the head. When examining the cervical spine no more than two or three gentle pressures are applied to each vertebra in turn. If there is no pain response to the gentle movements the amplitude and depth of the movement can then be appropriately increased, still applying only two to three pressures per vertebrae. The testing should be repeated more deeply until pain or abnormality is detected or until the movement achieved indicates that the joint has painless range in this direction. The results from each segmental test should be compared in the opposite direction, or to the segment above and below. If there is physical resistance during movement, or if pain is produced or protective muscle contraction are encountered during movement, their extent should be assessed.

The three primary directions in which the PAIVMs are applied are: Postero-anteriorly (P-A) on the spinous process, P-A on the articular masses, and transversely on the lateral surface of the spinous process. PAIVMs can also be applied in an antero-
posterior (A-P) direction on the anterior surface of the transverse processes.\textsuperscript{4} This is a good technique for patient's with parietal pain, the A-P PAIVM is applied on the same side as the pain.\textsuperscript{4} PAIVMs are applied at all levels of the cervical vertebral column. A P-A pressure on the tip of the lateral mass of the atlas has been found to be the main source of many headaches.\textsuperscript{4} Pressure on the lateral mass of the atlas can be painful, but the more sensitive to pressure it is, the more likely it is to be symptomatic. The smallest disturbance of the atlanto-occipital joint can provide immediate relief of severe headaches but exacerbations of not only pain but dizziness and nausea can occur as well when more than a Grade I pressure, or even if too many Grade I pressures are applied.\textsuperscript{4}

Special Tests

Tests for ligamentous stability of the upper cervical spine are tested in conjunction with accessory movement tests and prior to utilization of mobilization techniques. This is especially true after a traumatic injury has occurred. There are four tests that are specifically important to the integrity of the cervical spine. They are the longitudinal distraction test, the transverse ligament stress test, the alar-dens ligament test and the Sharp-Purser test. If any of these tests have positive results, further treatment of the cervical spine is contraindicated and the patient should have immediate follow up with a physician.

The longitudinal distraction test is a gross test for the integrity of the tectorial membrane. The axis is stabilized while a long distraction through the occiput is performed and craniovertebral flexion and extension are performed. This test is positive if excessive movement is perceived or a firm end-feel is not established. If this test is positive other instability tests should not be performed.
The transverse ligament stress test is a test of the anterior shear of the occiput and the atlas on the axis which is normally held very stable by the transverse ligament. The patient lies supine while the physical therapist supports the occiput and there index fingers are placed over the posterior arch of the atlas. The occiput and the atlas are then moved anteriorly together and held for ten to twenty seconds.\textsuperscript{59} Positive signs include dizziness, nausea, paresthesia of the face, or a soft end feel.

The alar-dens ligament test is meant to test the integrity of the alar ligament and its attachment to the dens of the axis. The patient lies supine while the physical therapists stabilizes the axis with a pinch grip around the spinous process and lamina.\textsuperscript{59} The head is then laterally flexed to the left and right. Right lateral flexion tests the left alar ligament and left lateral flexion tests the right alar ligament. A strong, stable and abrupt capsular end feel should be felt with minimal lateral flexion occurring.\textsuperscript{59}

The Sharp-Purser test is an instability test for the atlanto-axial joint and should be performed with extreme caution.\textsuperscript{59} The patient is in sitting with the physical therapists placing one hand on the patients forehead while the other hand is used to stabilize of the spinous process of the axis. The patient’s head should be in slight flexion. With the axis fixed the patient’s forehead is pushed in a posterior direction. A positive test is indicated by the forehead moving backward during the test.

**Palpation**

Palpation is used to note any tenderness, muscle spasm, temperature changes, referred pain patterns from trigger points or other signs and symptoms that may indicate the source of the pathology. Usually palpation is performed with the patient in supine so that maximum relaxation of the neck muscles is possible. Palpation of the cervical spine
should include all the intrinsic and extrinsic muscles that act on the head, neck, and upper shoulder girdle.

Patients with headaches are likely to be very sensitive to palpation because of the hypersensitivity associated with cervical headaches. Therefore, palpation at the first visit must be kept to a minimum.\(^4\) If the headache is coming from the occipito-atlanto-axial articulations the patient will be unusually sensitive to the touch and palpatory pressure of the therapist.\(^4,16\) The slightest pressure is likely to cause an exacerbation of pain. The location at which pain response is the greatest is likely to be the source of the headache.\(^4\) Through palpation of the muscles supplied by C\(_1\) to C\(_3\) spinal nerves, trigger points are likely to be found in the patient with headaches.\(^46\) Palpation can be both beneficial and unfavorable in the case of the patient with headaches because it can identify the cause of the symptoms but it can also cause an exacerbation of the pain if done too aggressively.

**Diagnostic Imaging**

The headache lesion in the upper cervical spine is seldom shown by means of X-rays, computed tomography (CT) scans, magnetic resonance imaging (MRI), etc.\(^4\) Lesions at other vertebral levels are more readily demonstrated by the use of the above stated tests.

It is through the described cervical evaluation that the relationship between the joints of the cervical spine and the symptomatic features of the patient's headache are made.\(^6\) As the symptomatic pattern of headache alone is seldom diagnostic, such an evaluation is one of the key components in deciding whether the cervical spine is the major cause, a partial cause, or has no part in the patient's headache. Based on the findings from the evaluation the physical therapist must decide on a treatment plan. If the
results from the evaluation fit together to form a diagnostic picture of cervical headache. The therapist must then decide on an appropriate treatment plan. There are numerous treatments for cervical headaches including manual mobilization techniques, which have been found effective in treating this condition. The most effective mobilization techniques for the upper cervical spine will be discussed in the following chapter.
CHAPTER VI
JOINT MOBILIZATION TREATMENT

The most effective form of treatment for cervical headache has not been established, but claims have been made with respect to transcutaneous electrical nerve stimulation (TENS), massage, manipulation and mobilization. Mobilization and manipulation are similar terms frequently used interchangeably in the literature. Both terms refer to passive movement techniques used to restore normal motion to a joint; however, they are very different in application. Manipulation is defined as a small amplitude, high velocity thrust to move the joint beyond its normal range of movement. Manipulation techniques are beyond the scope of this paper and will not be discussed. Mobilizations involve moving the joint components passively, in a graded fashion, of varying amplitude, to restore normal or expected range of motion. The focus of this chapter is to describe and discuss various methods of upper cervical mobilizations specific to the treatment and management of cervical headaches.

Many authors have reported the effectiveness of joint mobilization in reducing or alleviating headache, but few controlled clinical studies of joint mobilization have been reported. In a controlled study by Schoensee et al., mobilizations described by Maitland were applied to just the upper cervical joints (occiput – C3) of patients with headaches. The results revealed that the mobilizations had
a therapeutic effect in reducing the frequency, duration, and intensity of the headache. In a study of cervical manipulation vs. mobilization administered to three groups of patients with migraine headaches (one group being mobilized by physical therapist, the second group received manipulations by chiropractors, and the third group manipulated by either a physician or a physical therapist) concluded that all three groups showed a decrease in frequency, duration, and intensity of their headaches. Results also determined that the cervical manipulation groups were no more effective than the mobilization group. Moreover, in a study of 100 patients with chronic headaches treated by mobilization, Turk and Ratkolb reported an absence of headaches in twenty-five percent and an improvement in seventy-five percent of the participants in the study.

**Joint Mobilization**

Mobilization techniques must be simple, because without simplicity they cannot be adaptable and without adaptability they cannot be matched to the special requirements of each patient. Joint mobilization techniques are best performed in a rhythmical, oscillatory and controlled fashion. They help to relieve pain, decrease muscle guarding, lengthen tissue (especially joint capsule and ligaments), and reduce derangement of intraarticular structures. Additionally, the patient may experience neurophysiological benefits from the mechanical effects of passive joint motion. Restoring normal mobility in the joint reduces firing of pain receptors, which are activated when the joint is under excessive mechanical stresses.

During mobilization treatment, the physical therapist attempts to restore accessory motion and subsequently physiological motion normally present at a joint. The physiological and accompanying accessory joint motion may be hypomobile or
hypermobile. The anatomical limit of normal joint motion is the termination of motion by
the shape of the articular surfaces, ligaments and muscles, and the contact or tension of
extra-articular structures. A pathological limit of motion is found in a hypomobile
joint, when the anatomical limit is unattainable due to pain or tissue restriction. The
distance the joint is moved into its total range is divided into four mobilization grades
(Figure 8). Grades I and II are generally used in the treatment of pain and spasm
while, grades III and IV are used to increase motion beyond the pathological limit.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>I</td>
<td>Tiny amplitude movement near the starting position of range.</td>
</tr>
<tr>
<td>II</td>
<td>Large amplitude movement, which carries well into the range. It can occupy any part of the range but does not reach the limit of the range.</td>
</tr>
<tr>
<td>III</td>
<td>Also a large amplitude movement but one which reaches the limit of the range.</td>
</tr>
<tr>
<td>IV</td>
<td>Tiny amplitude movement at the limit of the range.</td>
</tr>
</tbody>
</table>

Figure 8. Grades of Joint Mobilization.

Precautions and Contraindications to Cervical Mobilization

There are many considerations influencing contraindications to manipulation of
the cervical spine. There are few conditions for which joint mobilization are
contraindicated. This is because mobilization by its definition and application is
usually very gentle and unlikely to injure the patient. In the case of cervical
headaches, most are totally relieved by means of the gentle joint mobilization techniques
and Grades I and II mobilizations are seldom contraindicated. With a careful
evaluation, most of the possible dangers are eliminated through screening for precautions
and identifiable contraindications prior to initiating treatment. The precautions and contradictions to utilizing joint mobilizations as a treatment technique are presented in Table 13.

Table 13. Contraindications and Precautions of Cervical Joint Mobilization

<table>
<thead>
<tr>
<th>CONTRAINDICATIONS</th>
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<tbody>
<tr>
<td>• Diseases of the spinal cord or cauda equina or any evidence of pressure on these structures</td>
</tr>
<tr>
<td>• Vertebral artery involvement pointing to occlusion</td>
</tr>
<tr>
<td>• In the presence of rheumatoid arthritis</td>
</tr>
<tr>
<td>• Radiologic evidence of excessive exostosis in the region to be treated</td>
</tr>
<tr>
<td>• The presence of cancer</td>
</tr>
<tr>
<td>• The presence of active of past bacterial infection that has affected the joint surfaces of ligaments surrounding the joints</td>
</tr>
<tr>
<td>• Instability of intervertebral joints in the region to be mobilized, whether due to fractures, subluxations or dislocations, or unstable congenital anomalies</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PRECAUTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Ankylosing spondylitis can be gently mobilized</td>
</tr>
<tr>
<td>• Neurological changes</td>
</tr>
<tr>
<td>• Protective muscle spasms</td>
</tr>
</tbody>
</table>

Once it is determined that the patient is suffering from a headache of cervical origin and a restriction has been found in the joints of the cervical spine, particularly the joints of the upper cervical spine, and the patient presents with zero contraindications to joint mobilization, the therapist must decide on the appropriate dosage of mobilizations to render. This is often difficult to decide in the patient with cervicogenic headache because it is easy to overtreat these patients and cause an increase in their pain symptoms.

**Dosage**

Dosage is the product of the mobilization grade used (I – IV) and the number of pressures of that grade applied. In the case of cervicogenic headache, the dosage of cervical joint mobilization should be carefully chosen in order to not risk exacerbation of symptoms. Dosages, which would be acceptable and therapeutic at other vertebral levels,
are likely to exacerbate headache in an exaggerated manner if mobilizations are done too aggressively. Poor success in the treatment of headache is most commonly attributed to over treating. Edeling recommends five Grade I pressures for an initial treatment. This dosage is often sufficient to alleviate a severe pain, which could easily be exacerbated if more mobilizations were applied. Consequently, too many or too strong of pressures (even 10 Grade II) constitute over treatment at the first session and could result in a serious increase of symptoms.

Treatment should focus on only those joints that have been identified as the cause of the headache. If a technique is identified which affects the pain in the head directly, it is wise to use only that technique in the low dose manner described above. Mobilizing several other joints may lead to confusion on reassessment.

**Treatment Progression**

With joint mobilization techniques the most reliable assessment parameter for use in evaluating headache response to the treatments is by the immediate change in the pain or symptoms following the application of a technique. The change in pain may be classified when any of the following occur: 1) the pain shifts, 2) it becomes less intense, 3) it becomes more diffuse, 4) it localizes, 5) it becomes more intense, 6) it goes away. Any of these changes in the pain signifies a positive response to a technique and that technique should be pursued and progressed. Daily joint mobilization treatments should be applied to the patient complaining of continuous or daily headaches and these techniques should continue until the headache pain skips a day. When this occurs the patient should be treated every second day. It is beneficial and important to see the patient on the day following the first treatment session to assess the effects of the first
treatment. If a physical meeting cannot be arranged a telephone conversation is still warranted. As the patient progresses and the time the patient is free from headaches increases, time between treatment sessions can become greater in order to assess how long the remissions are lasting.\(^4\) For example, if the headache symptoms have skipped several days, the next treatment session can be set up for the following week. If no headache has been present during a one-week period, treatment can follow what was done on the previous visit perhaps with a larger dose or stronger grades of mobilizations to ensure normal joint mobility is restored. The patient should then be rescheduled after two weeks to reassess and ensure no return of headache symptomology. If there are no headaches during the trial two-week period and no further complications are found during the reassessment the patient is discharged and only seen again if symptoms of the headache reappear.\(^4\) A reassessment of the patient's complaints and symptomology is necessary should the patient return for treatment of their cervical headache.

Localized Joint Mobilization Techniques Specific to the Patient with Cervical Headache

Headaches can arise from a number of sources (Table 4), but it is the upper cervical spine that is felt to be the primary source of headache with the lower cervical spine being a secondary source.\(^3,4,6,36\) Therefore, joint mobilization treatment directed at painful hypomobility of the upper cervical spinal joints usually relieves the head pain.\(^4\) Referral pain patterns have been developed from specific pain sources in the cervical spine.\(^4\) These patterns can be extremely helpful in locating a lesion, but it must be remembered that such patterns are merely a guide and that pain in any area of the head can arise from any number of sources.\(^4\) Edeling\(^4\) has developed a guide to help therapists locate the cervical articulation most likely to be causing pain in different parts of the head.
and the joint mobilization technique that has been used successfully in treating it. This
guide is presented in Table 14.

Table 14. Guide to Locating Cervical Headache Pain and Joint Mobilization Technique

<table>
<thead>
<tr>
<th>Area of Pain</th>
<th>Joint Responsible</th>
<th>Effective Technique</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertex</td>
<td>Occipito-atlantal</td>
<td>Central P-A vertebral pressure on the atlas</td>
</tr>
<tr>
<td>Frontal, Peri-orbital or Temporal</td>
<td>Occipito-atlantal</td>
<td>Transverse vertebral pressures on the atlas on the side of pain</td>
</tr>
<tr>
<td>Occipital and supra- or retro-orbital</td>
<td>Atlanto-axial or axis/C3</td>
<td>P-A unilateral pressure on the axis on the side of pain with head straight or rotated to the pain side</td>
</tr>
<tr>
<td>Parietal</td>
<td>Occipito-atlantal or atlanto-axial</td>
<td>A-P unilateral vertebral pressure on the atlas or the axis on the pain side</td>
</tr>
<tr>
<td>Facial, aural, nasal, tooth or gum</td>
<td>Temporomandibular joint or occipito-atlantal</td>
<td>Temporomandibular joint techniques and transverse pressure on the atlas on the side of pain</td>
</tr>
<tr>
<td>Neck pain and associated eye symptoms</td>
<td>C3</td>
<td>Central and unilateral P-A pressure or A-P pressures on C3</td>
</tr>
</tbody>
</table>


The joint mobilizations suggested in the above table are described thoroughly in Vertebral Manipulation, but have been adapted by Edeling to apply specifically to the symptoms of headache. The reader is encouraged to consult either Vertebral Manipulation or Manual Therapy for Chronic Headache for a complete description of these joint mobilization techniques. Over seventy percent of the true cervical headaches can be expected to respond well to treatment by these joint mobilization techniques.
Additional Mobilization Techniques

Joint mobilization techniques are not the only mobilization techniques that can be utilized for the patient with cervicogenic headache. There are a variety of other soft tissue techniques that can also be beneficial to the treatment of headache. These include the utilization of soft tissue mobilization as well as generalized joint mobilization, which is a technique that mobilizes two or more vertebral segments at a given time. The reader is encouraged to consult *The Spine: Basic Evaluation and Mobilization Techniques*\textsuperscript{71}, *Modern Manual Therapy for the Vertebral Column*\textsuperscript{65} and *Vertebral Manipulation*\textsuperscript{16} for further discussion and description of these mobilization techniques.
CHAPTER VII

CONCLUSION

The patient with cervical headache presents a challenge to the profession of physical therapy, both in diagnosis and in treatment. Though progress has been made in the area of cervicogenic headache, more studies are necessary in order to confirm not only the prevalence of cervical headache but also the effectiveness of joint mobilization in the treatment of this condition. In addition, research needs to be directed in the area of cervical spine biomechanics so a better understanding of this complicated region can be achieved, which ultimately will lead to improved management of cervical spine pathology.

There is, however, no doubt that disorders of the upper cervical spine can be a cause of headache and many patients complaining of headache are seen by physical therapists. The majority of cervicogenic headaches arise from the upper cervical spine and are caused from the convergence of noxious stimuli on the trigeminocervical nucleus.\textsuperscript{4, 6, 30} Not only is the cervical spine a complicated area to evaluate, but the symptomology of cervical headaches tends to overlap with many other chronic headache conditions. Therefore, a thorough and effective cervical spine evaluation is crucial to determining the source of headache and the appropriate treatment plan. The history, observation and physical evaluation of the patient will provide the therapist with the information necessary to decide whether the headache that the patient is experiencing is
emanating from the cervical spine. Once there is confirmation of cervical spine pathology, specifically, restrictions of the apophyseal joints, the therapist can choose to utilize joint mobilization techniques. Joint mobilizations have been shown to be effective in reducing the frequency, duration, and intensity of cervical headaches.
REFERENCES CITED
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