Radiographic Anomalies That May Alter Chiropractic Intervention Strategies Found in a New Zealand Population

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Abstract

Objective: To provide occurrence rates for anomalies discovered on radiographs in patients seeking chiropractic care.

Methods: One thousand four random patient files dated between 1997 and 2001 were obtained from the records of the outpatient clinic at the New Zealand College of Chiropractic. In cases in which radiographs were taken, the radiographic reports were analyzed by the authors for the presence of a number of anomalies.

Results: Eight hundred forty-seven full-spine radiographs were included in the study. Anomalies were found in 68% of patients who had radiographs taken. The 5 most frequently occurring anomalies in descending order were degenerative joint disease (23.8%), posterior ponticle (13.6%), soft tissue abnormalities (13.5%), transitional segments (9.8%), and spondylolisthesis (7.8%). Other noteworthy occurrences because of their generalized status as absolute contraindications to adjustment are fracture (6.6%), malignant tumor (0.8%-3.1%), abdominal aortic aneurysm (0.8%) and atlantoaxial instability (0.6%).

Conclusion: A large percentage of patients presenting for chiropractic care have anomalies present on spinal radiographs. Further research and analysis is necessary to investigate the risk-verses-benefit ratio of spinal radiographs for chiropractic patients. (J Manipulative Physiol Ther 2005;27:554-559).

Key Indexing Terms: *Chiropractic; Radiography; Anomaly; Bone Diseases*

The use of spinal radiographs in chiropractic practice is a contentious issue. Lack of agreement over the proper use and risk-versus-benefit ratio of spinal radiographs continues to plague the profession. There is little doubt that important clinical information can be gleaned from spinal radiographs. Anomalies are often detected during radiographic examination that present the possibility of causing harm to the patient if the force and the technique applied are not altered. The fact remains that use of radiographs involves ionizing radiation with cumulative effects that are potentially harmful to the patient.[1]

This article presents the data obtained from a survey of full-spine radiographs taken at the outpatient health center of the New Zealand College of Chiropractic. The data, when possible, have been compared with relevant studies internationally, many of which show a great deal of variation in their findings. Selected categories of anomalies have been discussed, including relevant information that may be influential in chiropractic clinical and case management decisions.

It has been suggested that practice guidelines for chiropractic use of radiographs should be different from those of a medical practitioner who does not use manipulation as a treatment.[2] We hope that the data presented in this study will supply some evidence to help answer some of the myriad controversial questions surrounding this issue.

Method

One thousand four random patient files dated between 1997 and 2001 were obtained from the records of the outpatient health center at the New Zealand College of Chiropractic. The radiographic reports were analyzed for the presence of any of the anomalies outlined in Table 1. This particular group of anomalies was chosen based on their

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Table 1. *Osseous anomalies and diseases detected on 847 full-spine radiographs*

Anomaly/Disease	Number Present	% Present
Transitional segment	83	9.8%
Posterior ponticle	115	13.6%
Spina bifida occulta	57	6.7%
Pagets disease	2	0.2%
Scoliosis (<20°)	11	1.3%
Rheumatoid arthritis	2	0.2%
Ankylosing spondylitis	2	0.2%
Reiters syndrome	1	0.1%
Psoriatic arthritis	1	0.1%
Nonunion/agenesis	26	3.1%
Atlantoaxial instability	5	0.6%
Fractures	56	6.6%
Malignant tumors	7-26*	0.8%-3.1%
Benign tumors	42	5.0%
Osteoporosis	42	5.0%
Osteomyelitis	1	0.1%
DISH	7	0.8%
DJD	202	23.8%
Abdominal aortic aneurysm	7	0.8%
Atherosclerosis	19	2.2%
Soft tissue abnormalities	114	13.5%
Scheurmann disease	9	1.1%
Spondylolisthesis	66	7.8%
Congenital block vertebra	12	1.4%
Facet tropism	6	0.7%

DISH, diffuse idiopathic skeletal hyperostosis; *DJD*, degenerative joint disease.

*Based on confirmed and suspected cases in which follow-up was incomplete.

likelihood of being classified as relative or absolute contraindications to chiropractic intervention.[3-8] Anomalies were also noted that were deemed to significantly alter case management or intervention strategies. The radiographic analyses were all performed by the same chiropractic radiologist (K.L.H.-G.). In cases in which a diagnosis could not be confirmed by radiographic findings alone, references to other diagnostic tests were made to confirm or to deny the radiographic findings.

Results

Radiographs were noted in 847 of 1004 patient files (84%) included in this study. Of the 1004 patient files, the ages ranged from newborn to 85 years, with a median age of 29 years and an average of 32.29 years. The standard deviation of age for the entire sample was 13.11. For the group that had radiographs taken, the ages ranged from 4 to 85 years, with a median of 30 years and an average of 33.44 years. The standard deviation was 12.04. Forty-eight percent of patients were male and 52% percent were female. These values fit well with the proportion of men and women reported in a study involving 6 American chiropractic clinics, where they reported a 51% to 58% female predominance.[9]

At the last New Zealand Census of Population and Dwellings conducted in 2001, the median age of the usual resident population was 34.8 years and the average age was 35.8 years. The standard deviation was 22.4, and 51.2% of the population were women.[10] The median and average age and age distribution are of interest. They suggest the sample in this study includes a younger age group than is evident in the New Zealand population and a disproportionately large number of patients in their twenties and thirties.

Anomalies were present in 68.1% of the cases in which radiographs were taken. Table 1 shows the occurrence percentages of the anomalies included in this study. The 5 most frequent anomalies or diseases in descending order were degenerative joint disease, posterior ponticle, soft tissue abnormalities, transitional segments (eg, sacralization/lumbarization), and spondylolisthesis. The anomalies occurring with the smallest frequencies were osteomyelitis, psoriatic arthritis, Reiter syndrome, rheumatoid arthritis, and Paget disease. Other noteworthy occurrences because of their generalized status as absolute contraindications to adjustment are fracture (6.6%), malignant tumor (0.8%-3.1%), abdominal aortic aneurysm (0.8%), and atlantoaxial instability (0.6%).

Discussion

We choose to discuss the 5 most common anomalies found in this study. Additionally, we have included abdominal aortic aneurysm and atlantoaxial instability because of their importance in clinical management.

Lumbosacral Transitional Segments

Transitional segments are thought to occur through failure of segmentation of the involved vertebral segments during embryonic development.[11] Generally, the term transitional vertebra or segment is preferred in the literature rather than the term sacralization or lumbarization because it is often not possible to determine which vertebra, lumbar, or sacral has failed segmentation.[12]

A wide range of occurrence (0.6%-25%) has been reported in the literature within the normal population. Several studies have narrowed the occurrence range within chiropractic populations to between 2% and 8%,[13-15] with 1 study reporting a combined rate of 11.5%.[16] The results of this study have indicated an occurrence rate of 9.8%. This value appears consistent with the incidence rates previously reported in the literature.

Although no conclusive evidence exists that relates the occurrence of transitional segments to back pain, some clinical implications do need to be considered by the chiropractor before adjusting these areas. The presence of a transitional segment may have anatomic or biomechanical implications on the adjustive strategy used by the chiropractor in terms of line of drive, force, and the techniques.

Posterior Ponticle

Several eponyms have been used to describe the posterior ponticle including "Kimmerle anomaly,"[17] "foramen arcuate," "pons ponticus," or "ponticulus ponticus."[18]

Some confusion exists as to the actual cause of the posterior ponticle; however, calcification or ossification of the posterior atlantooccipital ligament has been suggested.[18-20] Distinct ossification centers and well-organized bone have been shown in the ossified structure of the posterior ponticle, leading other authors to conclude it is not simply the ossification of a ligament but a true vestigial structure.[21,22]

Regardless of its origin, the ossified structure bridges from the posterior aspects of the lateral mass of atlas to the posterior arch, forming a bony arch called the arcuate foramen. This foramen transmits the vertebral artery and the dorsal rami of the first cervical nerve as they pass over the posterior arch to enter and exit the foramen magnum respectively.[18] The posterior ponticle may be unilateral, bilateral, complete or incomplete.[22] Buna et al[17] reported an occurrence rate in cadaveric dissections of 35% with complete ring formations in 15%. Several studies suggest that the radiologically reported occurrence rate is significantly lower with a range of 13% to 15% being commonly reported.[18,21,23] In this study we found an occurrence rate of 13.6%, which is in good agreement with the prevailing findings in the literature.

Clinically, the posterior ponticle has been linked with ischemic compression of the vertebral artery due to the restriction of the artery as it crosses through the arcuate foramen, particularly in the ranges of motion of cervical flexion and extension.[24] Posterior ponticle has also been linked to upper-cervical syndrome,[25] vertigo,[26] Barre-Lieou syndrome,[18] and common migraines,[22] and it has been weakly associated with epilepsy.[22]

Further clinical considerations for the chiropractor when considering cervical manipulation or adjustment must include the possible occurrence of the previously mentioned associated conditions, which, incidentally, do not occur in the majority of patients with a posterior ponticle. However, precautions should nevertheless be undertaken to minimize the risk of complications to the patient. Provocation positional testing for vertebral insufficiency has come under scrutiny in recent years. Strong evidence now suggests that premanipulation provocation testing may, in fact, cause more stress on the vascular structures than the manipulation itself.[27]

This would lead authors to advise chiropractors in the field to put more emphasis on the presentation of various risk factors in the history of their patients rather than the traditionally performed provocation tests. Risk factors, including hypertension, use of oral contraceptives, smoking, migraine headaches, or a family history of vascular problems occurring in a patient with a posterior ponticle, may indicate an increased risk of vascular complications after manipulation. Although the relationship between the presence of a posterior ponticle and vascular complications resulting from it remains unclear, Terrett[28] suggests clinicians use a trial of alternative treatment methods including soft tissue therapy, accessory joint play, or electrotherapy. Once improvement has been established that indicates a mechanical cause, manipulations involving progressively increasing thrust may be initiated.[28]

Atlantoaxial Instability

Atlantoaxial instability is defined as excessive nonphysiologic movement of the atlas.[18] Because, the odontoid process and its associated cruciate ligament complex are the primary stabilizers of the atlantoaxial articulation, instability of this complex most commonly results in atlas moving in an anterior direction. The transverse ligament is the major component of the cruciate ligament complex. The integrity of this ligament is essential in maintaining atlantoaxial stability.[29,30] The radiographic features suggestive of atlantoaxial instability include:

- An increase in the atlantodental interspace to >3 mm in adults and >5 mm in children. The optimum view to assess the interspace is in forward flexion because this position puts the most stress on the transverse ligament.[18,31,32]
- Displacement of the lateral masses of atlas of more the 6.9 mm in the anteroposterior view. It is important to understand that radiographic studies do not directly assess the integrity of the transverse ligament but rely on bone displacement to infer ligamentous stability.

The most common causes of atlantoaxial instability include trauma, Down syndrome, occipitalization, ankylosing spondylitis, rheumatoid arthritis, psoriatic arthritis, Reiter syndrome and pharyngeal infections (Grisel disease).[18,33,34]

The prevalence of atlantoaxial instability is difficult to determine because it will vary depending on the type of population presenting. For instance, in populations with high instances of cervical spine trauma or rheumatoid arthritis, we would expect higher occurrence rates to occur. In this study, we found a prevalence rate of 0.6%.

Clinically, the chiropractor must be aware that atlantoaxial instability may present with a variety of signs and symptoms. The most common symptoms include severely limited range of motion in all directions secondary to neck pain, pain radiating across the shoulders and into the intrascapular region, constant headaches radiating into the suboccipital area, and proximal leg weakness with impaired vibration sense of the feet.[35-37] Cervical adjustments are absolutely contraindicated in cases of atlas instability.[8]

In the case present in this study, the presenting complaint was tension headaches with no other signs or symptoms of atlantoaxial instability. The potential consequences of adjusting this patient's upper cervical spine were devastating.

DJD

DJD is a progressive, noninflammatory disease of unknown cause that results in pathologic changes to joint cartilage and their surrounding structures.[18] Virtually any joint of the body may develop this disease but the most commonly involved are the large weightbearing joints of the spine, hips, and knees; the small joints of the hand; and the acromioclavicular joints. The radiographic features of the DJD include asymmetric distribution, nonuniform loss of joint space, development of osteophytes, subarticular reactive sclerosis, subchondral bone cyst formation, joint deformity, and subluxation.[18,38] The prevalence of DJD in the spine has been estimated to approach 45%, even in asymptomatic adults with no history of trauma or organic disease.[39] In this study, we found an incidence of 23.8% of DJD with 7.6% involving significant disc degeneration. When these figures are corrected for age 40 or older, the occurrence rate is 45.8%.

Clinically, the chiropractor must be aware that the symptoms of this disease seem to have a very poor correlation with their radiographic appearance. In some cases that appear to be quite advanced on radiographs, the patient may be asymptomatic and vice versa. Degenerative instabilities, spondylolisthesis, and irregular bony proliferation are also considerations.

Abdominal Aortic Aneurysm (AAA)

The normal aorta measures <30 mm, beyond which it is described as being aneurysmal.[18] Clinically, AAA are often asymptomatic but can present with intermittent abdominal and back pain. The back pain is usually in the midlumbar region and is deep, boring, and nonspecific in nature. Approximately half of diagnosed AAAs are detected clinically; these are usually >5 cm in diameter.[40] Accidental discovery is common when plain film radiographs are taken for evaluation of back pain.[18] Up to 62% of patients with ruptured aneurysms die before reaching the hospital.[41] When these prehospital deaths are counted, the overall mortality rate after rupture may exceed 90%.[41,42] The overall incidence of AAA is estimated at between 2% to 4%.[43,44] A peak prevalence of 5.9% was found in men at the age of 80.[45] The incidence per 100,000 people years in the general population ranges from 21.1 to 36.5.[46,47] The incidence of AAA is age and sex related,[45] with men between 2 and 5 times as likely as women to be affected.[46] Greater than 95% of atherosclerotic aneurysms occur between 60 and 80 years of age.[48]

The results of this study showed an occurrence rate of 0.8%. The incidence per 100,000 people years was 22.03 with a male to female ratio of 2.5:1. The age of the patient at the time of discovery ranged from 36 to 82 years, with a mean of 61. The relatively low overall occurrence may be reflective of the young median age of the patients presenting to the health care facility, which was 29 years. When only the group of patients 60 or older are examined, the occurrence in this study leaps to 7.5%. It is expected that the occurrence rate for this study will be low, because a diagnosis of AAA can only be established in 80% of patients on the basis of abdominal plain films.[49] This is because of the lack of calcification in between 55% and 85% of cases.[18] The incidence per 100,000 people years and the male to female ratio in this study fall within the expected range.

The significance of AAA to the chiropractor is the potential for rupture after spinal adjustments. AAA is a relative to absolute contraindication to chiropractic care.[7,8] All adjustments that involve twisting of the spine or force applied to or passing through the abdominal area should be avoided. The presence of AAA on plain film requires referral for further diagnostic evaluation.

Table 2. *Soft tissue abnormalities found in this study*

Atherosclerosis
Calcification in bladder
Cardiomegaly
Lymph node calcification
HADD
Pineal gland calcification
Emphysema
Apical pleural thickening
Narrowing and deviation of the tracheal shadow
Widened mediastinum
Calcification of the diaphragm
Gall stones
Hepatomegaly
Lung tumor/disease
Tracheal deviation
Calcifications within joints
Sarcoidosis
Granulomas in lungs
Lung calcifications
Surgical clips and staples
Mass in thoracic cavity

HADD, hydroxyapatite deposition disease.

Soft Tissue Abnormalities

Soft tissue abnormalities are commonly seen on chiropractic spinal radiographs. In this study, we noted that 13.5% of patients had some sort of soft tissue abnormality. This figure includes those patients with an abdominal aortic aneurysm and atherosclerosis. The most common of these was atherosclerosis. The other abnormalities are presented in Table 2.

Many of these findings will significantly impact on the care plans and the treatment options for these patients. The findings of this study should act as a reminder to chiropractors of the potentially significant soft tissue findings that may show up on spinal radiographs and the prevalence at which they occur.

Spondylolisthesis

In this study spondylolisthesis is defined as an anterior displacement of a vertebral body in relation to the vertebral segment immediately below.[18] Spondylolisthesis creates much debate among chiropractors regarding its clinical significance. It is generally not considered a contraindication to intervention unless it has been shown to be unstable on stress radiographs.[7,8] In this case, it is still possible to safely adjust the segments above and below the slippage.[8]

Approximately half of patients with spondylolisthesis never develop back pain, and it has been suggested that pain arising from the spondylolisthesis itself does not exist.[18] Bull et al[50] proposed that the pain associated with an L5/S1 spondylolisthesis occurs as a consequence of an alteration in the associated lumbosacral biomechanics, in particular the L4/L5 motion unit, rather than directly arising from the presence of the spondylolisthesis.

The incidence of spondylolisthesis seems to vary among people of different ethnic backgrounds. The incidence among Whites is estimated to be 5% to 7%,[51] with some studies suggesting an equal sex distribution[50] whereas others suggest there is a 2 to 1 male predominance.[18] Rowe and Roche[18] report an incidence of 2.4% in the black populations of North America and South Africa, and Stewart[18] found the incidence of pars defects to be as high as 40.3% in Alaskan Eskimos. Wiltse[18] found a 13-fold increase in the prevalence of spina bifida occulta among people with pars defects when compared with the general population.

In this study, the overall incidence was 7.8%, which is slightly higher than previous estimates. Of these, 69.7% were men, which supports the study suggesting a 2 to 1 male predominance. The percentage of people with spondylolisthesis who also had spina bifida occulta was 4.6%. The overall incidence of spina bifida occulta was 6.7%. These figures do not support Wiltse's finding of a 13-fold increase in prevalence of spina bifida occulta among people with pars defects when compared to the general population.

A large variety of spinal anomalies appear on films taken by chiropractors in New Zealand. Some of these anomalies may not alter the adjustive strategy or treatment regime of the chiropractor; other anomalies, however, may have profound effects. In light of this, when should the clinician take radiographs? This is a perplexing issue. Do we routinely expose our patients to radiation on the chance that we have missed an anomaly? Do we risk serious injury to our patients should we not take radiographs? A thorough and complete history and physical examination can expose many clinical indications that help us decide whether or not radiographs should be taken. However, many of the anomalies covered in this article were not expected by the history or physical findings. It was noted that 11.6% of the patients included in this study were asymptomatic and presented for wellness care or performance enhancement. Of the asymptomatic patients who had radiographs taken, 69.4% showed an anomaly.

It is of interest that this study involved a sample that did not accurately represent the age spread of the population of New Zealand. It may also differ from the overall population of chiropractic patients in New Zealand. This sample involved a relatively young population of patients who may be expected to show fewer age-related anomalies than the general population and also included fewer crisis care patients than most chiropractors would generally expect in their practices. This may indicate that the percentage of anomalies not identified by history or physical examination found in the present study may underestimate the actual percentage that chiropractors may expect to find in practice.

Chiropractors should consider that our method of healing uses the application of a force through a tissue or joint complex. It has been suggested that practice guidelines for chiropractic use of radiographs should be different from those of a medical practitioner who does not use manipulation as a treatment.[2] If the chiropractic profession does not accept the responsibility to supply convincing evidence for the continued use of radiographs in practice and the development of reasonable protocols in this area, the decisions regarding use will be taken out of our hands and made by agencies outside of the profession.

Conclusion

A large percentage of patients presenting for chiropractic care in New Zealand have anomalies present on spinal radiographs. To further investigate the risk benefit ratio of spinal radiographs, research is needed to assess the prevalence of contraindications discovered that may alter the treatment regimen or case management strategies. Other investigations may include the reliability and benefit of using plain films to provide biomechanical information that may be directly applicable to the analysis of subluxation in the form of spinal listings.

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