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Standardized Measurement of Lateral Spinal Flexion and Its Use in Evaluation of the Effect of Treatment of Chronic Low Back Pain

Elna Jonsson,[1] Ingvar Ljungkvist[2] and Jern Hamberg[1]

[1]*Alfta Rehab Center, Alfta, Sweden, and* [2]*Department of Anatomy, Uppsala University, Uppsala, Sweden*

ABSTRACT

To evaluate the effect of treatment of chronic low back pain, the report of subjective pain needs to be supplemented by objective information such as, for example on changes in the functional capacity of the spine. This paper presents a simple but reliable method in this respect i.e. by measuring the range of lateral spinal flexion. When two independent testers used the method the correlation coefficient between their recorded values was 0.98. In patients with chronic low back pain, the method showed that the range of lateral flexion increased after treatment. At linear regression analysis a significant correlation was found between increased range of motion and reduced pain.

INTRODUCTION

Evaluation of the effect of treatment of chronic back pain is often based on the patient's pain report. This information, which is subjective, needs to be supplemented by more objective observations such as, for example on changes in the functional capacity of the spine (4,8,10). In assessment of the functional capacity of extremity joints, measurements of the range of motion provide important information. This must also be applicable to the spine, and indeed increased spinal mobility and improvement (decreased pain) seem to accompany each other (4,5,8).

The mobility of the spine can be measured in several ways, but

few are simple enough for use in clinical practice. Measurement of forward flexion has long been employed as an index of objective spinal function and is in common use in the clinical setting. However, measurement of lateral flexion might give a better picture of spinal mobility, since in contrast to forward bending it will not be augmented to any appreciable degree by hip joint movement. Furthermore, it is often easier to get patients with back pain bend to the side than forwards.

Good correlation has been found between clinical and radiological measurements of lateral spinal flexion (9). The clinical measurements of lateral flexion reported hitherto, however, have shown only slightly more than an acceptable degree of concordance between different testers measuring this movement (2,3,6,9,11).

The purpose of the present study was therefore to work out a simple method by which lateral flexion can be measured with a higher reproducibility than has been reported previously. Further, the method was to be applicable for evaluating the effect of treatment of patients with chronic low back pain. The development of the method was based on the premise that checking that lateral flexion always takes place in the frontal plane should increase the method's reproducibility -as also should fixation of the pelvis and the use of a constant, stable supporting surface for the person being examined. The specific aims of the study were to answer the following questions:

1. What is the reliability of the proposed method when used by two independent observers?

2. How is the reproducibility of the measurements influenced by having the subject stand freely on the floor, stand with his/her heels 15 cm from the wall end of the test apparatus and with or without pelvic fixation?

3. Do patients with chronic low back problems gain increased lateral flexion after physical treatment by the method of Alfta Rehab Center (ARC)?

4. Is there a correlation between increased range of movement in lateral flexion of the spine and reduced experience of pain?

MATERIAL AND METHODS

The study comprised two groups, 1) a group of 28 healthy subjects (12 men and 16 women) between the ages of 32 and 58 years, and 2) 31 patients (8 men and 23 women) consecutively selected among patients received at Alfta Rehab Center for treatment of non-radicular lumbar back pain. The healthy subjects were all physicians and included in the part of the study which sought answers to questions 1 and 2. They were invited to take part in the study when they participated in a one-week course in orthopedic medicine. The participants of two courses were invited and 18 and 10 individuals respectively from each course accepted the invitation.

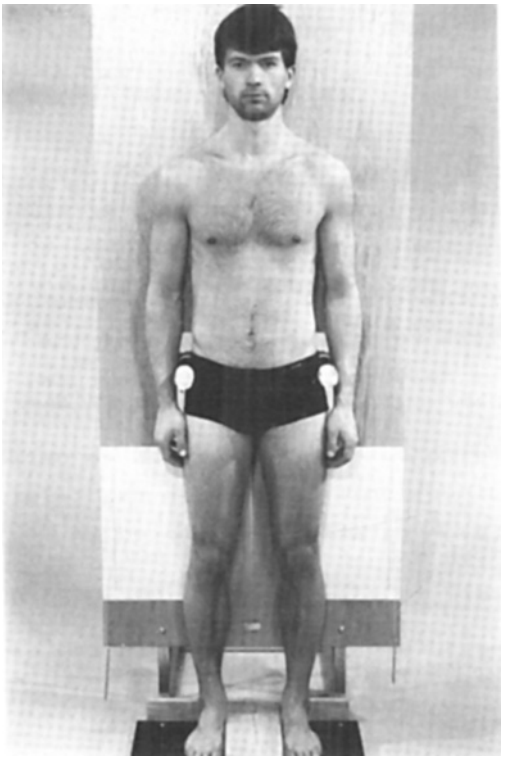

Fig 1. The testing apparatus. For description see text.

The testing apparatus can be seen in Fig. 1. During measurements with the apparatus, a wooden block 5 cm high, 15 cm wide and

approximately 30 cm long was placed between the subject's feet to provide a constant, stable supporting surface. The padded support for pelvic fixation was adjustable in both height and width so that it fitted tightly around the subject's hips immediately superior to the greater trochanters. Millimeter-squared graph paper, pencils and an eraser were affixed to the wall end of the testing apparatus.

During measurements of lateral flexion in this apparatus, the tester held one hand lightly on the shoulder of the subject on the side to which lateral flexion was to be performed. This was done to guide the movement and to ensure that the subject's shoulder-blade did not lift from the wall end of the apparatus or was elevated. When maximum lateral flexion was reached, the subject's palm was pressed against the graph paper and the position of the tip of the middle finger was marked with a pencil. The distance from the floor to the pencil mark could be read off directly from the graph paper, which was marked in centimetres from the floor.

Measurements of lateral flexion with the subject standing freely on the floor were made by having the subject perform a maximal lateral flexion with the palm of his hand on the flexion side pressed against the outside of the thigh/lower leg. In the extreme range of motion the distance between the tip of the middle finger and the floor was measured with a wooden rule.

On each occasion the subject being measured was asked to perform two lateral flexions in each direction in the order right-left-right-left. The mean value in each direction was noted in centimetres to one decimal point.

To answer questions 1 and 2, measurements were made in the same group of subjects by two testers, a physician and a physiotherapeut, at an interval of 30-60 minutes. At each occasion of testing the group of subjects to be studied was divided into two groups to make possible a "cross-over" between the test situations.

To answer questions 3 and 4, the range of motion of lateral spinal flexion was measured in the patients first before back treatment (test 1) and then after treatment by the method of ARC

(test 2). This treatment consists in principle of the customary therapy for the condition i.e. gentle mobilisation, traction and soft tissure treatment, accompanied by specific stretching of tight muscles around the hips. Some of the measurements were performed by the physiotherapist responsible for the treatment, some by one of the authors (Jonsson) and some by her locum, who was thoroughly instructed in the procedure. The physiotherapists in charge of the treatments were given both oral and written information explaining the measurement procedure.

The measurements were performed in the testing apparatus and the subject was positioned with his/her heels 15 cm from the wall end of the apparatus and with the pelvis fixed. Fifteen to 30 minutes before being measured, the patient was asked to estimate the degree of lumbar back pain he/she was experiencing at that moment, using a Borg scale with values from 0 to 10 (1).

Statistical analysis:

From the mean values obtained during measurements of lateral flexion in both directions, Pearson's coefficient of correlation between the results of the two testers was calculated. Initially the correlation coefficient was calculated for each side separately, but as there was no difference, this procedure was later abandoned. The error of the method was calculated from the values obtained by the two testers.

Differences in range of lateral flexion and experience of pain after treatment, compared with before, were tested for significance by means of a paired *t* test. The relation between increased range of lateral flexion and decreased pain was tested by linear regression analysis between the differences (test 1 - test 2) for range of lateral flexion and pain estimate. Pearson's coefficient of correlation was also calculated for these differences.

RESULTS

As seen in Table 1, the correlation coefficient was 0.95 when

two testers independently measured the lateral flexion of the spine in 18 healthy subjects standing in the test apparatus with their heels against the wall end and with their pelvis fixed.

The correlation coefficient obtained when two testers measured the lateral flexion in the same 18 healthy subjects as above but with the subjects standing freely on the floor decreased to 0.91 (see Table 1).

Table 1.
The correlation coefficient (r) and error of the method (s) when two testers measured spinal lateral flexion in healthy subjects.

	Subject standing in the test apparatus with fixated pelvis	Subject standing freely on the floor	Subject standing in the test apparatus with his/her feet 15 cm from the wall end -With pelvic fixation	-Without pelvic fixation
Tester 1 compared with Tester 2	n=36* r=0.95 s=1.2	n=36* r=0.91 s=1.4	n=20* r=0.98 s=0.7	n=20* r=0.94 s=1.8

*n= total number of observations, i.e. number of subjects x 2 (left and right side)

When two testers measured the lateral flexion in 10 healthy subjects standing in the test apparatus with their feet 15 cm from the wall end, the correlation coefficient for the values obtained was 0.98 (see Table 1). Furthermore, as seen in Table 1, the error of the method was lowest in this situation. Repeating the experiment but without pelvic fixation reduced the correlation coefficient to 0.94 (see Table 1).

The average age of the 31 patients tested was 48 years (range 27 - 65). The average duration of pain was 9.3 years, ranging individually from 1 to 40 years. The group included two patients with ankylosing spondylitis (non-acute).

The range of lateral flexion increased significantly in the group of patients as a whole after treatment, regardless of whether it was measured on the right side ($p < 0.001$) or on the left ($p < 0.01$) (see Table 2). The average increase in the range was 2-3 cm and the largest increase was 13 cm.

Table 2.
Increase in the range of spinal lateral flexion in patients treated for chronic lumbar back pain.

	Number of subjects	Average increase in centimetres	S.E.M.*	p value
Lateral flexion to right	31	2.5	0.7	< 0.001
Lateral flexion to left	31	2.8	0.8	< 0.01

* S.E.M. = the standard error of mean

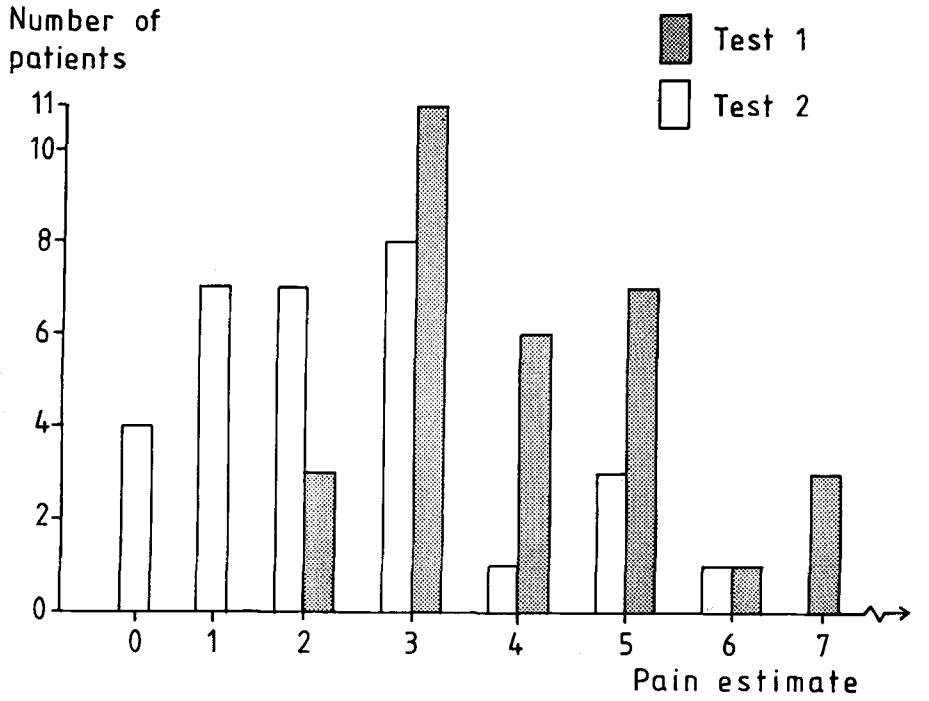

Fig 2. Differences in estimated pain between test 1 and test 2.

The estimated pain at the first test varied between 2 and 7 on the 10-degree Borg scale (see Fig. 2). At the second test, the values lay between 0 and 6. Of the 31 patients, six reported unchanged pain and two had increased pain at the second test. Some of the six with unchanged pain had unchanged mobility, while others showed increased mobility. The two patients with increased pain had reduced mobility. The mean difference between test 1 and test 2 on the Borg 0-10 scale was 1.7. The difference was significantly different from 0 (zero) (*t* test $p < 0.001$).

The correlation between increased mobility and reduced pain was tested by means of regression analysis, which showed a linear

relationship between increased lateral flexion to both the right ($p < 0.001$) and left ($p < 0.001$) and reduced pain (see Figures 3 and 4). The correlation coefficient between the change in range of lateral flexion and pain estimate was 0.68 for lateral flexion to the right and 0.61 for lateral flexion to the left.

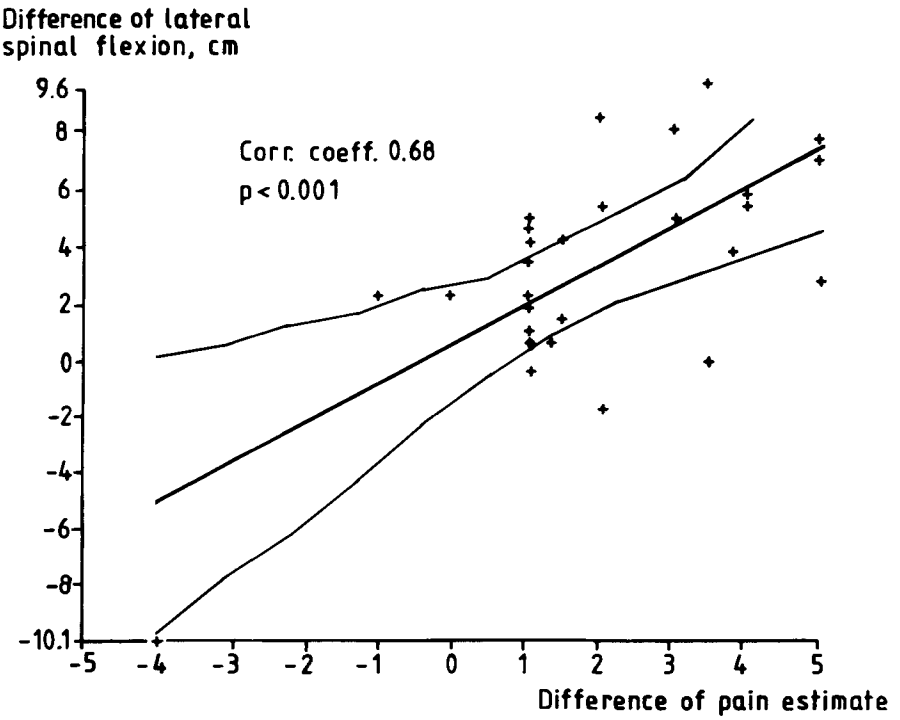

Fig 3. The fitted regression line and the 95 % confidence limits for the differences in range of lateral spinal flexion to the right and pain estimate, before and after treatment, in 28 of the 31 patients with chronic low back pain. The values of the 3 remaining patients were lost during calculation.

DISCUSSION

This study has shown that lateral flexion of the spine can be measured in a simple and reliable way. The ability of one tester to reproduce the recorded values of another was high for all the situations tested. Indeed it was higher than that reported in earlier studies (2,3,6,9,11).

Measurement of the range of lateral spinal flexion from the finger tip to floor distance can be criticized, since this neglects the influence of arm length and body height on the

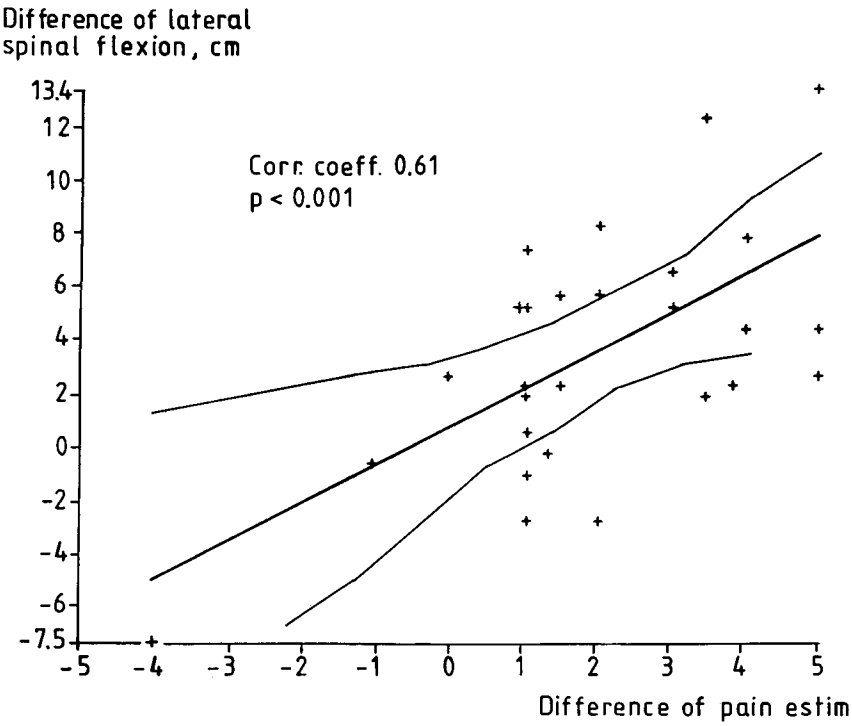

Fig 4. The fitted regression line and the 95 % confidence limits for the differences in range of lateral spinal flexion to the left and pain estimate, before and after treatment, in 28 of the 31 patients. The values of the 3 remaining patients were lost during calculation.

recorded values. However, we were only interested in comparing the range of motion before and after treatment for each individual. Should the present method be used to achieve normative values, the range of lateral spinal flexion would be better measured as the distance between the tip of the third finger when the person stands erect and the tip of the same finger in maximal lateral flexion.

The reproducibility of the measurements was higher in all situations when the subject stood in the test apparatus than it was when he/she stood freely on the floor. For the latter case the correlation coefficient between the testers agrees with that reported by Frost et al (3). The observed differences were suprisingly small considering the difficulties in the latter situation in preventing deviation of the trunk in the sagittal plane during lateral flexion. A possible explanation to this could be that the healthy subjects i.e. physicians used in this study have a better postural control than people in general. This is, however, not supported by the way they reacted during

the tests.

The highest correlation between the observed values of the two independent testers was noted when the subject stood with his/her heels 15 cm from the wall end of the test apparatus. Since the correlation coefficient in this case was only slightly higher than that recorded when the subject stood right up against the wall end a real difference may be questioned. Furthermore, the subjects were not identical in these two situations and this might have explained the difference. However, the testers were the same and the subjects did not differ in age or sex between the two situations. For that reason we suggest that lateral flexion is best measured with the subject's heels 15 cm from the wall end of the test apparatus. The lumbar spine is somewhat flexed in this position and this seems important, as when it was more flexed or when it was extended to varying extents the correlation coefficient was lower (unpublished results).

In assessment of the effect of treatment of chronic low back pain, the pain estimate should be supplemented by an evaluation of the patient's functional capacity (4,8,10). Mobility is an important factor in assessment of the functional capacity of the spine (4,5,8,10,12). In this study the range of lateral spinal flexion in a group of patients with chronic low back pain increased after treatment. Also, as in other studies (5,8), a correlation was found between increased range of motion and reduced pain. Even though the correlation was linear and reached an acceptable level, less than 50 % of the variance of the range in lateral flexion was nevertheless attributable to the variance of the pain estimate. A possible explanation for this could be the subjectivity, and consequent low reliability, of the pain estimate (7). In the present study the patients were asked to estimate their low back pain only just before measurement of lateral spinal flexion was performed. Since pain always varies slightly even in a chronic pain condition it might have been better if they had been asked to estimate their pain over a period of some days or a week.

No increase in the range of spinal lateral flexion was seen in those patients who showed no pain reduction. However, the reverse was not true since in some patients who reported reduced

pain the range of spinal lateral flexion was decreased. The number of patients was considered too small to make a meaningful, detailed analysis of signs and symptoms in those patients who reported reduced pain after treatment and those who did not. However, it was our general impression that patients considered to have pain because of segmental instability tended not to respond positively to the treatment. Furthermore, these patients did not report an increase in pain during the test, as most of the other patients did, but reported increased pain after the test.

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Address for preprints:

Ingvar Ljungkvist M.D.
Dept of Anatomy
University of Uppsala
Box 571
S-751 23 UPPSALA