THE USE OF MOBILITY PROVOCATION RADIOSTEREOMETRY IN 45 ANTERIOR CERVICAL SPINE FUSIONS

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**Introduction**. Abnormal motion on flexion-extension radiographs is often used to indicate instability in the cervical spine. This method is also used to evaluate healing after fusions. Correct interpretation of these radiographs is important, because an unhealed fusion is potentially unstable and eventually a source of pain. The true measuring errors by using conventional radiography to examine motions of the vertebrae in the cervical spine is not known. In earlier studies, RSA has been used to measure deformations over a period of time after anterior cervical spinal fusions. No previous comparison between conventional radiography and radiostereometry during mobility provocation test of cervical spine motion has been carried out. This study was done to evaluate if the mobility provocation RSA is more useful to analyze the time of healing of a fusion in comparison with the previous deformation studies. Furthermore, we compared the results of the mobility provocation RSA to data obtained using a method based on conventional flexion-extension radiography.

**Material and methods**

Between January 1994 and October 1995, 45 consecutive patients referred to our department with neck pain and arm radiculopathy were operated with disc excision and anterior fusion. The study includes 23 female and 22 men with mean age of 42 (range 25-60) years. 24 of the patients were randomized to stabilization with a graft and a CSLP plate (Synthes, Switzerland) and 21 patients to grafting without any internal fixation. 27 patients were operated on one level, 15 with plate fixation (WP), 12 without plate fixation (WOP) and 18 on two levels (9 WP, 9 WOP).

**Radiostereometric Analysis**. The patients were examined at 4 different end positions of motion (flexion, extension, rotation right and left) using radiostereometry. These examinations were done 3 and 12 months postoperatively. The stereoradiographs were obtained with the patient standing. Motions occurring between maximum flexion to extension and maximum rotation of the head from right to left was computed. In earlier studies we recorded the deformations over time (between the postoperative and the subsequent follow up examinations). Data from these deformation studies were used to evaluate if mobility provocation-radiographs added further information as regards the stabilization of the fusion. The precision of the measurements has previously been determined in 36 double examinations. The motions were determined as significant if they exceeded the 99 % confidence limits of the error calculated.

**Conventional Radiography**. At 3 months 37 cases were examined with conventional flexion-extension radiographs. The angular motion between the flexion- and extension radiographs was recorded using a pencil, a ruler and a goniometer by recording the angulation between lines drawn along the inferior endplates of the vertebrae included in the fusion.

**Results**

**Mobility provocation RSA**

- **Rotation right–left test**. The three-dimensional motions between the vertebrae did not differ between patients operated with a plate and those operated without plate fixation (Mann-Whitney-U-test). Ten cases showed significant motions at 3 months. Of these ten cases there were five cases that showed significant motions also with the flexion to extension mobility provocation RSA test. In 2 cases, significant motions were revealed despite that there were no significant deformations between 6 weeks and 3 months post operatively. In 11 cases this mobility test did not reveal any significant motions even though a continuous deformation between the vertebrae during the following 3 months was noted. At 12 months, 3 patients showed significant motions between right to left rotation of the head with only one of them showing significant motions on the extension to flexion test. One of these 3 patients displayed a significant deformation up to the 12-month follow up. The other two patients displayed no deformation after 3 months.

- **Flexion to extension test**. The use of plate fixation did not influence the inducible motions at any of the two follow-up occasions with this test (Mann-Whitney-U-test). In one case significant motion was revealed (at three months) despite that there was no deformation after 6 weeks on migration studies. In 8 cases the flexion-extension RSA test did not reveal any motion despite that there was a continuous deformation over the fusion during the following period of 3 months. At 12 months, 3 patients showed significant motions in flexion to extension. The mobility provocation test was considered to add information in two of these cases, where migration studies had indicated stability between 3 - 12 months and 6 - 12 months, respectively. However, continued deformation studies in these 2 cases revealed significant motions during the interval 12-24 months in one of them.

**Conventional radiography vs. radiostereometry**

The mean angular motion between flexion and extension measured with the conventional method at 3 months was 1.7 degrees (range 0-5, SD 1.2). No translations could be detected on plain flexion-extensions radiographs. The mean difference between angular motions recorded on plain radiographs and rotations around the transverse axis in flexion to extension recorded with RSA was 1.6 (range 0.04 – 8.04, SD 2.1) degrees. The corresponding 95 and 99 per cent confidence limits for difference between the two methods were 5.8 and 7.2 degrees respectively.

**Discussion**

In the present study several patients displayed significant motions on the 3 month (20 patients) and 12 (4 patients) month mobility provocation RSA. These inducible motions were not significantly influenced by the use of a plate. There was, however, a tendency for the patients operated without a plate to stabilize earlier than the patients without plate fixation, when only one level had been fused. The addition of mobility provocation RSA to the evaluation of patients in the study group did not seem to add much information about the healing time of the fusion. The small motions recorded with mobility provocation RSA of cervical spine fusions and the poor precision of conventional radiography question the use of these methods to evaluate postoperative healing, unless there is a gross instability. However, the use of RSA in the routine settings is not cost effective. RSA is time consuming and quite expensive and can therefore only be used for research purposes. As a clinician we still have to use conventional flexion-extension radiographs to evaluate fusions, but with an increased awareness of its limitations.

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