

THE ASSOCIATIONS OF COMMON RADIOGRAPHIC FINDINGS TO AGE AND TO THE REASONS COMMONLY GIVEN FOR ORDERING X-RAY IMAGING IN A CHIROPRACTIC COLLEGE CLINIC: A CROSS-SECTIONAL QUANTITATIVE STUDY

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ABSTRACT

Objective: The objectives of this study were (i) to report on the reasons students gave for ordering x-ray imaging at a chiropractic college outpatient clinic; (ii) to review radiographic findings on the x-rays ordered; (iii) determine if there was an association between the 2 and (iv) determine if there was an association of the findings to 3 age groups.

Methods: Students in a chiropractic college clinic were asked to complete a form which included age and the reasons the radiographs had been requested. The findings on these radiographs were determined and the common findings (those findings that occurred in 10 or more percent of the cases which the authors felt was an occurrence frequency that would represent a common occurrence) were analyzed for significant associations to age and common reasons for requesting

the radiographs (those reasons that were given in 10 or more percent of the cases) for seeking imaging.

Results: Common reasons for requesting imaging were significantly associated with common specific radiographic findings. Older age groups were significantly associated with more common findings. The youngest age group was significantly less likely to be associated with common findings.

Conclusion: Common reasons for requesting radiographs were associated with common radiographic findings. Age has a significant effect on the frequency of findings. (*J Contemporary Chiropr* 2023;6:14-27)

Key Indexing Terms: Radiographic Findings; Diagnostic X-Ray Imaging; Spine; Chiropractic; Radiography Guidelines

INTRODUCTION

Historically, x-ray imaging for examination of the spine has been part of chiropractic care since 1910. (1) Chiropractors were the first to use full-spine x-rays in practice. (2) One reason chiropractors use imaging is to examine the biomechanical integrity (which would include spinal alignment) of the spine as significant

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forces are introduced into the spine during spinal adjusting i.e. spinal manipulative therapy. (3-5) Current prevailing imaging guidelines, however, recommend against the use of imaging in the first 4-6 weeks of care for musculoskeletal (MSK) complaints, unless red flags indications are present in the patient's history or physical examination. (6) These imaging guidelines are the same for chiropractors as they are for medical practitioners, even though the treatment from chiropractors often includes forces applied to the spine with high-velocity, low-amplitude spinal manipulation/adjustments (HVLA SMT). The medical practitioner typically uses no such physical forces. Beck et al (7) and Jenkins et al (8) have noted findings on spinal radiographs that might influence chiropractic care. While those studies are of importance to the profession they do not answer the question as to what types of radiographic findings a practicing clinician would be likely to see in "everyday" practice. In 2004, a study from the New Zealand College of Chiropractic examined 847 full-spine radiographs in an effort to identify anomalies that would alter chiropractic interventions. The authors found that 68% of the patients in the study were found to have anomalies. But, they noted that further research was needed to determine how they might alter treatment. (7) Six years later, Jenkins et al reviewed 3519 radiographic reports and concluded that the frequency of anomalies was sufficient "to warrant closer inspection of the current x-ray guidelines". (8) However, Jenkins et al later reported, "The use of spinal x-rays should not be routinely performed in chiropractic practice, and should be guided by clinical guidelines and clinician judgement." (9)

It is beyond the scope of this paper to answer when imaging should be employed. However, it may be useful for the practicing clinician to understand what they are likely to commonly find on the radiographs of a particular presenting patient. In an effort to that end, this investigation examines which common radiographic findings were significantly more or less likely to be found in 1 of 3 age groups when compared to all the subjects not in that age group. Additionally, the significant associations between the reasons commonly given for requesting spinal radiographs and the findings commonly seen on those radiographs in a chiropractic college clinic were studied. These results may help the clinician to more accurately predict what findings would commonly be present on the radiograph in certain cases. This knowledge might better inform practicing clinicians about the condition of their patients.

METHODS

This study was conducted at Life Chiropractic College West with the approval of their Institutional Review Board and given the number P/N 2009-06. Students who had already determined that the care of their patient required a radiographic study and had received approval to obtain radiographs were asked to complete the first portion of a form (Appendix A) which established the sex and age for the patient and provided a list of possible reasons the radiographs were requested. On the provided list of possible reasons the radiographs were requested, the students were directed to "check all that apply." A category titled "Other Reasons X-rays were Requested" was provided for reasons not otherwise given as options on the collection form.

As is the custom of that institution, the radiographs obtained by students were reviewed by an experienced Doctor of Chiropractic who was also a Diplomate of the American Chiropractic Board of Radiology (DACBR) and who completed the second portion of the form which contained a list of possible findings for the radiographs. Two additional categories, "Other Clinically Significant Findings" and "Other Clinically Significant Disease Processes" were provided for findings not otherwise given as options on the collection form. Subjects were accepted if the patient was 21 years of age or older and the collection form was completed by the student and the DACBR. The data collection for this study was conducted over the course of 22 months. There were a total of 362 subjects. However, the forms were not adequately completed on 96 of the subjects. This resulted in the number of subjects who met the criteria and were entered into the study being 126 male and 140 female, for a total of 266 subjects. The reasons for obtaining the radiographs and age groups of the patients were compared to the findings on the radiographs made by the DACBR.

Age Groups

For convenience, 3 different age groups were selected by the authors (ages 21-35 consisting of 146 subjects; 36-50 consisting of 51 subjects; and 50+ consisting of 69 subjects). These subjects were compared to all the subjects not in that age group to determine if 1 group was significantly more or less likely to have a particular common finding on the radiographs as compared to all the other subjects not in that age group.

The radiographic findings which were used as comparisons for these groups were determined by the

authors as being reasonable to use for this comparison (Appendix B) as opposed to testing every finding. To avoid associations that might result by chance alone and to provide results that would be common findings and applicable to everyday practice only findings that occurred in over 10% of the cases, i.e. 27 cases or more qualified. For our purposes a common finding was defined as a finding that occurred in 10 or more percent of the cases which we felt was an occurrence frequency that would represent a common occurrence. The analyses were performed utilizing a STATA Version 14 program produced by StataCorp of College Station, Texas.

Associations of Reasons for Requesting Radiographs to Radiographic Findings

The reasons for obtaining the radiographs were compared to the findings on the radiographs to identify significant associations. To avoid obtaining results that might not be relevant, comparisons were made between the reasons given as to why the radiographs were requested and a list of findings that were determined by us as being reasonable to use for this comparison, as opposed to testing every finding (Appendix C). To avoid associations that might result by chance alone and to provide results that would be common problems and applicable to everyday practice only findings as well as reasons for requesting the radiographs that occurred in over 10% of the cases, i.e. more than 26 cases qualified for inclusion in the analysis. Chi-squared analyses were conducted to compare the association between incidence of outcomes and radiographic findings. Associations between radiographic findings and outcomes are reported for all instances of $p < 0.05$ and only for relatively common ($> \text{ or } = 10\%$ observations) problems, as noted above. The analyses were performed utilizing STATA Version 14.

For this study the following approach for categorization was designed. A number following a category i.e. (Cervical Hypolordosis 2) indicates the magnitude of that finding with higher numbers indicating larger magnitudes. The number in parentheses indicates the number of levels of magnitude possible in that category. This number is higher for greater magnitudes of that category. The assessment of magnitude was made by the DACBR reviewing the radiographs and is based on their judgement. If there is not a number following the category i.e. (Cervical Hypolordosis) it indicates that this category would include all Cervical Hypolorodisis findings regardless of magnitude.

RESULTS

Significant Associations between Age Groups and Common Radiographic Findings

There was a difference in which age group was more or less likely to be significantly associated with a particular common finding when compared to all the subjects not in that age group. In the age group of 21-35 the findings were all less likely to have a significant association. In the age group 36-50 all the findings except one were more likely to have a significant association. In the age group over 50 all the findings were more likely to have a significant association. The results in the age group 36-50 more closely resembled the results of the over 50 age group as compared to the 21-35 age group in the fact that the significant associations were more likely to occur as opposed to being less likely to occur. The results are shown in Table 1.

Significant Associations between Commonly Given Reasons for Requesting Radiographs and Common Radiographic Findings

Table 1. Age: Significant Associations between Age Groups and Common Radiographic Findings

AGES 21-35 SUBJECTS 146	AGES 36-50 SUBJECTS 51	AGE OVER 50 SUBJECTS 69
Significantly less Cervical disc degeneration	Significantly more Alanto-axial Subluxation	Significantly more Cervical Disc Degeneration
Significantly less Thoracic disc degeneration	Significantly more Cervical Disc Degeneration	Significantly more Thoracic Disc Degeneration
Significantly less Lumbar disc degeneration	Significantly more Cervical Vertebral Body Spurring	Significantly more Lumbar Disc Degeneration
Significantly less Cervical Spurring into or Narrowing of the Intervertebral foramina	Significantly more Thoracic Vertebral Body Spurring	Significantly more Cervical Spurring into or Narrowing of the Intervertebral Foramina
Significantly less Lumbar Spurring into or Narrowing of the Intervertebral foramina	Significantly more Lumbar Vertebral body Spurring	Significantly more Lumbar Spurring into or Narrowing of the Intervertebral Foramina
Significantly less Cervical Vertebral Body Spurring	Significantly more Cervical Hypolordosis Level 3(5 levels)	Significantly more Cervical Vertebral Body Spurring
Significantly less Thoracic Vertebral Body Spurring	Significantly less Thoracic Rotational Inter-vertebral Misalignment	Significantly more Thoracic Vertebral Body Spurring
Significantly less Lumbar Vertebral Body Spurring		Significantly more Lumbar Vertebral Body Spurring
Significantly less Thoracic Hyperkyphosis		Significantly more Thoracic Hyperkyphosis
		Significantly more Thoracic Rotational Inter-vertebral Misalignment

Table 2. Significant Associations between Commonly Given Reasons for Requesting Radiographs and Common Radiographic Findings- Neck Pain

NECK PAIN TIME POINTS	COMMON RADIOGRAPHIC FINDINGS				
NECK PAIN TODAY	Cervical Disc Degeneration	Cervical Vertebral Body Spurring	Cervical Hypolordosis	Cervical Hypolordosis 3 (5 levels)	Cervical Rotational Inter-vertebral Misalignment
NECK PAIN IN THE LAST WEEK	Cervical Hypolordosis	Cervical Hypolordosis 3 (5 levels)	Cervical Rotational Inter-vertebral Misalignment		
NECK PAIN IN THE LAST MONTH	Cervical Hypolordosis	Cervical Hypolordosis 3 (5 levels)	Cervical Disc Space Lateral Wedging	Cervical Rotational Inter-vertebral Misalignment	
NECK PAIN IN LAST 3 MONTHS	Cervical Hypolordosis	Cervical Hypolordosis 3 (5 levels)	Cervical Disc Space Lateral Wedging	Cervical Disc Space Lateral Wedging 3 (5 levels)	Cervical Scoliosis 3 (5 levels)
NECK PAIN IN THE LAST 6 MONTHS	Cervical Hypolordosis	Cervical Hypolordosis 3 (5 levels)	Cervical Scoliosis 3 (5 levels)	Cervical Disc Space Lateral Wedging 3 (5 levels)	Cervical Disc Space Lateral Wedging
NECK PAIN IN LAST YEAR	Cervical Hypolordosis	Cervical Hypolordosis 3 (5 levels)	Cervical Disc Space Lateral Wedging		
NECK PAIN IN LAST 2 YEARS	Cervical Hypolordosis	Cervical Hypolordosis 3 (5 levels)			
NECK PAIN IN LAST 3 YEARS	Alanto-Axial Subluxation	Cervical Hypolordosis	Cervical Hypolordosis 3 (5 levels)		

There are a large variety of different significant associations between the commonly given reasons for requesting radiographs and the common radiographic findings. Two different associations are seen for headaches.

Headache

Cervical Hypolordosis 3 (5 levels)
Cervical Hypolordosis

Neck Pain

Neck pain was found to have significant associations at 8 different time points. Both Cervical Hypolordosis and

Cervical Hypolordosis 3 (5 levels) showed a significant association at all 8 time points. The results are shown in Table 2.

Thoracic Pain

Thoracic pain was found to have significant associations at 6 different time points. Thoracic Hyperkyphosis showed a significant associated at all 6 time points and 5 of these time points showed a significant association to Thoracic Vertebral Body Spurring. The results are shown in Table 3.

Lumbar (Lumbo-Sacral) Pain

Lumbar (Lumbo-Sacral) Pain was found to have significant associations at 6 different time points. At 4 of these time points Lumbar Disc Degeneration showed a significant association. Results are shown in Table 4.

Pain Radiating into Leg(s) was found to have significant associations with 3 different commonly found radiographic findings.

Pain Radiating into Leg(s)

Lumbar Disc Degeneration
Lumbar Vertebral Body Spurring
Lumbar Disc Space Lateral Wedging

Pain Radiating into Arm(s)

Pain Radiating into Arm(s) was found to have significant associations with 2 different commonly found radiographic findings.

Table 3. Significant Associations between Commonly Given Reasons for Requesting Radiographs and Common Radiographic Findings- Thoracic Pain

THORACIC PAIN TIME POINTS	COMMONLY FOUND SIGNIFICANT ASSOCIATIONS		
THORACIC PAIN TODAY	Thoracic Vertebral Body Spurring	Thoracic Hyperkyphosis	
THORACIC PAIN IN LAST WEEK	Thoracic Vertebral Body Spurring	Thoracic Scoliosis	Thoracic Hyperkyphosis
THORACIC PAIN IN LAST MONTH	Thoracic Disc Degeneration	Thoracic Vertebral Body Spurring	Thoracic Hyperkyphosis
THORACIC PAIN IN LAST THREE MONTHS	Thoracic Vertebral Body Spurring	Thoracic Hyperkyphosis	Thoracic Rotational Inter-vertebral Misalignment
THORACIC PAIN IN THE LAST 6 MONTHS	Thoracic Scoliosis 1 (5 levels)	Thoracic Hyperkyphosis	
THORACIC PAIN IN LAST YEAR	Thoracic Vertebral Body Spurring	Thoracic Hyperkyphosis	Thoracic Rotational Inter-vertebral Misalignment

Table 4. Significant Associations between Commonly Given Reasons for Requesting Radiographs and Common Radiographic Findings- Lumbar (Lumbo-Sacral) Pain

COMMONLY FOUND SIGNIFICANT ASSOCIATIONS				
LUMBAR (LUMBO-SACRAL) PAIN TIME POINTS				
LUMBAR (LUMBO-SACRAL) PAIN TODAY	Lumbar Disc Degeneration	Lumbar Vertebral Body Spurring		
LUMBAR (LUMBO-SACRAL) PAIN IN LAST WEEK	Lumbar Disc Degeneration	Lumbar Scoliosis 1 (5 levels)	Lumbar Rotational Inter-vertebral Misalignment	Lumbar Rotational Inter-vertebral Misalignment 1 (5 levels)
LUMBAR (LUMBO-SACRAL) PAIN IN LAST WEEK	Lumbar Disc Space Lateral Wedging 3 (5 levels)	Lumbar Spurring Into or Narrowing of Intervertebral Foramen	Lumbar Vertebral Body Spurring	
LUMBAR (LUMBO-SACRAL) PAIN IN LAST 3 MONTHS	Lumbar Disc Degeneration	Lumbar Hypolordosis	Lumbar Vertebral Body Spurring	
LUMBAR (LUMBO-SACRAL) PAIN IN LAST 6 MONTHS	Lumbar Disc Degeneration	Lumbar Hypolordosis	Lumbar Disc Space Lateral Wedging 3 (5 levels)	
LUMBAR (LUMBO-SACRAL) PAIN IN LAST YEAR	Lumbar Hypolordosis			
LUMBAR (LUMBO-SACRAL) PAIN IN LAST 3 YEARS	Lumbar Scoliosis 1 (5 levels)			

Pain Radiating into Arm(s)
Cervical Spurring into or Narrowing of Intervertebral Foramen
Cervical Hypolordosis

On Examination: Loss of Cervical Motion, Loss of Thoracic Motion or Loss of Lumbar (Lumbo-Sacral) Motion

On examination loss of either Cervical, Thoracic or Lumbar (Lumbo-Sacral) Motion was significantly associated with different commonly found radiographic findings. Disc Degeneration was significantly associated

Table 5. Significant Associations between Commonly Given Reasons for Requesting Radiographs and Common Radiographic Findings- On Examination: Loss of Cervical Motion, Loss of Thoracic Motion or Loss of Lumbar (Lumbo-Sacral) Motion

LOSS OF CERVICAL MOTION	LOSS OF THORACIC MOTION	LOSS OF LUMBAR (LUMBO-SACRAL) MOTION
Cervical Disc Degeneration	Thoracic Disc Degeneration	Lumbar Disc Degeneration
Cervical Hypolordosis	Thoracic Rotational Inter-vertebral Misalignment 1 (5 levels)	Lumbar Rotational Inter-vertebral Misalignment
Cervical Hypolordosis 3 (5 levels)	Thoracic Rotational Inter-vertebral Misalignment	
Cervical Disc Space Lateral Wedging 3 (5 levels)		

to all 3 of these reasons for requesting radiographs. The results are shown in Table 5.

DISCUSSION

In this study we considered common radiographic findings related to age groups. We also examined the significant associations between commonly given reasons for requesting radiographs and common radiographic findings. These provide information that may better inform the chiropractic clinician as to what they are likely to find in particular types of patients in their everyday clinical practice.

In each age group, the commonly found radiographic findings, those findings that occurred in 10% or more of the cases, were compared to all the subjects not in that age group to determine if a finding was significantly more or less likely to occur in that age group. As might be expected, in the youngest age group, 21-35, the significantly associated radiographic findings we studied were always less likely to be present. Significantly associated radiographic findings in the oldest group, 50+, were always more likely to be present. The findings we studied were also more likely to occur in the 36-50 age group, except for having significantly less thoracic rotational intervertebral misalignment. Both

the 36–50 and the 50+ groups were significantly more likely to have cervical, thoracic, and lumbar vertebral body spurring as well as cervical disc degeneration. These findings might represent a reason for interest

to the chiropractor/clinician applying forces to spinal structures.

This article also explores which common radiographic findings are significantly associated with which common reasons, those reasons that occurred in 10% or more of the cases, for obtaining radiography. As might be expected there were multiple associations with the reasons for the radiographs being requested because of pain in the neck, thoracic or lumbar-lumbosacral areas and various radiographic findings. But once again, we note that our study was not intended to determine or explore the concept that a certain finding causes a particular condition. A number of findings were observed which may be used to inform care. These significantly associated findings fall into three broad categories: alignment changes, soft tissue problems and bony changes.

Alignment changes found include: Scoliosis, rotational inter-vertebral misalignment, disc space lateral wedging, which requires a loss of the normal parallel orientation of the vertebral end plates, atlanto-axial subluxation, kyphosis and lordosis changes. Disc space lateral wedging falls into both the categories of alignment and soft tissue changes as it also affects the intervertebral disc.

Soft tissue changes found include: disc degeneration and disc space lateral wedging. Bony changes found include: vertebral body spurring and spurring into or narrowing of the intervertebral foramen. Each significant association indicates changes in the integrity of the spine and/or the deviation of spinal alignment from neutral.

Alignment Changes

The decision-making process related to whether chiropractic care should be delivered and if so what care may be appropriate, includes the consideration of the direction of any applied forces that might be used by the chiropractic clinician. Imaging allows viewing of the state of spinal curves and vertebral positioning, some of which were found in this study to be significantly associated with the reasons given for requesting radiography. Forces can be applied in attempts to improve or correct structural malalignment. (10–12) But

Triano and Budgell have recommended that the use of x-rays should not be used to determine the site of care. (13)

However, forces applied in ill-informed directions would likely create adverse stresses and strains on soft tissues, especially in already injured or otherwise weakened spinal areas. A recent study of HVLA side-posture thrusts found a range of forces of 846 to 1208 N averaging 1010.9 N. (14) Owens, et al (4) found some forces were as high as 1400 N for side posture thrusts. Kirstukas and Backman, in a study on thoracic thrusts, found peak force magnitudes with means of 863 N for one participant and 1044 N for the second participant, with some thrusts reaching above 1300 N. (5) These thrust forces should be considered in the context of spinal load tolerances. One study showed that repeated shear loads to the lumbar spine of 1200 N led to a Grade 1 listhesis. (15) That study also showed shear strength up to failure levels in human lumbar specimens ranging from 600 to 3,200 N. These data suggest that the higher end peak forces of HVLA/SMT may be enough to cause further damage, especially in a previously injured and therefore relatively weakened spine, if the force is applied in an inappropriate direction.

Failure of supportive soft tissues may be involved in distorted vertebral alignment and should play a part in the clinician's decision on whether or not to apply HVLA-SMT treatment and aid in determining the magnitude of forces applied to the spine. "Damage to the ligaments from trauma or cumulative microtrauma can weaken the spine's structural capabilities, leading to spinal misalignment." (16) Imaging evidence of malalignment may also help determine the directions of any forces applied to the spine.

Soft Tissue Problems and Bony Changes

Although serious injury is rare, applying forces to the spine can potentially cause injury regardless of the intent. (3,17) Soft tissue problems and bony changes indicate compromised strength and integrity of the spine. In this study, there are a number of significant associations with soft tissue and bony changes. Each case is individual and the magnitude of findings such as disc degeneration and spurring into the intervertebral foramen can greatly influence the clinician's perspective in these matters. The findings listed under the categories of soft tissue problems and bony changes are conditions that play a part in the clinician's decision on whether or not to administer care. In that way, the magnitude and type of forces introduced into the spine

might be influenced by imaging of the injured spine.

The results of this study indicate which age groups were more or less likely to be significantly associated with a number of common radiographic findings. It also identifies commonly given reasons for requesting radiography that were significantly associated with certain common radiographic findings. These findings are relevant to the regular patients seen in a chiropractic practice and are common problems. They are not the type of findings that will be seen occasionally or even rarely. They are the problems that will be seen and considered in everyday practice and, as such, deserve consideration. These associations may allow the clinician to better determine what types of findings they might expect to find on the radiographs in various cases.

Limitations

This study reflects the findings of only this group of patients. Other study populations or a larger sample of subjects might show different results. We have selected the comparisons between the groups in our study population and various radiographic findings in this study. A selection of different comparisons may give different findings. The students in this study who had already determined that the care of their patient warranted a radiographic study and had received approval to obtain radiographs were asked to complete the first portion of the study form. However, the students were not required to do so, and we cannot, therefore, know the number of students who elected not to fill out the form. The types of patients presenting for care by students may be different from the types of patients presenting to practicing doctors of chiropractic. Patient positioning may affect radiographic alignment. Only one DACBR was used for the radiographic interpretation. The study does not determine the cause of the findings.

CONCLUSION

This study investigates radiographic findings in a group of patients seeking care in a chiropractic college clinic. Our analyses identify common radiographic findings which are significantly more or less likely to be found in 3 different age groups. We also identify significant associations between commonly given reasons for requesting spinal radiographs and the common findings seen on those radiographs. These are the types of findings that would be seen in everyday clinical practice. The practicing chiropractic clinician should determine

how important these types of problems might be in a particular case.

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APPENDIX A

Number:_____ (Number to be entered when x-rays are reviewed. Number in order of patients i.e. Number 1 for first patient, Number 2 for second patient etc.)

This area of form for completion by person requesting x-rays:

Patient Information:

Age groups: ☐ 21-35 ☐ 36-50 ☐ Over 50

☐ Male ☐ Female

Reason for x-ray (check all that apply)

☐ The patient suffered trauma to the neck: ☐ today ☐ in the last week ☐ in the last month ☐ in the last 3 months ☐ in the last 6 months ☐ in the last year ☐ in the last 2 years ☐ in the last 3 years (check all that apply)

☐ The patient suffered trauma to the thoracic area: ☐ today ☐ in the last week ☐ in the last month ☐ in the last 3 months ☐ in the last 6 months ☐ in the last year ☐ in the last 2 years ☐ in the last 3 years (check all that apply)

☐ The patient suffered trauma to the lumbar (lumbo-sacral) area: ☐ today ☐ in the last week ☐ in the last month ☐ in the last 3 months ☐ in the last 6 months ☐ in the last year ☐ in the last 2 years ☐ in the last 3 years (check all that apply)

☐ Biomechanical analysis

☐ Bowel or bladder symptoms

☐ Fever

☐ History of cancer

☐ Suspicion of cancer

☐ Unexplained weight loss

☐ Urinary tract infection

☐ Intravenous drug use

☐ Saddle anesthesia

☐ Prolonged use of corticosteroids

☐ Osteoporosis

☐ Headache

☐ The patient has had pain in the neck: ☐ today ☐ in the last week ☐ in the last month ☐ in the last 3 months ☐ in the last 6 months ☐ in the last year ☐ in the last 2 years ☐ in the last 3 years (check all that apply)

☐ The patient has had pain in the thoracic area: ☐ today ☐ in the last week ☐ in the last month ☐ in the last 3 months ☐ in the last 6 months ☐ in the last year ☐ in the last 2 years ☐ in the last 3 years (check all that apply)

☐ The patient has had pain in the lumbar (lumbo-sacral) area: ☐ today ☐ in the last week ☐ in the last month ☐ in the last 3 months ☐ in the last 6 months ☐ in the last year ☐ in the last 3 years (check all that apply)

the last 2 years _in the last 3 years (check all that apply)

_ Pain radiating into leg or legs

_ Pain radiating into arm or arms

_ Loss of _cervical _thoracic _lumbar (lumbo-sacral) motion on examination

_ Excessive _cervical _thoracic _lumbar (lumbo-sacral) motion on examination

_ Other reasons these x-rays were requested (please list and please print):_____

Has the patient done any of the following? (check all that apply)

_The patient has missed time from work due to neck pain: _today _in the last week _in the last month _in the last 3 months _in the last 6 months _in the last year _in the last 2 years _in the last 3 years (check all that apply)

Number:_____ (number to be entered when x-rays are reviewed)

_The patient has missed time from work due to thoracic pain: _today _in the last week _in the last month _in the last 3 months _in the last 6 months _in the last year _in the last 2 years _in the last 3 years (check all that apply)

_The patient has missed time from work due to lumbar (lumbo-sacral) pain: _today _in the last week _in the last month _in the last 3 months _in the last 6 months _in the last year _in the last 2 years _in the last 3 years (check all that apply)

The remainder of the form to be completed by D.A.C.B.R. reviewing x-rays:

Areas x-rayed (check all that apply):

_ Sectional views of the cervical area:

_ Nasium

_ Sectional views of the thoracic area:

_ Swimmers view

_ Sectional views of the lumbar area:

_ Oblique views _cervical _thoracic _lumbar

_ Fifth lumbar (lateral) spot shot

_ Sectional view of the pelvis:

_ Full Spine views (A-P and lateral full spine)

_ A-P Full Spine view

_ Lateral Full Spine view

_ Lateral bending views _cervical _thoracic _lumbar

_ Flexion and extension views _cervical _thoracic _lumbar

_ Other views (please list and please print):_____

Findings (check all that apply)

_ Calcification of the abdominal aorta

_ Enlargement of the abdominal aorta

_ Aneurysm of the abdominal aorta

_Atherosclerosis

_Calcified lymph nodes

_Cystic calcifications

_Loss of prevertebral fat stripe in the cervical spine

_ Atlanto-axial subluxation

_ Block vertebrae (congenital or surgical fusion):

_ Cervical disc degeneration

_ Thoracic disc degeneration

_ Lumbar disc degeneration

_ Dislocation in _cervical _thoracic _lumbar area (please list type and please print):_____

_ Enlarged atlanto-dental interspace

_ Fracture (compression fracture of the vertebral body 25% or under) in _cervical _thoracic _lumbar area

_ Fracture (compression fracture of the vertebral body 50% or under) in _cervical _thoracic _lumbar area

Number:_____ (number to be entered when x-rays are reviewed)

_ Fracture (compression fracture of the vertebral body 75% or under) in _cervical _thoracic _lumbar area

_ Fracture (compression fracture of the vertebral body over 75%) in _cervical _thoracic _lumbar area

- _ Fracture (other fracture) in _cervical _thoracic _lumbar area (please list type and please print):_____
- _ Hemi vertebrae in _cervical _thoracic _lumbar area
- _ Significant break in George's line:
- _ Spinal canal stenosis in _cervical _thoracic _lumbar area
- _ Spondylolysis _cervical _thoracic _lumbar area
- _ Spondylolesthesis cervical, grade_____ type (please list and print) _____
- _ Spondylolesthesis thoracic, grade _____ type (please list and print) _____
- _ Spondylolesthesis lumbar, grade _____ type (please list and print) _____
- _ Spurring into or narrowing of the intervertebral foramina in _cervical _thoracic _lumbar area
- _ Vertebral body spurring _cervical _thoracic _lumbar
- _ Paradoxical movement on lateral bending view _cervical _thoracic _lumbar
- _ Other clinically significant findings (please list and please print):_____
- _ Bone destruction
- _ Osteoporosis
- _ Other clinically significant disease processes (please list and please print):_____

Biomechanical issues: (Rate on a 1-5 scale with 1 being minimally clinically important and 5 being very clinically important) Please check appropriate box and circle appropriate number for all that apply.

Static Views

- _ Cervical hypolordosis 1 2 3 4 5
- _ Cervical hyperlordosis 1 2 3 4 5
- _ Thoracic hypolordosis 1 2 3 4 5
- _ Thoracic hyperlordosis 1 2 3 4 5
- _ Thoracic hyperkyphosis 1 2 3 4 5
- _ Lumbar hypolordosis 1 2 3 4 5

- _ Lumbar hyperlordosis 1 2 3 4 5
- _ Cervical Anterolisthesis 1 2 3 4 5
- _ Thoracic Anterolisthesis 1 2 3 4 5
- _ Lumbar Anterolisthesis 1 2 3 4 5
- _ Cervical Retrolisthesis 1 2 3 4 5
- _ Thoracic Retrolisthesis 1 2 3 4 5
- _ Lumbar Retrolisthesis 1 2 3 4 5
- _ Cervical Laterolisthesis 1 2 3 4 5
- _ Thoracic Laterolisthesis 1 2 3 4 5
- _ Lumbar Laterolisthesis 1 2 3 4 5
- _ Cervical Scoliosis 1 2 3 4 5
- _ Thoracic Scoliosis 1 2 3 4 5
- _ Lumbar Scoliosis 1 2 3 4 5
- _ Cervical Rotational Inter-vertebral Misalignment 1 2 3 4 5
- _ Thoracic Rotational Inter-vertebral Misalignment 1 2 3 4 5
- _ Lumbar Rotational Inter-vertebral Misalignment 1 2 3 4 5

Number: _____ (number to be entered when x-rays are reviewed)

- _ Cervical Disc Space Wedging Between Vertebrae (lateral flexion misalignment) 1 2 3 4 5
- _ Thoracic Disc Space Wedging Between Vertebrae (lateral flexion misalignment) 1 2 3 4 5
- _ Lumbar Disc Space Wedging Between Vertebrae (lateral flexion misalignment) 1 2 3 4 5
- _ Other clinically significant findings (please list and please print):_____

Dynamic Views

- _ Cervical hypomobility (lateral flexion) 1 2 3 4 5
- _ Cervical hypomobility (flexion-extension) 1 2 3 4 5
- _ Cervical hypermobility (lateral flexion) 1 2 3 4 5
- _ Cervical hypermobility (flexion-extension) 1 2 3 4 5

- _ Thoracic hypomobility (lateral flexion) 1 2 3 4 5
- _ Thoracic hypomobility (flexion-extension) 1 2 3 4 5
- _ Thoracic hypermobility (lateral flexion) 1 2 3 4 5
- _ Thoracic hypermobility (flexion-extension) 1 2 3 4 5
- _ Lumbar hypomobility (lateral flexion) 1 2 3 4 5
- _ Lumbar hypomobility (flexion-extension) 1 2 3 4 5
- _ Lumbar hypermobility (lateral flexion) 1 2 3 4 5
- _ Lumbar hypermobility (flexion-extension) 1 2 3 4 5
- _ Other clinically significant findings (please list and please print):-----

Nothing of clinical significance was found

- _ No clinically significant findings

APPENDIX B

Age

Ages 21-35, Age 36-50, Age 50+ compared to:

Calcification of Abdominal Aorta, Enlargement of Abdominal Aorta, Aneurysm of Abdominal Aorta, Atherosclerosis, Calcified lymph nodes, Cystic Calcifications, Loss of Cervical Prevertebral Fat Stripe, Alanto-axial Subluxation, Cervical Disc Degeneration, Thoracic Disc Degeneration, Lumbar Disc Degeneration, Cervical Vertebral Body Compression Fracture to 25%, Thoracic Vertebral Body Compression Fracture to 25%, Lumbar Vertebral Body Compression Fracture to 25%, Cervical Vertebral Body Compression Fracture to 50%, Thoracic Vertebral Body Compression Fracture to 50%, Lumbar Vertebral Body Compression Fracture to 50%, Cervical Vertebral Body Compression Fracture to 75%, Thoracic Vertebral Body Compression Fracture to 75%, Lumbar Vertebral Body Compression Fracture to 75%, Cervical Vertebral Body Compression Fracture over 75%, Thoracic Vertebral Body Compression Fracture over 75%, Lumbar Vertebral Body Compression Fracture over 75%, Break in George's Line, Cervical Stenosis, Thoracic Stenosis, Lumbar Stenosis, Cervical Spondylolysis, Thoracic Spondylolysis, Lumbar Spondylolysis, Cervical Spondylolesthesis, Cervical Spondylolesthesis Grade 1,2,3,4, Thoracic Spondylolesthesis, Thoracic Spondylolesthesis Grade 1,2,3,4, Lumbar Spondylolesthesis, Lumbar Spondylolesthesis Grade 1,2,3,4, Cervical Spurring into or Narrowing of Intervertebral Foramen, Thoracic Spurring into or

Narrowing of Intervertebral Foramen, Lumbar Spurring into or Narrowing of Intervertebral Foramen, Cervical Vertebral Body Spurring, Thoracic Vertebral Body Spurring, Lumbar Vertebral Body Spurring, Cervical Paradoxical Movement on Lateral Bending, Thoracic Paradoxical Movement on Lateral Bending, Lumbar Paradoxical Movement on Lateral Bending, Bone Destruction, Osteoporosis, Cervical Hypolordosis, Cervical Hypolordosis 1,2,3,4,5, Cervical Hyperlordosis, Cervical Hyperlordosis 1,2,3,4,5, Thoracic Hypokyphosis, Thoracic Hypokyphosis 1,2,3,4,5, Thoracic Hyper Lordosis, Thoracic Hyper Lordosis 1,2,3,4,5, Thoracic Hyperkyphosis, Thoracic Hyperkyphosis 1,2,3,4,5, Lumbar Hypolordosis, Lumbar Hypolordosis 1,2,3,4,5, Lumbar Hyperlordosis, Lumbar Hyperlordosis 1,2,3,4,5, Cervical Scoliosis, Cervical Scoliosis 1,2,3,4,5, Thoracic Scoliosis, Thoracic Scoliosis 1,2,3,4,5, Lumbar Scoliosis, Lumbar Scoliosis 1,2,3,4,5, Cervical Rotational Inter-vertebral Misalignment, Cervical Rotational Inter-vertebral Misalignment 1,2,3,4,5, Thoracic Rotational Inter-vertebral Misalignment, Thoracic Rotational Inter-vertebral Misalignment 1,2,3,4,5, Lumbar Rotational Inter-vertebral Misalignment, Lumbar Rotational Inter-vertebral Misalignment 1,2,3,4,5, Cervical Disc Space Lateral Wedging, Cervical Disc Space Lateral Wedging 1,2,3,4,5, Thoracic Disc Space Lateral Wedging, Thoracic Disc Space Lateral Wedging 1,2,3,4,5, Lumbar Disc Space Lateral Wedging, Lumbar Disc Space Lateral Wedging 1,2,3,4,5

APPENDIX C

Headache

Headache compared to:

Alanto-axial Subluxation, Block Vertebrae (congenital or fusion), Cervical Disc Degeneration, Enlarged Alanto-dental Interspace, Cervical Spondylolisthesis, Cervical Spondylolisthesis Grade 1,2,3,4, Cervical Spurring into or Narrowing of Intervertebral Foramen, Cervical Vertebral Body Spurring, Cervical Paradoxical Movement on Lateral Bending, Cervical Hypolordosis, Cervical Hypolordosis 1,2,3,4,5, Cervical Hyperlordosis, Cervical Hyperlordosis 1,2,3,4,5, Cervical Anterolisthesis, Cervical Anterolisthesis 1,2,3,4,5, Cervical Retrolisthesis, Cervical Retrolisthesis 1,2,3,4,5, Cervical Rotational Inter-vertebral Misalignment, Cervical Rotational Inter-vertebral Misalignment 1,2,3,4,5, Cervical Disc Space Lateral Wedging, Cervical Disc Space Lateral Wedging 1,2,3,4,5, Cervical Hypomobility Lateral Flexion, Cervical Hypomobility Lateral Flexion 1,2,3,4,5, Cervical Hypomobility Flexion/

Extension, Cervical Hypomobility Flexion/Extension 1,2,3,4,5, Cervical Hypermobility Lateral Flexion, Cervical Hypermobility Lateral Flexion 1,2,3,4,5, Cervical Hypermobility Flexion/Extension, Cervical Hypermobility Flexion/Extension 1,2,3,*5, Break in George's Line, Cervical Stenosis

* Cervical Hypermobility Flexion/Extension 4 was inadvertently left out of the comparison, however, it was not found 5 or more times so it was not eligible for inclusion in the tables.

Neck Pain

Neck Pain today, in last week, month, 3 months, 6 months, year, 2 years and last 3 years compared to:

Alanto-axial Subluxation, Cervical Disc Degeneration, Cervical Dislocation, Enlarged Alanto-dental Interspace, Cervical Vertebral Body Compression Fracture to 25%, Cervical Vertebral Body Compression Fracture to 50%, Cervical Vertebral Body Compression Fracture to 75%, Cervical Vertebral Body Compression Fracture over 75%, Other Type Cervical Fracture, Cervical Spondylolysis, Cervical Spondylolisthesis, Cervical Spondylolisthesis Grade 1,2,3,4, Cervical Spurring into or Narrowing of Intervertebral Foramen, Cervical Vertebral Body Spurring, Cervical Paradoxical Movement on Lateral Bending, Bone Destruction, Cervical Hypolordosis, Cervical Hypolordosis 1,2,3,4,5, Cervical Hyperlordosis, Cervical Hyperlordosis 1,2,3,4,5, Cervical Anterolisthesis, Cervical Anterolisthesis 1,2,3,4,5, Cervical Retrolisthesis, Cervical Retrolisthesis 1,2,3,4,5, Cervical Laterolisthesis, Cervical Laterolisthesis 1,2,3,4,5, Cervical Scoliosis, Cervical Scoliosis 1,2,3,4,5, Cervical Rotational Inter-vertebral Misalignment, Cervical Rotational Inter-vertebral Misalignment 1,2,3,4,5, Cervical Disc Space Lateral Wedging, Cervical Disc Space Lateral Wedging 1,2,3,4,5, Cervical Hypomobility Lateral Flexion, Cervical Hypomobility Lateral Flexion 1,2,3,4,5, Cervical Hypomobility Flexion/Extension, Cervical Hypomobility Flexion/Extension 1,2,3,4,5, Cervical Hypermobility Lateral Flexion, Cervical Hypermobility Lateral Flexion 1,2,3,4,5, Cervical Hypermobility Flexion/Extension, Cervical Hypermobility Flexion/Extension 1,2,3,*5, Hemivertebrae Cervical, Break in George's Line, Cervical Stenosis, Paradoxical Movement Unspecified

* Cervical Hypermobility Flexion/Extension 4 was inadvertently left out of the comparison, however, it was not found 5 or more times so it was not eligible for inclusion in the tables.

Thoracic Pain

Thoracic Pain today, in last week, month, 3 months, 6 months, year, 2 years and last 3 years compared to:

Thoracic Disc Degeneration, Thoracic Dislocation, Thoracic Vertebral Body Compression Fracture to 25%, Thoracic Vertebral Body Compression Fracture to 50%, Thoracic Vertebral Body Compression Fracture to 75%, Thoracic Vertebral Body Compression Fracture over 75%, Other Type Thoracic Fracture, Thoracic Spondylolysis, Thoracic Spondylolisthesis, Thoracic Spondylolisthesis Grade 1,2,3,4, Thoracic Spurring into or Narrowing of Intervertebral Foramen, Thoracic Vertebral Body Spurring, Thoracic Paradoxical Movement on Lateral Bending, Thoracic Hypokyphosis, Thoracic Hypokyphosis 1,2,3,4,5, Thoracic Anterolisthesis, Thoracic Anterolisthesis 1,2,3,4,5, Thoracic Scoliosis, Thoracic Scoliosis 1,2,3,4,5, Break in George's Line, Thoracic Stenosis, Thoracic Hyper Lordosis, Thoracic Hyper Lordosis 1,2,3,4,5, Thoracic Hyperkyphosis, Thoracic Hyperkyphosis 1,2,3,4,5, Thoracic Retrolisthesis, Thoracic Retrolisthesis 1,2,3,4,5, Thoracic Laterolisthesis, Thoracic Laterolisthesis 1,2,3,4,5, Thoracic Rotational Inter-vertebral Misalignment, Thoracic Rotational Inter-vertebral Misalignment 1,2,3,4,5, Thoracic Disc Space Lateral Wedging, Thoracic Disc Space Lateral Wedging 1,2,3,4,5, Thoracic Hypomobility Lateral Flexion, Thoracic Hypomobility Lateral Flexion 1,2,3,4,5, Thoracic Hypomobility Flexion/Extension, Thoracic Hypomobility Flexion/Extension 1,2,3,4,5, Thoracic Hypermobility Lateral Flexion, Thoracic Hypermobility Lateral Flexion 1,2,3,4,5, Thoracic Hypermobility Flexion/Extension, Thoracic Hypermobility Flexion/Extension 1,2,3,4,5, Paradoxical Movement Unspecified

Lumbar (Lumbo-Sacral) Pain

Lumbar (lumbo-sacral) pain today, in last week, month, 3 months, 6 months, year, 2 years and last 3 years compared to:

Lumbar Disc Degeneration, Lumbar Dislocation, Lumbar Vertebral Body Compression Fracture to 25%, Lumbar Vertebral Body Compression Fracture to 50%, Lumbar Vertebral Body Compression Fracture to 75%, Lumbar Vertebral Body Compression Fracture over 75%, Other Type of Lumbar Fracture, Lumbar Spondylolysis, Lumbar Spondylolisthesis, Lumbar

Spondylolisthesis Grade 1,2,3,4, Lumbar Vertebral Body Spurring, Lumbar Spurring into or Narrowing of the Intervertebral Foramen, Lumbar Paradoxical Movement on Lateral Bending, Lumbar Hypolordosis, Lumbar Hypolordosis 1,2,3,4,5, Lumbar Hyperlordosis, Lumbar Hyperlordosis 1,2,3,4,5 Lumbar Anterolisthesis, Lumbar Anterolisthesis 1,2,3,4,5, Lumbar Retrolisthesis, Lumbar Retrolisthesis 1,2,3,4,5, Lumbar Laterolisthesis, Lumbar Laterolisthesis 1,2,3,4,5, Lumbar Scoliosis, Lumbar Scoliosis 1,2,3,4,5, Lumbar Rotational Inter-vertebral Misalignment, Lumbar Rotational Inter-vertebral Misalignment 1,2,3,4,5, Lumbar Disc Space Lateral Wedging, Lumbar Disc Space Lateral Wedging 1,2,3,4,5, Lumbar Hypomobility Lateral Flexion, Lumbar Hypomobility Lateral Flexion *,2,3,4,5, Lumbar Hypomobility Flexion/Extension, Lumbar Hypomobility Flexion/Extension 1,2,3,4,5, Lumbar Hypermobility Lateral Flexion, Lumbar Hypermobility Lateral Flexion 1,2,3,4,5, Lumbar Hypermobility Flexion/Extension, Lumbar Hypermobility Flexion/Extension 1,2,3,4,5, Break in George's Line, Lumbar Stenosis, Paradoxical Movement Unspecified

*Lumbar Hypomobility Lateral Flexion 1 was inadvertently left out of the comparison, however, it was not found 5 or more times so it was not eligible for inclusion in the tables.

Pain Radiating into Legs(s)

Pain Radiating into leg(s) compared to:

Lumbar Disc Degeneration, Lumbar Stenosis, Lumbar Spondylolisthesis, Lumbar Spondylolisthesis Grade 1,2,3,4, Lumbar Spurring into or Narrowing of Intervertebral Foramen, Lumbar Vertebral Body Spurring, Paradoxical Movement Unspecified, Lumbar Paradoxical Movement on Lateral Bending, Lumbar Hypolordosis, Lumbar Hypolordosis 1,2,3,4,5, Lumbar Hyperlordosis, Lumbar Hyperlordosis 1,2,3,4,5 Lumbar Anterolisthesis, Lumbar Anterolisthesis 1,2,3,4,5, Lumbar Retrolisthesis, Lumbar Retrolisthesis 1,2,3,4,5, Lumbar Rotational Inter-vertebral Misalignment, Lumbar Rotational Inter-vertebral Misalignment 1,2,3,4,5, Lumbar Disc Space Lateral Wedging, Lumbar Disc Space Lateral Wedging 1,2,3,4,5

Pain Radiating into arm(s)

Pain Radiating into arm(s) compared to:

Alanto-axial Subluxation, Cervical Disc Degeneration, Cervical Spondylolisthesis, Cervical Spondylolisthesis Grade 1,2,3,4, Cervical Spurring into or Narrowing

of Intervertebral Foramen, Cervical Vertebral Body Spurring, Paradoxical Movement Unspecified, Cervical Paradoxical Movement on Lateral Bending, Cervical Hypolordosis, Cervical Hypolordosis 1,2,3,4,5, Cervical Hyperlordosis, Cervical Hyperlordosis 1,2,3,4,5, Cervical Anterolisthesis, Cervical Anterolisthesis 1,2,3,4,5, Cervical Rotational Inter-vertebral Misalignment, Cervical Rotational Inter-vertebral Misalignment 1,2,3,4,5, Cervical Disc Space Lateral Wedging, Cervical Disc Space Lateral Wedging 1,2,3,4,5

On Examination Loss of Cervical Motion

On Examination Loss of Cervical Motion compared to:

Alanto-axial Subluxation, Block Vertebrae (congenital or fusion), Cervical Disc Degeneration, Cervical Vertebral Body Compression Fracture to 25%, Cervical Vertebral Body Compression Fracture to 50%, Cervical Vertebral Body Compression Fracture to 75%, Cervical Vertebral Body Compression Fracture over 75%, Other Type Cervical Fracture, Hemivertebrae Cervical, Cervical Hypolordosis, Cervical Hypolordosis 1,2,3,4,5, Cervical Hyperlordosis, Cervical Hyperlordosis 1,2,3,4,5, Cervical Rotational Inter-vertebral Misalignment, Cervical Rotational Inter-vertebral Misalignment 1,2,3,4,5 Cervical Disc Space Lateral Wedging, Cervical Disc Space Lateral Wedging 1,2,3,4,5

On Examination Loss of Thoracic Motion

On Examination Loss of Thoracic Motion compared to:

Block Vertebrae (congenital or fusion), Thoracic Disc Degeneration, Thoracic Vertebral Body Compression Fracture to 25%, Thoracic Vertebral Body Compression Fracture to 50%, Thoracic Vertebral Body Compression Fracture to 75%, Thoracic Vertebral Body Compression Fracture over 75%, Other Type Thoracic Fracture, Hemivertebrae Thoracic, Thoracic Hypokyphosis, Thoracic Hypokyphosis 1,2,3,4,5, Thoracic Hyper Lordosis, Thoracic Hyper Lordosis 1,2,3,4,5, Thoracic Hyperkyphosis, Thoracic Hyperkyphosis 1,2,3,4,5, Thoracic Rotational Inter-vertebral Misalignment, Thoracic Rotational Inter-vertebral Misalignment 1,2,3,4,5, Thoracic Disc Space Lateral Wedging, Thoracic Disc Space Lateral Wedging 1,2,3,4,5

On Examination Loss of Lumbar (Lumbo-Sacral) Motion

On Examination Loss of Lumbar (Lumbo-Sacral Motion) compared to:

Block Vertebrae (congenital or fusion), Lumbar Disc Degeneration, Lumbar Vertebral Body Compression

Fracture to 25%, Lumbar Vertebral Body Compression
Fracture to 50%, Lumbar Vertebral Body Compression
Fracture to 75%, Lumbar Vertebral Body Compression
Fracture over 75%, Other Type of Lumbar Fracture,
Hemivertebrae Lumbar, Lumbar Hypolordosis, Lumbar
Hypolordosis 1,2,3,4,5, Lumbar Hyperlordosis, Lumbar
Hyperlordosis 1,2,3,4,5, Lumbar Rotational Inter-
vertebral Misalignment, Lumbar Rotational Inter-
vertebral Misalignment 1,2,3,4,5, Lumbar Disc Space
Lateral Wedging, Lumbar Disc Space Lateral Wedging
1,2,3,4,5