REVIEW ARTICLE

# Cervical Facet Joint Dysfunction: A Review

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ABSTRACT. Kirpalani D, Mitra R. Cervical facet joint dysfunction: a review. Arch Phys Med Rehabil 2008;89:770-4.

**Objective:** To review the relevant literature on cervical facet joint dysfunction and determine findings regarding its anatomy, etiology, prevalence, clinical features, diagnosis, and treatment.

**Data Sources:** A computer-aided search of several databases was performed, including Medline (1966 to present), Ovid (1966 to present), and the Cochrane database (1993 to present).

**Study Selection:** Selected articles had the following criteria: (1) all articles analyzed cervical facet joint pain—anatomy, prevalence, etiology, diagnosis, treatment; (2) only full, published articles were studied, not abstracts; and (3) all articles were published in English.

**Data Extraction:** All articles were critically evaluated and included the following categories: randomized controlled trials, meta-analyses, uncontrolled clinical trials, uncontrolled comparison studies, nonquantitative systematic reviews, and literature-based reviews.

**Data Synthesis:** We examined 45 references that consisted of 44 journal articles and relevant sections from 1 textbook. Cervical facet joints have been well established in the literature as a common nociceptive pain generator, with an estimated prevalence that ranges from 25% to 66% of chronic axial neck pain. No studies have reported clinical examination findings that are diagnostic for cervical facet mediated pain.

**Conclusions:** Overall the literature provides very limited information regarding the treatment of this condition, with only radiofrequency neurotomy showing evidence of effectively reducing pain from cervical facet joint dysfunction.

**Key Words:** Arthritis; Neck pain; Rehabilitation; Review [publication type]; Whiplash injuries; Zygapophyseal joint.



CERVICAL FACET JOINT dysfunction is hypothesized to result from trauma and/or degeneration of the cervical facet joints. The facet (or zygapophyseal) joints have been considered a source of spinal pain since the early 1900s. Ghormley, as referenced in Dreyer and Dreyfuss,[1] first coined the term "facet syndrome" to describe low-back pain associated with "sciatica." Although facet joint dysfunction in the lumbar spine has been well studied for decades, cervical facet joint dysfunction has received much less attention until recently. Bogduk and Marsland[2] conducted one of the earliest studies on the cervical facet joints in which diagnostic medial branch blocks and facet joint blocks with 0.5% bupivacaine were performed on 24 patients with undiagnosed neck pain. Complete relief of pain for at least 2 hours was obtained in 17 of the 24 patients. The researchers concluded that the cervical facet joints may be considered a source of axial neck pain. The purpose of this article was to review the relevant literature on cervical facet joint dysfunction and determine findings regarding its anatomy, etiology, prevalence, clinical features, diagnosis, and treatment.

## METHODS

A computer-aided search of several databases was performed, including Medline (1966 to present), Ovid (1966 to present), and the Cochrane database (1993 to present), using the key words *cervical*, *zygapophyseal*, *whiplash*, *neck pain*, and *arthritis.* In addition, we examined the references cited in these articles for key words. Selected articles were critically evaluated and had the following criteria: (1) all articles studied some aspect of cervical facet joint pain—anatomy, prevalence, etiology, diagnosis, treatment; (2) only full, published articles were studied, not abstracts; and (3) all articles were published in English.

## RESULTS

We examined 46 references that consisted of 45 journal articles and relevant sections from 1 textbook. The journal articles included randomized controlled trials (RCTs), meta-analyses, uncontrolled clinical trials, uncontrolled comparison studies, nonquantitative systematic reviews, and literature-based reviews.

## DISCUSSION

### Pathophysiology

The cervical facet joints are diarthrodial joints formed by the articulation of the superior articular process (SAP) with the corresponding inferior articular process of the cephalad vertebrae. The SAP and inferior articular process arise from the lateral mass of the vertebrae, which is formed at the junction of the lamina and pedicle. In the upper-cervical spine the facet joints begin with an angle approximately 45° superior to the transverse plane and gradually assume a more vertical position as they descend to the thoracic region.[3,4]

Each facet joint is surrounded by a fibrous capsule, lined by a synovial membrane, and contains articular cartilage and menisci.[3,5] Cervical facet joints also contain intra-articular inclusions of various shapes and sizes, which consist of fibrous connective and adipose tissues.[6] Inami et al[6] studied 20 embalmed cadavers to investigate the composition of synovial folds, or meniscoids, which are well-developed structures within these inclusions. The researchers found 3 types of synovial folds with varying amounts of fibrous and adipose tissue, suggesting that different levels of mechanical stress are placed on these structures and that synovial folds may play a role in cervical facet joint pain. Kallakuri et al[7] studied cadaveric human cervical facet joint capsules and found protein gene product 9.5 in 9 of 14 capsules, substance P in 6 of 12 capsules, and

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calcitonin gene-related peptide in 7 of 12 capsules. This finding suggests that the facet joint capsules may directly be involved as a pain generator in the cervical spine.

The innervation of the cervical facet joints was described by Bogduk.[8] From C3-4 through C8-T1, the joints are innervated by the medial branches of the cervical dorsal rami above and below the joint as these branches course around the waist of the articular pillars. The C2-3 facet joint is innervated by 2 different branches of the C3 dorsal ramus—a medial branch called the third occipital nerve and a separate articular branch arising from the origin of the communicating branch or from the communicating branch itself. The upper-cervical synovial joints (the atlanto-occipital and atlanto-axial joints) are not innervated by cervical dorsal rami but by branches of the C1 and C2 ventral rami.

Cervical facet joint pain results from either traumatic or degenerative processes. Traumatic causes include fracture and/or dislocation injuries and whiplash disorders. Facet dislocations or locked facet injuries occur with acute cervical trauma, may or may not be associated with cervical facet fracture, can be unilateral or bilateral, and are usually a surgical emergency.[3,9,10]

The etiology of whiplash injuries remains controversial. Facet joints in the cervical spine have been targeted as a possible nociceptive pain generator. Facet joint injury has been hypothesized to result from 2 different mechanisms during rear-end impact: (1) excessive compression of the facet joint and (2) excessive capsular ligament strain beyond the physiologic limit.[11,12] Kaneoka et al[13] concluded that the lower cervical segments undergo extension while the upper-cervical segments are flexed, causing the cervical spine to form an S-shape and shifting the normal C6 axis of rotation superiorly to C5. At the same time, the anterior ends of the adjacent vertebral bodies separate in an abnormal fashion, and the inferior articular process of the superior vertebrae compresses into the SAP of the inferior vertebrae. Pearson et al[12] proposed that facet joint compression occurs during the point of maximal extension, whereas capsular ligament strain begins during extension but peaks as the facets were returning from maximal extension back to neutral position.

Cervical facet joint pain can also be caused by degenerative processes such as osteoarthritis. Fletcher et al[14] compared age-related changes in 20 cadavers with no recorded history of spinal symptoms or disease using cryomicrometry, magnetic resonance imaging (MRI), and computed tomography (CT) scan. The facet joints in the cadavers under 20 years of age had uniform layers of cartilage and subarticular cortical bone, consistent with the conventional anatomic description. In cadavers over 37 years of age the articular cartilage was reduced to a thin, discolored or microscopic layer and the meniscus was nonexistent. The researchers concluded that age-related changes consistent with osteoarthritis are usually found in adults after the first 2 decades of life, but because all of the subjects in this study were asymptomatic, the findings suggest that degenerative changes are not always pathologic.

A proposed etiology of facet arthritis is based on the 3-joint complex theory. It is hypothesized that intervertebral disks degenerate first, leading to loss of disk height and increased load on the facet joints; these changes are thought to eventually lead to degenerative changes. Studies have found that facet joint arthritis is often found with disk degeneration but that disk degeneration can frequently be found without facet arthritis. In addition, 1 study found that it may take 20 or more years to develop facet joint arthritis after onset of disk degeneration.[15,16] However, other MRI studies of the lumbar spine have failed to show a correlation between degenerative disks and facet joint arthritis and have even found evidence of facet joint damage without disk degeneration.[16,17]

## Prevalence

Studies have shown a wide variability in the prevalence of cervical facet joint pain. Aprill and Bogduk[18] studied responses from 318 patients with intractable neck pain after they underwent either single facet joint injections, provocation diskography, or both. They estimated that the prevalence of facet joint pain in this population was at least 25% but could be as high as 63%, had the patients who underwent only provocation diskography also received facet joint injections. However, Barnsley et al[19] described a more specific double-blind, double-block paradigm in which the medial branches of patients with chronic neck pain were injected using 2 local anesthetics with different durations of action: 2% lidocaine and 0.5% bupivacaine. The responses to the 2 injections were compared, and a patient was considered a true positive if the duration of pain relief was longer with the bupivacaine than the lidocaine. In this randomized, double-blind, controlled trial, 34 of 44 patients had longer pain relief with bupivacaine than lidocaine ($P=.002$), leading the researchers to conclude that the double-block paradigm was a valid diagnostic method to identify painful cervical facet joints. Subsequent studies[20-22] using this method have estimated the prevalence of cervical facet joint pain to range from 36% to 55% and have found a false-positive rate with single diagnostic injection to be 27% to 66%. Although the double-block paradigm has shown a higher specificity with lower false-positive results, Lord et al[23] showed that when these patients are given a third placebo injection using normal saline, this method yields a lower sensitivity (54%) with higher false-negative results. In whiplash disorders, the double-block paradigm alone had a prevalence of 54%,[24] but when adding a placebo injection the prevalence was 50% for C2-3 facet joint pain and 49% for lower-cervical facet joint pain (overall prevalence, 60% for C2-3 or below).[25]

## Clinical Features

There have been no high quality studies that have shown that the presence of any particular signs or symptoms is significantly associated with cervical facet dysfunction. The clinical presentation of cervical facet joint pain is similar to axial neck pain of other etiologies including spinal stenosis, cervical strain, and diskogenic pain. Cervical facet pain is often characterized by axial neck pain, which may radiate suboccipitally to the shoulders or midback. Often there is a previous history of hyperextension injury to the neck or other trauma. Based on studies in which joints were injected with contrast medium in asymptomatic patients or treated with medial branch blocks in symptomatic patients, composite maps were created showing that each joint produces a distinct referred pain pattern.[26-28] Fukui et al[29] injected contrast medium into the joints of 61 symptomatic patients and subsequently performed facet denervation on patients whose pain was reproduced by the injection. During both the injection of the contrast medium and the facet denervation, patients were asked to report if their usual pain was reproduced and to describe the sites of their pain based on 10 regions identified by Fukui. The Fukui study findings were similar to the results found in the previous studies on referred pain patterns (fig 1).

To our knowledge, there are no physical examination maneuvers that are specific for the diagnosis of cervical facet joint dysfunction. Jull et al[30] compared the accuracy of manual diagnosis by a trained manipulative therapist to radiologically controlled diagnostic nerve blocks on 20 patients. Based on