THE VALIDITY OF CLINICAL TESTS FOR CRANIOVERTEBRAL INSTABILITY

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STATEMENT OF ORIGINALITY

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LIST OF ABBREVIATIONS

3D	three dimensional
AAD	atlantoaxial dislocation
AAS	atlantoaxial subluxation
ADI	atlantodental interval
A-P	anterior-posterior
BDI	basion dental interval
C1	first cervical vertebra
C2	second cervical vertebra
C3	third cervical vertebra
C6	sixth cervical vertebra
C7	seventh cervical vertebra
CI	confidence interval
CSA	cross sectional area
CT	computed tomography
CV	cervical vertebra
CVI	craniovertebral instability
DICOM	Digital Imaging and Communications in Medicine
FOV	field of view
ICC	intraclass correlation coefficient
mm	millimetres
MPA	Musculoskeletal Physiotherapy Australia

MRI	magnetic resonance imaging
MVA	motor vehicle accident
NA	not available
O	occiput
PADI	posterior atlantodental interval
PAL	posterior axial line
PD	proton density
PG	post-graduate
PLL	posterior longitudinal ligament
PPIVM	passive physiological intervertebral movement
r	Pearson's correlation coefficient
SD	standard deviation
SE	spin echo
SLE	systemic lupus erythematosus
T	Tesla
TE	echo time
TR	repetition time
TSE	turbo spin echo
WAD	whiplash associated disorder

ABSTRACT

The work contained in this thesis encompasses four studies to examine the validity of clinical testing for clinical instability of the craniovertebral region. Validity was explored through the utilisation and exploration of the constructs of convention, biological plausibility and empirical proof.

Consensual validity for clinical testing was explored through a survey of knowledge and attitudes to instability testing in a nationwide survey involving 1528 Australian physiotherapists. Details of respondents' understanding of the concept of instability, potential clinical presentations of patients with segmental hypermobility of the upper cervical spine, knowledge of published clinical stress tests, attitudes toward performing these clinical tests and inclusion of craniovertebral testing procedures in clinical guidelines were all assessed. On the basis of the information returned, it appears that the level of knowledge and understanding of these disorders, their clinical presentation, assessment and their risk factors is low. Understanding of the clinical testing manoeuvres was also poor, with the majority of respondents never applying these tests clinically. Completion of post-graduate coursework in musculoskeletal physiotherapy clearly improved exposure to these concepts and tests in respondents, but did not significantly affect use of testing for screening prior to treatment of the upper cervical spine overall. Consensual validity for clinical testing of craniovertebral instability must be considered to be low based upon the absence of agreement of the existence, presentation and assessment of the disorder.

Biological plausibility of testing was explored through examination of the morphology of the ligaments of the craniovertebral region. Observations made during the dissection of 11 cadaveric specimens were mostly in accordance with descriptions of the anatomy upon which the clinical test procedures have been based. However, the tectorial membrane was observed to be a more complex structure than has previously been understood with its fibre arrangement suggesting a role as a potentially limiting structure to axial rotation of the upper cervical segments. The existence of the previously reported 'atlantal' portion of the alar ligaments was also challenged. It was not observed in any specimen examined and the presence of these bands of tissue in any individual should be considered an anatomical variant. Overall, the gross morphology of the craniovertebral ligaments observed being consistent with the basis of the clinical tests confers face validity on the testing procedures.

The biological basis for testing was further explored using magnetic resonance imaging of six specimens at high (4.6T) and clinical (3.0T) definition acquisitions. Observations were confirmed by dissection and the accuracy of measurements and observations assessed. Again, the gross morphology was consistent with the structural assumptions underpinning the clinical tests, thus enhancing their face validity. Clinical acquisitions were compared using three different sequences to assess the optimal acquisition sequence to be used in subsequent patient studies. Proton density-weighted sequences were found to be superior in identification, delineation and measurement of the ligaments of this region.

Empirical proof that clinical tests are capable of influencing the ligaments of this region was addressed in the final study. The upper cervical spines of 16 healthy volunteers were imaged using MRI in both neutral and end-range clinical test positions. Ligaments were assessed using both direct measurement and indirect estimates of bony displacement. Statistically significant changes in ligament dimension were demonstrated for the ligaments in all tests examined. Direct evidence that the ligament may be influenced in a predictable manner through the imposition of clinical tests provides a strong case for the establishment of construct validity for each of these described clinical tests.

Through utilising the three axioms of convention, biological plausibility and empirical proof, a number of aspects of the validity of clinically testing the craniovertebral region for instability have been assessed. Whilst the consensual validity of testing appears poor, the case for face validity and construct validity for the ligament stress tests is strong suggesting that further research is warranted which may now potentially involve individuals with demonstrable instabilities of this region.

PUBLICATIONS AND PRESENTATIONS ARISING FROM THE WORK IN THIS THESIS

Parts of the work presented in this thesis have been published and/or presented in the following forums:

PUBLISHED PAPERS

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CONFERENCE PRESENTATIONS - ORAL

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