

# CORRELATING MOTION PALPATION WITH FUNCTIONAL X-RAY FINDINGS IN PATIENTS WITH LOW BACK PAIN

PHIL GREGORY D.C., D.O., M.Chiro.Sci.\*

RAY HAYEK B.Sc.(Hons), M.Chiro.†

ALISON MANN-HAYEK B.Sc., M.Chiro.‡

## Abstract:

**Objectives:** To determine whether a correlation between motion palpation findings and abnormal coupling patterns, as viewed in lumbar functional X-rays, can be demonstrated in low back pain (LBP) patients.

**Design:** A prospective observational study of patients who present to a chiropractic clinic for assessment of low back pain.

**Subjects:** The sample population consisted of 27 consecutive patients presenting with LBP between the ages of 20-50 year old and who were capable of pain free lateral lumbar flexion.

**Intervention:** All subjects underwent motion palpation to determine whether a "fixation" at the L4/5 existed. All had lumbar spine X-rays in an anterior-posterior (AP) and bilateral AP lateral flexion position. X-rays were then analyzed to determine whether the coupling pattern at L4/5 was considered abnormal.

**Results:** In those patients with a perceived L4/5 motion restriction no coupling patterns were found in 6 cases (22.4%) and normal coupling patterns in 13 cases (48%). In those patients who presented with LBP and no motion findings at L4/5 no coupling was observed in 4 cases (14.8%) and normal coupling in another 4 cases (14.8%). The chi-squared test demonstrated no statistical differences ( $p > 0.05$ ) between the motion fixation at L4/5 and coupling patterns from lateral flexion X-rays.

**Conclusion:** It is of particular interest to note that the presence of the L4/5 fixation was not associated with abnormal coupling but conversely was frequently observed to be associated with normal coupling patterns. A simple correlation between a single motion palpation finding of a restriction at a L4/5 facet and an alteration in coupling patterns could not be supported.

**Keywords (MeSH):** Chiropractic, lumbar X-rays, motion palpation, biomechanic.

\* Private Practice, 281 Barrenjoey Rd, Newport, NSW. 2106. Australia.

† Lecturer, Centre for Chiropractic, School of Biological Sciences, Macquarie University, Sydney, Australia.

‡ Private Practice, Suite 1, 202 Merrylands Rd, Merrylands, NSW. 2160. Australia.

Correspondence to:  
Dr. Ray Hayek, Centre for Chiropractic, Macquarie University, Sydney Australia.  
Tel: 61 2 9850 9380, RHayek@ma.bio.mq.edu.au

## INTRODUCTION

It has been argued that the primary effect on the spine of the chiropractic adjustment is a restoration of movement to restricted or fixated articulations (1). While other changes to the neurology and soft tissues may occur as secondary effects of the mechanical changes. Lack of joint motion may lead initially to joint stiffness (2), associated pain (3), and possibly followed by degeneration and ultimately joint fusion (4).

The idea that joint restriction or fixation is an integral part of the Chiropractic subluxation was first proposed at the turn of this century and more recently, the basic concepts of the diagnosis of spinal fixations by motion palpation have been organized by Schaefer and Faye (5) into a system of joint palpation called motion palpation. The accuracy of these palpation skills by an experienced practitioner has been documented by Evans (6). However, the technique requires ongoing scrutiny to determine the strengths of its reliability.

Gunzburg (7) has shown that there is considerable variation in the axial rotation of the lumbar vertebrae within the same spine and across different spines. He found that the apophyseal joint capsules limit rotation both in neutral and flexed positions. Subjects with motion restrictions as determined by X-ray analysis have been shown to have a higher prevalence of low back pain as shown by Mensor (8) in his study on the absence of motion at the 4th and 5th lumbar interspaces in patients with and without back pain. In clinical practice, restrictions in vertebral motor unit movements are frequently observed in combinations of lateral flexion, rotation, flexion and or extension. The hypothesis that specific combinations of movements occur concurrently due to the intrinsic nature of the joints involved is referred to as coupled motion.

Coupled motion may be defined as the induction of motion in one plane or direction following the imposition of a motion in a different plane or direction. Lovett (9) observed that a flexible rod already bent in one direction induces an axial torque if simultaneously flexed in a different plane. Experiments on the spines of fish, cat, cadaver and a living human spine models all showed this same coupled motion. He concluded that a compound movement of lateral flexion and torsion occurs and these components cannot be disassociated (9).

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Miles and Sullivan (10) described this coupling action in the lumbar spine, as axial rotation combined with lateral bending, such that the spinous processes point in the same direction as the lateral bending. This coupled motion concurs with that described by Krag (11) where, within the lumbar spine, the spinous processes move toward the concavity of the curve.

Pearcy and Tibrewal (12) using stereoscopic X-ray technique found a different polarity of coupled motion in the upper and lower spine. They demonstrated that in the upper lumbar spine axial rotation to the right was accompanied by lateral bending to the left and vice versa. At L5/S1, axial rotation and lateral bending generally accompanied each other in the same direction, while L4/5 was a transitional area.

However, Schultz(13) in an in vitro study of the mechanical properties of the intervertebral joint, found only inconsistent and weak coupling between lateral bending and axial rotation and concluded from his observations that "coupling is seldom inherent in lumbar motion segment kinematics, and probably arises from other sources". It is possible that coupled motion in vivo may be due to the contractile pattern of both intrinsic and extrinsic paraspinal muscle groups.

Gracovetsky (14) stated that the nature of coupling is determined by the position of the instantaneous axis of rotation, which if when it lies outside the vertebral column will alter the nature of coupling between lateral bend, lordosis and axial rotation.

A comparison of LBP patients diagnosed by motion palpation as having a notional fixation at a particular intervertebral segment warranted investigation to explore an association with their radiographic presentation and whether there was a change in the coupling patterns at that same level. The potential relationship between the motion palpation finding of a restriction at L4/5 and a radiographic finding of a change in the coupling pattern at that level was explored to determine whether such a correlation can be observed.

### MATERIAL AND METHODS

In this observational study patients who presented for the first time to a chiropractic clinic for assessment of low back pain were examined for spinal fixation then X-rayed. X-rays included AP and bilateral AP with lateral flexion views. The lateral flexion views were analyzed for normal or abnormal coupled motion at L4/5. The sample consisted of 81 consecutive X-ray studies from 27 suitable and consenting subjects between 20-50 years old. Subjects who were determined by motion palpation to have spinal fixation at L4/5 became the experimental group and subjects without fixation at L4/5 acted as the control group.

All patients were informed of the nature of the study and gave written consent. Those patients who were incapable of lateral flexion of the lumbar spine or who were determined to be unsuited to X-ray or simple physical examination were excluded from this study. This study was approved by Macquarie University's Human Ethics Committee.

Subjects were examined by the motion palpation techniques set forth by Schafer and Faye (5) to determine whether spinal fixation was present at the right or left L4/5 level and the results tabulated.

**Radiographic Technique;** The X-ray studies were performed using a Chiroprax X-ray unit utilising 100KVP and 100 MAS with a film to focal distance of 200cm. For the A.P view, the X-ray tube was adjusted so that the X-ray beam was centered at the level of the iliac crests and angled upwards 15o to compensate for the usual lordosis. The patient stood on an even surface with a block 15cm wide between the feet with a backstop to position the heels. The patient was instructed to stand relaxed with equal weight on both feet with knees straight, and to lean back gently against the cassette holder, as per the method devised by Travell and Simons (15). For the lateral flexion views, the subjects were X-rayed erect as for the AP view with their hands on top of their heads. Each subject was asked to bend maximally to the right to a position that could be held without discomfort, a film was then taken. The same procedure was followed for the left hand side. The patients were asked to avoid movements of the pelvis. Restraining bands were not used as they may have interfered with the subjects lateral flexion, Miles and Sullivan (10).

**X-ray analysis;** The L4/5 segment was considered to have a normal coupling pattern if the spinous process rotated in the same direction as the lateral bending ie. toward the concavity of the lateral curve as proposed by Miles and Sullivan (10) and Krag (11) and an abnormal coupling pattern if the spinous process did not deviate from the midline or pointed in the contralateral direction to the concavity of the curve. This was assessed by aligning the L5 vertebra of the sidebending views (figure 1), with the L5 vertebra of the A-P/lateral flexion view (figure 2) and comparing the relative position of L4 on each film to determine if movement at L4 on L5 has occurred (figures 3&4).

A single practitioner assessed the motion restriction at L4/5 and allocated patients to the control and sample groups, tabled the results and X-rayed the patients. Then a second practitioner analysed the films without prior knowledge of the patient details, and tabled the coupling patterns at L4/5.

Figure 1: demonstrates an X-ray of the A-P view with black dots on the spinolaminar junction.

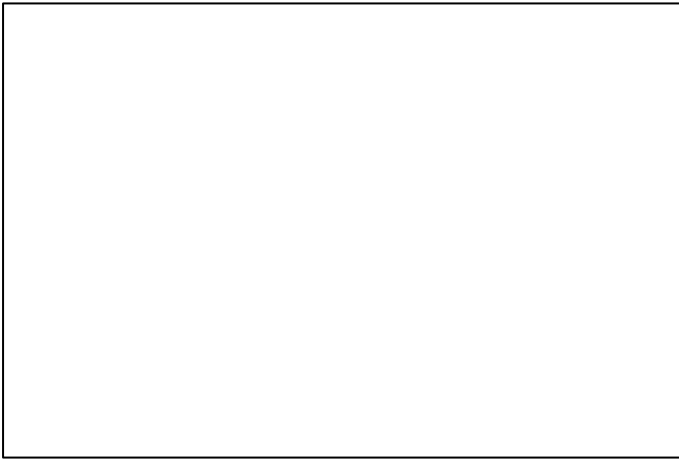
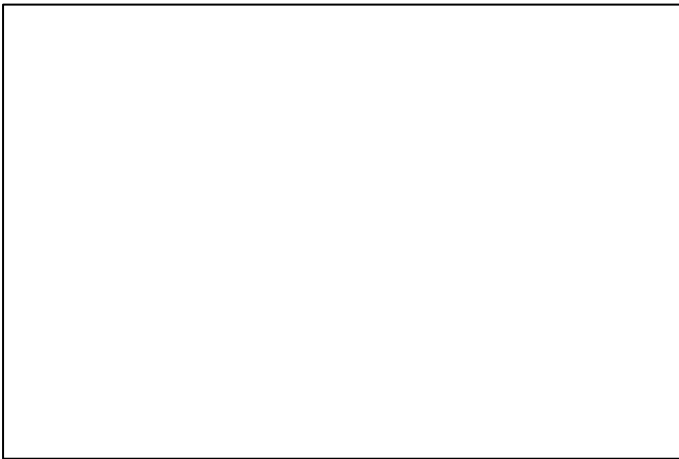


Figure 2: demonstrates X-rays of both left and right sidebending views with black dots on the spinolaminar junction.

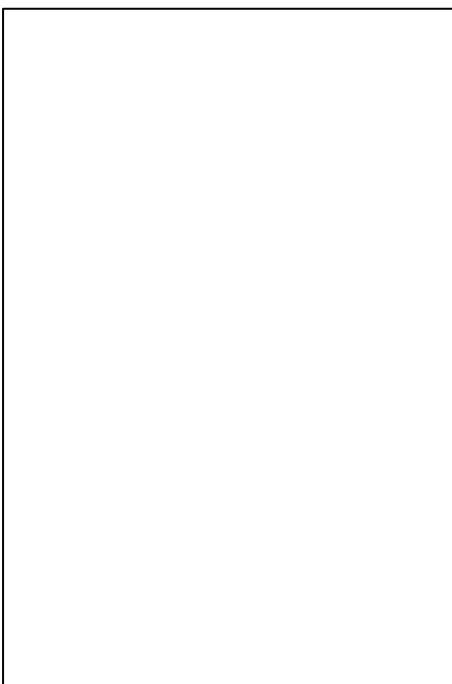


## RESULTS

In those subjects where an L4/5 fixation was deemed to be present, on motion palpation, no coupling patterns were found in 5 cases and a single abnormal coupling pattern was found, totalling 6 cases (22.4%) and normal coupling patterns were found in 13 cases (48%). In those subjects where a L4/5 fixation was not found on motion palpation, no coupling was observed in 4 cases (14.8%) and normal coupling was also found in 4 cases (14.8%) (table 1). It is of particular interest to note that the presence of the L4/5 fixation was not associated with abnormal coupling but rather demonstrated a predisposition for normal coupling patterns.

Analysis of the data (table 2), demonstrated no statistical difference between the experimental and control groups for correlation of abnormal coupling patterns and the side of spinous process deviation ( $\chi^2=0.819$ ,  $p>0.05$ ).

Figure 1 demonstrates an AP view of the lumbar spine with a distinct black spot on the spinolaminar junction from a typical subject. While figure 2 demonstrates both left and right lateral flexion of the lumbar spine. The AP view (figure 1) was superimposed after spinolaminar markings onto the lateral flexion views (figure 2). Using only the deviation of the spinolaminar marking from the centre of the AP view, determinations to the side of coupling were made. While it is understood that the coupling pattern involves several components of movement, these were not the subject of this study. This complex movement

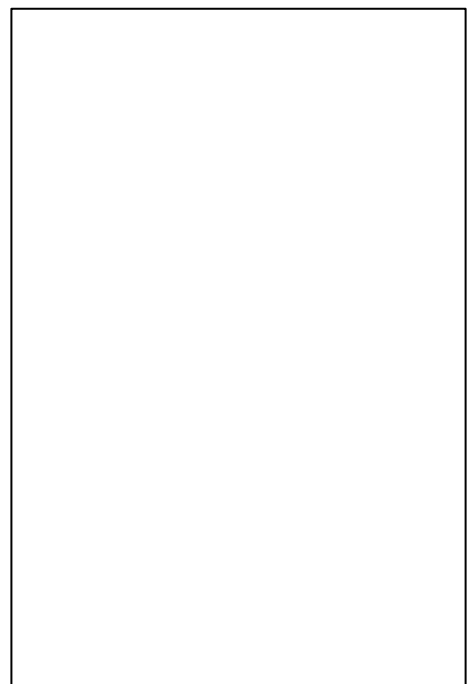


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Figure 3: demonstrates the left lateral flexion view superimposed on the A-P view. The black dots on these views show the direction of the spinous process movement between the left lateral flexion and the AP neutral view. (Note the tilting of L4 in the lateral flexion view compared to the A-P as part of the normal coupled motion).

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Figure 4: demonstrates the right lateral flexion view superimposed on the A-P view. The black dots on these views show the deviation of the L4 spinous process on right lateral flexion. (Note the tilting of L4 in the lateral flexion view compared to the A-P as part of the normal coupled motion).



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was simplified to a measurement of spinous process movement from the mid line in coupled rotation and lateral flexion. Further, L4/5 fixation was present in 19 of the subjects presenting with low back pain (table 1). While 8 subjects presented with low back pain and without L4/5 motion palpation fixation. A motion palpation fixation was present in all cases at one or more levels in the lumbar spine (27 cases, table 1).

Table 1: Observed frequency.

L4/5 Fixation	Abnormal coupling	Normal coupling	Totals
Present	6 (22.4%)	13 (48%)	19 (70.4%)
Absent	4 (14.8%)	4 (14.8%)	8 (29.6%)
Totals	10 (37.2%)	17 (62.8%)	27 (100%)

Table 2: Summary table of statistical analysis.

	Calculated Values	p value
Chi-Square $\chi^2$	0.819	p>0.05
G Statistic	0.805	
Phi Coefficient $r_{\phi}$	0.174	p>0.05
Chi-Square with contingency correction	0.22	p>0.05
Degrees of freedom (d):	1	

## DISCUSSION

Utilising the methodology described, there was no correlation between coupling patterns and motion palpation findings. It may be that such a correlation does not exist or that the technique of measurement was inadequate. It was noted that in only one case out of 27, the spinous process deviated into the convexity of the curve, representing true abnormal coupling. The more common abnormality was that of no movement of the spinous process on lateral bending, ie: a fixation of movement.

A more critical analysis of what is being palpated when a joint is determined to be fixated is needed. It may be a capsular restriction of the joint in question, however, a restriction of the contralateral joint at the same level may alter the motion palpation findings. A positive motion palpation finding may be due to an intrinsic muscle spasm, which on gross lumbar lateral flexion to the ipsilateral side would reduce the tension on this muscle and thereby not alter the coupling pattern. However, on lateral flexion to the contralateral side the resistance to stretch of this irritated muscle may restrict normal coupling patterns and movement. This may have contributed to the observation of normal coupling on the ipsilateral side at those levels determined to have a motion palpation fixation. It may also be argued that the fixation felt in motion palpation may be at the end of joint play and as such only partially alter the gross movement of the spine. This may explain why functional X-rays have

not been able to accurately demonstrate those joint subtleties detected by clinicians on motion palpation. Conversely it could be argued that motion palpation requires a critical evaluation of the methodologies used to establish its correlation coefficient.

Deviation of the L4 spinous process was determined with respect to L5 and correlated to the ipsilateral L4/5 facet. The intersegmental movement measured on X-rays may not only be affected by the contralateral facet but also L3/4 articular facets. Fixation of movement at L3/4 may affect the coupling pattern of L4 on L5 either directly or through influences on the neighboring extrinsic muscle groups.

The coupling pattern at the L4/5 was found by Percy et al (12) to be transitional. These findings are supported by the observations made in this study. The L4/5 coupling patterns may be altered by adjacent anatomical structures such as the attachment of the iliolumbar ligaments.

The determination of 'normal coupling' on lateral flexion included a range of deviations from the midline, between 1mm to 7mms. It may be that closer scrutiny of the degree of movement is warranted. A range of normal coupling movements from the midline for different age groups and for each sex, may be the subject of future experiments. This would aim to establish the range of coupling patterns inherent in healthy asymptomatic patients against which LBP patients can then be measured.

Patients in this study were asked to laterally flex to a point they could maintain without discomfort, as such a wide range of gross spine lateral flexion movements were included in this study. These included patients who stopped at the point of reproducing their symptoms as well as those who stopped lateral flexion at the end of the range of movement of the spine. This may be why observations in spinous process deviations into the ipsilateral side of lateral lumbar flexion ranged from 1mm to 7mms. In 13 cases a L4/5 restriction was associated with normal coupling. An analysis of the raw data reveals no noticeable reduction in the degree of movement as compared to the no restriction at L4/5 group. While no pattern seems to be evident correlating fixation with a change in the coupling patterns. It may be concluded that the findings of motion palpation restrictions at L4/5 may arise from myriad of structures including either the ipsilateral or contralateral facets and the intrinsic muscle and that alterations in the coupling patterns on X-ray may be affected by any of the above mentioned structures and in addition may be affected by the extrinsic muscles, the superior intersegmental joint function and or iliolumbar ligament. A simple correlation between a single facet restriction and an associated alteration in intersegmental coupling pattern has not been supported.

The manual ruling up of X-rays lends itself to a margin of error, in this study 1mm movement was sufficient to be included in the normal coupling group. The sensitivity and accuracy of measuring techniques needs to be improved to warrant further investigation. It would be of interest in future studies to utilize computer aided scanning of superimposed functional X-rays to observe initially, the coupling patterns, axis of rotation and degrees of spinous process deviation from the midline in asymptomatic patients characterized by age and sex. Should a definable pattern arise within the asymptomatic patient population, a hypothesis that a the symptomatic patient may differ from this pattern can then be tested.

### CONCLUSIONS

This study demonstrated a strong tendency toward either normal coupling or no movement, corresponding with the findings of Mile and Sullivan (10). Abnormal coupling was noted in only one case, unilateral to the side of L4/5 restriction. It is of particular interest to note that the presence of the L4/5 fixation was not associated with abnormal coupling but conversely was frequently observed to be associated with normal coupling patterns. However, a simple correlation between a single motion palpation finding of a restriction at a L4/5 facet and an alteration in coupling patterns could not be supported. There may be a multitude of structures which effect the perceived findings of a restriction at an intersegmental level some of which may alter the coupling patterns found on X-rays. In addition coupling patterns may also be altered by structures which may or may not elicit a finding of intersegmental fixation on motion palpation.

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