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Passive Lumbar Mobility

A prospective study of back pain in young men during their military service

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ABSTRACT

Mobility of the back is mostly evaluated through active mobility in a standing position. In this study, also the passive mobility between lumbar vertebraes was assessed in sidelying, and grouped in four categories. More than five hundred young men were examined three times over a period of 3-4 years, before and after their basic military training.

The lumbar vertebra L5 was judged to have decreased mobility in 29% and increased mobility in 17% of the cases. The corresponding values for L4 were 39% and 13%, respectively. There were significant positive correlations between the results of all the examinations. The total agreement between examinations was around 50%. Decreased passive lumbar mobility correlated to the current amount of back discomfort at the second and third examinations, but at the first examination it could not predict the future incidence of back pain.

INTRODUCTION

Mobility is one of the important characteristics of the spinal column. There is, however, no real agreement about how the mobility should be quantified or what is considered normal.

For examination of lumbar mobility the standing patient is mostly asked to flex forward in an attempt to touch his toes or the floor. It is important to look or palpate for smoothness in the movement as well as the range (5,17,19,21). The mobility is considered to be decreased if the fingers do not reach the floor (16,21,30). To exclude the hips in the measurement of flexion, the change in distance between two skinmarks on the back is measured. The caudal mark is placed on the spinal intersection of a line joining the dimples of Venus (1,2,31), or five cm below this line (18,25). The cranial mark is placed 10 cm above the first one (Schober´s measure, 31) or 15 cm above (1). The normal increase between the marks should in both cases be 4-6 cm. The total angular mobility can also be measured with a normal goniometer or, with different designs of inclinometers, spondylometers or kyphometers (20,25,36).

Examination of extension is not so commonly described. Clinical studies seldom include recording of extension. A plumb-line pointer or a kyphometer can be a help in quantification (20,24,25,36). If skinmarks are used they shall approach each other during extension. Radiographic methods have been used both for measuring the total range of mobility, and the mobility or displacement between two certain vertebrae (3,28,29,34). For clinical non-complicated cases it is, however, neither ethically nor practically acceptible, but have proved valuable in assessing long-standing pain cases (3). Comparisons between different methods of quantifing the mobility did not show correlation between finger-floor distance and distance between skin marks (1,2). The finger-floor distance correlated however to hamstring muscle suppleness measured by straight-leg-raising (2).

Stretched hamstring muscles has also been shown to allow increased range of flexion in standing (4), but the distance between skin marks did not increase (13). No one has compared the range of active flexion with the passive mobility used in this study. A higher frequency of decreased flexion has been shown in groups with previous back pain than in control groups both among different industrial workers (30) and in a mixed population 30-60 years old (2). At the same time the current pain shows a very poor correlation to the range of motion (23).

All the above methods test the active mobility of the spine. Peripheral joints are normally tested both for active and passive mobility, which gives valuable information for diagnosing. The examination of passive mobility in the spine is not commonly used, possibly because it takes some time to learn. Only a few papers have been found where the passive lumbar mobility is critically studied (6,7,9,14,15).

Within a project of finding out the predictive value for back pain in young men by physical examination, the passive mobility of the lumbar spine was tested (10).

THE AIMS of this further evaluation of the project were to find out:

1. What are the observed frequencies of normal, increased and decreased

mobility within the lumbar spine examined as the passive mobility between vertebraes?

2. How reproducable are the recordings of this passive mobility when examined three times by the same person?
3. How do the findings relate to other relevant parts of the back examination and to the level of discomfort?

METHOD

The sample

At enlistment for compulsory military training 999 men, 18-19 years old participated in an extra standardized back examination including examination of passive lumbar mobility. They were seen again at the beginning and end of their military service. The second examination was undertaken 1-3 years after the first one, and the third around 1 year after the second; a total span of 4 years. On each occasion every man answered a questionnaire about, among other things, his level of back pain. The answers were not seen by the examiner until after each examination. All these men were healthy and fulfilled their basic military training, but 95% at the start stated some degree of back pain.

The test The movements were assessed by flexing and extending the spine of the relaxed sidelying person according to fig. 1.

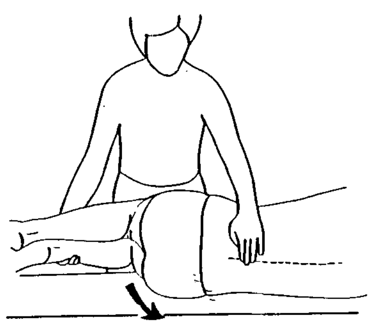

Fig.1
Position for examination of passive lumbar mobility. The movement is palpated with the left hand. The arrow indicates the direction for extension, induced by the examiners´ trunk. The right hand takes the weight of the legs.
(with permission from Odd Hellström)

Because of shortage of time only flexion, extension and stability in the sagittal plane were tested. All judgements were named after the cranial vertebra. The assessments were placed in four groups according to Kaltenborn (15):

* Without remark
* Obviously decreased mobility
* No palpable movement (blocked)
* Increased mobility

In the case of flexion the free palpable separation of spinous processes was considered normal. The greatest separation in flexion was expected between L4 and L5, a little less between L5 and S1 and decrease upwards from L4. During the normal extension the spinal processes should be felt to smoothly approach. A slightly bigger movement was then expected between L5 and S1 than between L4 and L5, with decrease above L4 (15,16,17). The movements were considered decreased if a soft or hard stop was felt earlier than expected compared to the neighbours, or if they were very obviously decreased on several levels. The movement was considered increased if there was a great mobility and a clear gapping was felt during the test of stability. That means both a quantitative and qualitative measure corresponding to Paris´grade 4-5 and Grieve´s hypermobility a) and b) (8,27). No palpable movement was considered as "blocked". The degree of discomfort or pain during the test was recorded separately and not taken into the judgement of mobility.

Drop outs

The second examination was performed completely on 613 subjects and the third on 547. Apart from 262 exempted or not yet drafted (10) the absence was mainly due to difficulties for the subjects of leaving their military training. The drop outs from the second to the third examination showed no significant differences in examination results from the rest, nor did they differ in their degree of pain.

Statistical methods

Contingency coefficient, c, has been used as a measure of the strength of correlation. Neither the usual correlation coefficient, r, or Spearman´s rank correlation can be used if one of the variables is expressed in a nominal scale. Like the usual correlation coefficients the value of c is zero when there is no correlation, but c never reaches the value 1.0 even if the correlation is perfect. The upper limit for c depends on the number of categories for the studied variables. For 2x2 and 3x3 tables the upper limit value is 0.707 and 0.816. The chi square test has been used to judge if the correlations are statistically significant or not. The level of significance is shown as p (probability), i.e. the probability for a random sample to show at least the observed value, even if there is no correlation.

RESULTS

Frequencies

From table 1 can be seen that when L5 is concerned, around 50% were without remark, and in case of L4, slightly less. Decreased mobility was judged a little more frequent for L4 than for L5.

Table 1
Result of lumbar passive mobility test - frequencies of findings at the three different examinations. Per cent of total at each examination within brackets.

Examination	1 n=999	%	2 n=613	%	3 n=547	%
L5						
No remark	517	(52)	350	(57)	271	(50)
Decreased mob.	299	(30)	155	(25)	169	(31)
Blocked	28	(3)	6	(1)	8	(1)
Increased mob.	155	(15)	102	(17)	99	(18)
L4						
No remark	471	(47)	301	(49)	237	(43)
Decreased mob.	332	(33)	242	(40)	236	(43)
Blocked	26	(3)	7	(1)	8	(2)
Increased mob.	170	(17)	63	(10)	66	(12)
L3						
No remark	639	(64)	383	(63)	354	(65)
Decreased mob.	190	(19)	153	(25)	149	(27)
Blocked	5	(0.5)	7	(1)	2	(0.4)
Increased mob.	165	(17)	70	(11)	42	(8)
L2						
No remark	649	(65)	452	(74)	425	(78)
Decreased mob.	144	(14)	95	(15)	71	(13)
Blocked	10	(1)	3	(0.5)	5	(1)
Increased mob.	196	(20)	63	(10.5)	46	(8)
L1						
No remark	689	(69)	465	(76)	450	(82)
Decreased mob.	115	(11)	56	(9)	36	(7)
Blocked	8	(1)	-		-	
Increased mob.	187	(19)	92	(15)	61	(11)
Th12						
No remark	856	(86)	566	(92)	507	(93)
Decreased mob.	68	(7)	19	(3)	9	(2)
Blocked	4	(0.4)	-		1	(0.2)
Increased mob.	71	(7)	28	(5)	30	(5)

Reproducability

The comparisons between the three examinations showed highly significant, but not very strong, correlations between the judged mobilities. On the levels L5,L4 and L3 p-values were in all cases <0.00, with contingency coefficients between 0.25 and 0.40. The total agreement between the different examinations was 43-56%.

There were in most cases significant, but weak correlations within the examinations even with neighbour vertebraes.

Table 2 shows the comparison between examinations 1 and 3 for L5. In most of the cases where the judgement was changed, the change was to the nearest class.

Table 2

Comparison between results of passive mobility test from examinations 1 and 3 concerning L5.
n=547, p=0.0021, c=0.252, per cent of total in brackets

EXAMINATION 1	EXAMINATION 3 No remark	%	Decreased mob.	%	Blocked	%	Increased mob.	%	Total
No remark	159	(29)	86	(16)	1	(0.2)	51	(9)	297
Decreased mob.	66	(12)	63	(11)	5	(1)	20	(4)	154
Blocked	7	(1)	5	(1)	1	(0.2)	1	(0.2)	14
Increased mob.	39	(7)	15	(3)	1	(0.2)	27	(5)	82
Total	271		169		8		99		547

Table 3 shows the same comparison between examinations 2 and 3 for L4. The correlation is better, but not perfect.

Table 3

Comparison between results of passive mobility test for examinations 2 and 3 concerning L4.
n=489, p=0.0001, c=0.412, per cent of total in brackets

EXAMINATION 2	EXAMINATION 3 No remark	%	Decreased mob.	%	Blocked	%	Increased mob.	%	Total
No remark	118	(24)	90	(18)	-		28	(6)	236
Decreased mob.	68	(14)	111	(23)	6	(1)	14	(3)	199
Blocked	2	(0.4)	2	(0,4)	2	(0.4)	-		6
Increased mob.	22	(4)	8	(2)	-		18	(4)	48
Total	210		211		8		60		489

Correlation to other variables. There was no correlation between remarks on the passive lumbar mobility at enlistment and later reported back-pain, as reported earlier (10). However remarks on mobility at the second and

third examinations showed significant, but weak correlations to the reported back-pain at the same occasion (p<0.000, c=0.15-0.31). Local pain during the test of passive mobility showed in most cases a positive correlation to other pain tests like lumbar springing test and coin-test (10) and to pain during inward rotation of the hip joint. Like other variables local pain during the mobility test showed significant correlations between the different examinations (p<0.000, c=0.15-0.31).
Within examination 1 there were positive correlations between the quality of motion of L5 and L4 and the sacro-iliac joints (p-values 0.0962-0.0009). Unfortunately the groups in most cases turned out to be very small. Leg length inequality did not show any positive correlation to passive lumbar mobility, not even over the follow-up period.
It has not been possible to detect any consistent pattern between changes in passive lumbar mobility and changes in hamstring tightness, change in mobility of sacro-iliac joints or change in subjective discomfort.

DISCUSSION

The palpatory examination of passive lumbar mobility includes assessment of both quantity and quality, based on clinical experience, which makes it prone to subjectivity. On top of that the ranges are small but: "The fact that they are small does not mean that their importance is not great" (22). The assessment depends greatly upon the ability of the subject to relax. Relaxation in its turn depends both on emotional and somatic state, and is sensitive to changes in both. As hamstring-tightness has been shown to correlate with decreased active mobility of the spine (2) it could be expected that even the passive mobility would correlate with hamstring-tightness measured by straight-leg- raising. As this correlation was not demonstrated (see report about muscle tightness), it could indicate that relaxation was sufficient.
One main question is how normal mobility feels during palpation. The feeling of movement smoothly stopping would perhaps more correct be called optimal. As back pain is a symptom of multifactorial origin (26), evidently not even optimal passive mobility can quarantee a future without back pain.
The active movement pattern which is considered a cause or a result of back pain (12) could not be taken into the judgements. For the assessment of movement patterns more time and extensive methods are needed as there is no simple mechanical coupling of the active movements (28).
When pain is discussed here it has to be born i mind that it is not the

degree of pain expected in back-pain-patients. Even those men who ticked "pain even when sitting for a short time, or lifting even light objects" moved about freely. But the subject´s assessment of their problems has to be trusted as their real situation.
Unfortunately the first sampling was not, for ethical reasons, allowed to be at random. This fact has to be kept in mind when drawing conclusions. The influence of convenience and purposive sample is probably greatest when considering the level of subjective pain. Comparisons between the results at the different examinations should not be so sensitive to the sampling method. Of course no conclusions can be drawn about females, as they were not represented.
In some cases the judgements were changed in an apparently contradictory way, between increased and decreased mobility. Part of the explanation can be that pain leads to decreased mobility through muscle action and makes relaxation insufficient. When the pain ceases it is not uncommon in clinical work to be able to palpate the hidden increased mobility. Muscle soreness after heavy training or hard work can be enough to cause the same effect.
There are no similar studies with which to compare the found frequencies. Those studies using the same method (6,15) contain very few subjects. The difficulties in defining limits even for normal active mobility (20,24) could explain the reported range of 10-30% of decreased mobility among normal persons (2,11,30).
In clinical situation the judgement of mobility is always guided by the presence or absence of pain (32). Assessment in this study was made without consideration to pain which made the test very sensitive and could explain the high amount of remarks. Conclusions about what test of passive lumbar mobility means and can predict about the individual in the long run, can only be drawn in subsequent follow-up studies to this one.

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REFERENCES

1. v Adrichem, J.A.M., van der Korst, J.K.: Assessment of the flexibility of the lumbar spine. Scand J Rheumatol 2:87-91, 1973.

2. Biering-Sørensen, F.: Physical measurements as risk indicators for lowback trouble over a one year period. Spine 2:106-119, 1984.

3. Dupuis, P.R., Young-Hing, K., Cassidy, J.D. & Kirkaldy-Willis, W.H.: Radiologic diagnosis of degenerative lumbar spinal instability. Spine 3:262-276, 1985.

4. Fieldman, H.: Relative contribution of the back and hamstring muscles in the performance of the toe-touch test after selected extensibility exercises. Res Q Am Assoc Health Phys Educ 3:518-523, 1967.

5. Frankel, V. & Nordin, M.: Basic Biomechanics of the Skeletal System. Lea & Fabiger, (page 262-63) Philadelphia, 1980.

6. Gonnella, C., Paris, S.V. & Kutner, M.: Reliability in evaluating passive intervertebral motion. Phys Ther 4:436-444, 1982.

7. Grant, E.R.: Lumbar sagittal mobility in hypermobile individuals and professional dancers. In Modern Manual therapy of the Vertebral Column. (ed G.P. Grieve), Churchill Livingstone, 1986.

8. Grieve, G.P.: Common vertebral joint problems. Churchill Livingstone, pp. 358-359, 1986.

9. Grieve, E.F.M.: The measurement of pressures used in simulated passive accessory oscillatory mobilisation techniques. Xth International Congress of The World Confederation for Physical Therapy 1987, Proceedings.

10. Hellsing, A.-L., Nordgren, B., Schele, R., Ahlborg, B. & Paulsson, L: Individual predictability of back trouble in 18-year-old men. A prospective study during military service. Manual Medicine 22:72-76, 1986.

11. Hult, L.: Cervical, dorsal and lumbarspinal syndromes. Acta Orthop Scand, Suppl 17, 1954.

12. Janda, V.: Gestörte Bewegungsabläufe und Ruckenschmerzen. Manuelle Medizin 22:74-78, 1984.

13. Johnsson, B.: Postural faults in school children. A physiotherapeutic approach. Dissertation, Lund University, Lund, Sweden, 1883.

14. Jull, G.: The changes with age in lumbar intersegmental motion as assessed by manual examination. Xth International Congress of the The World Confederation for Physical Therapy 1987, Proceedings.

15. Kaltenborn, F. & Lindahl, O.: Reproducability of examination of intervertebral mobility. Läkartidn 10:962, 1969.

16. Kapandji, I.A.: The physiology of the joints. Vol III. Churchill Livingstone, 1982.

17. Lewit, K.: Manipulative therapy in rehabilitation of the motor system. Butterworth & Co. Ltd., 1985.

18. Macnab, I.: Backache. Williams & Wilkins Co, Baltimore, 1977.

19. MacRae, I.F. & Wright, V.: Measurement of back movement. Ann Rheum Dis 28:584-589, 1969.

20. Mayer, T.G., Tencer, A.F., Kristoferson, S. & Mooney, V.: Use of noninvasive techniques for quantification of spinal range-of-motion in normal subjects and chronic low-back dysfunction patients. Spine 6:588-595, 1984.

21. McRae, R.: Clinical orthopaedic examination. Churchill Livingstone, 1976.

22. Mennell, J.: Back Pain. Little, Brown & Co, 1960.

23. Million, R., Hall, W., Nilsen, K.H., Baker, R.D. & Jayson, M.I.V.: Assessment of the progress of the back-pain patient. Spine 3:204-212, 1982.

24. Moll, J. & Wright, V.: Measurement of Spinal Movement. In the lumbar spine and back pain (ed. M.I.V. Jayson), Pitman Medical Ltd, Melbourne, Wellington, 1980.

25. Moll, J.M.H. & Wright, V.: Normal range of spinal mobility. An objective clinical study. Ann Rheum Dis 30:381-386, 1971.

26. Nachemson, A.L.: The lumbar spine. An orthopaedic challenge. Spine 1:59-71, 1976.

27. Paris, S.V.: Physical signs of instability. Spine 3:277-279, 1985.

28. Pearcy, M.J. & Tibrewal, S.B.: Axial rotation and lateral bending in the normal lumbar spine measured by three-dimensional radiography. Spine 6:582-587, 1984.

29. Pennal, G.F., Conn, G.S., Mc Donald, G., Dale, G. & Garside, H.: Motion studies of the lumbar spine. A preliminary report. J Bone Joint Surg 8:442-452, 1972.

30. Rowe, M.L.: Low back pain in industry, A position paper. J Occup Med 4:161-169, 1969.

31. Schober, P.: Lendenwirbelsäule und Kreuzschmerzen. Munch Med Wschr 84:336-338, 1937.

32. Schwerdtner, H.: Klinische und röntgenologische Kriterien der segmentalen Instabilität und schmerzhaften Lockerung im lumbalen Bewegungssegment. Manuelle Medizin 24:35-38, 1986.

33. Stoddard, A.: Manual of osteopathic technique. 9th ed., p. 73. Hutchinson of London, 1977.

34. Stokes, I.A.F.: Medlicott, P.A. & Wilder, D.G.: Measurement of movement in painful intervertebral joints. Med Biol Eng 9:694-700, 1980.

35. Stokes, I.A.F., Wilder, D.G., Frymoyer, J.W. & Pope, M.H.: Assessment of patients with low-back pain by biplanar radiographic measurement of inververtebral motion. Spine 3:233, 1981.

36. Troup, J.D.G., Hood, C.A., Chapman, A.E.: Measurements of the sagittal mobility of the lumbar spine and hips. Ann Phys Med 8:308-321, 1968.

37. Twomey, L.T. & Taylor, J.R.: Factors influencing ranges of movement in the lumbar spine. In Modern manual therapy of the vertebral column (ed. G.P. Grieve). Churchill Livingstone, 1986.

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