Computed Tomography Parameters for Atlanto-occipital Dislocation in Adult Patients: The Occipital Condyle-C1 Interval

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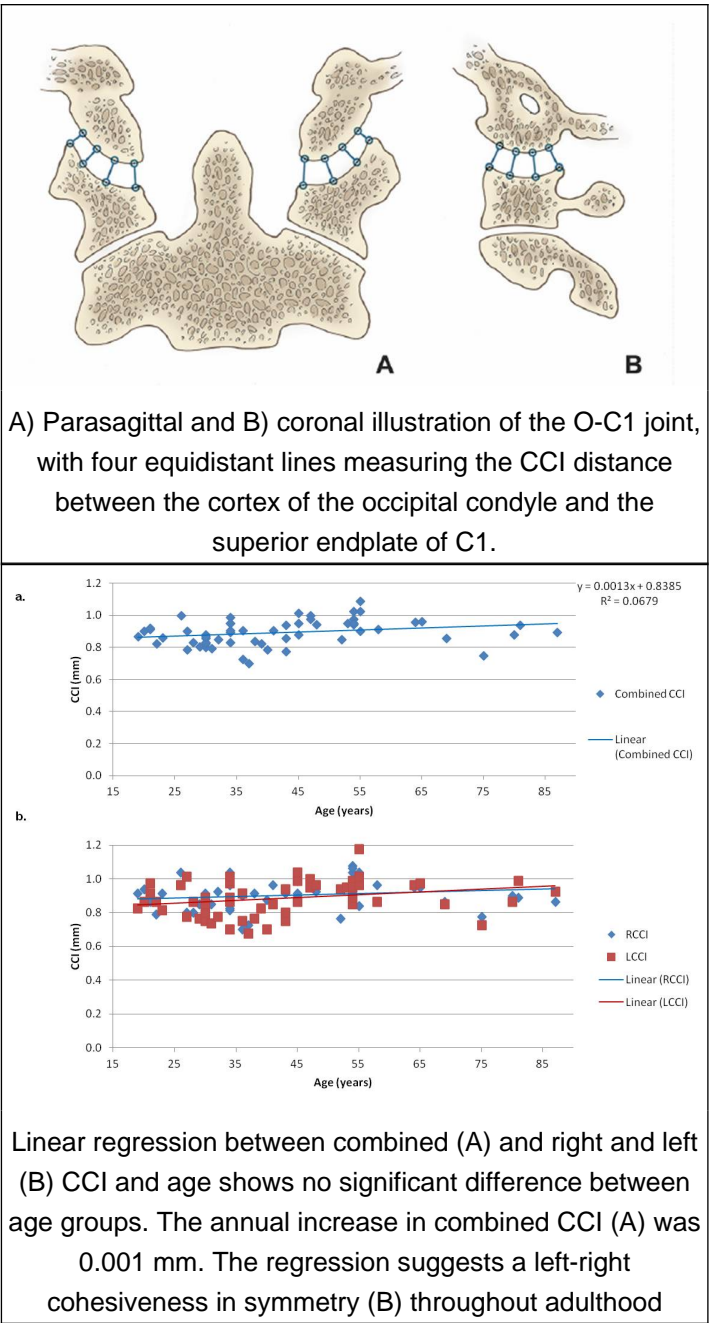
Introduction

Our goal was to identify and compare the normal occipital-condyle-C1 interval (CCI) in healthy adults with the CCI in adults with atlanto-occipital-dislocation (AOD) and establish a highly sensitive and specific cutoff value to diagnose AOD radiographically.

Methods

Eighty-one patients (59 non-AOD, 22 AOD), were included. Measurements obtained from thin-cut computed tomography scans of the craniovertebral joint to assess atlanto-occipital dislocation included: CCI, condylar sum, and "standard" diagnostic tools.

Results

Non-AOD patients were 50.8% (N=30) male and 49.2% (N=29) female, mean age was 42.4 ± 16 years (range 19–87 years). AOD patients were 45.5% (n = 10) male and 54.5% (n = 12) female with a mean age of 38.2 ± 9.7 years (range 20–56 years). Inter-rater reliabilities were all above 0.98 (95% CI) for CCI measurements. A total of 1296 measurements were made of the CCI in 81 patients. The mean CCI for non-AOD patients was 0.89 ± 0.12 mm, the single largest CCI measurement was 1.4 mm, and the largest mean for either right or left CCI was 1.2 mm. The mean condylar sum was 1.8 ± 0.2 mm, and the largest condylar sum value was 2.2 mm. Linear regression with age predicted an increase in CCI of 0.001 mm/year (p < 0.05). The mean CCI in AOD patients was 3.35 ± 1.8 mm (range 1.5 mm to 6.4 mm). A cutoff value for AOD was determined at 1.5 mm for the CCI and 3.0 mm for the condylar sum, both with a sensitivity of 1 and false-negative rate of 0. Sensitivity for Powers', Wholey's, Harris', Sun's, Wackenheim's, and Lee's tests were determined to be 0.55, 0.46, 0.27, 0.23, 0.41, and 0.41, respectively.

A) Parasagittal and B) coronal illustration of the O-C1 joint, with four equidistant lines measuring the CCI distance between the cortex of the occipital condyle and the superior endplate of C1.

Linear regression between combined (A) and right and left (B) CCI and age shows no significant difference between age groups. The annual increase in combined CCI (A) was 0.001 mm. The regression suggests a left-right cohesiveness in symmetry (B) throughout adulthood

Conclusions

The revised CCI (1.5 mm) and condylar sum (3.0 mm) cutoff values have the highest sensitivity and specificity for the diagnosis of AOD in the adult population.

Learning Objectives

To determine whether a highly sensitive and specific cutoff value for diagnosing AOD with radiological scans can be defined.

Sensitivity and false-negative rates for AOD using the CCI from 22 AOD patients		
	Sensitivity (%)	False-negative rate (%)
CCI ≥ 1.5 mm	100	0
CCI ≥ 2 mm	90.1	13.6
CCI ≥ 2.5 mm	81.8	22.7
CCI, occipital condyle-C1 interval		

ROC analysis for CCI yields a cutoff of 1.3 mm (100% sensitivity and specificity) with an area under the curve (AUC) of 1.0 (95% CI = 0.96–1.0). Pairwise comparison of ROC curves (CCI vs. standard tests) shows CCI is significantly more accurate than the other standard tests for diagnosing AOD (p 0.05).