Knowledge and use of craniovertebral instability testing by Australian physiotherapists.

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ABSTRACT

Internationally, manual therapy has moved toward formalised guidelines for pre-manipulative screening of the cervical spine. A controversial aspect to emerge from this involves craniovertebral instability (CVI) testing. This study examined current practice, knowledge and attitudes of Australian physiotherapists regarding pre-manipulative testing for CVI. Members of Musculoskeletal Physiotherapy Australia were surveyed by formally validated questionnaire. Sub-group analysis was performed by post-graduate musculoskeletal qualification. The response rate was 37.8%. Respondents provided differing definitions of CVI; 46.5% describing loss of anatomical integrity and 24.9% a biomechanical problem. Over half indicated they rarely or never used stress tests for CVI screening. Of 42 published signs and symptoms associated with CVI, seven were identified by more than 50% of respondents. Of published disorders associated with CVI, four were considered worthy of testing by more than 30% of respondents. Support for inclusion of information on CVI in pre-manipulative guidelines was given by 87% of respondents. Recommendations for screening tests received less support, particularly among physiotherapists holding post-graduate musculoskeletal qualifications ($p = 0.0002$). These results indicate disagreement regarding the nature and presentation of CVI. Clinical testing is inconsistent, reflecting underlying confusion about CVI. Currently, there is not an appropriate level of knowledge or willingness to recommend guidelines for CVI screening.

INTRODUCTION

The application of stress tests for the ligaments linking the upper cervical spine and skull is considered by some authorities to be a routine safety exercise prior to the treatment of a patient with pain or dysfunction of the upper cervical spine using manual techniques, particularly if the treatment involves high velocity thrust or end-range techniques (Cattrysse et al., 1997, Hing & Reid, 2004, Pettman, 1994).

Clinical screening tests are considered to be capable of detecting hypermobility and instability of the cranio-cervical ligaments, i.e. transverse and alar ligaments and tectorial membrane (Aspinall, 1990, Pettman, 1994). Detection of these problems should allow the manual therapist to select a treatment regime with a lesser risk of severe complications for these patients (Cattrysse et al., 1997). Potential complications arising from high velocity or end-range treatment techniques applied to an undiagnosed unstable upper cervical segment can be catastrophic and include the onset of cardinal neurological signs as the segment is displaced toward the brainstem, a situation that may be life threatening (Pettman, 1994). Consequences may include cerebrovascular accident (Rivett & Milburn 1997), arterial dissection and brainstem injury (Di Fabio, 1999).

Interpretation of these tests frequently involves recognition of presence or ablation of symptoms other than pain. A review of the published literature indicates that there is considerable disagreement about the actual symptoms and signs exhibited by an individual with craniovertebral ligament lesions (Osmotherly & Rivett, 2005). Furthermore, there is inconsistency in the anatomical descriptions upon which

clinical testing has been based (Osmotherly et al., 2008). Despite the recent work of Kaale et al (2008) corresponding the results of specific manual tests with MRI findings in patients following whiplash trauma, the absence of a body of research establishing validity for most of the clinical stability tests used in manual therapy of the upper cervical spine (Mintken et al., 2008; Swinkels & Oostendorp, 1996a) and the varying estimates of reliability of these tests (Cattrysse et al., 1997; Olson et al., 1998; Swinkels et al., 1996a) ensures inclusion of stress testing for CVI in pre-manipulative screening will remain contentious.

This study sought to examine the knowledge, understanding and practical application of CVI testing in Australian physiotherapists by surveying physiotherapists working in the management of musculoskeletal disorders. By appreciating the knowledge, attitudes and practices of clinicians, a better understanding of the need, benefits and obstacles pertaining to pre-manipulative screening guidelines incorporating CVI testing can be achieved.

METHODS

Ethical approval for this study was granted by The University of Newcastle's Human Research Ethics Committee.

Study sample

A survey designed to elicit the knowledge and understanding of CVI testing was disseminated to all 1528 members of Musculoskeletal Physiotherapy Australia (MPA). MPA is the special interest group of the Australian Physiotherapy Association (APA) for clinicians with an interest or specialist skills in musculoskeletal

physiotherapy. By surveying the entire membership, an understanding of the knowledge and practice across differing levels of experience and post-graduate education was anticipated.

Study design

A 21-item questionnaire was developed and validated. Following this process, questionnaires were distributed by post. After six-weeks, a follow-up questionnaire was posted to all non-respondents. Management of all postage was undertaken by the APA to maintain participant confidentiality.

Survey instrument

The survey instrument was designed following an exhaustive review of the literature published in the area of CVI. Using open and closed questions and checklist responses, items were constructed to permit respondents to demonstrate their understanding of the clinical problem, signs and symptoms of instability disorders, assessment techniques available for diagnosing CVI, as well as current practice and attitudes toward screening for instability disorders of the upper cervical spine.

Demographic information collected included gender, years of experience in the treatment of musculoskeletal disorders, physiotherapy qualifications, frequency of treating disorders of the upper cervical spine and types of manual therapy techniques used in this region.

The instrument was further refined following a process examining face and content validity. The draft questionnaire was circulated for comment to all convenors of post-

graduate manipulative physiotherapy programs in Australia and New Zealand (n=10) and all authors who had published on the subject of CVI in the English language literature in the previous 20 years (n=8). Responses were received from eight program convenors and four of the authors approached. Respondents were asked to comment on completeness of domains examined, including any other domains or content required to assess current knowledge and practice appropriately, and to express an opinion on the capability of the instrument to reflect knowledge, opinion and current practices of physiotherapists treating cervical spine problems.

Peer review of the validated instrument to clarify feasibility and language acceptability was performed in a convenience sample of six physiotherapists with post-graduate qualifications and clinical experience in musculoskeletal physiotherapy. Participants provided feedback in a structured open-ended interview examining item selection and terminology used in the questionnaire.

Statistical analysis.

Closed questions were evaluated by a frequency analysis of responses and expressed as a proportion of respondents in the sample. Open-ended responses were listed and examined by three physiotherapists with post-graduate qualifications and in excess of 20 years experience each in musculoskeletal physiotherapy. Responses were discussed until saturation with respect to categorisation of response was achieved.

Subgroup analysis was performed with respect to post-graduate qualifications in musculoskeletal physiotherapy. Between-group comparisons were subject to formal hypothesis testing using chi squared statistics.

RESULTS

Response rate and respondents

In total, 578 surveys were completed and returned. This equated to a response rate of 37.8%. Demographics of respondents are included in Table 1.

Clinical assessment of a patient with an upper cervical spine disorder was performed at least once per week by 74.7% of respondents. Manual treatment options for the upper cervical spine utilised by respondents included upper cervical mobilisation (93.9%) and upper cervical high velocity thrust manipulation (27.9%).

Defining craniovertebral instability.

Participants' responses to the open-ended question "What do you understand by the term 'instability' in the upper cervical spine?" fell into five categories. Most respondents described instability in terms of loss of anatomical integrity (46.6%). Other responses included alteration in upper cervical biomechanics including descriptions of excessive joint range or translation (24.7%) or descriptions of inadequacy of muscular action influencing the joint collectively labelled changes in neuromuscular control (18.2%). Some respondents defined the problem clinically in terms of presenting signs and symptoms (6.5%). Responses, stratified by respondents' post-graduate qualifications in manual therapy, are given in Table 2.

Detection of craniovertebral instability.

Twenty-two percent of respondents reported detecting a previously undiagnosed craniovertebral instability using clinical stress tests, clinicians with further qualifications being significantly more likely to report detecting an upper cervical instability ($Chi^2 = 7.31$, $p=0.007$) (Table 2).

A checklist of 42 items previously published in association with clinical presentations of CVI was provided. Respondents were asked which signs and symptoms they would associate with CVI. Only seven items were considered to be possible components of a CVI presentation by more than 50% of respondents (Table 2). Statistically significant differences between responses existed when examined by post-graduate qualification. However, the direction of the differences was inconsistent.

Figure 1 lists percentage of responses to the item “Would you test for CVI when treating an upper cervical spine disorder in a patient with any of the following problems?” All disorders listed in this item had been previously published as associated with CVI. Clinicians responded with a clear association between CVI and cervical spine trauma (67.9%) including whiplash associated disorder (64.8%), as well as rheumatoid arthritis (64.4%). Other possible inflammatory conditions associated with CVI received lesser recognition as potentially requiring screening. Headache was considered a disorder worthy of screening by 24.3% of respondents.

Recognition and use of clinical stress tests.

Recognition, use and self-rated ability to perform named stress tests are summarised in Table 3. Respondents with post-graduate qualifications were, on average, 1.4 times more likely to recognise the tests and 1.6 times more likely to report using the tests in clinical practice.

For the item “How often do you test for CVI?”, the most common response given was “whenever indicated” (56% of therapists with and 47.9% without post-graduate qualifications). Testing prior to upper cervical manipulation (15.6% and 6.2% respectively) or end range mobilisation of the upper cervical joints (10.2% and 20.1% respectively) was reported. The majority of respondents indicated that they either rarely or never used stress tests to screen for CVI (54.5% and 62.4% respectively). Clinicians with post-graduate qualifications were more likely to report screening for CVI in patients with cervical spine disorders ($Chi^2 = 28.2$, $p<0.001$). Responses are summarised in Table 4.

<u>Attitudes toward testing, recommendations and guidelines.</u>

Respondents indicated their opinion of when CVI tests should be performed in clinical practice using a list of responses. Nomination of multiple responses was permitted. Again, the most common response was “whenever indicated” (55.6% of respondents with and 47.9% without post-graduate qualifications), followed by “prior to upper cervical manipulation” (15.6% and 6.2% respectively) or upper cervical mobilisation (10.2% and 20.1% respectively). Responses are summarised in Figure 2.

Open-ended questions permitted elaboration on their response. Clinicians with post-graduate qualifications were more likely to test based on clinical presentation than on the technique they intended to administer compared with their counterparts. A larger number of clinicians with post-graduate qualifications also indicated that in their opinion these tests should not be used clinically. Reasons suggested revolved around two themes; absence of validation of the individual tests and inherent risks due to provocation of symptoms.

When asked whether clinicians would support the use of CVI screening tests before applying manipulation or end-range techniques to the upper cervical spine if recommended by the APA, 76.9% of respondents indicated that they would comply with a recommendation. Respondents with post-graduate qualifications were less likely to state they would comply with guidelines (71.3% versus 87.4%, $Chi^2 = 18.36$ $p<0.001$). Respondents indicating in the negative were asked to provide free comment. Ninety-nine comments were received. Comments included assessment should be based on individual presentation rather than general recommendations (32.3%), the absence of published evidence to support the validity and reliability of CVI screening (28.3%) and lack of knowledge of the tests and their performance and interpretation (14.1%).

Finally, participants responded to the item asking whether information and recommendations regarding CVI testing should be included in the current “Clinical guidelines for assessing vertebrobasilar insufficiency in the management of cervical spine disorders” (Rivett et al., 2006). There was strong support from clinicians for inclusion of information in the guidelines with 82.5% of clinicians with and 97.8%

without post-graduate qualifications indicating support (between-group comparison Chi^2=26.47, p<0.001). Using open responses, 29.4% commented that patient safety and therapist knowledge would both be improved by inclusion of information and 15.6% commented that clinician awareness of the possible presence of CVI would be improved by inclusion.

Interestingly, 12.4% of respondents indicated that information regarding CVI would be a useful inclusion but recommendations for testing should not be made. Similarly, 10.6% of comments received from this group indicated that the decision to test should be based solely on the clinician's assessment of the individual patient. Comments from respondents who indicated they would not support inclusion of CVI information in the pre-manipulative guidelines included that the tests themselves lack the necessary reliability or validity for inclusion (23.7%), the current guidelines were only concerned with vertebrobasilar insufficiency, CVI being a separate issue (15.8%), testing should be based on patient presentation and examination alone (10.5%), and there are already too many guidelines and screening procedures which encumbered clinical practice (10.5%).

DISCUSSION

The response rate to the survey of 37.8% is considered low. Respondents do, however, reflect the demographics of the membership of MPA as indicated in Table 1 suggesting that these findings may be indicative of the opinions and attitudes of the membership as a whole. It is also within the range reported by other published surveys that have attempted to gauge the opinions of Australian physiotherapists.

Wajon and Ada (2003) achieved a response rate of 22.2% in their examination of thumb pain in MPA members and Grimmer et al (2002) achieved a 38% response rate researching knowledge of non-steroidal anti-inflammatory medicine use in the same group. Our response rate may also reflect the comparatively lower level of pre-existing knowledge and understanding CVI amongst the target group.

The variety of responses to the request to define CVI highlights the greatest difficulty in examining this and other areas of spinal instability; the absence of a clear and accepted definition of spinal instability. Given the complexity of clinical instability, the anatomical, biomechanical and clinical aspects listed could all be considered basic elements of the problem. This gives rise to differing interpretations of disorders classed as “instabilities” and an apparent conflict within the literature. In responding to our question, there is a clear difference in interpretation between clinicians with and without post-graduate qualifications in manual therapy. Respondents without post-graduate education more frequently classified CVI as an anatomical disruption, whereas a greater proportion of those with further education considered instability as a broader biomechanical disorder. This latter approach is more indicative of the model of stability proposed by Panjabi (1991) currently underpinning motor control approaches to spinal stability.

Given the absence of defined and agreed pathology constituting CVI, consensus regarding the clinical characteristics of patient presentation would not be expected. There are a number of possible reasons why more than 50% of our sample only considered a small number of the 42 listed signs and symptoms to be associated with CVI. Recognition of these disorders clinically may be low due both to their low

297 prevalence in the clinical setting and poorly defined and varied presentation
298 (Swinkels et al., 1996a; Swinkels et al., 1996b). Many of the signs and symptoms
299 listed are also a component of other cervical spine presentations and not specifically
300 indicative of CVI on their own. A clinical reasoning process involves the processing
301 of a set of clinical data inclusive of patient history in reaching a decision. Listing
302 signs and symptoms as discrete criteria may not have been suggestive of CVI to our
303 respondents without being placed in a broader clinical context. Finally, in
304 summarising clinical presentations in some texts and review articles, some authors
305 have described CVI in terms of presenting cardinal neurological symptoms or signs
306 caused by central nervous system disorders such as spinal cord compression or
307 vertebrobasilar insufficiency (Hing & Reid, 2004; Meadows, 1998; Pettman, 1994;
308 Sanchez-Martin, 1992; Swinkels et al., 1996a). Published clinical reports would
309 suggest such severe presentations are rare in CVI. Many patients will tolerate
310 marked instability without exhibiting neurological symptoms or signs, instead
311 presenting with a wide variety of less severe symptoms (BenEliyahu, 1995; Derrick &
312 Chesworth, 1992; Niibayashi, 1998; (Swinkels et al., 1996b; Uitvlugt & Indenbaum,
313 1988).
314
315 The item asking whether clinicians would pre-manipulatively test for CVI in the
316 presence of certain disorders showed an understanding that CVI may be associated
317 with trauma, including motor vehicle accidents, and with rheumatoid arthritis. This is
318 understandable given these types of problems commonly present clinically, but is
319 interesting given that despite subsequent research (Kaale et al., 2008), no CVI
320 stress test had been validated within a post-traumatic population prior to the
321 performance of this survey. On the other hand, the finding that only 24% of clinicians

would consider screening a patient with a headache for CVI is puzzling since two-thirds of respondents nominated headache as a symptom associated with CVI.

The low level of association of congenital disorders with CVI would once again indicate that clinicians do not encounter these disorders frequently and hence do not recognise the potential association. The non-recognition of inflammatory disorders as a potential predisposing factor to CVI represents a more critical gap in therapist knowledge. The association with inflammatory conditions extends beyond rheumatoid arthritis as ankylosing spondylitis and systemtic lupus erythematosus have also been linked to CVI (Swinkels et al., 1996a; Swinkels et al., 1996b). Furthermore, atlanto-axial instability has been demonstrated following infections such as tonsillitis and pharyngitis (Gibb, 1969; Locke et al., 1966; Sullivan, 1949) where hyperaemia associated with inflammation may lead to local bone decalcification and softening of ligaments and their attachments (Hensinger, 1986; Roche et al., 2001; Yochum & Rowe, 1985).

Recognition and use of craniovertebral instability screening tests is associated in our sample with post-graduate studies in manual therapy. This suggests that testing for instability in the craniocervical region is not consistently taught in undergraduate curricula but is encountered through post-graduate study. Recognition of tests examining the integrity of the transverse and alar ligaments ranged from moderate to high in the post-graduate sample. There was less awareness of tests for the tectorial membrane, perhaps indicating that the role of this structure in craniocervical stabilisation receives less consideration. Self-reported rates of performance of these screening tests would indicate they are not in routine use with clinicians examining

and treating the upper cervical spine. Of the tests listed, only the ‘sidebending stress test’ for the alar ligament was used by more than 40% of respondents with and over 30% without further qualifications.

Self-reported levels of CVI screening in our respondents are perplexing. Fifty-six percent of respondents with post-graduate qualifications and 48% of those without reported screening “whenever indicated”. However, the most commonly utilised screening test, the sidebending stress test for the alar ligament, was only used by 43.5% and 31.3% of respondents respectively. If these rates of assessment are accurate, clinicians must be relying on other forms of assessment than just the described tests to assess for this disorder. Given the lack of agreement on clinical presentation and recognition of predisposing conditions, it remains unclear upon what basis respondents are judging whether screening for instability in the upper cervical spine is indicated. It is possible that clinicians are relying on other parts of the physical examination such as passive physiological intervertebral movement tests (PPIVM’s) to assess for perceived excessive ‘joint play’ rather than the described specific tests for ligament integrity.

The use of the response option “whenever indicated” may need to be seen as a limitation in this study. Response options in this questionnaire were not exclusive. Therefore, this option did not limit choice of response. However, some respondents may have selected this response on the basis of an ‘all covering’ option, reducing the discriminative ability of these items.

This theme continues when the sample is asked to provide an opinion on when CVI screening tests should be used in clinical practice. The greatest response was to perform the tests “whenever indicated”. Whilst this is an obvious response in the context of clinical examination and clinical reasoning processes, responses to the questions already discussed fail to show that we are clear about who is ‘at risk’ and how CVI might present clinically.

Whilst the majority of respondents indicated that they would support any recommendation made by their professional body in regard to clinical testing for CVI, there is clearly a sentiment that recommendations for routine required screening tests are not warranted in the current environment. This is particularly evident in the responses from physiotherapists with further qualifications in musculoskeletal physiotherapy. Free comments give an insight into the reasons why they are less likely to support recommendations for testing in clinical guidelines. Concerns expressed about the value of clinical reasoning and the related need to test in context, the largely unknown validity of the tests themselves, and the limited overall level of knowledge possessed by clinicians are reasons with considerable foundation and it is beyond doubt that the area of clinical diagnosis of CVI needs to be the subject of further research. It will not be possible to achieve consensus in clinical approach in the absence of consensus in the scientific literature regarding the validity of clinical testing. It remains questionable whether there is real support by Australian physiotherapists for any move toward formal prescriptive screening guidelines.

There is, however, a much stronger sentiment for the provision of accessible information in guidelines which clinicians may use to inform their clinical practice. Whilst this again garnered less support from those with higher qualifications, almost 90% of respondents indicated that they would support the inclusion of information on CVI in pre-manipulative clinical guidelines. Free comments provided reinforced this position as respondents expressed the desire for an accessible body of knowledge which could be used to improve clinician awareness and patient safety within a clinical reasoning framework but would highlight both the benefits and limitations of this form of screening.

CONCLUSION

Instability is a term that has taken on a variety of meanings in the contemporary physiotherapy vernacular. This is reflected in our findings that when physiotherapists describe upper cervical instability, they appear to be considering differing aspects or interpretations of the term.

Similarly, there appears to be no accepted or consensus set of diagnostic criteria used by Australian physiotherapists through which they are able to determine whether CVI is present in patients presenting to them for treatment.

There is clearly support for inclusion of information regarding CVI testing in pre-manipulative guidelines as an aide to clinical reasoning but when we consider both the existing evidence for the accuracy of these clinical tests and responses of Australian physiotherapists in this study, we can at most state that this should

include information on possible risk factors and aspects of potential presentation of CVI. There is not the appropriate underpinning of knowledge, evidence base or professional will to currently recommend guidelines for routine CVI screening for patients with cervical spine disorders. These findings do, however, highlight the directions required to further understand the nature of craniovertebral instability and its diagnosis.

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525

526 **TABLE 1 – Characteristics of survey respondents.**

527

	N (% of respondents)	MPA membership (%)
Gender		
Male	268 (46.4%)	45.7
Female	285 (49.3%)	54.3
Missing data	25 (4.3%)	
Employment setting		
Public hospital	58 (10.0%)	12.1
Private hospital	28 (4.8%)	4.4
Private practice	440 (76.1%)	72.7
Other	31 (5.4%)	10.8
Missing data	21 (3.6%)	
Entry qualifications in Physiotherapy		
Bachelor degree	440 (76.1%)	
Diploma	55 (9.5%)	
Graduate diploma	50 (8.7%)	
Masters degree	16 (2.8%)	
Missing data	17 (2.9%)	
Country of qualification		
Australia	520 (90.0%)	
Other	58 (10.0%)	
Post-graduate qualifications in		

musculokeletal physiotherapy		528
None	194 (32.4%)	
Graduate certificate	12 (2.0%)	
Graduate diploma	26 (4.3%)	
Coursework Masters	320 (53.4%)	
Research Masters	23 (3.8%)	
Professional Doctorate	1 (0.2%)	
Doctor of Philosophy	14 (2.3%)	
Other	9 (1.5%)	

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531 **Legend: MPA = Musculoskeletal Physiotherapy Australia**

532

533 **TABLE 2 – Respondent clinical characteristics and background knowledge of**

534 **CVI**

	All respondents N (% of respondents)	Post-graduate qualifications N (% of respondents)	No post-graduate qualifications N (% of respondents)
Frequency of upper cervical spine patient assessment			
More than once/day	193 (33.4%)	143 (39.3%)	50 (26.0%)
Once/day	72 (12.5%)	43 (11.8%)	29 (15.1%)
Less than daily/ more than weekly	120 (20.8%)	73 (20.1%)	47 (24.5%)
Once/week	47 (8.1%)	27 (7.4%)	20 (10.4%)
Less than weekly/ more than monthly	52 (9.0%)	34 (9.3%)	18 (9.4%)
Once/month	21 (3.6%)	13 (3.6%)	8 (4.2%)
Less than once/month	51 (8.8%)	31 (8.5%)	20 (10.4%)
Missing data	22 (3.8%)	4 (1.1%)	1 (0.5%)
Manual therapy used in the upper cervical spine			
None	8 (1.4%)	5 (1.4%)	3 (1.6%)
Manipulation only	4 (0.7%)	4 (1.1%)	0 (0.00%)
Mobilisation only	386 (66.8%)	219 (60.0%)	167 (87.0%)
Mobilisation and	157 (27.2%)	136 (37.3%)	22 (11.5%)

manipulation	22 (4.0%)	3 (0.8%)	2 (1.0%)
Missing data			
Definition of the term ‘instability’ in the upper cervical spine	307 (46.6%)	196 (44.7%)	111 (50.2%)
Anatomical	163 (24.7%)	122 (27.9%)	41 (18.6%)
Biomechanical	120 (18.2%)	77 (17.6%)	43 (19.4%)
Neuromuscular control	43 (6.5%)	30 (6.8%)	13 (5.9%)
Clinical (signs and symptoms)	26 (4.0%)	13 (3.0%)	13 (5.9%)
Other			
Past detection of a craniovertebral instability using stress tests	125 (21.6%)	95 (25.2%)	30 (15.5%)
Yes	437 (75.6%)	274 (72.7%)	163 (84.5%)
No	16 (2.8%)	8 (2.1%)	0 (0.0%)
Missing data			
Most commonly recognised signs and symptoms of CVI			
Increased mobility on passive testing	429 (77.2%)	277 (76.1%)	152 (79.2%) p=0.413
Dizziness	375 (67.5%)	231 (63.5%)	144 (75.0%) p=0.006
Headache	370 (66.6%)	234 (64.3%)	
Upper cervical pain	341 (61.3%)	215 (59.1%)	136 (70.8%)
Nausea or vomiting	321 (57.7%)	203 (55.8%)	

Suboccipital pain	303 (54.6%)	191 (52.6%)	p=0.120
Bilateral/quadrilateral paraesthesia	299 (53.8%)	214 (58.8%)	126 (65.6%) p=0.116
			118 (61.5%) p<0.001
			112 (58.3%) p=0.198
			85 (44.3%) p=0.001

535
536 **TABLE 3 – Self report of knowledge and use of craniovertebral stress tests.**

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CVI Stress Test	Post-graduate qualifications N (% of respondents)			No post-graduate N (% of resp	
	Recognise	Can perform	Uses clinically	Recognise	Can perfor
Sharp Purser (transverse ligament)	250 (68.7)	196 (54.1)	142 (39.3)	75 (38.7)	51 (26
Anterior shear (transverse ligament)	266 (73.3)	194 (54.2)	118 (32.7)	110 (56.7)	63 (32
Lateral stability (alar ligament and dens)	268 (73.8)	200 (56.2)	142 (39.3)	93 (47.9)	55 (28
Side bending stress test (alar ligament)	261 (71.9)	212 (59.1)	157 (43.5)	111 (57.2)	88 (45
Rotation stress test (alar ligament)	225 (61.8)	174 (48.5)	109 (30.2)	102 (52.6)	76 (39
Distraction test (tectorial	215 (59.4)	179 (49.6)	107 (29.6)	92 (47.4)	61 (31

membrane)					
Passive upper cervical flexion (tectorial membrane)	236 (65.4)	198 (55.5)	123 (34.1)	123 (63.4)	88 (45
Distraction in craniovertebral flexion (tectorial membrane)	170 (47.1)	142 (39.6)	85 (23.6)	53 (27.3)	34 (17

Abbreviation: CVI = craniovertebral instability

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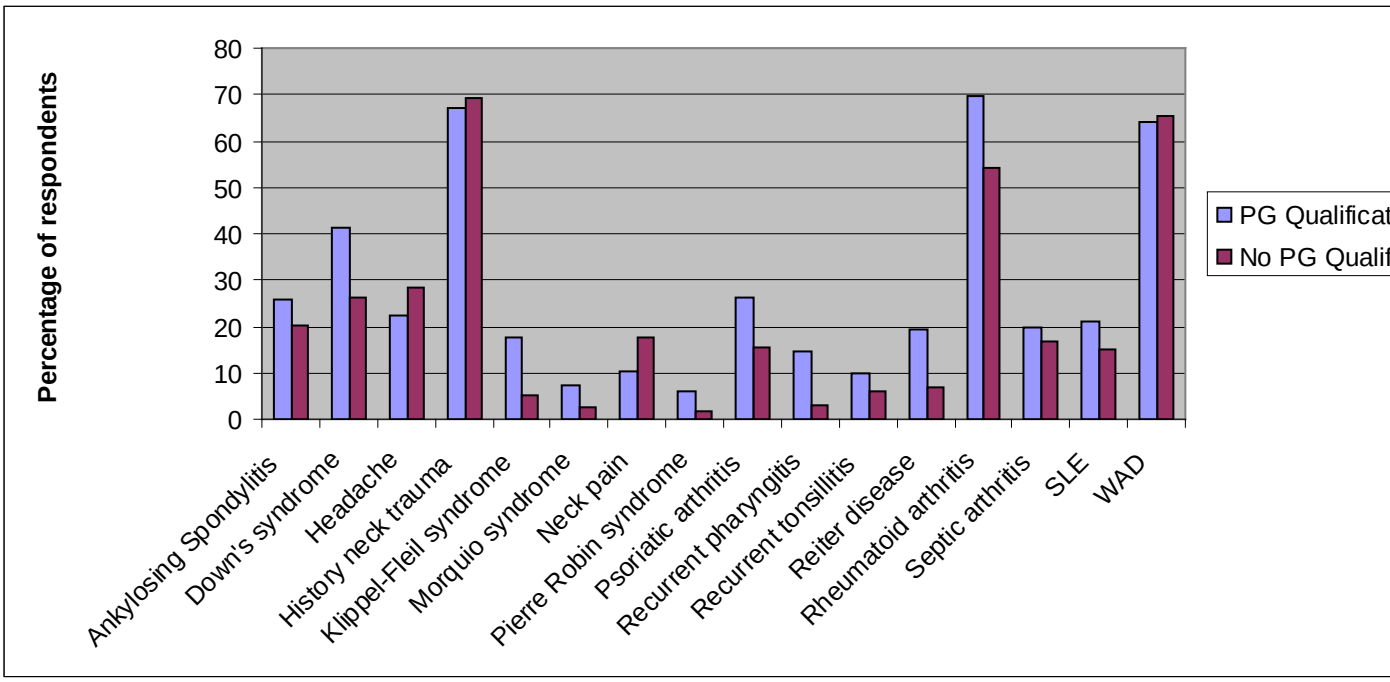
TABLE 4 – Self report of CVI screening

	All respondents N (% of respondents)	Post-graduate qualifications N (% of respondents)	No post-graduate qualifications N (% of respondents)
All cervical spine patients	35 (6.1)	24 (6.3)	11 (5.7)
Whenever indicated	308 (52.9)	215 (56.0)	93 (47.9)
Rarely	198 (34.3)	130 (33.9)	68 (35.1)
Never	132 (23.0)	79 (20.6)	53 (27.3)
Prior to cervical manipulation	71 (12.1)	45 (11.7)	26 (12.4)
Prior to upper cervical manipulation	72 (12.3)	60 (15.6)	12 (6.2)
Prior to end-range upper cervical mobilisation	78 (13.2)	39 (10.2)	39 (20.1)
Prior to end-range assessment of upper cervical spine	44 (7.1)	21 (5.5)	23 (11.9)

Between-group difference $chi^2 = 29.2$, $p < 0.001$

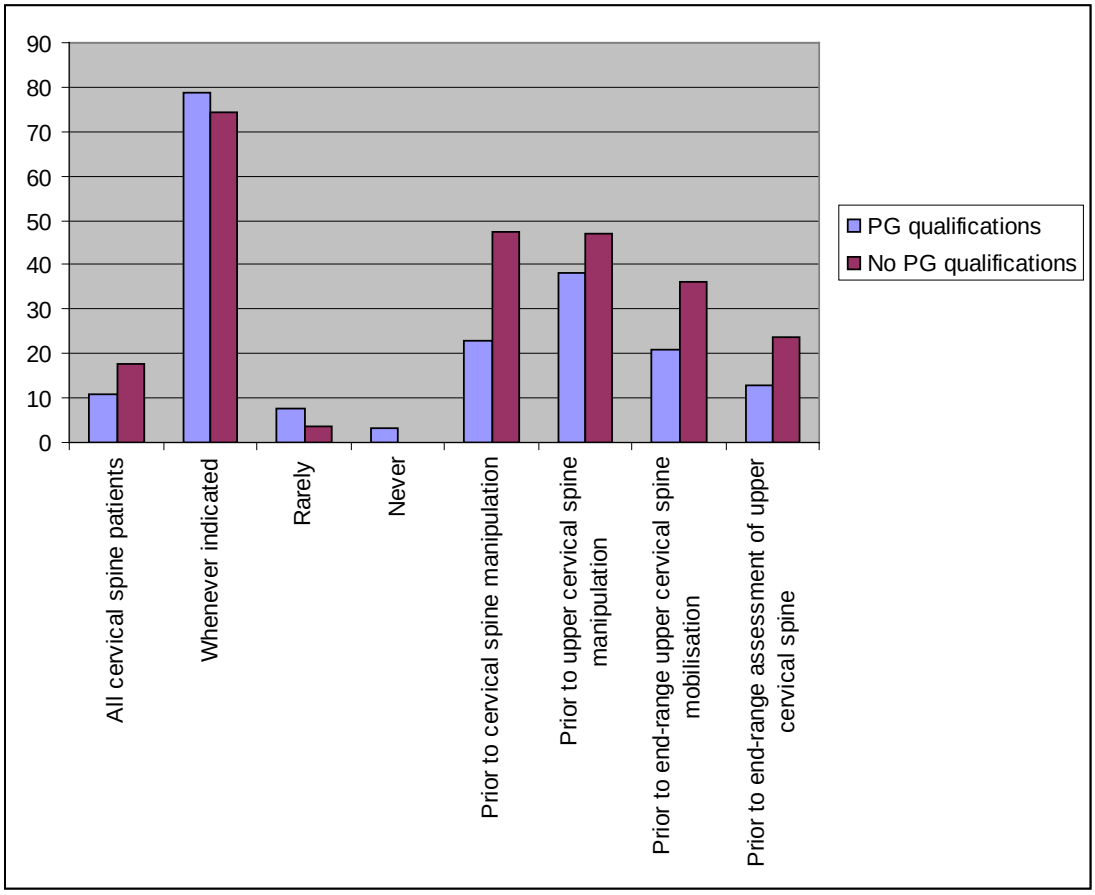
Abbreviation: CVI = craniovertebral instability

Figure 1. – Testing in presence of disorders associated with CVI



Abbreviations: PG = post-graduate, SLE = Systemic Lupus Erythematosus, WAD = Whiplash Associated Disorder

Figure 2. - Response to the question "When should CVI tests be used in clinical practice?"



Abbreviations: PG = post-graduate