Why do a significant percent of depressed and/or chronic pain patients report cognitive deficits without evidence of brain injury?

Why do a significant percentage of MVA clients with mTBI still report cognitive symptoms months or years after the trauma?

“Traumatic brain injury is an event not an explanatory diagnosis.” (Silver, J.M., 2014)
ASSUMPTIONS

- **PAIN** = physical and/or psychological
- **DEPRESSION** = common emotional response to persistent pain
- **COGNITIVE IMPAIRMENT** = brain injury, traumatic (TBI) or natural (ie. aging)

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![Neuromatrix](image-url)
Connecting the Dots: Pain, Depression and Cognitive Impairment

Consistently identified changes in the brains of patients with chronic pain

**ACC**=anterior cingulate cortex, **PFC**=prefrontal cortex, **IC**=insula

Bushnell, M.C. et al., Nature Reviews, Neuroscience, 2013, 14, 502-511

Gray matter decreases in CBP

Regional gray matter density decreases in chronic back pain (CBP) subjects. A nonparametric comparison between CBP and control subjects is shown.

Gray matter density is bilaterally reduced in the DLPFC. A nonparametric comparison limited to the thalami revealed a significant decrease in gray matter density in the right anterior thalamus.

Gray Matter Changes

- **Fibromyalgia**: decrease in gray matter volume was 3 times that of age-matched controls (Kuchinad et al., 2007)

- **Temporomandibular joint (TMJ)** (Younger et al, 2010, Moayedi et al, 2011)

- **Migraine** (Schmidt-Wilcke et al., 2008)

Gray Matter & Depression


Fig. 1. Voxel based morphometry volume differences between the MDD and control groups (MDD > controls at p < 0.05 FDR-corrected). The dominant three bilateral clusters are shown in two axial slices (columns 1 & 2).
“Given that normal whole-brain gray matter atrophy is 0.5% per year of aging and that atrophy caused by CBP is 5-11%, the magnitude of brain gray matter atrophy caused by CBP is equivalent to 10-20 years of aging.”

(Apkarian et al, 2004).

“The results are consistent with the hypothesis that anti-inflammatory drugs may provide protection against age-related decreases in brain volume.”

(Walther et al, 2011)

Post-Concussive Syndrome (PCS)

- Cognitive difficulties
  - Attention/concentration, memory

- Affective (emotional) difficulties
  - Irritability, anxiety, depression

- Physical (somatic) complaints
  - Headache, dizziness, sensory sensitivity (i.e. sound, light)
Table 1
Acute and long-term cognitive sequelae of TBI by levels of severity

<table>
<thead>
<tr>
<th>Acute</th>
<th>Mild TBI</th>
<th>Moderate- Severe TBI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loss of consciousness (min)</td>
<td>0–30</td>
<td>&gt;30</td>
</tr>
<tr>
<td>Posttraumatic amnesia (h)</td>
<td>0–24</td>
<td>&gt;24</td>
</tr>
<tr>
<td>Subacute and long-term</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Memory</td>
<td>Resolves rapidly within 80%–85% patients&lt;sup&gt;2,10–12&lt;/sup&gt;</td>
<td>Persists in w65% of patients&lt;sup&gt;8&lt;/sup&gt; Can include deficits of awareness, reasoning, language, visuospatial processing, and general intelligence&lt;sup&gt;14–16&lt;/sup&gt;</td>
</tr>
<tr>
<td>Attention</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Processing speed</td>
<td>May persist in w15% of patients&lt;sup&gt;13&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Executive functions</td>
<td></td>
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</tbody>
</table>


mTBI Recovery Course

Post-injury symptom recovery in 635 concussed high school and college athletes. (McCrea et al, 2009)
Neuropsychological Functioning Comparison

Effect size of factors affecting neuropsychological functioning.
.2=mild effect, .5=moderate, .8=large.
(McCrea et al., 2009)

Why persisting symptoms in MVA clients with mTBI?

- **Litigation?**
  - malingered—little support in the literature.
  - litigation selects serious injuries.

- **Co-Morbidities:**
  - Pain
  - Depression, Anxiety
Diagnosing Depression & PCS

**Challenges:**
- Diagnostic symptoms of depression similar to PCS: diminished concentration, indecisiveness, loss of energy, irritability, strained social relationships
- Depression is common with co-morbidities that frequently coexist with PCS (ie. pain, PTSD)
- Patients with depression are expected to have cognitive complaints.

"Perceived cognitive impairment is a cardinal feature of depression." (Lange et al. 2011)

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Depression & Cognitive symptoms

![Depression & Cognitive symptoms](image)

Figure 1. Mann-Whitney U tests and Cohen's effect sizes for British Columbia Post-concussion Symptom Inventory total scores by group.

Depression Strongly Influences Postconcussion Symptom Reporting Following Mild Traumatic Brain Injury.

Journal of Head Trauma Rehabilitation.

Depression & cognitive symptoms

Figure 2. Cumulative percentages of the number of symptoms endorsed on the BC-PSI by group: Mild or greater symptoms.

CONCLUDE

1. Pain and emotional response are related to physiological and structural changes in the brain which may explain cognitive difficulties.

2. The effect of pain and emotional response on cognition likely explain persisting “PCS” symptoms in mTBI after MVA.
Treatment - Depression

- Talk therapy (CBT, Mindfulness, CPT)
- Medication
  - Cognitive effects
  - Placebo – Dr. I. Kirsch, Harvard Medical School
    - Only 14% due to drug.
    - NHS in Great Britain – Exercise for mild/moderate depression

Treatment - Pain

- **Counselling:**
  - Education
  - CBT, CPT
  - Mindfulness meditation
- **Physical:**
  - Physiotherapy, massage, chiropractic
  - Medication incl. nerve block, Botox inj.
  - Rehabilitation exercise
Meditation & Morphology

Fig. 1. Convergent brain structure differences in meditation practitioners. Note: Convergent findings from all morphometric studies of meditation practitioners (from both long-term practitioners and novices undergoing short-term training). Regional labels are approximate, and are shown for illustrative purposes only. Blue circles: gray matter regions; red circles: white matter pathways. ACC: anterior/mid cingulate cortex; ITG: inferior temporal gyrus; RLPFC: rostrolateral prefrontal cortex; SLF: superior longitudinal fasciculus.

Treatment (cont’d)

- **Video/Computer games – remote control “toys”**
  - Distraction for pain
  - Self-reinforcing
  - Cognitive benefits:
    - Attention
    - Memory
    - Concentration
    - Planning/follow-through

Treatment (cont’d)

- **Relaxation/Meditation/Yoga**
- **Supplements:**
  - Magnesium (pill or Epsom salts baths)
  - Fish oil
- **Cardiovascular exercise**
  - Mood: depression/anxiety/anger
  - Improved blood flow to brain
  - Reduces fatigue, increases cognitive abilities
Future-Treatment

- Use of functional imaging to:
  - a) “fine-tune” current treatment strategies
  - b) validate emerging treatments

Future-Diagnosis

- Greater understanding – brain changes both structurally and physiologically with pain and emotionality.

- Objective evidence of pain through imaging of structural changes?

- BIOMARKERS such as S100B (Jeter, C.B., Biomarkers for the diagnosis and prognosis of mild traumatic brain injury/concussion. J. of Neurotrauma, 2013, 30, 657-670)
Thank you and a special thanks to Mary Friesen, B.A., M.Psy. (cand.)


