WHIPLASH INJURY

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QTF Definition

- The Quebec task force (QTF) on whiplash associated disorders (WAD) defined whiplash as “bony or soft tissue injuries” resulting “from rear-end or side impact, predominantly in motor vehicle accidents, and from other mishaps” as a result of “an acceleration-deceleration mechanism of energy transfer to the neck”

How whiplash occurs

Motorists involved in rear-end crashes commonly experience whiplash. Injuries to the neck occur as the torso accelerates forward and the neck lags, then the head whips forward.

1. During normal driving, the head and torso move relative to the vehicle.
2. As the vehicle is struck from behind, the head tilts backward.
3. After the initial impact, the head snaps forward.

Vehicle traveling forward

The torso rises up.

The torso rebounds.
# QTF Grade Classification of WAD

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
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<tbody>
<tr>
<td>0</td>
<td>No complaint about the neck. No physical sign(s)</td>
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<tr>
<td>I</td>
<td>Neck complaints of only pain, stiffness or tenderness. No physical sign(s)</td>
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</table>
| II    | Neck complaints AND musculoskeletal sign(s)  
Musculoskeletal signs include decreased range of motion and point tenderness |
| III   | Neck complaints AND neurological sign(s)  
Neurological signs include decreased or absent tendon reflexes, weakness and sensory deficits |
| IV    | Neck complaints AND fracture or dislocation |
WAD Clinical Diagnosis

- Neck pain or stiffness
- Arm pain and paresthesias
- Temporomandibular dysfunction
- Headache
- Visual disturbances
- Memory and concentration problems
- Psychological distress

Psychosocial Symptoms

- Depression, anger, fear, anxiety, and hypochondriasis may be seen with WAD

- A so-called whiplash profile has been described, which includes high scores on subscales of somatization, depression, and obsessive-compulsive behavior

Most Common X-Ray Findings

- Preexisting degenerative disease

- Slight loss of the normal lordotic curve of the cervical spine

- Flexion-extension films at the time of injury may also reveal a kyphotic angle. This is thought due to hypermobility at a level adjacent to a level of hypomobility, secondary to muscle spasm

When to Order C-Spine Films

Canadian C-Spine Rule
Canadian C-Spine Rule

For alert (GCS=15) and stable trauma patients where cervical spine injury is a concern.

1. Any High-Risk Factor Which Mandates Radiography?
   - Age ≥ 65 years
   - Dangerous mechanism*
   - Paresthesias in extremities

   If No: Radiography
   If Yes:

2. Any Low-Risk Factor Which Allows Safe Assessment of Range of Motion?
   - Simple rear end MVC**
   - Sitting position in ED
   - Ambulatory at any time
   - Delayed onset of neck pain***
   - Absence of midline c-spine tenderness

   If No: Radiography
   If Unable: Radiography
   If Yes: Radiography

3. Able to Actively Rotate Neck?
   - 45° left and right

   If Able: No Radiography
   If Unable: Radiography

* Dangerous Mechanism:
  - Fall from elevation ≥ 3 feet / 5 stairs
  - Axial load to head, e.g. diving
  - MVC high speed (~100km/hr), rollover, ejection
  - Motorized recreational vehicles
  - Bicycle struck or collision

** Simple Rearend MVC Excludes:
  - Pushed into oncoming traffic
  - Hit by bus / large truck
  - Rollover
  - Hit by high speed vehicle

*** Delayed:
  - i.e. not immediate onset of neck pain
MRI and CT

- MRI is not generally indicated at initial presentation due to high false positive results.

CT and MRI are reserved for:

- Suspected disc or spinal cord injury
- Fracture
- Ligamentous injury
- Persistent arm pain, neurologic deficits, or clinical signs of nerve root compression

Incidence

- Based on US population evaluation
- Neck pain following WAD is common
- More than 300 persons per 100,000 population evaluated each year

Predictors of Poor Prognosis

- Increased symptom severity
- Neurological signs
- Feelings of helplessness in controlling pain
- Fear of movement
- Catastrophizing
- Anxiety
- Low educational level

Chronic Work Impairment

- Hospital population studies at an average 2 year follow-up report

- 20-45% of patients with soft tissue neck injuries after WAD complained of pain sufficient to interfere with capacity to work

Economic Burden

- $3.9 billion estimated annually in the US including medical care, disability, and sick leave.  
  \(^1\)  
- Greater than $29 billion if litigation is included. \(^2\)

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Acute Treatment

- WAD are difficult to treat due to complex interactions of psychosocial, legal, and physical factors that make effective treatment highly variable among different patients.

- Initial treatment has traditionally included a soft cervical collar to restrict cervical range of motion.

- More recent studies suggest, that early mobilization may lead to improved outcomes and that rest and motion restriction may delay recovery.

WAD Treatment

- Clinical guidelines for best practice management of acute and chronic whiplash-associated disorders. South Australian Centre for Trauma and Injury Recovery (TRACsa) 2008
- Acute pathway: 0-12 weeks
- Chronic pathway: greater than 12 weeks
Acute WAD Pathway

- Active exercise including functional, range of motion, strengthening of neck and scapular muscles and strengthening of deep neck flexors
- Advise ‘act as usual’, reassurance and education
- Short term NSAIDs and non-opioid analgesics
- Passive modalities: heat, massage, TENS & U/S
- No collars
- Trigger point injections *
- Greater Occipital Nerve Blocks for occipital neuralgia *
Chronic WAD Pathway

- Continue exercise including an active treatment component, reassurance and education
- Vestibular rehabilitation for chronic dizziness
- Trigger point injections
- Radiofrequency neurotomy after positive diagnostic medial branch facet blocks
- Cognitive behavioral therapy
- No collars, rest, analgesic injections or Botox
- Greater Occipital Nerve Blocks *
Cervical Pain Treated in Pain Clinics

- Facet (zygapophyseal) joints
- Whiplash associated disorders (WAD)
- Radiculopathies (disc herniation)
- Spondylosis and myelopathy
- Cervicogenic headache
- Myofascial
- Peripheral nerve entrapments
- Arthritis
- Failed surgery (postlaminectomy syndrome)
- Neuropathic pain & CRPS
Most Common Cause of Chronic Neck Pain is Cervical Facet Joint

- In pain clinics this is the overall basis about 60% (50-70%) of the time 1
- In all whiplash patients with high impact speeds it is the cause in about 74% (65-83%) of the cases 2
- In rehabilitation clinic patients it accounts for at least 36% (27-45%) of occurrences 3

No other form of treatment for neck pain is as effective as cervical rhizotomy according to three independent reviews.


Medial Branch RF Neurotomy

- At least 64% of patients had complete pain relief for an average of about 14 months $^{1,2,3}$

- People with at least 90 days of relief had an 82% chance of further success with a repeat of the treatment $^{1,3}$

Facet Joint (A-P)
Facet Joint (Lateral)
Facet Joint Innervation

- Facet joints are innervated by the medial branch of the dorsal ramus of spinal nerves
- There is dual innervation from the corresponding level and the level above
Cervical Facet Pain Referral Patterns
Occipital Nerve Origins

- Greater Occipital Nerve (GON) is the medial branch of the dorsal ramus of C2
- TON is the medial branch of the dorsal ramus of C3
- Lesser Occipital Nerve is not a medial branch nerve. It is one of the cutaneous branches of the cervical plexus, formed by the ventral rami of the upper 4 cervical spinal nerves
Occipital Nerves

![Diagram showing the distribution of right occipital nerves](image)

- Greater occipital nerve
- Third occipital nerve
- Lesser occipital nerve
- Great auricular nerve
- Posterior ramus from C1 nerve (suboccipital nerve)
- Posterior primary ramus from C2 nerve (greater occipital nerve)
- Posterior ramus from C3 nerve (third occipital nerve)
Radiofrequency Medial Branch Neurotomy

- No other form of treatment for neck pain is as effective as cervical rhizotomy according to three independent reviews.


Medial Branch Block and Radiofrequency Target

- Midportion of the articular process usually.
The Third Occipital Nerve (TON) is the Exception

- The TON, the medial branch of the dorsal ramus of C3, runs transversely across the lateral aspect of the C2-3 facet joint and may be at a level anywhere between opposite the apex of the C3 superior articular process to opposite the bottom of the C2-3 intervertebral foramen.
The TON Requires Three (3) Separate Blocks:

- C2 inferior facet
- C3 superior facet
- Over the middle of the C2-3 facet joint
Target Zones for Cervical MBB & Rhizotomy
Target Zones C3 to C6 & TON (Lat)
3 RF Cannulae in Middle of Facet Pillar at C3, C4 & C5 on Left (A-P)
C5 Medial Branch Technique
(Oblique A-P)
Multilevel Cervical MB Technique (Oblique)
Multilevel Cervical MB Technique (A-P)
Dangerous Needle Placement:
Posterior to Bone of Facet Column:
May Pass Between Laminae into SC
Use Magnification as Needed with Fluoroscopy

- To get good cervical A-P views
Sensory Testing Prior to Radiofrequency Lesioning

- Stimulation at 50 Hz at less than 0.5 V according to the literature

- Clinical experience shows that in certain cases, especially following fusion surgery, need up to 1.0 V

- Pearls: Proper questioning of patients during stimulation and during lesioning
Motor Stimulation Prior to Radiofrequency Lesioning

- 2 Hz at 1-10 V quickly. Look for “thumping” of midline muscles
- Beware of extremity or facial twitching
- Again, questioning is paramount
Pulse RF & Then Thermal Lesioning

- **Pulse RF**: maintaining voltage fluctuation of 40-45 V for 120 seconds at 42° centigrade

- **Pulse RF mechanism** is unclear, ISIS & others note disruption of axonal transport & not a structural lesion

- **Recently (2013)**: modulated expression of pain regulatory genes was observed in the SNI animal model after pulse RF along with reversal of mechanical allodynia.


Cervical Thermal RF Lesioning

- 65° Centigrade for 60 seconds versus 80° for 90 seconds for lumbar rhizotomy. (60° minimum temperature for reimbursement by most US insurance companies)

- In cervical applications a 5cm length, 5mm active tip, 22 gauge cannula is used.

- (While for lumbar RF a 10cm length, 10mm active tip, 20 gauge cannula is sufficient)
Atlanto-Occipital (A-O) Block for WAD & Cervicogenic HA
Atlanto-Occipital Block

- Mastoid process
- Foramen magnum
- Occipital condyle
- Atlanto-occipital joint
- Atlas
- Axis
- Vertebral artery
- Spinal dura
Atlanto-Occipital Block
Atlantoaxial (A-A) Block is Often Combined with A-O Block
Atlantoaxial Block

- Mastoid process
- Foramen magnum
- Occipital condyle
- Atlas
- Atlantoaxial joint
- Axis
- Vertebral artery
- Spinal dura
Needle in Lateral Part of A-A Joint (A-P)
A: Lateral A-A Joint
B: Needle Tip & Contrast in Lateral A-A Joint
Side Effects & Complications with A-O & AA Blocks

- Seizure- intravascular inj. of 1 cc or less of LA
- Direct cord injury, syringomyelia and paralysis
- Respiratory arrest
- Hypotension- secondary to LA via epidural inj.
- Total spinal block- with intrathecal injection
- Episodes of dizziness & ataxia post injection
- Injury to Chiari malformation and other path.
- Infarction & Death
Before & During A-O & AA Blocks

- MRI to R/O brainstem & intracranial pathology
- Cervical Spine X-Rays to R/O congenital anomalies
- Consider the Risks Versus Benefits
- During both blocks do contrast injection under real-time fluoroscopy, preferably with digital subtraction
- During A-A block direct needle toward posterolateral aspect of joint to avoid C2 nerve root medially & vertebral artery laterally
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American Pain Clinic

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