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Post-Traumatic Atlanto-Axial Instability: A Combined Clinical and Radiological Approach for the Diagnosis of Pathological Rotational Movement in the Upper Cervical Spine

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Background: Post-traumatic rotational instability at the atlanto-axial (C1-2) joint is difficult to assess, much less quantify, due to the orientation and motion plane of the joint. We have previously demonstrated that a novel orthopaedic test of rotational instability, the atlas-axis rotational test (A-ART), may have utility in identifying patients with imaging evidence of upper cervical ligament injury. In the present investigation, we assessed the correlation between a positive A-ART and a CT scan assessment of the relative quantity of residual C1-2 overlap, as a percent of the superior articulating facet surface area of C2.

Objective: A retrospective review was conducted of consecutive patients presenting to a physical therapy and rehabilitation clinic, for chronic head and neck pain after whiplash trauma.

Methods: The primary inclusion criteria were that the patient had undergone both a clinical evaluation with A-ART and a dynamic axial CT to evaluate for C1-2 residual facet overlap at maximum rotation. The records for a total of 57 patients (44 female/13 male) were identified who fit the selection criteria, and among these, there were 43 with a positive A-ART (i.e., "cases") and 14 with a negative A-ART (i.e., "controls).

Results: The analysis demonstrated that a positive A-ART was highly predictive of decreased residual C1-2 facet overlap: the average overlap area among the cases was approximately one-third that of the control group (on the left, 10.7% versus 29.1%, and 13.6% versus 31.0% on the right).

Conclusion: These results suggest that a positive A-ART is a reliable indicator of underlying rotational instability at C1-2 in patients with chronic head and neck symptoms following whiplash trauma.

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Fig. 1

Figure 1. Examiner hand position during the atlas-axis rotational test (A-ART). While standing behind the seated patient, the examiner places both hands on the occipito-cervical junction, opposite the side of head rotation. With the 2nd and 3rd fingers, the examiner's lower hand (right, in the photograph) is used to stabilize and traction posteriorly against the transverse process of C2. The 2nd and 3rd fingers of the other hand (left, in the photograph) contact the mastoid process of the occiput and lateral mass of the atlas, respectively. The test is then performed with varying angles of cervical rotation, to locate the position that yields maximal movement between C1 and C2, and graded by the amount of C1 versus C2 movement described in the text. For the purposes of the present study, a grade of 0–1 equates to little perceived relative rotational motion between the transverse processes of C1 and C2 (subjectively gauged, less than ~5 mm), and 2 or more exceeds this threshold.

Fig. 2

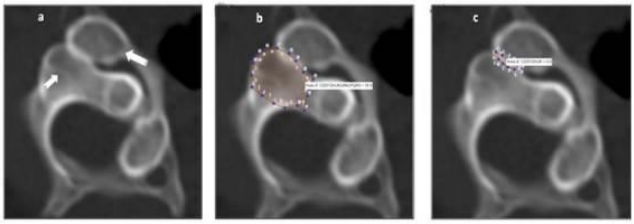

Figure 2. (a) CT scan, axial view, with the patient's head rotated maximally to the left. The notched arrow points to the right superior articulating facet of C2, and the striped arrow points to the right inferior articulating facet of C1. (b) The same scan as in Figure 2a, with the outer margin of the right superior articulating facet of C2 outlined using the GeoGebra software, resulting in an area of 18.9 cm^2. (c) The same scan as depicted in Figure 2a and b, but with the residual overlapping area of C1 and C2 outlined using the GeoGebra software, resulting in an area of 0.9 cm^2. The area of residual overlap, as a percent of the total area of the superior articulating facet of C2, is calculated as (0.9/18.9 × 100%), and is thus 4.8%. (R—right, L—left, A—anterior, P—posterior).

Fig. 3

Table 1. Mean Values (Standard Deviations, SD) of percent of atlanto-axial residual facet overlap at the extreme of right and left rotation, and average difference between the 2 groups (95% confidence intervals [CI]), and age distribution among 43 cases and 14 controls.

	Mean Values (SD)				
	N	**Female/Male**	**R Overlap**	**L Overlap**	**Age (Years)**
Cases	43	33/10	13.6% (5.81)	10.7% (5.06)	39.8 (12.27) Range 15–70
Controls	14	11/3	31.0% (10.11)	29.1% (11.15)	47.9 (12.83) Range 28–77
p-value			<0.001	<0.001	0.0499
Mean difference (95% CI)			17.4% (11.5, 23.3)	18.4% (12.0, 24.8)	8.1 years (0.02, 16.2)