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Technical and measurement report

## Clinical management of cranio-vertebral instability after whiplash, when guidelines should be adapted: A case report

Trudy Rebbeck\*, Ann Liebert

*Discipline of Physiotherapy, Faculty of Health Sciences, The University of Sydney, C43A Cumberland Campus, NSW 2006, Australia*

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## ABSTRACT

Cranio-vertebral instability (CVI) due to loss of bony or ligamentous integrity is one of the sequelae that may result after a whiplash mechanism injury. Due to the lack of specificity of diagnostic tests, this condition is often missed and the default classification of whiplash associated disorder (WAD) is assigned. This case report describes a 14-year-old boy who was initially classified with WAD II after a rugby injury. He was initially advised to return to usual activity, a treatment recommended in clinical guidelines for WAD. Due to an adverse response to this course of action, his primary carer, a musculoskeletal physiotherapist, continued with facilitating secondary referrals that ultimately led to a specialist physiotherapist. The patient was subsequently found to have CVI arising from a loss of bony integrity due to spina bifida atlanto, a congenital defect in the atlas. Treatment thus was immobilization and stabilization, a treatment usually recommended against in WAD guidelines. The patient recovered and within 8 weeks had returned to school and non-contact sports. This case study, therefore, presents a scenario where current clinical guidelines for whiplash could not be followed, and where pursuing clinical reasoning led to accurate diagnosis as well as safe and tailored management. The case also highlights the integrated roles that primary and specialist health professionals should play in the clinical pathway of care after WAD. As a result, an expanded diagnostic algorithm and pathway of care for WAD are proposed.

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## 1. Introduction

The disorders that occur after a whiplash mechanism injury (eg rugby tackle or motor vehicle accident) are termed whiplash associated disorders (WADs) (Spitzer et al., 1995). Classification is a triage process that seeks to initially exclude clinically important cervical spine injury or specific diagnoses that may arise. Such diagnoses are defined as fracture, dislocation or cranio-vertebral instability (CVI), detectable with diagnostic imaging, requiring surgical or specialist follow-up (Stiell et al., 1999, 2001). If the diagnosis is missed, serious consequences such as spinal cord injury and death may result. Although of low prevalence (<3%), accurate diagnosis is required for safe, effective management (Pimentel and Diegelmann, 2010).

Using the WAD system, fracture or dislocation is classified as a WAD IV (Spitzer et al., 1995) Clinical guidelines (e.g. NHMRC, 2008)

recommend following clinical decision rules such as the Canadian C-spine rule (Stiell et al., 2001), to detect pathology such as fracture or dislocation. Criteria to proceed to X-ray using the Canadian C-spine include a dangerous mechanism (such as an axial load to the head, as may occur in rugby tackles) and the presence of paraesthesia in the extremities. Using this decision rule, serious pathology is rarely missed (Michaleff et al., 2012).

Once cleared of fracture or dislocation (WAD IV), the WAD classification recommends clinical screening to exclude neurological injury (WAD III). If screened and cleared, patients are classified with WAD 0-II, where classification is based on signs and symptoms with no specific diagnosis generally able to be assigned. CVI due to loss of either bony or ligamentous integrity, without neurological signs, therefore falls under WAD 0-II classification. Specialised imaging such as magnetic resonance imaging (MRI) and computed tomography (CT) is not usually recommended, due to the lack of specificity of these investigations in detecting specific diagnoses such as ligamentous instability in WAD (Vetti et al., 2009, 2010, 2011; Ulbrich et al., 2011).

In the present case, multiplanar CT was pursued and revealed a congenital anatomical variant, spine bifida atlanto, which was

\* Corresponding author. Tel.: +61 2 93519540; fax: +61 2 92990400.

E-mail addresses: [trudy.rebbeck@sydney.edu.au](mailto:trudy.rebbeck@sydney.edu.au), [t.rebbeck@specialistphysio.net](mailto:t.rebbeck@specialistphysio.net), [au](mailto:au) (T. Rebbeck).

thought to contribute to the clinical manifestation of CVI observed. Management recommended therefore, was immobilisation and a collar, which deviates from the recommended management for WAD II in clinical guidelines (e.g. [NHMRC, 2008](#); [Verhagen et al., 2008](#)). This case report therefore highlights the need to modify clinical guidelines for WAD and the pathway of care to allow for appropriate diagnosis and management in particular circumstances.

## 2. Clinical presentation

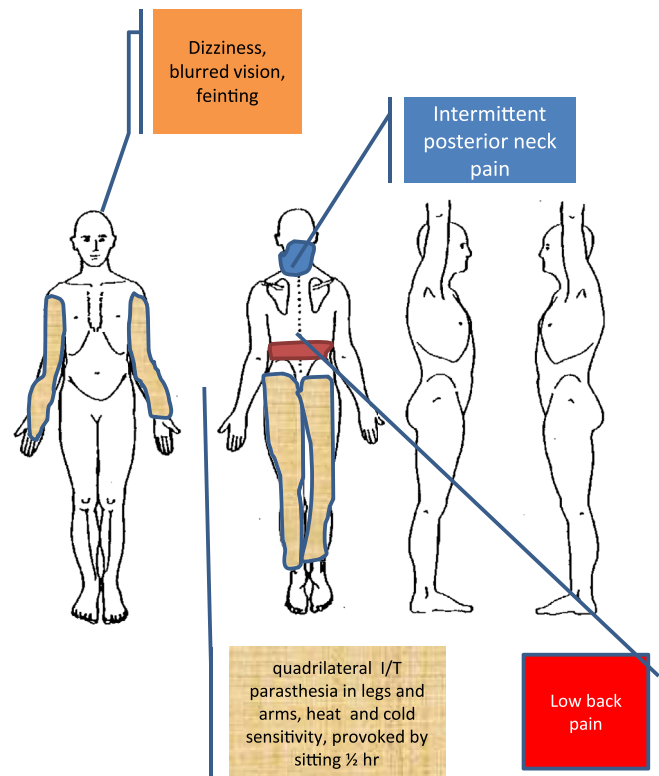
A 14-year-old male presented to his primary carer, a musculoskeletal physiotherapist in Australia. He reported being involved in a rugby tackle the previous day where he underwent a flexion–extension or whiplash mechanism injury. The patient's presenting symptoms included neck and right arm pain, neck parasthesia, headache and dizziness. Accordingly, he was referred to a hospital emergency department, where the X-ray taken excluded fracture or dislocation (WADIV), and he was discharged home. Symptoms further progressed to include dizziness and quadrilateral parasthesia. His mother became concerned and placed him in a collar, noting this reduced the parasthesia, and she sought further advice from the primary carer.

The primary carer facilitated a series of specialist referrals until a satisfactory result was achieved. The patient's first referral was to a specialist in sports medicine. The patient reported that the examination undertaken included palpation of the cervical spine which resulted in dizziness, parasthesia in the extremities and collapse. The assigned diagnosis was 'WAD II with anxiety'. The patient was then referred to a second specialist, an orthopaedic surgeon, who ordered an MRI and CT scan. These were reviewed, reported as normal and a diagnosis of 'probable whiplash' assigned. The symptoms of dizziness and parasthesia in the extremities persisted. The patient again turned to his primary carer who this time referred to a specialist physiotherapist for a second opinion and advice.

Upon presentation to the specialist physiotherapist, the patient's reported symptoms were intermittent posterior neck pain, intermittent dizziness, blurred vision and fainting, and intermittent quadrilateral parasthesia ([Fig. 1](#)). He stated that symptoms were aggravated by sitting (30 min) and walking (10 min). There was moderate self-reported neck disability, of 28/50 ([Vernon and Mior, 1991](#)). He otherwise had no significant prior history and was medically well.

The key findings on the physical examination included provocation of quadrilateral parasthesia with cervical flexion (positive L'hermittes sign). Similar symptoms were provoked with cervical rotation with noted asymmetry of motion ([Table 1](#)). A neurological assessment revealed normal responses to testing of cranial nerves V, VII, IX, XI, and XII. The upper limb neurological examination was normal and clinical testing for spinal cord compromise, including Babinski and clonus tests, were unremarkable. The bilateral straight leg raise produced neck pain and quadrilateral parasthesia at approximately 40°.

The most significant findings in the physical examination were the results of palpation and cranio-vertebral ligament stress testing. Quadrilateral parasthesia was reproduced with gentle palpation over the C1 posterior arch. When sitting inclined, quadrilateral parasthesia was abolished with the Sharp Purser ([Uitvlugt and Indenbaum, 1988](#)) relocation test. Because quadrilateral parasthesia was reproduced with cervical rotation and C1 arch palpation, the rotation stress test ([Beeton, 1995](#); [Cattrysse et al., 1997](#)) to evaluate alar ligament integrity was not undertaken. Instead, the C1,2 complex was held stable manually, and cervical rotation repeated. When this occurred, 60° of cervical



**Fig. 1.** The body chart summarising the patient's symptoms 6 weeks after injury when presenting to the specialist physiotherapist.

rotation was available bilaterally with no reproduction of quadrilateral parasthesia.

### 2.1. Investigations

The radiological reports were all reported as normal. The cervical MRI report read 'There is no evidence of fracture, subluxation or cord injury'. The multiplanar CT scan read 'There is no evidence of fracture or of other abnormality.' However, when the films were viewed by the specialist physiotherapist, it was observed that the posterior arch of the atlas was absent, consistent with spina bifida atlanto ([Fig. 2](#)).

### 2.2. Onward referral

The patient was referred to a neurologist where a 4 day reducing dose of cortisone was administered.

### 2.3. Diagnosis

The patient's presenting symptoms are consistent with WAD II. The clinical diagnosis was CVI producing spinal cord sensory irritation. Contributions to the CVI were considered as both bony (spina bifida atlanto) and ligamentous given the positive cranio-vertebral ligament stress tests and clinical improvement with cranio-vertebral stabilization.

**Table 1**  
Cervical range of motion (measured by inclinometer) and symptom response.

| Movement       | Range | Symptom response                                  |
|----------------|-------|---|
| Flexion        | 20°   | Increased neck pain and quadrilateral parasthesia |
| Extension      | 10°   | Increased pain and produced nausea                |
| Right rotation | 40°   | Increased quadrilateral parasthesia               |
| Left rotation  | 80°   | Increased quadrilateral parasthesia               |

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