Whiplash – latest evidence for rehabilitation and recovery

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Whiplash: The Problem

- Most common ‘minor’ RTC injury
- Up to 50% will not recover; 30% moderate/severe pain/disability (Carroll et al, 2008)
- Poor mental health outcomes:
  - PTSD, Depression, Generalised Anxiety Disorder (Heron-Delaney et al, 2012)
- Greater costs than SCI and TBI from RTC (MAIC, Queensland 2009)
- Usually within a compensable environment
- Precipitated by a traumatic event

Whiplash – likely there is a ‘lesion’ but usually can’t be seen with clinical imaging (Curatolo et al, 2011, Spine)

Karen, July 27 2015

I found your info while I was looking for answers, as you can see I can not sleep even after taking diazepam.

I was working at Greenslopes Hospital in the dispensary and March 2014 slipped on wet stairs, hit my elbow but as I was trying to keep my head from hitting the concrete stairs, strained to keep it up I returned to the dispensary and two hours later my neck was stiff so I was sent down to Emergency where I was sent home with ibuprofen and Panadeine, four days later I could not move my neck, over the course of the next 6 months I suffered, vertigo, tinnitus, nausea & headaches (I still have) and very tight neck pain (feels like an elastic band requires cutting & still have it), also feels heavy and struggled to do my job as looking down at charts seemed to aggravate it, needless to say I was terminated but I still have no answers even after changing GP’s as he told me that I am sensitive and imagining it all.

Karen, July 27 2015
**Whiplash: Where to Start?**

- What is the recovery pathway like?
- What processes underlie WAD?
- Can we predict those who will not recover?
- Does current treatment work?
- Can we develop better treatments?

**Health outcomes and reduce costs?**

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**Recovery Pathways**

Predicted disability trajectories & predicted probability of membership (%).

- Chronic severe (19%)
- Moderate (39%)
- Mild/recovered (46%)

N=155
Group based trajectory modeling
2-3 months important

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**Trajectories: PTSD symptoms**

Predicted PTSD trajectories with 95% confidence limits

- Severe
- Mod/severe
- Moderate

Sterling, Hendrikz, Kenardy 2010 Pain 150:22-28

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**Trajectories: Dual Analyses**

Joint probability of NBD and PTSD groups

- 68% are in sync

Sterling, Hendrikz, Kenardy 2011, Pain 152(6):172-178
Processes underlying WAD

- Why bother looking? Isn’t it just neck pain? “It’s just a minor injury”
- Physical and psychological
  - Nociceptive (pain) processing
  - PTSD symptoms and stress responses
  - Motor/movement deficits
  - Psychological factors
    - Recovery expectations
    - Perceived injustice
    - Pain catastrophising

Aetiological Processes of WAD

- Movement/motor dysfunction
- Augmented nociceptive processing
- Stress related factors
- Psychosocial
  - Sociocultural
  - Environmental

Motor/muscle function

- Similar patterns of motor dysfunction occur in various neck pain conditions
  - Altered muscle recruitment (Jull et al. 2004; Johnston et al. 2008)
  - Altered muscle activity with functional tasks (Falla et al. 2004, Johnston et al. 2008)
  - Kinaesthetic deficits (Field et al. 2008, Treleaven et al. 2003)
- Not a consistent predictor of poor recovery
  - Altered muscle recruitment patterns, kinaesthetic deficits, eye movement control not predictive of outcome (Sterling 2005, 2006; Nederhand et al. 2002; Kongsted et al. 2008)
  - Decreased range of movement inconsistent predictor (Sterling et al. 2005)
Different mechanisms seem to underlie different neck pain conditions

Sensory features predict poor functional recovery following whiplash injury
Stress Related Responses

Neurobiological Stress Systems

- Genetic variants which affect noradrenergic system function (COMT) predict vulnerability to acute pain and persistent neck pain following MVC
- Genetic variants that affect glucocorticoid system function (FKBP5) predict chronic pain after MVC

Bostov et al Pain. 2013 Aug;154(8):1419-26

How does all this fit together?

PTSD symptoms predict poor recovery

34% high levels of stress understanding claim
30.4% with claim delays
27% with number medico-legal assessment
26% with amount of compensation

Predicted disability:
- WHODAS (+6.94 pts); HADS (+2.61)
- Lower QOL – WHODAS (-0.73 pts)
Recall of traumatic event
2x2 Mixed Experimental design

<table>
<thead>
<tr>
<th>Baseline</th>
<th>Trauma cue exposure</th>
<th>Post-exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTSD</td>
<td>↑ Arousal and negative affect</td>
<td></td>
</tr>
<tr>
<td>(n = 33)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No PTSD</td>
<td>↓ Pain threshold</td>
<td></td>
</tr>
<tr>
<td>(n = 33)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Between groups = PTSD, No PTSD
Repeated Measures = Baseline and Post-Exposure

Pressure Pain Thresholds

Cervical Spine
- PTSD group lower across time.
- Further decrease in PTSD group after trauma-cue.

Remote Sites
- PTSD group lower across time
- Minimal changes after trauma-cue.

Thermal Pain Thresholds

-PTSD group had lower thresholds to cold and heat across time.
- Significant decrease in cold threshold for PTSD after trauma cue.
- Minimal change in heat thresholds after trauma-cue.

A Randomized Controlled Trial of Cognitive-behavioral Therapy for the Treatment of PTSD in the Context of Chronic Whiplash

Rachel Lisner Duma, PhD*, Justin Konesky, PhD, FAPS*, and
Michelle Sterling, PhD, MPH, MPH, Grad Dip Psych, PhD, FACPP

(Chin J Pain 2012;28:755-760)

* Minimal changes between groups or over time for PTSD, Chronic or Both PTSD.
MUSCULOSKELETAL SECTION

Original Research Article
Cervical Radiofrequency Neurotomy Reduces Central Hyperexcitability and Improves Neck Movement in Individuals with Chronic Whiplash

<table>
<thead>
<tr>
<th>Gender (F/M)</th>
<th>Age (yrs +/- SD)</th>
<th>Duration of symptoms [months] (median)</th>
<th>NRS (0/-) (± SD)</th>
<th>NBR (0/-) (± SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F/WD: 36/17</td>
<td>44.7 (10.9)</td>
<td>43 [30,60]</td>
<td>(± SD)</td>
<td>(± SD)</td>
</tr>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time Period</th>
<th>GHQ-28 % &gt;23</th>
<th>SF-36 PCS % &gt;24</th>
<th>PCS % met criteria PTSD</th>
<th>PDS % met criteria probable PTSD</th>
<th>Symptom Score [IQR]</th>
</tr>
</thead>
<tbody>
<tr>
<td>t(1)</td>
<td>64%</td>
<td>19%</td>
<td>30%</td>
<td>30%</td>
<td>7 [2,13]</td>
</tr>
<tr>
<td>t(2)</td>
<td>62%</td>
<td>23%</td>
<td>34%</td>
<td>34%</td>
<td>8 [2,14]</td>
</tr>
<tr>
<td>t(3)</td>
<td>40%</td>
<td>13%</td>
<td>26%</td>
<td>26%</td>
<td>5 [0,14]</td>
</tr>
<tr>
<td>t(4)</td>
<td>34%</td>
<td>10%</td>
<td>16%</td>
<td>16%</td>
<td>6 [2,11]</td>
</tr>
</tbody>
</table>

|------|-----------------------------------|----------------------------------|----------------------|----------------------|----------------------|------------------------------------|

PTSD symptoms
Other psychological factors
Nociceptive processing
Movement/motor deficits

WHIPLASH
**Can we predict those who don’t recover?**

**Most consistent predictors:**
- Initial pain intensity
- Initial disability levels
- Most have been phase 1 (exploratory) studies


**Phase 2 (validation study)** [Sterling et al, Pain, 2012, 153: 1727-1734]
  - Initial disability levels
  - Decreased neck movement
  - Cold hyperalgesia
  - PTSD symptoms – Impact of Events Scale

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**Can we predict those who will recover?**

- Not well investigated

- **Important**
  - Patient assurance
  - Too much treatment may be detrimental – treatment iatrogenesis [Cote et al 2007]
  - May need minimal intervention
  - Avoid ‘medicalisation’

**Clinical Prediction Rule**

- 2 Prospective, longitudinal studies, 12 month NDI values, n=262
- Included variables
  - NDI
  - VAS
  - ROM
  - Hyper-arousal symptoms (PDS)
  - Cold pain threshold
  - Age
  - Gender
  - Presence of headaches

* 12 month
  - Recovered 43% (n=110)
  - NDI/Moderate disability 31% (n=83)
  - Chronic disability 26% (n=69)

1. Univariate logistic regression
2. ROC curve analyses
3. Backwards stepwise multiple logistic regression
4. Accuracy statistics
Posttraumatic Stress Diagnostic Scale (PDS)

- Similar to IES
- 3 subscales:
  - Intrusive thoughts
  - Avoidance
  - hyper-arousal

Having trouble falling or staying asleep 0 1 2 3
Feeling irritable or having fits of anger 0 1 2 3
Having trouble concentrating 0 1 2 3
Being overly alert 0 1 2 3
Being jumpy or easily startled 0 1 2 3

0: Not at all or only one time
1: once a week or less/ once in a while
2: 2 to 4 times a week / half of the time
3: 5 or more times a week / almost always

NDI

<table>
<thead>
<tr>
<th>Age</th>
<th>Hyperarousal</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;30</td>
<td>&lt;35</td>
</tr>
<tr>
<td>≥30</td>
<td>≥40</td>
</tr>
</tbody>
</table>

Predicted: Chronic/Moderate/severe
HIGH RISK

Accuracy Statistics

<table>
<thead>
<tr>
<th>Predicted Chronicity</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>+LR</th>
<th>PPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presence of all 3 factors</td>
<td>0.435 (31.55)</td>
<td>0.918 (89.96)</td>
<td>7.02 (3.81-12.94)</td>
<td>71.1 (55.84)</td>
</tr>
</tbody>
</table>

Implications

Predicted:
- Recovery
- Medium Risk
- Chronic/Severe

Further assessment:
- Nociceptive processing
- Psychological factors
- Movement/Motor function

Does current treatment work?

**REVIEW**

A research synthesis of therapeutic interventions for whiplash-associated disorder: Part 1 – overview and summary

- Robert W. Russell
- Matthew E. Hendrikz
- J. Andrew Kenny
- J. Ritchie
- M. Stewart
- M. Kenardy
- Michele Sterling

**To be tested:** NHMRC Pathway Grant (MAA, MAIC), GU, USyd, UQ

**Acute WAD**

Emergency department treatments and physiotherapy for acute whiplash: a pragmatic, two-step, randomised controlled trial


To be tested: NHMRC Pathway Grant (MAA, MAIC), GU, USyd, UQ

**Interpretation:** Provision of active management consultation did not show additional benefit. A package of physiotherapy gave a modest acceleration to early recovery of persisting symptoms but was not cost effective from a UK NHS perspective. Usual consultations in emergency departments and a single physiotherapy advice session for persistent symptoms are recommended.

**PAIN** 154 (2013): 1798-1806

Management of acute whiplash: A randomized controlled trial of multidisciplinary stratified treatments

- Gwenolen Jull
- Justin Kenny
- J. Andrew Hendrikz
- Milton Cohen
- Michele Sterling
### Management of acute whiplash: A randomized controlled trial of multidisciplinary stratified treatments

<table>
<thead>
<tr>
<th>(I) Medication</th>
<th>(II) Physiotherapy</th>
<th>(III) Psychology</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) NDI &lt;30</td>
<td>Simple Analgesia</td>
<td>a) No hyperalgesia</td>
</tr>
<tr>
<td>b) NDI &gt;30</td>
<td>Opioid Analgesia</td>
<td>b) Reduced kinaesthesia</td>
</tr>
<tr>
<td>(c) NDI &gt;30</td>
<td>Adjuvant agents</td>
<td>c) NDI &gt;30 + hyperalgesia</td>
</tr>
<tr>
<td>(d) NDI &gt;30</td>
<td>Neopathic pain</td>
<td></td>
</tr>
</tbody>
</table>

### Chronic WAD

Comprehensive physiotherapy exercise programme or advice for chronic whiplash (PROMISE): a pragmatic randomised controlled trial

<table>
<thead>
<tr>
<th>1 PT session/information booklet</th>
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</table>

1 PT session and simple advice was equally as effective

No significant treatment effect modifiers could be identified
Where do we go from here?

- Predominantly physical rehabilitation approaches have only modest effects - is this so unexpected?
- May be effective in some - who are they

People need activity/exercise – important!!

May need to consider additional interventions that target those at high risk
  - Pain modulation processes
  - Psychological factors – eg stress related factors & others
  - Neuro-immune responses
  - Environmental/system & social processes

Target processes/risk factors:
  - Pain modulation processes
  - Psychological factors – eg stress related factors & others
  - Neuro-immune responses
  - Environmental/system & social processes

Who should be targeted?
  - Avoid iatrogenesis

How will this be done?
  - primary care

Do we really understand the condition?

Mechanism studies still required
  - How do all the processes fit together
  - Need to further understand identified processes
  - New yet to be identified processes
  - Will drive intervention research
Whiplash Research Group

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Dr Leanne McGregor
Dr Annick Maujean
Dr Ash Fedler
Dr Angelo Basteris
Dr Dan Harvie
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Joan Carlisle
Tania Manning
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Viviana Silva
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Gail Durbridge