

Original Article

Sensitivity of Lateral View Cervical Spine Radiographs Taken in the Neutral Position in Atlantoaxial Subluxation in Rheumatic Diseases

M. Kauppi^{1,3} and M. H. Neva²

Departments of ¹Rheumatology and ²Surgery, Rheumatism Foundation Hospital, Heinola and ³Department of Medicine, University of Oulu, Finland

Abstract: The value of lateral view cervical spine radiography in various positions of the neck was assessed in patients with rheumatoid atlantoaxial subluxation (AAS). We wanted to find out how much information is lost if only neutral position radiographs are used. The series consisted of 65 rheumatoid patients with unstable AAS. Lateral view cervical spine radiographs were taken in the neutral position and during flexion and extension. Neutral position radiographs would have failed to confirm the diagnosis of AAS in 31 cases (48%) and would have failed to record its true severity in 43 cases (66%); their diagnostic sensitivity was 52%. The sensitivity of the neutral radiographs in showing the reversibility of AAS was 48%. Routine cervical spine radiography of rheumatoid patients should include lateral view radiographs taken during flexion and extension. The result may be applied to magnetic resonance imaging, which is usually performed in the neutral position.

Keywords: Atlantoaxial subluxation; Cervical spine; Radiography; Rheumatoid arthritis

Introduction

Subluxations between cervical vertebrae are common in rheumatoid arthritis (RA) and are also seen in other rheumatic diseases and some other conditions (e.g. in

Down's syndrome) [1–6]. Anterior atlantoaxial subluxation (AAS) is the most frequent cervical abnormality in RA, with a reported prevalence of 19–70% depending on the patient group studied and the diagnostic methods used [3]. AAS develops if the stabilising ligaments of the atlantoaxial area are injured, enabling the atlas to subluxate anteriorly in relation to the axis. Subluxation is usually most extensive during flexion and may disappear during extension. Diagnosis of AAS is performed by conventional radiography. The subluxations may cause severe complications including tetraplegy and death, and thus cervical spine radiography is indicated quite often in clinical rheumatology [1–3].

Cervical spine radiographs may be taken in several projections and in neutral or dynamic positions [7,8]. A routine examination may include several radiographs, but there is a need to limit their number to spare unnecessary radiation, especially if a patient (e.g. with RA) will probably need repeated examinations during the course of the disease. The lateral view radiograph in the neutral position is the basic examination in general clinical work, but the flexion radiograph is especially useful in cases with suspected subluxation between cervical vertebrae. In most rheumatological units (but not in all of them) the lateral view radiograph during flexion is taken as a routine part of the examination, while flexion radiographs are rarely taken in other clinics, not even in patients with RA. How much information is lost, if only neutral position radiographs are used? The value of lateral view cervical spine radiography in various positions of the neck was assessed here in patients with rheumatoid diseases. The result may be applied to computed tomography and magnetic resonance imaging, which are usually performed in the neutral position.

Patients and Methods

The series consisted of 65 consecutive patients (53 women and 12 men) with unstable AAS treated at the Rheumatism Foundation Hospital, Heinola, Finland. Their mean (SD) age was 51.9 (12.4) years and the mean (SD) duration of the disease was 19.5 (9.5) years. Sixty-three patients had RA and two had RA type chronic polyarthritis resulting from other rheumatic diseases (psoriatic arthritis and mixed connective tissue disease). None of them had neurological symptoms or signs suggesting cervical myelopathy, but most of them had or had had cervical pain.

Lateral view cervical spine radiographs in the neutral position and during flexion and extension were taken using a 150 cm tube-to-plane distance. The distance between the posterior aspect of the anterior atlas arch and the anterior aspect of the axis (AA distance) was measured. AAS is diagnosed if the AA distance exceeds 3 mm [4,7], but we excluded the most slight cases to find true unstable cases. The patient was included in the

series if this distance was at least 5 mm during flexion and 3 mm or less during extension, such that the difference between the flexion and extension values (=the instability) was 3 mm or more (Fig. 1).

The AA distance in flexion radiographs was chosen as the gold standard in diagnosing AAS and its severity, and extension radiographs as the gold standard in evaluating reversibility of the subluxation, i.e. severity of the instability. The qualitative (diagnostic) and quantitative (ability to measure the true extent of AAS) values of the neutral position radiographs were assessed by comparing them with the respective flexion and extension radiographs. Sensitivity was calculated as true-positive/(true-positive + false-negative) × 100 (%) and specificity as true-negative/(true-negative + false-positive) × 100 (%).

Results

The mean (SD) AA distance was 7.4 (1.5) mm during flexion, 1.1 (0.9) mm during extension and 4.1 (3.1) mm in the neutral position. The differences between flexion, extension and neutral values were statistically significant ($p < 0.0001$, *t*-test). The mean (SD) AA instability was 6.4 (1.8) mm.

The maximal AA distance was always seen in lateral view radiographs taken during flexion and thus is a true indication of the presence of AAS. This maximal AA distance was also seen in the neutral position radiographs in 22 out of 65 cases and an abnormal, but shorter AA distance was seen in 12 additional cases, thus constituting 34 true-positive cases of AAS. The sensitivity of neutral position radiographs in diagnosing AAS was 52% (95% confidence interval (CI) 39.5 to 64.9), and the sensitivity of measuring the true extent of the abnormality was 34% (95% CI 22.6 to 46.6) (Table 1). The specificity of neutral position radiographs was 100%, because false-positive subluxations were obviously not seen.

The shortest AA distance of these patients was seen in lateral view radiographs taken during extension, which was supposed to be the true smallest AA distance demonstrating reversibility of AAS. In 31 out of 65 cases the AA distance was normal (3 mm or less) in the neutral radiographs, and in 25 of the 31 cases the neutral and extension values were identical. The sensitivity of neutral position radiographs in showing reversibility of

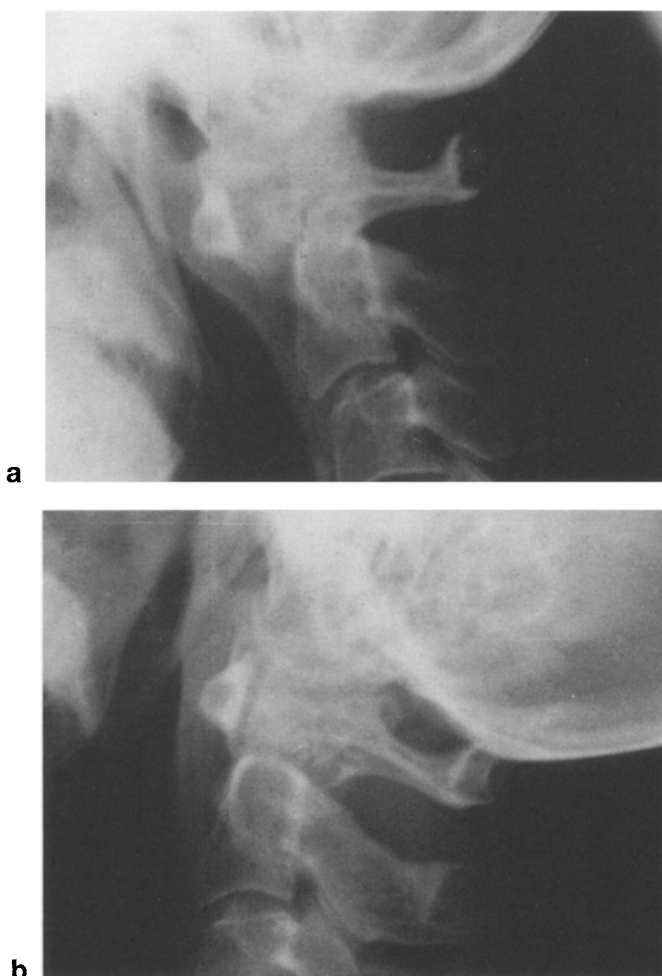


Fig. 1. (a) Lateral view radiography taken during flexion. A 9 mm atlantoaxial subluxation is seen. (b) Lateral view radiography taken during extension demonstrates reduction of the atlantoaxial subluxation. On a neutral lateral radiograph, the atlantoaxial distance could be the same as in flexion, extension, or somewhere in between.

Table 1. The value of atlantoaxial (AA) distance measured on lateral view radiographs taken in the neutral position compared with the respective flexion and extension values

| AA value in neutral position | Number of cases (%) |
|---|---------------------|
| Same as during flexion | 22 (34) |
| Pathological but less than during flexion | 12 (18) |
| Normal but more than during extension | 6 (9) |
| Same as during extension | 25 (38) |

the abnormality was 48% (95% CI 35.1 to 60.5) (Table 1) with a specificity of 100%. In only 18 cases (28%) was the AA distance in the neutral position intermediate to the flexion and extension values (Table 1, Fig. 1).

Discussion

Arthritis in the cervical spine is very characteristic of RA [1–4]. The incidence of cervical subluxations is 15% after 3 years of RA and increases when inflammation continues in the area [9]. The prevalence of anterior AAS was 32% in a population-based study of RA patients [4]. AAS is usually unstable but may become stabilised spontaneously, mainly due to the development of atlantoaxial impaction, which was reported to occur in 15% of AAS cases [10–12]. If AAS is diagnosed, active conservative treatment should be started [13,14], because AAS may cause severe complications and in selected cases the area must be stabilised surgically.

Cervical subluxations are common and clinically important in RA, but the patient may sometimes have no symptoms; for this reason, cervical spine radiographs should be taken at least occasionally for every patient with RA [13,14]. Cervical or occipital pain and neurological complaints are common indications for radiography, which should also be performed routinely before any major surgical operation because the anaesthesiologist should know the cervical status [13,15].

The intention was that the study group should consist only of cases with undoubtedly unstable AAS, and thus the inclusion criteria were a maximal AA distance of at least 5 mm, and that it should be reversible to the normal situation (3 mm or less). In this type of series it was possible to assess the value of dynamic radiography.

If only neutral position radiographs would have been taken of our patients, the AAS diagnosis would have been missed in 31 cases (48%) and its true severity in 43 cases (66%); thus lateral view radiographs taken during flexion are essential in AAS cases. Because AAS has been reported to exist in every third RA case, each RA patient is a potential AAS case [4]. We propose that flexion radiographs are always needed when cervical spine radiography is performed in RA patients. The flexion position is not advisable for RA patients, but its duration is minimal during the examination, compared with flexion positions occurring in daily life [13], and there is no true risk of complications from flexion during radiography if the patient performs the flexion voluntarily.

The poor diagnostic value of the neutral position examination in patients with AAS should be considered when computed tomography or magnetic resonance imaging is used [16,17]. The supine position used during these examinations may also reduce the detection rate of AAS, compared with plain radiographs taken in the upright position. In the supine position, gravity may be responsible for a partial or complete reduction of the

AAS that is clearly evident on the upright flexion lateral radiographs, in which the gravity even increases the strength and range of flexion.

If AAS is diagnosed, it is important to know whether or not the situation is stable [10,13]. For that purpose, lateral view radiographs during extension are needed, because neutral radiographs would have missed the reversibility in 34 cases (52%).

Anterior AAS is the most frequent rheumatoid abnormality of the cervical spine in RA, but several other types of abnormality may also occur in which dynamic radiography would be useful [1–4,18]. Vertical atlantoaxial dislocation (atlantoaxial impaction) occurs in 4–35% of patients with RA and may be exaggerated during flexion [3,4,18]. Infrequent (prevalence 3% or less) posterior AAS is best diagnosed by lateral view radiography taken during extension [3,4,7,8,19]. Dynamic lateral view radiographs are also important in patients with subaxial subluxations (prevalence 7–29%) [3,4]. The anteroposterior open-mouth view radiograph is needed in diagnosing lateral and rotational AAS [7,8]. The stabilising effect of a stiff collar in patients with unstable AAS may be predicted by a lateral view radiograph taken in the neutral position [13].

We conclude that when cervical spine radiographs are taken of a rheumatoid patient, lateral view radiographs should routinely be included, at least during flexion and preferably also during extension. If unstable AAS is diagnosed, a neutral position radiograph may be a useful aid in planning the treatment, but it is not always needed. The need for other projections may depend on the clinical situation.

Acknowledgements. M. K. is grateful to the doctors of the Warsaw Institute of Rheumatology, Warsaw, Poland for the inspiring discussions and their wonderful hospitality during my visit there. We would also like to thank Pekka Anttila, MD, for his comments on most of the radiographs included in the study, and Hannu Kautiainen, BA, for the statistical assistance.

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*Received for publication 27 July 1997
Accepted in revised form 24 October 1997*