

Atlantodontoid osteoarthritis: comparison of lateral cervical projection and CT

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Summary. The purpose of this study was to assess the accuracy of lateral cervical spine radiography in the detection of degenerative atlantodontoid (AO) osteoarthritis, with CT as gold standard. In 50 patients, lateral radiographs and CT of the AO joint were blindly and independently graded by two radiologists: 0 = normal, 1 = mild degenerative disease, 2 = severe degenerative disease. Radiography was most accurate in distinguishing absent or mild disease from severe disease (83% sensitivity, 84% specificity). Sensitivity in distinguishing absent disease from mild or severe disease was 87%. Specificity, however, was low (52%), due to overestimation of the degenerative involvement on radiography. It is concluded that conventional radiography is a useful technique in screening for AO osteoarthritis, especially in severely degenerated joints. However, CT provides the best radiographic detail necessary for accurate diagnosis.

Key words: Spine – Osteoarthritis – Atlanto-axial joint – Computed tomography (CT)

Since the early 1940s, several authors have suggested a possible correlation between high cervical/suboccipital headache with motion disturbance and atlantodontoid (AO) osteoarthritis [1–4, 10, 12]. Patients with symptoms referable to the upper cervical spine or suboccipital area are routinely first evaluated with conventional radiography. The greatest value of this diagnostic modality lies in providing a rapid and inexpensive screening. Only the lateral projection can provide adequate information about the anatomical relationships at the AO joint because of

obscuration of this joint by overlying osseous structures on the frontal view, and inadequate visualisation on the oblique views. Degenerative abnormalities that can be seen on a lateral radiograph include narrowing or obliteration of the space between the anterior arch of the atlas and the odontoid process, cortical thickening and osteophytosis [8].

To our knowledge, an evaluation of the accuracy of lateral cervical radiographs in the detection of AO osteoarthritis has not been reported in the literature. Prompted by the frequent and clear demonstration of degenerative changes at the AO joint in patients who underwent computed tomography (CT) of the craniovertebral junction, we undertook a prospective study to evaluate the sensitivity and specificity of lateral cervical spine radiographs in the assessment of degenerative AO osteoarthritis. We used CT as the quality standard.

Materials and methods

The study population included 50 patients (29 women and 21 men, aged 21–86 years) referred for a CT scan of the brain, paranasal sinuses, craniovertebral junction or cervical spine between September 1993 and January 1994. Patients were included in the study if a lateral cervical spine radiograph had been performed in the 1 year preceding the CT examination. In all patients, at least two CT slices through the anterior C1–C2 joint were performed. All CT examinations were performed by means of standard techniques (420 mAs, 120 kVp; Somatom plus-S, Siemens, Erlangen, Germany) with 5-mm parallel sections. The AO joint was photographed at both soft-tissue and bone window settings in each patient. All CT slices and lateral radiographs of the cervical spine were blindly and independently interpreted by two experienced radiologists (W.M.C.M. and J.S.). The names and ages of the patients were masked.

The degree of abnormality was scored on a three-point scale: 0 = normal, 1 = mild degenerative disease, 2 = severe degenerative disease. Normal referred to a normal AO joint space; mild degenerative disease referred to narrowing of the joint space and some hypertrophy of the superior, inferior and lateral articular surface of the joint; severe degenerative disease referred to obliteration of the joint space, sclerosis and marked osteophytes arising from the lat-

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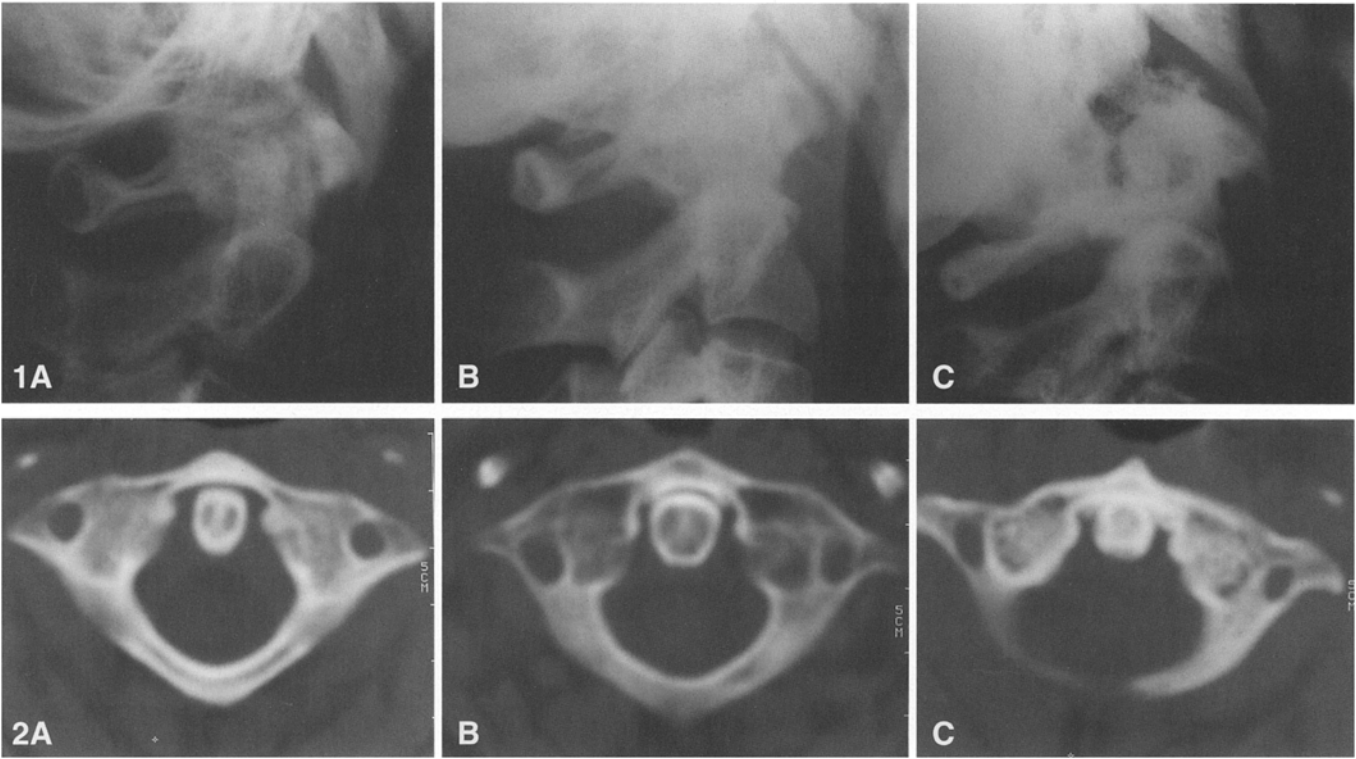


Fig. 1. Degree of degenerative involvement at the AO joint as seen on lateral radiographs of the cervical spine. **A** 0 = normal; **B** 1 = mild degenerative disease with narrowing and hypertrophy; **C** 2 = severe degenerative disease with obliteration of the joint space, osteophytes and sclerosis

Fig. 2. Degree of degenerative involvement at the AO joint as seen on CT scans. **A** 0 = normal; **B** 1 = mild degenerative disease with narrowing and hypertrophy; **C** 2 = severe degenerative disease with obliteration of the joint space, osteophytes and sclerosis

eral, superior and inferior surface of the anterior arch of the atlas (Figs. 1, 2).

For both imaging methods, kappa values for interobserver agreement and for agreement between the two methods scored by each observer were calculated. Additionally, sensitivity, specificity, positive predictive value and negative predictive value for each group (normal vs mild or severe, and normal or mild vs severe) were determined with CT as gold standard.

Results

All CT scans and lateral radiographs demonstrated the AO joint sufficiently well to permit scoring. On CT, the two observers showed agreement in 44 of 50 AO joints (88%). There was a disagreement within one grade in the remaining 6 patients (12%). The kappa value was 0.80, indicating good interobserver agreement. Regarding the lateral radiographs of the cervical spine, there was complete interobserver agreement in the scores of 32 of 50 AO joints (64%). There was disagreement within one grade in the remaining 18 patients (36%). The kappa value on lateral radiographs was 0.46, indicating moderate interobserver agreement (Fig. 3).

		Observer B			
		<u>Lateral radiography</u>			
			0	1	2
Observer A	0		12	6	0
	1		4	10	4
	2		0	4	10
			16	20	14
					50
					Kappa = 0.46
		<u>CT</u>			
			0	1	2
Observer A	0		25	1	0
	1		3	11	0
	2		0	2	8
			28	14	8
					50
					Kappa = 0.80

Fig. 3. Interobserver agreement (kappa) in the evaluation of degenerative involvement in atlantoodontoid osteoarthritis on lateral radiographs and CT (0 = normal, 1 = mild degenerative disease, 2 = severe degenerative disease)

Both observers evaluated 50 AO joints on CT images and lateral radiographs. The first observer (A) achieved perfect agreement in 31 cases (67%); in 14 cases there was discrepancy of one grade and in 5 cases discrepancy

		CT				
		0	1	2		
Lateral radiography	0	15	2	1	18	
	1	7	9	2	18	
	2	4	3	7	14	
		26	14	10	50	$Kappa = 0.42$

		CT				
		0	1	2		
Lateral radiography	0	13	3	0	16	
	1	13	7	0	20	
	2	2	4	8	14	
		28	14	8	50	$Kappa = 0.34$

Fig. 4. Agreement (*kappa*) between lateral radiography and CT scored by observer A and observer B (0 = normal, 1 = mild degenerative disease, 2 = severe degenerative disease)

of two grades. The radiographic score was higher than CT 14 times and 5 times the opposite occurred. The kappa coefficient of agreement between the two methods was 0.42. The second observer (B) achieved perfect agreement in 28 cases (56%); with one grade discrepancy in 20 cases and two grades discrepancy in 2 cases. The radiographic score was higher than CT 19 times, and 3 times the opposite occurred. The kappa coefficient of agreement between the two methods for observer B was 0.34 (Fig. 4). Thus, both observers showed moderate agreement between the two methods.

Table 1 summarises the radiographic interpretations of both observers in distinguishing degrees of degenerative involvement (normal vs mild or severe, and normal or mild vs severe) at the AO joint, using CT as gold standard. Sensitivity in distinguishing normal vs mild or severe, and normal or mild vs severe, as well as specificity in the latter group, was high. On the other hand, specificity in distinguishing normal vs mild or severe was relatively low.

Table 1. Analysis of radiographic interpretations in distinguishing degrees of degenerative involvement at the atlantodontoid joint, using CT as gold standard

		Sensitivity (%)	Specificity (%)	Positive predictive value (%)	Negative predictive value (%)
Normal vs mild or severe	Observer A	21/24 = 88	15/26 = 58	21/32 = 66	15/18 = 83
	Observer B	19/22 = 86	13/28 = 46	19/34 = 56	13/16 = 81
Normal or mild vs severe	Observer A	7/10 = 70	33/40 = 83	7/14 = 50	33/36 = 92
	Observer B	8/8 = 100	36/42 = 85	8/14 = 57	36/36 = 100

Discussion

In 1942, Olsson [7] discussed the radiographic findings in degenerative arthritis of the AO joint and suggested that a decreased range of motion and high cervical neck pain could be due to AO osteoarthritis.

Sager [9] found that degenerative changes in the AO joint are more common than in the lateral atlantoaxial or apophyseal joints of the cervical spine, probably due to different patterns of stress and excursion. Additionally, Fischer and Schmidt [2] noted that degenerative changes at the AO joint occur frequently in the elderly and can be predisposed to or accelerated by a variety of developmental and/or acquired factors. Harata et al. [6], in a study of 31 patients with AO osteoarthritis, found that degenerative abnormalities occur predominantly between the ages of 50 and 70 years without sex difference. He reported several patients with AO osteoarthritis complaining of suboccipital headache. He also found, on pathological examination of cadaver specimens, that AO osteoarthritis showed the same histologic changes found in osteoarthritis of the other joints.

In a previous study, we evaluated diverse pain syndromes and the coexistence of cervical spondylarthrosis in 40 patients with severe AO osteoarthritis [11]. Our findings showed that suboccipital or high cervical pain is a common symptom in patients with severe AO osteoarthritis. Furthermore, marked degenerative abnormalities at the AO joint occurred in the absence of other radiographic degenerative abnormalities of the cervical spine in 20% of patients.

CT is an excellent imaging modality for visualising the AO joint [5, 12]. Conventional radiography of the cervical spine has significant limitations in the evaluation of the AO joint. Overlying bony structures can make it impossible to identify anatomic abnormalities on frontal or oblique views. Transbuccal views are unrevealing of the AO joint space, but may show a horseshoe-like calcification around the odontoid process in AO osteoarthritis, representing osteophyte formation on the superior and lateral border of the anterior arch of the atlas.

No previous study has assessed the accuracy of conventional radiography in the detection of AO osteoarthritis. In this study we used CT as the gold standard with which to investigate and compare the sensitivity and specificity of conventional lateral radiography of the cervical spine in depicting degenerative changes at the AO joint. Our findings indicate good interobserver agreement in the evaluation of degenerative AO disease on CT. In evaluating AO osteoarthritis on lateral radiographs, expe-

rienced radiologists achieved moderate interobserver agreement. Furthermore, no disparity greater than one grade was noted. On the other hand, both observers tended to overestimate the degree of degenerative involvement on lateral radiographs.

The study further indicates that lateral radiography of the cervical spine is useful for the detection of severe degenerative disease. On the other hand, the specificity of lateral radiography in distinguishing absent from mild or severe degenerative disease is relatively low owing to the tendency for overestimation of the disease; no abnormalities, as graded with CT criteria, was sometimes graded as mild on the basis of conventional radiographs.

In conclusion, lateral radiography of the cervical spine in patients with pain related to the suboccipital area is a rapid, inexpensive and valuable modality in screening for degenerative disease, especially severe degenerative changes at the AO joint. However, CT is best for assessment of this condition.

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