4 Spinal Examination

MARK A. LOPES with the assistance of GREGORY PLAUGHER, PETER J. WALTERS, and EDWARD E. CREMATA.

The goal of the spinal examination is to assess normal and abnormal spinal function accurately. Neuromechanical disorders such as the vertebral subluxation complex (VSC) will manifest characteristic signs and symptoms that are readily identifiable. The effects of intersegmental dysfunction on the global posture of the spine are also analyzed. The doctor must be able to evaluate the entire locomotor system and its related areas to obtain a comprehensive assessment of the patient. The spinal examination therefore, has a number of components.

A differential diagnosis of the major complaints should always be performed. The patient assessment includes a determination of spinal levels or thrusting actions that are contraindicated for treatment.

Chiropractors need to be aware of the multitude of conditions that subjectively and/or objectively mimic the signs and symptoms associated with a VSC. Viscerosomatic referred pain patterns are encountered in practice and can include such etiologies as kidney or bladder infection, myocardial infarction, and gall bladder disease.

Determining the treatment of choice in patient management requires reliable and valid multiparameter procedures (i.e., multistaged regimen). Chiropractors should use analytical tools that are both sensitive and specific to the manifestations of a VSC. At this point, the usefulness of most of the examination strategies available to the chiropractor, including those presented here, is unknown. The information presented here is largely based on clinical observation from various sources and is corroborated with scientific information wherever possible.

In addition to clinical necessity, third-party payers and independent examiners will increasingly require documentation and rationale that support treatment regimes. Little uniformity exists regarding the desired approach to a given clinical situation. Some consensus exists, however, for manipulation as a treatment for low back pain (1). Unfortunately, the vast majority of legal precedence for the substantiation of the need for treatment of physical injuries are orthopaedic and neurologic tests aimed at detecting gross pathology, neuropathy, and dysfunction. The complete clinical picture of all the characteristics of the VSC may be subtly and easily missed with traditional orthopaedic or neurologic examinations. For example, it is common for an individual to have intersegmental dysfunction without symptomatic or apparent limitations (2). An orthopaedic test showing a full range of motion is not sensitive to abnormalities of individual motion segments. Another example of an inappropriate examination is the use of a neurologic test that can only detect gross motor weakness, when only minor changes may be present. Subtle, early signs may exist in individuals with partial involvement of the neural elements. Such subtle signs may take the form of trophic skin changes or vascular dysfunction from abnormalities in autonomic or sensory function (3).

Chiropractors are a primary portal of entry for public health care. When a patient enters a chiropractor’s office, the doctor must first decide whether or not that patient is a candidate for chiropractic treatment. Without the proper skills of clinical evaluation, the doctor may not be able to determine if the presenting signs and symptoms originate from a VSC or from a condition beyond the scope of chiropractic practice. Appropriate treatment is possible only after using adequate examination procedures and arriving at an accurate assessment.

RELIABILITY AND VALIDITY OF DIAGNOSTIC TESTS

One of the major research activities in the profession focuses on determining the reliability and validity of various diagnostic instruments or tests (e.g., lumbar motion palpation). The reliability and validity of most of our common means for assessing the status of the patient with a VSC are largely unexplored. When adequate research is performed, some of our traditional examination procedures may prove to be unreliable for certain patient groups. Those procedures that have been researched, have been tested primarily for reliability and not for validity. The results of trials performed on end-feel motion palpation for example, have not, thus far, shown acceptable levels of reliability (4). Most of these experiments lack clinical extrapolation because a large portion of them were performed using relatively pain-free individuals as subjects. Other procedures, such as palpation for tenderness (5) and bilateral thermocouple skin temperature analysis (6), have shown reliability in some instances but have yet to be tested for validity.

*Sensitivity* is defined as the proportion of subjects with the disease who have a positive test. Sensitivity indicates how good a test is at identifying the diseased. *Specificity* is the proportion of subjects without the disease who have a
negative test. Specificity indicates how good a test is at identifying normal individuals. The usefulness of a diagnostic test depends not only on its sensitivity and specificity, but also on the prevalence of the disease in the population. As the prevalence of a disease decreases, it becomes less likely that someone with a positive test actually has the disease and more likely that the test represents a false positive (7). The more rare a disease is, the more specific a test must be to be clinically useful. If the disease is relatively common, then the test must be very sensitive to be useful. Otherwise, a negative test is likely to represent a false negative (7).

CLINICAL RELEVANCE

Scientific studies do not always give us information that is clinically applicable. It is difficult to design experiments to duplicate the manner in which an examination tool is used in the clinical setting. Practitioners must use caution in extrapolating too much from one or a few studies, unless the design of the experiment is close to the clinical use of the procedure. For example, studies that are done on pain-free subjects testing procedures commonly used on patients with symptoms of back pain may not be applicable to the clinical setting. The preceding hypothetical experiment may be more appropriate in determining the ability of the test to identify normal individuals (i.e., specificity).

Perhaps one reason for the marginal reliability found when testing examination procedures relates to the researcher’s inability to reproduce the actual clinical use of the instrument tested during the experiment. Often, the design of a research project dictates blinding or controlling parameters that demand a modified use of the examination tool, thus allowing uninterpretable data or data that cannot be interpreted as a direct measurement of clinical usefulness of the examination tool tested. In motion palpation studies, perhaps we have discovered several ways in which not to use motion palpation, but it is still premature to comment on the test’s clinical usefulness in perhaps a slightly different application, particularly if this modified use more closely resembles the actual clinical use (7). Perhaps the use of diagnostic tests in pain-free subjects, sometimes not reproducing the test’s usual clinical use, adversely influences the outcome and interpretability of some reliability testing. Caution is advised when attempting to apply the results of these investigations to modify clinical protocols. Until further research is completed, chiropractors and other health care practitioners must rely primarily on clinical experience and informed logical thought progression for decision making in regards to the diagnosis and treatment of choice.

CLINICAL DECISION MAKING

The potential for variability in spinal assessment is illustrated in the following example. Schalimtzek (8) reported that of a total of 420 lumbar segments analyzed with functional radiography, more than half (i.e., 220 segments) demonstrated signs of dysfunction.

A complex disorder such as the VSC requires different types of assessment procedures to obtain a comprehensive evaluation. The different parameters (i.e., signs and symptoms) of the VSC, such as the neurologic and biomechanical components, require their respective examination strategies. Although a multistest examination protocol is advocated here, occasionally the doctor must rely on one or a few important findings to decide on the treatment that is indicated or contraindicated. One factor may weigh more heavily than any other if it appears that this factor is pathognomonic of the presenting disorder. Consider the following example. A patient presents with localized, upper neck pain. Examination reveals equivocal x-ray and instrumentation findings, palpable muscle spasm and tenderness on the right between the C2 and C3 vertebrae. Let us assume that the doctor has ruled out the possibility that the muscular and tenderness findings are compensatory in nature. With an awareness of the possible underlying causes of these findings (e.g., meniscoid entrapment, reflex spasm, etc.), the doctor may speculate from these few findings and decide to apply a safe, short, manipulative trial.

Test Magnitude

In the interpretation of some diagnostic tests, a cut-off point needs to be determined to differentiate a negative from a positive test. Often the magnitude of the positive findings of a test helps in the determination of the amount of weight that the test deserves. A cholesterol test showing twice the normal amount expected for a particular patient should be given much more weight than a cholesterol test showing only marginal elevation above “normal” (normal values are usually a mean of a given population). Retrolisthesis of 3 millimeters on a lateral weight-bearing radiograph is much more likely to interfere with the neural contents of the foramina than a 1-millimeter displacement. This likelihood is due to the fact that the transverse diameter of the IVF, when diminished, will interfere with the neural contents contained within (9). In contrast, reduction of the vertical dimension, will have little effect.

A reproducible bilateral thermocouple difference of 15 points on the meter, will likely be more reliable, because it can be more easily differentiated from normal, than a three point difference. If only those patients with the magnitude of findings for either of the above examples were selected for interexaminer reliability studies of these parameters, reliability coefficients might be more encouraging. Reliance on high magnitude (clinically obvious) tests and the discarding of marginal tests, therefore, is one way that the clinician can increase the accuracy of the examination. The discarding of marginally positive tests (slight fixation, slight positional dyskinesia, suggestive but
not definitively positive orthopaedic tests) will likely help the clinician in the reduction of error during the interpretation of the examination.

Diagnostic Treatment

The fact that chiropractic adjustments are partially diagnostic can assist in patient management. Even if two doctors do not agree on where to adjust a patient at the beginning of treatment, the step by step approach to the follow-up of a series of adjustments may eventually lead the two practitioners to the same “primary” area. Adjustments administered to areas of secondary involvement, or compensations, often result in symptomatic exacerbations of primary areas. Unsuccessful treatment in this situation will usually direct treatment to another level involved in VSC, given that more than one level exists in that patient. Adjusting one segment too high will often direct the force to a compensatory hypermobile articulation, causing irritation. Hypermovility and instability commonly occurs above the level of fixation dysfunction as in the case of surgical fusion for the lumbar spine (10). Adjustments applied below the level of subluxation commonly cause less irritation unless provided on an ongoing basis.

Outcome Measures

Clinical assessment tools are essentially outcome measures used to determine the effectiveness of health care. Outcome measures are categorized according to whether the information they reflect is physiologically or clinically relevant (11). The dependability of the assessment procedure is its most important attribute. Unfortunately, few outcome measures that are pertinent to chiropractic care have unambiguous literature support or consensus among clinicians. Electromyographic, thermographic, radiographic, and palpatory findings are used as outcome measures for a patient, but without strong data as to their reliability and validity it is sometimes difficult to determine their clinical usefulness. The absence of absolute certainty does not preclude their use in clinical practice for the time being, because most current applications are largely based on empirical evidence.

Valid outcome measures that have strong research support include assessments of regional mobility (e.g., goniometric) (12), pain reporting instruments (e.g., pain drawing, McGill Pain Questionnaire, Visual Analog Scale) (13), self-care activities, and limited performance measures (e.g., Sickness Impact Profile, Oswestry Disability Score) (14). Because many individuals can have spinal lesions that are relatively silent in terms of symptomatology or functional limitations, there is a preference for “hard data” (objective) over “soft data” (subjective) types of measures in the spinal evaluation, where an adjustment may be indicated.

One very interesting test is the Schema Assessment Instrument (SAI). In a study by Lacroix et al. (15), the SAI was the only measure that accurately predicted the return to work for patients with low back pain. Other measures investigated in that study were orthopaedic physical evaluations and other soft data measures. The SAI is an assessment of the accuracy of the patient’s understanding of his or her own condition. The above findings strongly suggest that patient education is important in the recovery from low back pain conditions. Patient education and awareness has a significant effect on the percentage of those patients that successfully return to work after an episode of low back pain. White (16) believes that once a patient understands and takes responsibility for the condition, the ability to control the pain is enhanced.

DIAGNOSTIC USEFULNESS

Several criteria are used to determine the usefulness of an assessment procedure. Some of these factors include applicability, practicality, reliability, validity, sensitivity, and specificity (17). Vendors selling an instrument or procedure to practitioners often present data suggesting that their instrument has been adequately tested for some of the above criteria. Unless scientific evidence is presented, no firm conclusions should be made. Not being prepared to make a qualified decision, practitioners are often sold on the instrument based on income potential or technical appeal rather than diagnostic usefulness. It is easy to increase a doctor’s income by artificially inflating the cost per visit average through the addition of unnecessary diagnostic testing. Sackett et al. (18) have developed the following guidelines for determining the clinical usefulness of a diagnostic test:

1. Has there been an independent, “blind” comparison with a “gold standard” of diagnosis?
2. Has the diagnostic test been evaluated in a patient sample that included an appropriate spectrum of mild and severe, treated and untreated disease, as well as individuals with different but commonly confused disorders?
3. Was the setting for this evaluation, as well as the filter through which the study patients passed, adequately described?
4. Have the reproducibility of the test result (precision) and its interpretation (observer variation) been determined?
5. Has the term “normal” been defined sensibly as it applies to this test?
6. If the test is advocated as part of a cluster or sequence of tests, has its individual contribution to the overall validity of the cluster or sequence been determined?
7. Have the tactics for carrying out the test been described in sufficient detail to permit their exact replication?
8. Has the utility of the test been determined? (Will the patient be better off for it?)

The above is a rigorous but necessary protocol for evaluating any assessment strategy. Most diagnostic tests, in any health field, will not satisfy many of the above guidelines. Often Guideline 1 cannot be met, simply because of the lack of a valid “gold standard” or reference test.
Diagnostic Strategies

Diagnostic approaches have been described as one or a combination of the following four types (18). The first is pattern recognition—often unconsciously used by the seasoned clinician. A second type is the multiple branching method, which is an algorithmic progression of logical steps toward the correct diagnosis. The third type of diagnostic approach is the exhaustion method, the "complete" history and physical exam used by the novice directly out of the classroom setting. Finally, the most widely used strategy is the hypothetico-deductive approach. The hypothetico-deductive strategy is the formulation of a short list of potential diagnoses or actions followed by clinical actions that will best reduce the length of the list. The initial short probabilities list is formulated on average within 28 seconds after exposure to the earliest clues (19).

If clinicians can ferret out the key observations, their effectiveness and efficiency will sharply increase. One must determine which data are useful and which should be ignored. One must also know how to obtain the relevant data in a reliable and accurate manner. The clinician is the most important factor in the advancement of the art and science of examination (20).

CLINICAL DISAGREEMENT

Patient Histories

Even experienced clinicians often disagree over patient histories. In one study (21), two senior British surgeons independently interviewed the same group of patients who had undergone operations for peptic ulcers. Using the same set of clinical criteria, the two surgeons agreed on whether or not the operation had been successful in less than two-thirds of the cases. Such clinical disagreement is of major concern, in light of the fact that the history is often the most important factor in clinical assessment.

Physical Findings

Because most clinical manifestations of the VSC do not lend themselves to simplistic evaluations, decisions regarding the treatment of choice (e.g., segment to be adjusted) may vary from doctor to doctor. This variation is true even when both providers share the same techniques and philosophies of approach. Neuroradiologists tested for agreement of interpretation of lumbar CT scans showed that total agreement was obtained in only 6 of the 52 asymptomatic subjects (22). Chiropractors tested for interexaminer reliability of lumbar radiographic analysis of 56 different measures showed statistically significant agreement for only 6 of the 56 marking procedures used (23). When clinicians examine the same patient twice, they are only slightly more likely to agree with themselves than with another clinician (24).

The interpretation of diagnostic tests is a common source of disagreement. Among the medical diagnostic tests interpreted inconsistently are mammograms, coronary angiograms, ECGs, and pathology specimens (18). Assessment of patient compliance may also be inaccurate. Clinicians in one study were no more accurate than random chance in assessing patient compliance (25). Patients were found to be accurate in assessing their own compliance in another study (26). These same patients tended to be biased, however, and overestimated their compliance by an average of 20%.

Keating et al. (5) tested the interexaminer reliability of a multitest regimen for lumbar segmental dysfunction. Of the eight assessment strategies tested, only the determination of palpatory pain over osseous or paraspinal tissues showed good agreement beyond that expected by chance alone. Weaker agreement levels were noted for skin temperature differences and for visual inspection of segmental abnormality. Little agreement was detected for passive or active lumbar motion palpation.

Diagnosis and Treatment Recommendations

The least agreement seems to exist with respect to diagnostic or management decisions. Researchers have tested clinicians on several occasions about agreement of diagnosis and management. A most glaring example of inaccuracy occurred in the following study (27). Three hundred eighty-nine children with intact tonsils were examined by a group of physicians; tonsillectomy was recommended for 45%. The remaining children not recommended for surgery were then reexamined by another group of clinicians for a second opinion. Of the second opinion group, 46% were then recommended for surgery. The rest of the children, twice passed over for surgical recommendations, were examined a third time. Remarkably, 44% of these children were recommended for tonsillectomy. More recent examples of the above type of inaccuracies suggest that the contemporary situation is relatively unchanged (18).

Suppose, for example, a study similar to the one above was designed to test whether or not a motion segment exhibited fixation dysfunction and needed an adjustment, using motion palpation findings as the inclusion/exclusion criteria. As the clinicians are asked to scrutinize segments that were previously determined to be normal, there is likely to be a tendency to try and identify a dysfunctional level. When a clinician is forced to make a decision, bias becomes a considerable confounding variable.

Sources of Clinical Disagreement

The difficulties in maintaining consistency in clinical decision making are evident. Clinical disagreement can arise from the examiner, the examined, and the examination. Factors influencing clinical consistency are the
biologic variation in the senses, the tendency to record inference rather than evidence, getting overcome by diagnostic classification schemes, entrapment by prior expectation, and ignorance (18).

It is most important to reduce clinical disagreement in the crucial areas of the history, examination, and diagnosis to ensure proper patient management. One must pay particular attention to certain questions and answers in the history, skillfully use the most reliable examination procedures, eliminate the most variable methods, and approach the decision from an unbiased perspective.

When a specific element has a crucial effect on the management of the patient, the clinician must be certain to prevent or minimize the inaccuracy and inconsistency in determining its presence and significance. Table 4.1 is a list of strategies for maximizing accurate and consistent clinical assessment.

**ACCURACY AND BIAS**

Consistency between clinicians is essential, but consistency by itself is insufficient. Clinicians may agree but be inaccurate. To illustrate the difference between accuracy and consistency, we will consider an example involving motion palpation. Palpation of the range of motion of an articulation lacks acceptable gold standards for comparison and is therefore subject to variation and bias. Bias is a systematic distortion or a preconceived opinion about something (28). One may develop bias about the meaning or interpretation of a procedure such as motion palpation, as one is left to freely interpret the evidence obtained from clinical experience, because of the lack of a gold standard for comparison. If a biased clinician sets out to teach motion palpation, that bias will likely be systematically shared. The students of that clinician may skillfully and consistently agree with the findings of the instructor after enough practical experience. The accuracy of these consistent palpators may still be poor, if the initial instructor’s interpretations are invalid.

The authors conclude that a pragmatic approach by knowledgeable clinicians, striving to eliminate bias, inconsistency, and inaccuracy, will provide the most useful information. Applying a judicious trial of chiropractic care after diligent evaluation may help reveal the effectiveness of the treatments and assessments used.

**INTEGRATING ELEMENTS OF THE EXAMINATION**

When attempting to determine whether or not the source of low back pain is stemming from a lower lumbar disc region or the sacroiliac area, the historical facts of the timing and location of the pain are crucial. Sacroiliac pain less often refers or radiates below the knee, is rarely severe and incapacitating, and is commonly relieved by sitting and worsened by walking or lying down. Pain generated from the lower lumbar areas is more commonly referred below the knee, can be excruciating in intensity, and is generally worsened by sitting and reduced by walking or lying recumbent.

Examination of the sacroiliac and lumbar spine may take various paths. In assessing the sacroiliac area for motion abnormalities, inspection, motion palpation, or lateral bending radiographs are readily available options. The most tested of the above procedures is the Gillett motion palpation test, with preliminary evidence that the intraexaminer reliability of the assessment is acceptable (29,30).

Radiographic findings are important differentiating factors in these patients. The lateral radiograph is often the most direct way to assess the structural position of the lower spine and may quickly point to one area or the other as being potentially involved. A lumbar retrolisthesis (31) indicates a likely disc injury, whereas a gross abnormality of the lumbar lordosis may imply a compensatory reaction from a lower level, such as the sacroiliac joint. A properly exposed, well-positioned lateral lumbar radiograph, and a Gillett motion palpation test of the sacroiliac articulations, in combination with a history of the timing and location of the pain are valuable components for this type of evaluation. The above protocol does not encompass a complete work-up. Particular attention should be paid to the carrying out of the above tasks if one expects to assess this type of condition in reliable fashion.

If the findings from the above assessment are equivocal, a logical progression should follow. Suppose there are two levels that show the presence of retrolisthesis (e.g., L4 and L5). A lumbar flexion radiograph may be helpful. If the joint is not fixed, the segment will move anteriorward on flexion due to the anterior shear that is increased during forward flexion. If L4 moves anteriorward (as is often the case) and L5 remains posterior, then a posterior to anterior (+Z) adjustment at L4 is contraindicated because of the instability that is present at that level (See Chapter 7). Lateral bending radiographs may detect dysfunction in another dimension of possible movement. Lateral bending radiography may be useful, especially if sagittal plane motion is relatively normal.

---

**Table 4.1.**

**Strategies for Minimizing Inaccuracy and Inconsistency in Clinical Assessment**

1. Seek agreement of critical factors
   - Repeat the evaluation
   - Ask a blinded colleague to repeat the evaluation
   - Confirm or refute findings using a gold standard when available
   - Seek documentation or witnesses for corroborated key findings
2. Differentiate between inference and evidence in case notations
3. Use appropriate tests and tools
4. Blind each assessment from other data
5. Continually seek to improve academic knowledge and the skill of assessment

EXAMINATION

A comprehensive chiropractic examination hinges on the ability of the practitioner to combine the history taking, orthopaedic, neurologic, and chiropractic examinations into one smooth, flowing procedure under clinical conditions. The first visit to a doctor's office may leave a lasting impression. The confidence a patient has in the doctor can be greatly enhanced by a quality interaction during the initial encounter.

The physical confines of the clinical setting will provide certain limitations to the format of the initial visit. Streamlining procedures for the expedition of business practices may jeopardize the quality of the examination and treatment process.

Patient Interview

History taking is enhanced when the doctor waits until most of the communication is completed before writing down what was reported. One wants to project the image of a doctor that listens and cares, as well as one who understands the presenting complaints of the patient. Projecting this image is difficult when the doctor is looking down and writing while the patient is talking. The conversation flows and becomes more natural when it is not interrupted.

If certain questions are of a rhetorical nature or if the response the patient is going to give is likely to be false, then the question should not be asked. For example, a parent is unlikely to volunteer information that they have been abusing a child.

Meaningful history taking is a skillful art. If the doctor is going to be rushed during the process, then the examination should be postponed to a later time. It is often difficult to elicit a lengthy history from a patient in acute pain. If the patient is extremely uncomfortable, the doctor should be thorough enough to assess only those needs of the patient that are immediate.

Experienced clinicians manage clinical disorders ranging from the common to the obscure. Patterns of symptoms may allow the astute practitioner to develop initial impressions of the cause of the patient's condition before any examination. The doctor should use an eclectic approach during the history to determine whether or not the patient's condition is amenable to chiropractic treatment, as well as which levels of the spine may be involved in subluxation.

Notations

The initial history notations are essentially the same for all practitioners. The chiropractor, however, must use a slightly different note taking procedure than other health care disciplines. The follow-up visit notations are very specific and are modified from initial history and examination findings. S.O.A.P. notes are common to both medicine and chiropractic. The "S" stands for subjective complaints, "O" for objective findings, "A" for assessment, "P" for prognosis and prescription.

Vernon (32) advocates the use of S.O.R.E. notes for chiropractic practice. The "S" stands for subjective, "O" for objective, but the "R" stands for prescription (as in Rx or treatment; i.e., adjustment), and "E" represents exercises and ergonomics. The rationale for the use of S.O.R.E. rather than S.O.A.P. notes is due to the frequency of chiropractic visits. Assessment and prognostic indicators are not as useful on a routine visit to the chiropractor as they are to the medical doctor. The medical doctor usually sees the patient after considerable time has elapsed and may make an assessment that changes the prognosis or prescription. The chiropractor may see the patient more frequently and can use the "R" and the "E" to list treatment rendered and exercise or ergonomic instructions on an ongoing basis. The occasional use of S.O.A.P. notes with the frequent use of S.O.R.E. notes, provides a useful balance of information in monitoring the progress of the chiropractic patient.

Abbreviations that are universally understood are useful. Specific to a multiparameter approach are notations concerned with each of the parameters of the VSC. Each of these are then monitored at each visit.

Edema, hyperemia, motion characteristics, instrumentation findings, muscle characteristics, and tenderness are commonly checked each visit. These objective findings may be supplemented with traditional history taking as well as orthopaedic and neurologic test results. Follow-up instructions concerned with the "R" and "E" portions are continually reassessed. Abbreviated notations are acceptable if interpretable by others, such as independent examiners, because patient records are often subjected to outside review.

Abbreviations for decreased symptoms, an exacerbation, or no change may take the form of arrows pointing down, up, or sideways (e.g., → LBP stands for no change in low back pain). A positive instrumentation finding with a thermocouple skin temperature device could be: TD C7-T1. The "TD" represents a temperature differential (See Appendix 4A).

LISTINGS

The Palmer-Gonstead-Firth (PGF) listing system of vertebral misalignments are abbreviations for descriptions of interarticular alignment characteristics (33). Keeping current with the standards of practice necessitates the entry of more than these traditional listings into treatment records. For example, a data entry on a particular visit cannot consist solely of the segment contacted and how it was adjusted; progress is equally as important. Without careful documentation, especially in the busy practice, patient management can include a large proportion of guess work.
The listing describes the positional state of a vertebra relative to its subjacent foundation. We have included a table that shows what each letter of a listing represents. This has been combined with the right-handed orthogonal coordinate system (See Chapter 2) (Fig. 4.1A-B). Because this method has been proposed for international acceptance (34–36), it will be referred to here as the International System (33). The letters used in the PGF and International listing systems and their meaning are presented. Generally, the first letter of the listing denotes translation along the Z axis, the second letter is for rotation of the vertebrae around the Y axis. The third letter is for listing any lateral flexion positional dyskinesia.

<table>
<thead>
<tr>
<th>Direction</th>
<th>PGF</th>
<th>International</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior</td>
<td>A</td>
<td>+Z</td>
</tr>
<tr>
<td>Posterior</td>
<td>P</td>
<td>−Z</td>
</tr>
<tr>
<td>Right (Spinous)</td>
<td>R</td>
<td>+θY</td>
</tr>
<tr>
<td>Left (Spinous)</td>
<td>L</td>
<td>−θY</td>
</tr>
</tbody>
</table>

If there is a lateral flexion malposition of the vertebra, this is listed with the PGF system in relation to the direction of spinous rotation (i.e., right or left). If the spinous has rotated towards the open or superior side of the wedge (opposite the direction of lateral flexion), this is noted as an “S.” If the spinous has rotated towards the closed or inferior side of the wedge, this is listed with an “L.” Two examples are presented that also have the component of posteriority listed with them.

**PRS  PLI**

The International system lists lateral flexion positional dyskinesia as a rotation, around the Z axis (clockwise (+θ) or counterclockwise (−θ)). The preceding examples would be listed as follows.

\[-Z, +θY, −θZ \quad -Z, −θY, −θZ\]

Listings for the pelvic ring are somewhat more complex. Gonstead (37) is the originator for most of these listings. Some assumptions must be made regarding the axes of rotation for the pelvic bones to describe their positional states meaningfully.

**Ilium.** Internal or external rotation of the ilium with respect to the sacrum is essentially a rotation around the Y axis (See Chapter 6). The ilium is listed with respect to the sacrum. External ilium movement (Posterior superior iliac spine (PSIS) moving away from midline) is listed
with an "Ex" and internal movement with an "In." The international system denotes internal and external ilium rotations relative to the sacrum as movements around the Y axis. An Ex ilium on the right would be a clockwise rotation around the Y axis and would be listed as +\( \theta Y \). An In ilium on the left side would also be a clockwise rotation and would be listed as +\( \theta Y \). It therefore becomes important to list the side of the sacroiliac involvement.

Antero-superior motion of the PSIS relative to the sacrum ipsilaterally is listed as "AS" and postero-inferior motion as "PI." This type of movement is essentially a rotation around the X axis. In the International System an AS would be listed as +\( \theta X \) and a PI as -\( \theta X \).

**Sacrum.** Rotation of the sacrum relative to the ilium at the sacroiliac joints in the Gonstead system is listed as a posterior rotation on either the right or left side (e.g., P-R or P-L). There is no listing for anterior sacrum rotation because the ilium would be adjusted to posterior to anterior in this instance. A P-R sacrum is essentially a counterclockwise rotation around the Y axis and would be listed as -\( \theta Y \). A P-L sacrum would be listed as +\( \theta Y \).

**C2-L5.** Hyperextension of the vertebral body is commonly listed as inferior or "inf." This movement is a rotation around the X axis and would be listed as -\( \theta X \) in the international system. Contact points for adjusting the vertebrae are abbreviated and follow the main listing:

- m = mamillary process, sp = spinous process,
- t = transverse process, la = lamina

One would not apply a listing to a motion segment unless the articulation in question met the criteria of a VSC, a prerequisite of which is fixation dysfunction (See Chapter 3).

Movements of the motion segment are easily listed with the International system. Fixation dysfunction can be represented with a descending arrow just preceding the listing of the particular movement. If motion is increased in a particular direction, then the arrow preceding the listing can be oriented upward. If the movement of the joint is the same as when last examined a "no change" could be listed with a horizontal arrow or by "no\( \Delta \)."

- **Flexion** = +\( \theta X \)
- Anterior Translation = +\( Z \)
- Right Lateral bending = +\( \theta Z \)
- Right Translation = -\( X \)
- Body Right Rotation (Spinous Left) = -\( \theta Y \)
- Body Left
- Rotation (Spinous Right) = +\( \theta Y \)
- Caudal Translation = -\( Y \)
- Extension = -\( \theta X \)
- Posterior Translation = -\( Z \)
- Left Lateral Bending = -\( \theta Z \)
- Left Translation = +\( X \)
- Cephalad Translation = +\( Y \)

A complete list of chart abbreviations used frequently in chiropractic practice is presented in Appendix 4A (38).

S - MDLN LBP w/ @ Lat hip P, 2 wks drtn, wrs to sit, insidious onset
O - edema, HE, TNDR L2/3; T L2, L5;\( \downarrow -\theta X \) L5
A - flare-up
P - L5 PL adj @ PB, ice, ergnmc cnslt; (W,F)

**Figure 4.2.** Notations from an office visit after a few weeks of inactive care. SOAP notes were used because an assessment was made regarding the patient's overall status. The patient presented with an insidious flare-up of two weeks duration. The patient had midline low back pain with right lateral hip pain that was worsened by sitting. Objective findings included edema, hyperemia, and tenderness at the L2 and L3 levels, skin temperature alterations at L2 and L5, and restricted extension of L5 vertebrae on S1 detected with motion palpation. Treatment consisted of adjustment of the L5 vertebra on S1 in the right pelvic bench position, cryotherapy, and ergonomic consultation for prevention of further injury. The patient was rescheduled for Wednesday and Friday.

S - Nk Pn imp 50%, sl HA post adj, LBP no \( \Delta \)
O - 1 +\( \theta X \) & dim edema C7-T1; TD C7, L5; HE L5-S1, i +\( \theta X \) L5
Rxs - C7 PLS-inf, L5 P; watch UC; 3x/2wks
E - exs next wk, reduce sting

**Figure 4.3.** Notations from a routine follow-up visit during the initial phase of relief care. S.O.R.E. notes were used as they are more appropriate for routine visits with chiropractic care. The patient experienced a fifty percent improvement in neck symptoms since the last visit. A slight headache was reported after the last adjustment. There was no change in the low back symptoms. Limited examination revealed increased flexion range of motion and diminished edema of the C7-T1 articulation. Skin temperature alterations were noted at C7 and L5. Hyperemia and restricted flexion range of motion was evident at L5-S1. Treatment consisted of specific adjustment of C7 and L5 vertebrae with the listings noted. Concern for possible indications for treatment of the upper cervical region on future visits was noted. Further treatment is scheduled at three times per week for two weeks. Exercises will be implemented the following week and the patient was advised to decrease the amount of sitting for the ergonomic reduction in postural stress.

An example of typical chiropractic office visit notations is illustrated in Figure 4.2. The notations are exemplary of a patient seen for reevaluation or for treatment for an exacerbation. Figure 4.3 represents notations more commonly used for routine or multiple visits for chiropractic care. Large amounts of narrative information may be gleaned from the brief notations written in this format. The S.O.R.E. format is illustrated.

**GENERAL GUIDELINES**

Differential Spinal Pain Assessment. Guidelines for assessing cases of spinal pain have been provided by Hogan (39). These general guidelines are as follows:

1. Neuromuscular skeletal disorders will have their symptoms caused or aggravated by stressing the part involved with movement or activity.
2. Referred pain usually shows no local signs or stiffness, full range of motion, and no increase in pain when the part is stressed. The patient may, however, suggest that some positions are more comfortable than others.

3. Neoplasia should be considered when the symptoms of the patient are that of a constant or relentless pain unrelieved by rest and usually worse at night. Usually, the primary site of the neoplasia is overlooked or asymptomatic.

4. Infections should be suspected when the pain is increased by motion but not relieved by rest. Range of motion will be decreased and there will be local tenderness. The patient is usually afebrile. The white blood cell count is usually normal, but the erythrocyte sedimentation rate will be elevated. The condition is usually subacute or chronic.

5. When dealing with viscerosomatic pain radiating to the low back, consider the following: a) sacral pain usually indicates disease of pelvic organs; b) lumbar pain usually indicates disease of lower abdominal organs; and c) lower thoracic/upper lumbar pain usually relates to diseases of the upper abdominal organs.

6. Simple mechanical low back pain rarely extends below the knee.

7. Acute pain in the abdomen is usually not a common feature in patients with low back problems. It should be remembered that pain in the abdomen for longer than 12 hours may indicate appendicitis. If nausea and vomiting, constipation or diarrhea are present, one should strongly consider a visceral origin.

8. Women of child-bearing age who have missed their period by 10 days may be pregnant. When evaluating female patients with low back pain, it is important to determine the date of the last period and the expected date of the next period, and suggest a pregnancy test if the possibility of pregnancy exists.

9. No one is too ill to examine.

10. It is unlikely that someone seeking to visit a physician for any reason is “healthy.”

The doctor should work backwards from the history of any visceral symptoms (when present) to the possible area of spinal involvement. The reader is directed to the appropriate chapter for differential diagnosis of specific regional subluxation patterns, and management of the patient with a visceral concomitant.

Order of the Examination

It is helpful to organize the examination into postural categories, so that it can flow from the standing tests to those of sitting, supine, and prone. One may mingle orthopaedic and neurologic tests with the chiropractic analysis. Some choose to go from history taking directly into the comprehensive chiropractic analysis, then on to a complete orthopaedic and neurologic exam, before deciding which radiographic examination, if any, is indicated. It is generally best to work continuously and concisely, and avoid interruptions of exam procedures with manual recording of results after each test. Try to perform a group of tests, then record.

Patient with Acute Pain

Static evaluations are preferred over dynamic tests when examining the acute pain patient where movement is restricted by the severity of the pain. A complete history may be followed by static palpation, instrumentation, and radiographic examination. At times, a patient will be unable to bear weight long enough to be examined in the sitting or standing positions. A hi-lo table with hydraulic raising and lowering capabilities facilitates the changing of positions. Static evaluations may be done in the prone position. In rare cases, a radiograph taken non-weight bearing on the floor, or on a table top, may be the only radiographic exposure tolerated by the patient in severe pain. If only one exposure is possible in the above rare cases, the lateral radiograph is preferred. The lateral radiograph usually provides more useful information for determining the levels indicated and contraindicated for chiropractic adjustment.

IATROGENICS

It is important to remember that many tests function to isolate the problem at hand by reproducing the pain. It is not uncommon for the patient to suffer an exacerbation of pain due to rigorous examination. Care must be taken to adapt the examination to each patient. Streamlining examination procedures may be necessary to eliminate unnecessary patient discomfort. One must do what is required to make an accurate determination of the patient’s status, yet avoid duplication of similar tests when possible.

FOLLOW-UP EXAMINATIONS

Chiropractic care requires more frequent and numerous patient visits than medical outpatient care for similar conditions during the early stages of care. The initial examination provides the “working diagnosis” that enables the doctor to prescribe necessary treatment for the first few visits. Follow-up visits provide additional information each time the patient is seen, allowing the doctor to modify the diagnosis and treatment plan as necessary. Commonly, several sessions are required to assess the initial success of the treatment plan.

Adequate examination must include at least a brief analysis of the spine on each follow-up visit, in addition to the initial comprehensive examination. It is unfortunate for patients that some chiropractors do not gown patients (i.e., female patients) on follow-up visits and continue to treat patients on an ongoing basis without direct exposure to the skin overlying the spine. One should never administer an indiscriminate adjustment. It is an act of malpractice to treat without adequate examination.

A description of the methods of each examination procedure follows. Procedures that are performed routinely on most patients such as visual analysis, palpation,
instrumentation, and plain film radiography are described first. Additional procedures that supplement the differential diagnosis are discussed after the routine procedures. Analytical methods in this section are described primarily on the basis of their relevance to the VSC. Orthopaedic and neurologic tests complete the diagnostic work-up and are listed at the end of the chapter.

MECHANISMS OF INJURY

For a number of injuries, a description of the trauma by the patient or a third party can aid in isolating an area of joint dysfunction. For example, if the lumbar spine is unable to resist a flexion moment, the result will be injury of the posterior ligamentous structures. The ligaments furthest from the center of rotation, such as the supraspinous, will have to move through a large arc and will usually undergo plastic deformation before other ligamentous elements. This ligament is easily palpated for the presence of tenderness, edema, or scar tissue.

A rotational injury to the pelvis would displace the ilium if the ligaments have been stretched beyond their ability to resist the tension. A common example of such a mechanism would be a blow to the ASIS, as can occur in contact sports. The well-positioned antero-posterior radiograph of the pelvis would likely show evidence of a positional dyskinesia in the region (40–41).

A torticollis presentation may be due to an atlantoaxial rotatory fixation/subluxation (See Chapter 11). This condition can be caused by sleeping with an awkward, rotated, neck posture such as in the prone position. The radiograph will often show the displacement as will a movement assessment of the upper neck (e.g., Dvorak Test).

INSPECTION

The most important aspects of the visual inspection are gait and postural analysis, static and dynamic intersegmental visualization, and global movement visualization. The chiropractor attempts to discover the presence of the VSC by picking up visual clues of positional dyskinesia (intervertebral misalignment) and fixation dysfunction at the skin surface. Body symmetry or asymmetry of posture and motion is scrutinized. A complex approach is advocated here where elements of the history (e.g., mechanism of injury), examination findings, and potential treatment choices are continually integrated and compared. This process provides for a thorough and eclectic understanding of the patient's needs and allows for proper follow-up assessments.

Gait

In the absence of profound neurologic disorders, gait analysis may reveal subtle signs of VSC. Distress during ambulation, as well as functional manifestations of lumbo-pelvic and upper cervical subluxation may be observed while the patient is walking. A patient in noticeable pain will reveal guarded movement of the affected area with or without postural deviation. For example, in cases with severe neck pain, a distinct lack of head movement will be observable.

Sacrum and ilium subluxations may have noticeable effects on lower limb positions and movements. Fixation dysfunction of the sacro-iliac joint will often result in a decrease in the length of the stride ipsilaterally. Functional lower limb length inequalities are likely to occur if sufficient positional dyskinesia accompanies the fixation dysfunction. An internal or external foot flare with concomitant uneven heel or sole wear of the shoe may be caused by Ex or In ilium subluxations. Heel wear on the medial side of the shoe may indicate the side of a functional or anatomical long leg; laterally worn heels may indicate the short leg side.

A fixed, extended positional dyskinesia of the sacrum with respect to the L5 disc space (−θX sacral base or "base posterior" sacrum), or a posterior first or second sacral segment (S1 or 2, −Z), may result in bilateral toe-in foot flare and/or a genu valgus waddling appearance to the gait. Because adaptive mechanisms often occur in a patient with a long-standing lesion, this particular gait pattern is often more noticeable in the pediatric patient, and warrants early intervention.

Gonstead recognized a relationship between persistent occiput/atlas disrelationships and gait (42). An AS occiput (−θX restricted position of the occiput on the atlas) may be accompanied by bilateral outward toe flare. A PS occiput (+θX) and other upper cervical subluxations may cause toe walking.

Posture

An individual's posture reflects the disposition of the interrelationships of the structural architecture. Standing posture requires little muscular activity (43). The conformation of bone, as well as the articulations between the bones, most directly influence the postural attitude. The posture of the spine is extremely important to its biomechanical function (44).

Biomechanical adaptation is the biologically mediated change in the structures and material properties of the body. In the growing skeleton, these alterations in epiphyseal growth rates can be altered by asymmetrical loads. This phenomenon has been termed the Heuter-Volkmann (HV) Law. This law states that increased pressure across the epiphyseal growth plate inhibits vertical growth, and decreased pressure across the plate accelerates growth (36). The HV Law and Wolff's Law, as well as the phenomenon of creep (See Chapter 2), generally explain an individual's posture. Deviations from optimal intersegmental alignment will be reflected as abnormal
posture, provided the changes are of sufficient magnitude to affect more than a few functional spinal units (FSUs) (Fig. 4.4). Constant asymmetric postural loads on the vertebral elements will eventually lead to dysfunction.

The posture of the spine during various movements should also be scrutinized. “Inflexion points” in the intersegmental alignment, present in either static or stressed postures, indicate probable local structural anomaly or intersegmental dysfunction. An inflexion point is an abrupt change in the contour of the spine. This change can be detected in the neutral posture or when the patient moves into a particular position, such as lateral bending (Fig. 4.5A-B). Hypertrophy, atrophy, or asymmetry of musculature, edema, hyperemia, and deviation from bilateral symmetry of any bony landmarks may indicate potential areas of subluxation.

**Standing**

**PATIENT PREPARATION**

The patient should be gowned and barefoot with the posterior spine exposed. Instruct the patient to stand upright and walk in place or backwards while looking directly forwards, and come to rest with the feet hip width apart, heels even, and the knees fully extended. Next, have the patient bend the neck, head, and upper body, forward, back, and side to the side, while maintaining the eyes closed. The patient should then come to rest in a position that feels as if the eyes are looking directly forward and the spine is straight.

**Figure 4.4.** Posture in the sagittal plane showing regional adaptation resulting in forward carriage of the head. Flexion (+θX) malpositions of a few to several upper thoracic vertebra levels is the likely etiology. Tall people, those occupations involving forward bending and lazy posture, commonly show these findings.

**Figure 4.5.** A, Left lateral bending shows a smooth arcing motion of the thoracolumbar spine with slight dysfunction noted from approximately T5 to T9. B, Posture during right lateral bending. Notice the overall restriction compared to A. An abrupt inflexion point is seen at T9.
Standing visual examination may be aided by the use of a plumb line for more precise analysis. Visualizing the patient from the back, the structural landmarks include: the feet, knees, gluteal folds, intergluteal line, hips, waist, spine, scapulae, shoulders, and ears. Visual inspection of the trunk should begin with gross visual inspection for scoliosis (See Chapter 9).

Sagittal Plane. From the side one should examine the balance of the three main centers of mass (head, thorax, and pelvis), and inclination of the lower limbs. The spinal curves should also be scrutinized from the side view. Relaxed or “lazy” posture is best observed in this view (See Fig. 4.4). Disorders of intersegmental and global ligamentous and muscular function will commonly be revealed as forward weight bearing of the head, hyperkyphosis of the thoracic spine, and/or hyperlordosis of the lumbar spine. Lateral postural assessment exposes the “poker spine,” which is characterized by a decreased lumbar lordosis, flattened thoracic kyphosis, and a kyphotic cervical spine (Fig. 4.6). Genu recurvatum of the lower extremities may have effects on the lumbopelvic area. The altered inclination of the femur, as seen in the lateral view, may rock the pelvis in the −θX direction, thus leading to a tendency for compensatory (lumbar) hyperlordosis.

Forward head carriage is common and may indicate flexion (+θX) positional dyskinesia of the middle to upper thoracic spine. Marked anterior weight bearing of the head may be accompanied by upper cervical hyperextension and lower cervical kyphosis, although each case should be considered individually. Patients with this forward head carriage have a tendency for symptoms related to increased mechanical tension in the spinal cord (e.g., headache, etc.), cervical muscle tension, and the mechanics of intervertebral strain in the compensatory middle cervical area. Decreased anterior height of the thoracic vertebral bodies also creates forward flexion of the area involved, with compensatory changes above.

Senile kyphosis is detected in older patients and appears as a prominent upper thoracic spine or hump. Upper to middle thoracic kyphosis is commonly associated with osteoporosis, especially in older women. Long-standing hyperkyphosis may increase when the patient grows old. With age, the female kyphosis tends to increase in magnitude at a greater rate than the male. Aside from obvious effects of compression fractures, this increase is due primarily to anterior degeneration of the intervertebral discs. Degeneration in this area, caused by increased pressure on the anterior annulus, appears to compound the effect of the hump (45).

In a controlled study investigating the relative effects of chiropractic adjustments and exercise in geriatric kyphosis, three groups were observed over a period of 4 months. The group that received chiropractic adjustments revealed a decreased kyphosis of 11.4 mm, the exercise group improved 7.1 mm, and no change was seen in the control (46).

The stance of the patient with a disc protrusion creating lumbar nerve root compression is characteristically hypolordotic. This flattened lumbar lordosis reduces the posterior bulge of the disc, whereas flexion of the hips and knees reduces the stretch on the sciatic nerve roots (36). Findings from the postural assessment can be correlated with a lateral full-spine radiograph (See Chapter 5).

Coronal Plane (viewed from the posterior). A scoliotic spine can be detected with postural analysis of the coronal plane. Abnormal curvature in this view appears as a lateral deviation of the normally erect spinal column, with raised musculature on the side of posterior rotation of the transverse processes. Noticeably raised musculature over the transverse processes will not occur without grouped rotation of several levels, such as in patients with scoliosis. Intersegmental rotation will likely not be visible in this manner.

Segmental inconsistencies of skin pigmentation, patches of hair, fatty or fluid cysts, increased subcutaneous tissue thickness, mottled skin, and singular moles near the spine may give clues to areas of trophic disturbances from chronic, subtle nerve dysfunction (3). Visual assessment of leg length inequality (LLI) can be accomplished in the standing position. Several points of reference can be used, including the iliac crests, sacral base, gluteal folds, and the PSISs. The presence or absence of scoliosis should be noted. Asymmetry of structures

Figure 4.6. Sagittal profile. This patient has diminished sagittal curves. The thoracic curve is especially flattened. There is an associated AS ilium subluxation on the patient's AP radiograph (not shown). This is the same patient as in Figure 4.5.
when compared bilaterally or the presence of scoliosis is not pathognomonic of LLI. Leg length inequality is best evaluated with a standing antero-posterior radiograph of the pelvis. Postural evidence of possible LLI, necessitating orthotic correction, is erroneous unless corroborated by a radiograph.

Standing assessment may also be used to make a gross determination of the effectiveness of shoe lift implementation. Place the desired amount of lift under the short leg side while visually assessing the attitude and posture of the lower spine and pelvis using the above mentioned landmarks. This type of assessment should be used only in the interim or in cases for whom radiography is contraindicated. Follow-up radiographic assessment after approximately one month is indicated in most cases (See Chapter 6).

In the P to A view, the AS or PI ilium is easily visualized as asymmetric gluteal folds and iliac crest heights. Asymmetry in the dimples normally seen just below the PSIS may also reveal the AS or PI ilium. Notice any asymmetry in the posterolateral iliac crests, suggestive of an In or Ex ilium. In (−θY) ilium movement on the right sacrum may cause a more flattened appearance of the soft tissue overlying the postero-lateral portion of the ilium. The Ex ilium will demonstrate a more protuberant gluteus.

**Anterior to Posterior View.** The important landmarks from the standing front view include: the feet, knees, hanging hand position, head, eyes, and ears. Hand position may reveal regional thoracolumbar rotation. A relative difference in the distance between the hands and the torso is indicative of rotational distortions. Foot flare and biomechanical alterations of the feet are easily viewed from the anterior. Inspection of the level of the eyes and ears may reveal head/torso deviations.

### Sitting Posture

Static visual assessment in the sitting position can demonstrate many of the same findings as the standing assessment. When the patient assumes the sitting position, however, posture may appear vastly different. For example, in cases with “slouched” posture and hyperlordosis of the lumbar spine evident on standing analysis, sitting posture may reveal a lumbar kyphosis. This difference is likely due to compensatory laxity of the thoracolumbar ligaments or poor muscle tone. Slouched posture puts unnecessary stress on the ligaments because of inactivity of the paraspinous musculature (See Chapter 2 for muscle/ligament relationships).

The In or Ex ilium is sometimes more easily detected in the sitting versus the standing position. These asymmetries are seen as a flattened and wider gluteal appearance on the In side and a more rounded and narrower appearance on the Ex side. A fixed rotated (θY) positional dyskinesia of the sacrum may deviate the intergluteal cleft to one side. The distance between the cleft and the ilium will be wider on the posteriorly rotated side.

### Stressed Posture Inspection

Motion characteristics can be visualized in the standing or sitting position. As the patient bends the neck and trunk in various directions, asymmetrical and atypical motion may be evident. Fixation dysfunction in one area may result in a compensatory increase in motion in a nearby region. Asymmetrical structure can lead to atypical motion patterns. The radiograph can be of help in determining whether or not motion patterns are the result of structural asymmetries.

The doctor should be very specific in directing the patient through motions to isolate the problem, as the patient may have adapted to a restriction by developing regional movement patterns that appear to be quite normal on gross inspection. During dynamic inspection, the examiner should be attentive to patient remarks referring to symptoms brought on by the movement being assessed. Pain or stiffness while stressing the structure is often of considerable diagnostic value. Pain fromcontractile elements would typically present itself on stretching the involved muscle during contralateral bending. Active movements will also provoke pain of muscle origin. Pain from noncontractile tissue (e.g., ligaments) is characteristically worsened by movements that stretch these elements. Flexion movement that worsens the compression of a pain sensitive structure such as cartilage or neural elements may elicit a pain response. Both passive and active motion can provoke symptomatology.

### Sitting

All six degrees of freedom of each region may be visualized in the sitting position. Sitting assessment of the spine in chiropractic practice is common, as this position facilitates multiple phases of the evaluation (e.g., skin temperature analysis, motion and static palpation, etc). To visualize (or palpate) intersegmental motion, it is important to instruct the patient to assume postures that will aid the discovery of restrictions in each area. The following positions aid intersegmental motion analysis in lateral flexion:

1. Sacroiliac dysfunction is easily tested with the spine in lumbar lordosis, which locks the lumbar facets and isolates movement to the pelvis.
2. A neutral lumbar lordosis enables analysis of lumbar motion.
3. The thoracic spine is isolated for analysis when the lumbar region is in lordosis.
4. The cervical and upper thoracic spine is best viewed with the thoracic spine upright, and the cervical area very slightly flexed.

Intersegmental lateral flexion dysfunction is most easily seen in the thoracic and lumbar areas. A “blocking” of
vertebrae on the side of restriction and an abrupt “kinking” of the spine on the side of hyperflexion expose dysfunction in lateral bending (See Fig. 4.5A-B).

The coupling motion of rotation on lateral bending should be examined also. Watch for the lumbar erector spinae muscles to depress on the side of lateral bending, and protrude on the opposite side. Erector spinae motion on lateral bending is usually not as pronounced in the thoracic spine as it is in the cervical and lumbar area. The cervical and thoracic areas should be checked for coupling. In this area the spinous processes will move to the convexity of bend.

Unilateral restriction of lateral flexion (θZ) motion in the lower cervical and upper thoracic spine may result in visible and palpable tension in the lateral superficial neck muscles on the opposite side of lateral flexion. The mid to upper cervical vertebrae yield to the lower restriction in lateral flexion and as a result may be pulling on the opposite lateral neck musculature, thus causing the band-like protruding muscles.

Lateral flexion dynamic visual analysis may help to differentiate a primary muscle etiology from that of primary nerve involvement causing pain. If the presenting pain is reproduced or worsened by lateral flexion ipsilaterally, nerve etiology is more likely, because entrapment of an irritated nerve caused by the compression of the movement is increased. Pain increased or reproduced by contralateral lateral flexion is more likely due to the stretching of a sore muscle or ligament.

Flexion/extension inspection is useful to determine the presence of dysfunction in the cervical, low thoracic, and lumbar regions, as this motion is relatively great in these areas compared with other movements (e.g., axial rotation). A smooth fanning out of the spinous processes in flexion, and even accentuation of the lordotic curvatures on extension should be observed during normal motion. Look for an abrupt inflexion in curvature or spinous process separation as evidence of possible interspinal dysfunction (e.g., fixation dysfunction or hypermobility).

To view lower spine function, direct the patient to “arch and slouch” the low back. An obvious restriction at the end-range of lumbo-sacral extension (−θX) often reveals a “blocked” appearance in the lumbosacral area with a concomitant hyperlordotic curvature in the thoraco-lumbar area. A “base posterior” sacrum or retrolisthesis of L5 may produce the above scenario. Flexion/extension of the cervicothoracic junction is readily visible because of the protuberant spinous processes in the region.

Axial rotation visualization is particularly useful for the analysis of the cervical spine. Dvorak and Dvorak (47) propose functional examination of the cervical spine in rotation by isolating either the atlantoaxial or the lower cervical spine. Flexion of the head and neck permits primarily upper cervical rotation, whereas extension of the neck and straightening of the thoracic spine, isolates the lower cervical vertebrae for axial rotation analysis (Fig. 4.7A-B).

**Palpation**

**STATIC**

Digital palpation is one of the chiropractor’s chief means of directly assessing the patient’s condition. Palpation for tenderness is integral to the examination because it can indicate pathology of the superficial fascial and ligamentous elements or referral pain patterns. A firm pressure should be applied to the tip of the spinous process followed by a “rolling up” motion along the length of the spinous. The “laying on of hands” in itself is manual communication to the patient that the doctor understands and can locate the involved areas. Gonstead (42) thought it useful to identify tender spinal levels by pressing on the
spinal process enough to elicit a pain response. He felt that the patient would be aware that the doctor knew where the problem was and that the severity of the tenderness would alert the patient to the gravity of the condition.

**Soft Tissue Palpation.** Palpation is a method used to search for signs of damage and inflammation in the paraspinal soft tissues. The paraspinal areas reveal injury of the interspinous/supraspinous ligaments (48). The paraspinal musculature may show evidence of abnormal anatomic and physiologic phenomena.

Superficial, localized edema is characterized by a detectable accumulation of excessive fluid in the subcutaneous tissues (49). Localized inflammatory edema (as opposed to other edematogenic conditions) may be found at traumatized spinal levels (48). Clinical experience has been that palpation close to the spinous processes most readily reveals VSC related edema. Edematous areas over the spinous may reflect damage to the supraspinous ligament. Moving the palmar aspect of finger caudocephalad and cephalocaudal, asymmetries in tissue texture can be determined which may be indicative of underlying edema, muscular hyper or hypotonicity or autonomic nervous system dysfunction (e.g., denervation supersensitivity).

**Hyperemia or Red Response.** A superficial vascular response of vasodilation may result from stimulation of the paraspinal soft tissue due to pressure from digital palpation or skin-contact instrumentation scanning. The red response can persist for several minutes and is most evident in the thoracic region (50). This response may be related to the local autonomic nervous system dysfunction secondary to VSC in that area.

**Tenderness.** The most tender segment is often associated with the etiology of the patient’s pain. Spinous process tenderness is commonly used to locate the potential subluxation. Pressure should be applied to the spinous tip while moving cephalad. The lowest, most tender thoracic or cervical spinous have been reported by Gonstead as likely candidates for adjustment (42). Facet area tenderness in the cervical region can be indicative of a symptomatic facet articulation. Tenderness at the lower aspect of the sacroiliac joint may indicate an AS ilium subluxation, whereas tenderness at the upper sacroiliac may reflect a PI ilium. If the entire sacroiliac articulation is tender, the doctor should suspect a posteriorly rotated sacrum or an Ex ilium. Palpation of tenderness in the thoracic spine is more likely related to the level of involvement, due to the lack of intersegmental connections between the nerves supplying contiguous spinal segments (51). One must be careful not to assume that these findings of tenderness are in themselves indications for an adjustment to that articulation. Hypermobility can cause tenderness yet would be a contraindication for an adjustment.

**Musculature.** Normal muscle is soft and pliable. Hypertonicity of paraspinal musculature may relate segmentally to the area of nerve irritation or dysfunction. Inspect the paraspinal musculature for active trigger points as a possible cause of local symptomatology. Trigger points may or may not be segmentally related. An area of hypertonicity is often related to hypermobility, because the reflex neurologic mechanisms will attempt to splint or stabilize the area (i.e., arthrokinetic reflex; see Chapter 2). The area of subluxation may exhibit a very edematous and boggy texture of the affected tissues (Fig. 4.8A-B). Hypertonicity of paraspinal muscles can also occur in areas of fixation dysfunction secondary to reflexes initiated by increased mechanoreceptor activity (See Chapter 3).

**Trophic Changes.** A boggy or doughy consistency felt on palpation near the spinous process is a very common finding that may reveal the intersegmental level of subluxation. A combination of neurologic dysfunction and soft tissue reaction to injury of the supraspinous/interspinous ligaments and muscles may be responsible for these findings.

**Lateral Flexion.** Inflection points in spinal symmetry can be accentuated by placing the spine in lateral flexion. Isolate the areas being assessed and laterally flex the area almost to its end range. Next, in this sidebent position, run your finger(s) along the concavity of the spinal curvature, then along its convexity (Fig. 4.8A). Note any deviation from a smooth curvature. Often, at a fixed inflexion point, one will detect an abrupt spinous deviation relative to the adjacent spinous process(es).

**MOTION PALPATION**

The two main types of chiropractic motion palpation are “end-feel” palpation and intersegmental range of motion palpation. Several studies have tested the reliability of end-feel palpation; whereas little has been done to test intersegmental range of motion palpation (4). There is no conclusive evidence that motion palpation is a reliable or valid procedure. The lack of evidence supporting motion palpation does not, however, indicate that it should be abandoned as a clinical procedure. Future research must incorporate larger sample sizes with symptomatic subjects.

One very interesting study illustrates the potential practicality of the procedure as an examiner was asked to determine the presence or absence of symptomatic cervical zygapophyseal joints (52). The examiner’s accuracy was tested against radiologically controlled, diagnostic cervical nerve blocks. A positive motion palpation finding indicating a symptomatic joint was defined as meeting all of the following three criteria: abnormal end-feel, abnormal quality of resistance to motion, and reproduction of pain (either local or referred) when passive accessory movements (end-feel) were tested. Of the 20 subjects in the study, the examiner correctly identified all 15 patients with proven symptomatic zygapophyseal joints, and all
five without. The examiner further singled out the correct segmental levels of symptomatic joints in all cases. The authors concluded that manual diagnosis can be as accurate as radiologically controlled, diagnostic nerve blocks in the diagnosis of cervical zygapophyseal joints.

INTERSEGMENTAL RANGE OF MOTION PALPATION

The authors advocate the use of intersegmental range of motion palpation (IRMP) as the primary method of motion palpation. IRMP is described here as the palpation of intervertebral movement assessed during passive and/or patient-assisted motion. Passive intersegmental motion assessment is conducted while the patient is directed by the examiner to allow the examiner to move the area through the desired range of motion. Clinical experience has been that if the patient assists the movement, it is more difficult to determine intersegmental range of motion because of the global movement tendencies of muscle action. Active intersegmental motion is assessed when passive motion assessment is not possible due to the size or position of the area. The lumbar and sacroiliac areas are commonly palpated during patient assisted motions, whereas the cervical and thoracic spinal areas are easily palpated during passive motions.

Often the patient will experience pain when a relatively restricted articulation is moved towards the restricted end-range of motion. The patient will commonly and sometimes unconsciously resist the movement in the above situation. This abnormal quality of resistance to motion can be sensed by the examiner. An abnormal resistance to motion may be noticeable during either or both types of intersegmental range of motion palpation. When present, this resistance may indicate a positive finding for a symptomatic articulation. It is commonly found in the cervical spine over a hard mass of soft tissue overlying the facet articulation.

Many manual practitioners will manipulate a cervical articulation on the basis of an apparent symptomatic articulation alone, especially when radiographic examination is not part of the assessment. The above application of manipulation may or may not provide rapid symptomatic relief. The doctor must take care to make certain that the manipulation is not only for pain relief. Chiropractors must be aware of the complex array of compensation mechanisms that can be responsible for such painful cervical facet articulations. Often, further examination will reveal subluxations in the mid to upper thoracic spine that are responsible for painful compensatory reactions above.

The contact point of the examiner’s hand for intersegmental palpation is usually the tip of the finger(s). The segmental contact point of the bone depends on the level being palpated. Most commonly the spinous process is used. In the cervical spine from C1-C7 the interlaminar area of the articular pillars may be contacted. From C0-C2, the mastoid, articular condyle areas, and transverse processes may be used. Intersegmental range of motion
palpation of the sacroiliac joint can be determined by contacting above and below the PSIS in the joint space between the sacrum and ilium.

**OPTIMIZING THE MOTION PALPATION ASSESSMENT**

Prepositioning the area to be assessed with motion palpation is the same as for visual inspection. A light touch is essential when motion palpating (37). If the patient’s pain is exacerbated during the assessment, then the adjustment might be more difficult to perform. Too much pressure may also decrease the ability of the fingertips to detect subtle changes in movement. It is important that intersegmental movements are evaluated rather than the total global posture. The global motion may not be reflective of the intersegmental biomechanics of the joint in question.

The most accurate means for assessing the movement of the intervertebral joint is likely through stress radiography (See Chapter 5). Comparing the radiographic results to the palpation assessment will increase the examiner’s ability to know what he/she is feeling. As the patient undergoes a course of treatment, the movement can be compared to previous findings. It is not prudent to repeat x-rays continually to determine the movement of the joint after each adjustment. Stress radiography may not be indicated for the initial examination in all cases.

**Pelvic Motion Palpation.** Fixation dysfunction may be revealed by palpating the relative motions of the sacrum and the ilium during different types of movements. Sacroiliac range of motion palpation has shown more interexaminer reliability than motion palpation of the lumbar spine. The Gillet motion palpation test exhibited moderate levels of intraexaminer reliability in one study (29). This test is performed in the standing position. The doctor contacts the PSIS on one side with the ipsilateral thumb and the S2 tubercle of the sacrum with the opposite thumb. The patient is directed to slowly raise the ipsilateral leg with the knee bent, until the knee is waist high. Motion between the PSIS and S2 are compared bilaterally for differences. The downward motion of the PSIS relative to S2 is diminished on the side of fixation dysfunction.

A variation of the above procedure is performed by contacting each PSIS with the examiner’s thumbs (Fig. 4.9). As the patient raises the flexed knee, the PSIS on the side of the raised knee should lower. Relative movements of the PSISs are compared.

Another test is conducted in the sitting position. The doctor contacts the PSISs bilaterally with the thumbs and instructs the patient to bend forward at the waist. Symmetry of PSIS movement is monitored and compared bilaterally. The PSIS that raises more is likely the restricted articulation because as the lumbar spine flexes and pulls the sacrum forward (i.e., nutation), fixation at

**Figure 4.9.** Motion palpation of the sacroiliac joints. The examiner is contacting both PSISs. As the patient raises each leg the examiner notes the inferiorward excursion of each PSIS. Failure of the PSIS to drop in comparison to the contralateral side may be indicative of SI joint fixation dysfunction. Because rotation of the fifth lumbar vertebra could cause unilateral tensioning of the iliolumbar ligament and thus failure of the ilium to move inferiorward, this type of positional dyskinesia should be ruled out before assuming a SI fixation is present.

the SI joint will move the PSIS upward ipsilaterally (Fig. 4.10A-B).

Lateral flexion of the sacroiliac articulation is evaluated by placing the tips of two digits just medial to the PSIS. As the subject is laterally flexed ipsi- and contralaterally to the side of contact, the examiner detects movement at the SI joint. Palpation can be performed at both the superior and inferior margins of the joint (Fig. 4.11A-B). If a marked fixation is present, inspection may reveal that the contralateral buttoc will raise when the spine is laterally flexed ipsilaterally to the side of contact.

**Lumbar Motion Palpation.** Lumbar motion palpation is usually performed in the seated position but can be done standing. Here, the doctor will attempt to detect lateral flexion of the motion segment by placing the finger(s) just lateral and inferior to the spinous process of the segment in question. The spine is then laterally flexed. If lateral flexion motion is present, there will be a relaxation of the ipsilateral soft tissues lateral and inferior to the spinous process of the segment in question (Fig. 4.12). Normal coupled motion of the lumbar spine occurs when the spinous moves toward the concavity of lateral bend (See
Figure 4.10. A, Motion palpation of the sacroiliac joints. The examiner is contacting each PSIS. B, During flexion, if a PSIS moves more superiorward, this may be indicative of SI joint fixation on the same side.

Figure 4.11. A, Motion palpation of the superior portion of the right sacroiliac joint during right lateral bending. B, Motion palpation of the inferior portion of the right sacroiliac joint during right lateral bending.

Chapter 7). This subtle movement is difficult to palpate and may be best evaluated with stress radiography because it normally involves about one degree of rotation at each segmental level. To palpate spinous movement on lateral bending, place the index finger in the interspinous space slightly favoring the side of lateral bending.

Extension motion is evaluated in the seated position (Fig. 4.13A-B). If a base posterior sacrum is present, the sacral base will appear not to nutate during extension. The spinous processes of the lumbar spine should move anteroinferior during extension. This arching forward of the lumbar spine for motion palpation is slightly different from the motion that occurs when the spine is extended from the neutral position for a stress radiograph. During the radiographic procedure the segments move in a posterior and inferior direction.

Flexion motion is evaluated by passively flexing the subject forward and noting separation of the spinous processes. The middle and upper lumbar segments are usually more easily evaluated for this motion because of the prominence of the spinous processes.

Thoracic Motion Palpation. Lateral bending of the thoracic spine can be evaluated similarly to the lumbar spine (Fig. 4.14). Lateral flexion is more difficult to eval-
Figure 4.12. Motion palpation of L5 during left lateral bending. The first digit is at the inferior lateral margin of the L5 spinous process. During lateral flexion motion, there will be a relaxation of the soft tissue elements on the ipsilateral side of bend.

Figure 4.13. A, Motion palpation of lumbosacral movement. The examiner is contacting L5 and S1. B, Motion palpation of the lumbosacral junction. During extension, the examiner’s finger approximate as L5 and the sacrum extend.

Figure 4.14. Motion palpation of the thoracic spine during left lateral flexion. The spinous processes approximate during bending and move toward the convexity of bend if normal coupling motion is present. This assessment can be accomplished while contacting either the ipsi- or contralateral interspinous spaces during lateral bending.
uate here because intersegmental motion is much less than the lumbar spine. Coupled motion of the segment involves rotation of the spinous process toward the convexity of bend, provided the thoracic spine is laterally flexed in isolation (See Chapters 2 and 8). Flexion-extension motion assessment is depicted in Figure 4.15. Rotational evaluation is demonstrated in Figure 4.16.

**Cervical Motion Palpation.** Motion palpation of the cervical spine is performed with the patient seated. A back support should be provided because this will facilitate the isolation of the region. Lateral bending and coupled motions of the spinous process toward the convexity of bend are assessed (Fig. 4.17A-C). The examiner may place one finger caudal to the segment in question and evaluate the suprajacent level. As the head and neck are laterally flexed, care should be taken to limit the lateral bending of the subjacent level. A relaxation of the soft tissues on the ipsilateral side of bending will be detected if normal motion is present. Lateral flexion is more difficult to assess than spinous rotation coupling. The movement of the spinous process toward the convexity of the bend can be palpated with the digit placed on the contralateral side of lateral flexion. Coupled motion in the mid cervical spine is greater than at the cervicothoracic junction (Fig. 4.18). These coupled motions, therefore, may be more easily evaluated here. Contacting the appropriate process may be difficult through the thick cervical musculature.

The hyperlordotic cervical spine is more difficult to evaluate in the mid cervical area.

During forward flexion, the spinous processes should separate and on extension, approximate. This movement can be detected by feeling the separation while the examiner contacts two adjacent spinous processes (Fig. 4.19). This movement is more difficult to evaluate in the midcervical area, where direct contact on the spinous process is more difficult to obtain. During extension, the spinous processes normally move closer together. If paradoxical motion is present (i.e., the segment flexes when extended), then approximation of the spinous process will not occur.

When extending the head, the C5 and C6 spinouses seem to “tuck away.” Rather, the spinous moves posterior and inferior during extension and anterior superior during flexion. The sensation of the spinous disappearing during extension is likely due to the buckling of the posterior ligaments (i.e., ligamentum nuchae), thereby increasing the distance between the palpator's finger and spinous process (See Chapter 2: Landmark Identification).

Axial rotation is evaluated by noting movement of the spinous toward the contralateral side of axial rotation (Fig. 4.20). This movement is small in the lower cervical spine and greater in the upper cervical region.

**Upper Cervical Motion Palpation.** The atlantoaxial articulation is usually evaluated in lateral bending (Fig. 4.21) and axial rotation. The axis of rotation of the atlas on axis during lateral bending is toward the side of lateral bending (See Chapter 11). Rather than the atlas closing
down on the side of bend, it raises on the contralateral side. The Dvorak test may preferably be used to assess rotational fixation (See Fig. 4.7). The upper cervical spine is first isolated by having the patient flex the upper cervical spine followed with rotation of the head to each side. Palpation of C1-C2 rotation can be assessed with either the same contact as for lateral flexion assessment or by contacting the anterior intertransverse area between C1 and C2. The transverse process of C1 normally moves beyond that of C2 in the direction of the rotation. Flexion of C1-C2 may be evaluated with the same anterior intertransverse contact and slight flexion movement of the head.

The major motion for the occipitoatlantal motion segment is flexion extension. This movement can be evaluated by isolating each articulation in lateral flexion first by compressing the head into lateral bending followed with a rocking motion in flexion and extension. Anterior and posterior contacts similar to those of the C1-C2 assessment may be used.

Lateral flexion is evaluated by noting a relaxation of the soft tissue elements between the condyle and the transverse process of atlas on the ipsilateral side of bend. This motion is approximately 5° to each side. It is important that movement is not created at the mid and lower cervical spine during upper cervical motion assessments.

**Instrumentation**

**Paraspinal Skin Temperature Thermocouple Instruments**

The main reasons for the use of skin temperature analysis are to obtain objective neurologic evidence of a VSC and to monitor the progress of patient care. Intersegmental
Figure 4.18. Motion palpation of the midcervical spine during left lateral bending. Notice how the soft tissue elements are moved anteriorward so that contact can be made at the lateral margins of the posterior articulations.

Figure 4.19. Motion palpation of the lower cervical spine during flexion. The examiner is noting separation of the spinous processes.

Figure 4.20. Motion palpation of the lower cervical spine during right axial rotation. The spinous processes should move toward the contralateral side of rotation.

Figure 4.21. Motion palpation of C1-C2 during lateral bending. Notice how the soft tissue elements are moved forward in order that contact can be made just inferior to the atlas transverse processes and lateral to the C2 transverse process. If lateral flexion is present, there will be a relaxation of the soft tissue elements on the ipsilateral side of bend.

Variations in skin temperature are a probable connection to nervous system phenomena related to the VSC.

Gonstead hypothesized that intersegmental variations in skin temperature were produced by inflammation from nerve root compression that radiated heat to the skin surface or from radiation of heat from the skin surface to the area of chronic nerve root compression (37). Heat exhibited on the surface of the skin is radiated from a maximum of 1 to 1.8 millimeters below the skin (53). The results of research into the mechanisms involved in the production of variations in skin temperature have provided more likely theories than the historical Gonstead hypotheses (34).
Thermographic findings are largely accepted as resulting from changes in underlying blood vascularity (55). Two main mechanisms thought to cause such blood vessel changes include Substance P release in response to dorsal sensory nerve stimulation and sympathetic nervous system activity. Sympathetic modulation is one of the more popular theoretical mechanisms of thermal dysfunction. Traditionally, preganglionic cell bodies were thought to be confined to the thoracic and upper lumbar levels (56), however, preganglionic sympathetic cell bodies have been identified at all levels of the spinal cord (57,58).

The recurrent meningeal (sinuvertebral) nerve innervates the articular capsule, PLL, and annulus. It has mixed sensory and sympathetic components and when stimulated may give rise to pain or thermal manifestations. Antidromic stimulation (propagation of an impulse in a reversed direction) of the dorsal root ganglion can raise skin temperature (59,60). The above has been termed the cutaneous axon reflex. It is possible that many different neural and myofascial mechanisms are involved in thermoregulation.

In the cervical and lumbar regions of the vertebral column there are large numbers of intersegmental connections between the nerves supplying contiguous spinal segments (51). The same is not true of the thoracic spine. Skin temperature alterations, therefore, may be more directly related to the segmental level involved in the thoracic region.

Thermocouple instruments, such as the Nervoscope (Fig. 4.22), consist of two thermal sensors composed of metal wires. When the sensors are at different temperatures, the voltage generated between them is roughly proportional to the difference in temperature because of the thermoelectric effect involving the drifting of free electrons in a metal from the warmer junction to the cooler junction (61). The low impedance thermocouples are connected in series with a micrometer to provide a differential measurement of temperature.

The Nervoscope and other similar instruments (Fig. 4.23) yield a qualitative assessment of thermal asymmetry. The temperature on one side of the spine is compared with that on the other. A scanning method is conducted whereby a bilateral skin temperature difference is depicted as a meter needle movement to one side or the other. A “reading” or temperature differential (TD) is considered significant if an abrupt “over and back” needle movement is seen over a one spinal segment distance during the scan (Fig. 4.24A-C). The magnitude of the TD (the amount of paraspinal temperature differential), is thought to be directly proportional to the amount of neurophysiologic involvement caused by the VSC. In the acute stage of spinal subluxation, large variations in heat are often seen. A gradual diminishment in the magnitude of the TD is interpreted as improvement in the aberrant neurophysiology. The monitoring of the intersegmental

![Figure 4.22. The Nervoscope.](image)

![Figure 4.23. The GO scope.](image)
heat differential is one of several parameters of assessment used to gauge patient progress in response to specific spinal adjusting.

The level of the TD is considered to be specifically associated with the functional spinal unit (FSU) underlying it. The location of the TD level relative to the bony landmarks helps to associate the temperature differential with a certain spinal nerve level. The relationship of the reading locations to the bony landmarks is mildly variable from patient to patient. The main factors influencing the relative reading location include the state of the sagittal curves and the presence of a scoliotic curve. The segmental nature of the spinal nerves, the posterior primary rami, and autonomic connections have led to the assumption that a local skin temperature differential will likely occur at the intersegmental level. For example, a C8 spinal nerve dysfunction that produces a paraspinal skin temperature differential will likely produce a differential at the C7-T1 disc space level. See Table 4.2 for a list of TD locations and their corresponding spinal levels.

There are some unanswered questions about reading locations and their significance. For instance, in the cauda equina region, a disc protrusion causing nerve root compression at one level most likely will affect the nerve root

<table>
<thead>
<tr>
<th>Table 4.2. Corresponding Segmental Levels for Temperature Differentials*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>C0–C2</strong></td>
</tr>
<tr>
<td><strong>C2–T3</strong></td>
</tr>
<tr>
<td><strong>T4</strong></td>
</tr>
<tr>
<td><strong>T5–T9</strong></td>
</tr>
<tr>
<td><strong>T10–T12</strong></td>
</tr>
<tr>
<td><strong>L1–L5</strong></td>
</tr>
<tr>
<td>Sacroiliac and inferior</td>
</tr>
</tbody>
</table>

that exits the intervertebral foramen at the level below. In the case of a lumbar disc protrusion at L4, the L5 nerve root will more likely be compressed than the L4 nerve root.

The presence of an intersegmental temperature differential is not synonymous with the existence of VSC. Neurophysiologic involvement may exist at a specific spinal level without the concomitant presence of other subluxation parameters. Such a spinal level would not be considered a “subluxation.” A hypermobile FSU may create aberrant nervous system activity. The hypermobile FSU can be a compensation for a restricted and subluxated FSU at another level, usually below the hypermobility (62).

It is possible that VSC induced skin temperature abnormalities may exist distally to the paraspinal region, or directly over the spine, without being revealed in the region of the skin scanned by the thermocouple. This phenomenon is one probable limitation of the exclusive employment of a bilateral thermocouple device for skin temperature analysis.

The reliability of the Nervoscope has been tested statistically and in the dynamic scanning mode. The consistency in the measurement of the differential was determined to be excellent when tested by placing and then replacing the thermocouples statically on the same location on the skin (63). The statistical analysis methods used in the above study are suspect. In a study using the dynamic scanning mode, good intra and interexaminer reliability was seen in the thoracic region (kappa > 0.56), but not in the cervical region (6). Good intraexaminer correlation (ICC > 0.50) of the location marked for a temperature differential was found in the above study, once readings were detected in a given region. The same study yielded poor interexaminer concordance (ICC < 0.3) for temperature differential location in one series and good concordance (ICC = 0.64) for the second.

Caution must be taken in applying results from studies such as those above to the clinical setting. The dynamic scanning study must be repeated with more subjects and symptomatic patients. Other studies comparing the bilateral thermocouple to a more established reference test such as telethermography would be useful.

In summary, the bilateral thermocouple instrument is used to monitor skin temperature on each patient visit to aid in the location of neurologic dysfunction and to help determine the timing of and response to spinal adjustments.

SCANNING PROCEDURE

Typically, paraspinal skin temperature instruments are used to scan small sections of the spinal column, one after another (6). The probes are kept in perpendicular contact with the skin surface with sufficient pressure to prevent air gaps forming at the skin/thermocouple interface. The glide is caudocephalad for T2 to C0 and cephalocaudal for T2 to S2 (Fig 4.25A-B). Glide speed for nonamplified instruments should not exceed 0.5–1.0 cm/sec. If a temperature differential is suspected at a segmental level, the scan should be repeated several times to confirm the finding. Differentials that are accentuated with a repeat scanning procedure are considered more significant than those that diminish. The presence of moles or other lesions in the glide path lessens the validity of the procedure. If a scoliosis is present, then the scan and orientation of the instrument should follow the curvature. The newborn or toddler’s loose skin will usually alter the scanning protocol (See Chapter 14).

Leg Length Inequality

Prone measurement of leg length inequality (LLI) is common in the chiropractic profession. The procedure is
likely most reliable when measured on a self-lowering table without altering the resting position of the legs before measuring. The patient is directed to stand on the platform of a table such as the hydraulic "hi-lo," with the patient’s feet approximately six inches apart and heels even. The patient should then lean into the table as straight and as balanced as possible. Lower the table and instruct the patient not to move any part of his or her body. View the medial malleoli bilaterally, comparing the relative length of the legs without moving them. The thumbs can be placed on the inferior portion of the malleoli for comparison.

Measurements such as this are not likely reliable (64). The use of an apparent visually observed LLI as a sole indication of the need for treatment, or as a major outcome measure of the response to treatment, is likely invalid. Differentiation between functional and anatomical leg length inequality is presented in Chapter 6.

Plain Film Radiographic Examination

In this chapter, the discussion of the radiographic examination will focus on integrating the findings of radiographic analysis into the examination of the chiropractic patient. Historically, the use of radiography in chiropractic centered around the detection and quantification of the intervertebral misalignment. Stress radiography was added to the routine examination when ligament integrity was suspect. Such “bending views” have been proposed as valuable in determining intervertebral motion characteristics and can augment or replace motion palpation assessments.

As licensed x-ray supervisors, chiropractors usually expose and interpret their own radiographs, unlike the practicing medical doctor whose films are normally taken by a medical radiologist. For the above reason, chiropractors must differentiate diagnose the results of the radiographic examination. The radiograph must be screened for pathology, fracture, and dislocation, as well as be interpreted for biomechanical relevance (See Chapter 5).

The minimal examination includes two views of the area of primary complaint, preferably perpendicular to each other (65). Other areas that might require adjunctive intervention may be exposed. Additional projections, such as oblique radiographs, supplement the examination when indicated.

Adjustments given to aid the primary presenting complaint often result in the development of symptoms elsewhere, especially in chronic situations. These symptoms likely arise from compensation for the biomechanical changes resulting from adjustments at other spinal levels. The ability of some areas to respond to direct treatment often necessitates that other (symptomatically silent) areas be adjusted. The interdependency of the different spinal regions necessitates a full-spine examination (66). When the entire spine needs to be viewed, a properly exposed full-spine radiograph (See Chapter 5) will offer diagnostically useful information with comparatively less patient exposure than sectional analyses that require projectional overlap. For the above reasons and others, full spine visualization is preferable whenever possible in the chiropractic management of a VSC.

There are those in the profession that believe that chiropractic treatment is appropriate for pain relief only. Many chiropractors and some chiropractic institutions only take x-rays of a patient if fracture or pathology is suspected. It is the opinion of the authors that the application of the force required to cavitate an intervertebral articulation is a relatively invasive maneuver. It should be assumed that an individual presenting for treatment for spinal related pain or other symptoms is likely to have a history of paraspinal ligament damage. As was discussed in Chapters 2 and 3, the spinal ligaments are subject to the phenomenon of plastic deformation or creep. Previously injured ligaments will allow distortion of the alignment of the vertebra(e) they are meant to support. To introduce a force into the spine sufficient to produce abrupt intervertebral movement and cavitation, without previously determining the presence or absence and, most importantly, the direction of creep deformation at the level(s) being adjusted or manipulated, is to invite injury to the patient. The chiropractor has a responsibility to protect the patient at all times by ensuring that the treatment rendered is safe, as well as maximally effective.

Another important reason that radiographic examination is requisite for proper administration of the adjustment is that the symptomatic level is not necessarily the level to be adjusted. A hypermobile articulation may cause spinal related pain yet is not a candidate for spinal adjustment. Radiographic examination is the most useful tool for locating contraindications for the chiropractic adjustment. The use of stress radiographs appears to be far more accurate in assessing the intricacies of fixation dysfunction and abnormal coupling patterns, than other procedures. Because an adjustment is not a benign procedure, it is important that the force be directed where appropriate.

Spinal alignment characteristics are determined from qualitative inspection and the measurement of various anatomical configurations. The clinical significance of these measurements is controversial. To rely on static radiographic measurements as the primary criteria used to apply chiropractic care is to invite disaster. Clinical correlation of radiographically derived information is requisite for a complete evaluation. Generally, small measurements derived from radiographic marking systems must be suspect, especially if they are used to determine large postural asymmetries. Radiographic distortion and magnification will magnify slight changes such as those associated with scoliosis. If one focuses on intersegmental relationships, the significance of radiographic distortion reduces dramatically. The images of adjacent vertebrae
will be projected and distorted similarly, producing relatively insignificant differences.

It is important to remember that plain film radiographs are static, two-dimensional instantaneous shadows of the patient. Often, the most misaligned motion segments are compensations for subluxations elsewhere. The freely movable areas compensate for the restricted areas when the individual is weight bearing and moving about. Global abnormalities in structural alignments may result from intersegmental fixed positional dyskinesia.

The lateral view is considered more important than the AP radiograph in spinal diagnosis. The disc space is most easily viewed on the lateral radiograph. Abnormalities in the integrity of the disc space may be suggestive of the physiologic age and state of health of the FSU (See Chapters 2 and 3).

FUNCTIONAL OR STRESS RADIOGRAPHY

The use of functional or stress radiography (bending views) is common for the purposes of the differential diagnosis of the presence or absence of ligament failure (65). The use of bending views for the differential diagnosis of the presence or absence of fixation dysfunction and abnormal coupling patterns is somewhat controversial, yet relatively common. The reliability of this measure to assess fixation dysfunction has not been determined. One review of the literature on lumbar functional radiography concludes that there may be a role for functional radiographs in ascertaining the physiologic age of the spine, disc protrusions, and instability (67).

Jirout (68) has demonstrated some of the intricate parameters of the three-dimensional nature of cervical lateral bending movement. The sagittal component of lateral bending varies considerably from deep inspiration to mid respiration to deep exhalation. The variability of all types of bending views must be determined to ascertain the indications and contraindications of their usage. Bending views aid in the visualization of intersegmental and global movement characteristics, and as such, often provide valuable insight into the nature of the presenting dysfunction.

All intervertebral articulations can be visualized with stress radiography in any single or combination of range(s) of motion(s). In the determination of fixation dysfunction, a very important factor to rule out is the presence of anatomical variation that may explain any apparent asymmetry in motion visualized on bending views. Equally important is the ruling out of projection distortion. It is also crucial that painstakingly diligent attempts are made to instruct the patient properly as to the movement desired and to observe that the patient has moved equally from side to side, when taking views of opposing movements.

A routine assessment of spinal movement includes the neutral position and extremes of movement to either side in the desired directions. One cannot adequately compare one direction with the other without the neutral view. Clinical experience has been that comparisons are best made from end-range to neutral on one side, then again on the other side. Analysis of intermediate movements of the FSU, determined through cineradiography, may prove to be a valuable method of assessment. Preliminary reports of interexaminer reliability in the mid cervical spine are encouraging (69). Possible indications of fixation dysfunction include an intersegmental decrease in one or more of the normal planes of motion for the articulation in question. The articulation in question is compared with those directly adjacent to it. Motion abnormalities consistent with the presence of fixation dysfunction may exist in singular or multiple planes.

Hypermobility dysfunction may occur secondarily to fixation dysfunction, primary ligament damage, or anomaly. Possible indications of hypermobility include an increase of intersegmental movement in one or more degrees of freedom. For a complete discussion of aspects of the functional radiographic examination, the reader is referred to Chapter 5.

ADVANCED DIAGNOSTIC PROCEDURES

In the past several years new developments in the area of sophisticated diagnostic procedures have contributed to a more complete illumination of the objective evidence associated with the VSC. Magnetic resonance imaging (static, functional and three-dimensional), thermography, and video fluoroscopy have and will continue to provide us with new insights into the nature of the VSC and its identification.

With the maturation of the chiropractic profession comes a sophistication in examination and treatment protocol. With an increase in the availability and understanding of special testing methods, those not routinely necessary, comes the opportunity to address the needs of the challenging patient more completely. An adequate understanding of the clinical value of special tests is necessary to avoid under or overutilization of any testing procedure.

Enthusiasm and criticism are often stimulated by new or popularized diagnostic tests. It is in the patient's best interests to develop the skill of filtering the emotional arguments of the critics and the promoters and rely on reason and available facts regarding the usefulness of any test. Historically, clinicians in all disciplines have developed their clinical protocols based on the workshops that they have attended, their instructor's views, trial-and-error experience, and their emotional bias toward treatment styles, rather than on scientifically validated protocols (70). It is refreshing to see a declining number of pseudo-religious practitioners that refuse to keep abreast of advances in the profession and incorporate them into
their practices for the benefit of their patients. An increased emphasis is being placed on the development of standards of practice based on reason and the conclusions of scientific trials. Unfortunately, a number of the more progressive practitioners give up the principles and philosophy of chiropractic and in spite of a scientifically sound approach to their patient, ignore the reason for delivering chiropractic care. This approach sabotages the patient's right to the primary benefit of chiropractic care; the reduction or elimination of components of the vertebral subluxation complex which may contribute to or cause an alteration in homeostasis.

When considering special testing, one needs to consider whether an anatomic or a physiologic test is required. An anatomic test, as the name implies, gives information regarding a given structure and is helpful for viewing "visible" phenomenon. For example, an MRI can help the doctor "see" inside the spinal canal to assist in the evaluation of suspected disc herniation or other space occupying lesion. A physiologic test, such as an EMG or a thermogram, offers quite different information that may be of lesser or greater value depending on the specific information sought. The choice of a physiologic or anatomic test depends on the suspected diagnosis and the information required to progress with a modified treatment plan dependent on the results of the special test. When the results of a test, whether negative or positive, are not likely to affect the clinical course, a question arises regarding the need for the examination. The following discussion of specialized testing procedures is provided as a brief description of the possible applications available to the chiropractor.

Magnetic Resonance Imaging

Magnetic resonance imaging is generally regarded as an anatomic test, allowing the practitioner to "see" inside the involved area. An MRI is helpful to evaluate a suspected space occupying lesion in a patient with intractable headaches or suspected cord tumor. More commonly, an MRI assists in the characterization of a radicular lesion and verifies or negates the need for surgical consultation. MRI is useful for viewing changes resulting from chronic subluxations such as disc dehydration and protrusion and degenerative joint disease (71). These degenerative changes, commonly attributed to wear and tear due to old age, can be seen at levels of fixation dysfunction or at surrounding segments where hypermobility may occur.

Computerized Axial Tomography

Computerized axial tomographic (CT) scanning is an imaging tool quite similar in its application to MRI. Generally speaking, a CT scan is preferred for viewing bony changes and MRI is preferred for characterizing soft tissue lesions. Because hydrogen atoms found in high concentration in water assist in optimal MRI viewing, the cortical area of bone, which has a low water content, may be viewed better with CT than with MRI. Conversely, the medullary cavities of bone have a high hydrogen atom concentration and are viewed adequately with MRI scanning. Medullary tumors are sometimes best characterized with MRI (See Chapter 7). CT and MRI can offer much assistance, whether the results are positive or negative, in consideration of continued patient management, but caution is in order because of the fact that approximately 20 to 30% of "normal," asymptomatic individuals have positive findings on an MRI (35). Of course, what in fact constitutes normal has not yet been resolved.

Electromyographic Tests

Needle EMG is a functional test and is helpful for characterizing neural function. It verifies nerve damage as is often found as a result of components of the VSC, such as disc herniation, or peripheral neuropathies caused by carpal tunnel syndrome. A needle EMG is typically performed by neurologists and physiatrists and aids in the localization and characterization of neural involvements.

Needle EMGs are clinically useful when positive, but because of a high rate of false negatives, a negative test with high clinical suspicion should be followed by a thermogram or conduction velocity examination.

Conduction Velocity Tests

As implied by the name, these are tests used to measure the speed at which a nerve delivers an electrical signal. When the conduction velocity is altered in a section of or throughout the length of a nerve, this test assists in the location and presence of a lesion. This test is commonly performed by neurologists and physiatrists but also by some chiropractors.

Surface EMG

Paraspinal EMG has become popular within the chiropractic profession in recent years. Preliminary evidence (72–74) suggests that good levels of reproducibility can be obtained with surface EMG, provided technicians are adequately trained in the protocol of the examination, patient postures are controlled (75) and electrodes are of sufficient sensitivity.

Bone Scans

Bone scans are generally considered a physiologic test as they measure the amount of uptake of a radioactive isotope into bone. The injected isotope competes with blood calcium for absorption into bone and this phenomenon can help to identify areas of abnormal bone physiology as found with metastatic carcinoma and osteomyelitis.
Thermography

Thermography is a physiologic test considered sensitive for sensory/neural abnormalities and myofascial irritations (55). This test is typically used to characterize radicular pain patterns and soft tissue pain and differentially diagnose these conditions from vascular or referred etiologies for similar pain syndromes. Additionally, a negative thermogram is considered a strong indicator for the absence of an organic cause for a patient’s pain complaints and is therefore an excellent test for malingering.

Liquid crystal thermography, where cholesterol esters change colors dependent on known temperature ranges, is used for all thermographic applications and is considered superior for breast and temporal mandibular joint (TMJ) studies. Much more research has been published regarding the use of electronic or telethermography and this method of thermographic analysis is generally preferred (55). This method uses an infrared detector that transfers the information to a computer for interpretation and visualization on a monitor. This information is often stored on video tape or stored on a hard disk for future interpretation.

Perhaps it is the sensitivity of the test which contributes to its suspected rate of high false positives. A large volume of research is now available in this field. Much of the skepticism regarding the validity of this procedure has diminished among informed investigators and clinicians. The insistence of established clinical protocol by thermographic societies has contributed greatly to the standardization and reliability of thermographic interpretation.

The worker’s compensation system in California allows thermograms after sixty days of treatment, and the American Medical Association recently released an opinion on thermography classifying it as useful for a variety of neuromusculoskeletal disorders (76). It appears that overutilization of this procedure by a few has contributed to a widespread prejudice toward thermography. Future research should incorporate rigorous designs especially binding and interpretation reliability. The use of thermography as an outcome measure following chiropractic care could also be a fruitful area for future research.

Computerized Musculoskeletal Analysis

Various manufacturers produce both similar and differing computerized instruments that measure muscular strength. These instruments seem to offer significant contributions in the diagnosis and management of musculoskeletal problems. The popularity and common use of these types of analyses will likely increase as the prices lower and physicians and physical therapists become more aware of the questionable reliability of manual muscle testing. These machines are designed to isolate a particular muscle or muscle group, assisting in correlating myologic weakness with other evidence of neuropathy in the diagnosis of a particular disorder.

Computerized testing units generally measure isometric, isotonic, and isokinetic muscular activity. Often, initial exercise rehabilitation is performed on these machines and this information assists in determining the need for endurance, strength, or power testing. Additionally, patterns of abnormalities can be diagnostically helpful as well.

Chiropractors typically use these instruments to determine the muscle weakness that may be correlated with nerve root pathology, and the determination of strength/body weight and agonist/antagonist muscular ratios. Specifically, a runner may have recurring knee injuries if the quadriceps/hamstring ratio is abnormal, as is commonly found. An optimal exercise rehabilitation, as can be properly determined from information obtained from this test may help a runner achieve a more desirable ratio of a hamstring with a muscular strength which is 75% that of the quadriceps. This balance will add to the stability of the knee and allow for a quicker rehabilitation, as well as protect against reinjury.

Studies suggest that extensor trunk strength is lost in the patient with back pain and bidirectional causal relationships have been discussed (See Chapter 7). The question still arises as to whether the low back pain contributes to the extensor muscular weakness or whether the extensor muscle weakness contributes to the development of low back pain, but most agree that the trunk extensor muscles should be 40% stronger than the trunk flexors. The term extensor weakness refers to either an actual muscular weakness as compared with body weight or a relative extensor weakness when compared with the strength of the trunk flexors.

It is suggested that muscular strength be accurately assessed before implementing a rigorous strengthening program in patients. The possibility exists of increasing a muscular ratio problem with low back patients that are given sit-ups to help assist in their management. It is likely that the extensors are weak in patients with low back pain. If computerized musculoskeletal analyses are not available, it is suggested that extensor strength always be prioritized in any trunk exercise program. McKenzie extension maneuvers have been shown to be more effective than the more traditional William’s exercises in the management of low back patients (See Chapter 7).

Velocity measures for patients with impaired spine motion appears to be a valuable assessment. Velocity measures often show a greater ability to distinguish between symptomatic and pain-free subjects (77) (Fig. 4.26).

ORTHOPAEDIC AND NEUROLOGIC TESTING

A comprehensive physical examination includes orthopaedic tests. A properly executed orthopaedic evaluation
Figure 4.26. Computerized analysis of cervical spine range of motion and velocity. Courtesy of Orthopedic Systems Inc., Hayward, CA.

Figure 4.27. The dermatomes of the human. This distribution is based on hypalgesia from the compression of single nerve roots. Modified from Chusid JG. Correlative neuroanatomy and functional neurology. 19th ed. Los Altos, CA: Lange Medical Publishers, 1985:237.
can be complete, reliable, systematic, and practical. For assessment of components of the subluxation, the orthopaedic examination is relatively insensitive. For the purposes of localizing and reproducing the patient’s experience of pain, the orthopaedic examination can be helpful. Spratt et al. (78) developed an assessment protocol for measuring outcomes for low back pain patients. A total of 21 physical examination tests were used. Interrater agreements were statistically high in the following areas: patient reported pain aggravation and pain location; rater observed dynamics of motion and degrees elevated in the straight leg raise; location of the most tender area; recording pain behaviors; test-retest comparisons. The above comprehensive examination was performed in an average of less than 14 minutes. This protocol is an example of a reliable and practical use for orthopaedic testing.

An alphabetical listing of orthopaedic tests that may be of use to the chiropractor is presented in Appendix 4B. This list is presented as a reference for the student or practicing doctor. It is expected that the individual will compile groups of tests from this list, and organize them into a flowing set of procedures for testing specific neuro-mechanically related, painful conditions.

Neurologic testing of dermatomes is very important, especially in the patient with a referred pain syndrome. Sensory evaluation can be performed with a pin wheel. In addition, reflex alterations and muscle strength loss will be indicative of impaired neural function. The human dermatomes are depicted in Figure 4.27.

REFERENCES
33. Gerow G. Osseous configurations of the axial skeleton: specific

APPENDIX 4A. Chart Abbreviations

A  assessment; anterior
abd  abduction
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACJ</td>
<td>acromioclavicular joint</td>
</tr>
<tr>
<td>add</td>
<td>adduction</td>
</tr>
<tr>
<td>adj</td>
<td>adjustment</td>
</tr>
<tr>
<td>agg</td>
<td>aggravated</td>
</tr>
<tr>
<td>am</td>
<td>morning</td>
</tr>
<tr>
<td>AP</td>
<td>antero-posterior</td>
</tr>
<tr>
<td>ASAP</td>
<td>as soon as possible</td>
</tr>
<tr>
<td>ASIS</td>
<td>anterior superior iliac spine</td>
</tr>
<tr>
<td>ASS</td>
<td>assisted</td>
</tr>
<tr>
<td>asym</td>
<td>asymmetrical</td>
</tr>
<tr>
<td>atr</td>
<td>atrophy</td>
</tr>
<tr>
<td>B</td>
<td>brisk; burning (pain)</td>
</tr>
<tr>
<td>B4</td>
<td>before</td>
</tr>
<tr>
<td>B</td>
<td>bilateral</td>
</tr>
<tr>
<td>bog</td>
<td>bogginess of tissue</td>
</tr>
<tr>
<td>BP</td>
<td>blood pressure</td>
</tr>
<tr>
<td>BSE</td>
<td>bilaterally symmetrical and equal (DTRs)</td>
</tr>
<tr>
<td>BT</td>
<td>bitemporal</td>
</tr>
<tr>
<td>C</td>
<td>cervical</td>
</tr>
<tr>
<td>CC</td>
<td>chief complaint; cervical chair</td>
</tr>
<tr>
<td>chr</td>
<td>chronic</td>
</tr>
<tr>
<td>c/o</td>
<td>complains of</td>
</tr>
<tr>
<td>CP</td>
<td>cervical pillow; cold pack</td>
</tr>
<tr>
<td>crep</td>
<td>creptation(s)</td>
</tr>
<tr>
<td>CSPT</td>
<td>cervical support</td>
</tr>
<tr>
<td>CT</td>
<td>cervico-thoracic; computerized tomography</td>
</tr>
<tr>
<td>cx</td>
<td>coccyx</td>
</tr>
<tr>
<td>D</td>
<td>dorsal</td>
</tr>
<tr>
<td>d</td>
<td>dull</td>
</tr>
<tr>
<td>/d</td>
<td>per day</td>
</tr>
<tr>
<td>dev</td>
<td>deviation (-ate)</td>
</tr>
<tr>
<td>DF</td>
<td>dorsiflex (-ion)</td>
</tr>
<tr>
<td>dim</td>
<td>diminish</td>
</tr>
<tr>
<td>distrx</td>
<td>distraction</td>
</tr>
<tr>
<td>DJD</td>
<td>degenerative joint disease</td>
</tr>
<tr>
<td>DOI</td>
<td>date of injury</td>
</tr>
<tr>
<td>DPAT</td>
<td>decreased pain after treatment</td>
</tr>
<tr>
<td>DTR</td>
<td>deep tendon reflexes</td>
</tr>
<tr>
<td>Dx</td>
<td>diagnosis</td>
</tr>
<tr>
<td>E</td>
<td>examination</td>
</tr>
<tr>
<td>EP</td>
<td>end play</td>
</tr>
<tr>
<td>ext</td>
<td>extension</td>
</tr>
<tr>
<td>exs</td>
<td>exercise(s)</td>
</tr>
<tr>
<td>fx/dys</td>
<td>fixation dysfunction</td>
</tr>
<tr>
<td>Fx</td>
<td>fracture</td>
</tr>
<tr>
<td>FS</td>
<td>full spine</td>
</tr>
<tr>
<td>GHJ</td>
<td>glenohumeral joint</td>
</tr>
<tr>
<td>GI</td>
<td>gastrointestinal</td>
</tr>
<tr>
<td>grd</td>
<td>grade</td>
</tr>
<tr>
<td>HA</td>
<td>headache</td>
</tr>
<tr>
<td>HBP</td>
<td>high blood pressure</td>
</tr>
<tr>
<td>hern</td>
<td>herniation</td>
</tr>
<tr>
<td>HNP</td>
<td>herniated nucleus pulposus</td>
</tr>
<tr>
<td>HT</td>
<td>hypertonus (-ic); hypertension</td>
</tr>
<tr>
<td>HE</td>
<td>hyperemia</td>
</tr>
<tr>
<td>Hx</td>
<td>history</td>
</tr>
<tr>
<td>IC</td>
<td>intercostal</td>
</tr>
<tr>
<td>ins</td>
<td>inspection</td>
</tr>
<tr>
<td>int</td>
<td>intermittent; internal</td>
</tr>
<tr>
<td>ISL</td>
<td>interspinous ligament</td>
</tr>
<tr>
<td>IVD</td>
<td>intervertebral disc</td>
</tr>
<tr>
<td>J</td>
<td>joint</td>
</tr>
<tr>
<td>KC</td>
<td>knee-chest table</td>
</tr>
<tr>
<td>L</td>
<td>lumbar</td>
</tr>
<tr>
<td>l</td>
<td>left</td>
</tr>
<tr>
<td>Lat</td>
<td>lateral</td>
</tr>
<tr>
<td>LB</td>
<td>low back</td>
</tr>
<tr>
<td>LBP</td>
<td>low back pain</td>
</tr>
<tr>
<td>LC</td>
<td>lower cervical</td>
</tr>
<tr>
<td>LCU</td>
<td>lower cervical-upper thoracic</td>
</tr>
<tr>
<td>LOD</td>
<td>line of drive</td>
</tr>
<tr>
<td>L/S, L-S</td>
<td>lumbosacral</td>
</tr>
<tr>
<td>MC</td>
<td>midcervical</td>
</tr>
<tr>
<td>MT</td>
<td>midthoracic</td>
</tr>
<tr>
<td>/m</td>
<td>per month</td>
</tr>
<tr>
<td>mm</td>
<td>muscles</td>
</tr>
<tr>
<td>mob</td>
<td>mobilize</td>
</tr>
<tr>
<td>MP</td>
<td>motion palpation</td>
</tr>
<tr>
<td>N</td>
<td>normal; negative</td>
</tr>
<tr>
<td>Noa</td>
<td>no change</td>
</tr>
<tr>
<td>N &amp; V</td>
<td>nausea and vomiting</td>
</tr>
<tr>
<td>N &amp; T</td>
<td>numbness and tingling</td>
</tr>
<tr>
<td>O</td>
<td>objective</td>
</tr>
<tr>
<td>occ</td>
<td>occipital; occiput</td>
</tr>
<tr>
<td>OTJ</td>
<td>on the job</td>
</tr>
<tr>
<td>OV</td>
<td>office visit</td>
</tr>
<tr>
<td>P</td>
<td>pain; plan; procedure; posterior</td>
</tr>
<tr>
<td>PA</td>
<td>posterior-anterior</td>
</tr>
<tr>
<td>Pass</td>
<td>passive</td>
</tr>
<tr>
<td>PB</td>
<td>pelvic bench</td>
</tr>
<tr>
<td>PC</td>
<td>phone call</td>
</tr>
<tr>
<td>PDPR-%</td>
<td>patient describes pain reduction as ...%</td>
</tr>
<tr>
<td>PE</td>
<td>physical examination; physical education</td>
</tr>
<tr>
<td>Pg, preg</td>
<td>pregnant</td>
</tr>
<tr>
<td>PI</td>
<td>personal injury; personal illness; posterior inferior</td>
</tr>
<tr>
<td>PIS</td>
<td>preinjury status</td>
</tr>
<tr>
<td>palp</td>
<td>palpation (-ate) (-atory) (-able)</td>
</tr>
<tr>
<td>pm</td>
<td>afternoon; physical medicine</td>
</tr>
<tr>
<td>PMS</td>
<td>premenstrual syndrome</td>
</tr>
<tr>
<td>Pn</td>
<td>pain</td>
</tr>
<tr>
<td>Pn-&gt;</td>
<td>radiating pain</td>
</tr>
<tr>
<td>PNF</td>
<td>proprioceptive neuromuscular facilitation</td>
</tr>
<tr>
<td>P'n S</td>
<td>permanent and stationary</td>
</tr>
<tr>
<td>pos, +</td>
<td>positive</td>
</tr>
<tr>
<td>POT</td>
<td>pattern of thrust</td>
</tr>
<tr>
<td>PPD</td>
<td>permanent partial disability</td>
</tr>
<tr>
<td>PRAE</td>
<td>patient responding as expected</td>
</tr>
<tr>
<td>PSIS</td>
<td>posterior superior iliac spine</td>
</tr>
<tr>
<td>Pt</td>
<td>patient</td>
</tr>
<tr>
<td>PT</td>
<td>physical therapy</td>
</tr>
<tr>
<td>PTPW</td>
<td>patient tolerated procedure well</td>
</tr>
<tr>
<td>R</td>
<td>right</td>
</tr>
</tbody>
</table>
rad  radiating; radial; radius
ref refer (-red)
rel  relief (-ieved)
resp respiration
ROM range of motion
Rot rotation
RTW return to work
Rx  recommended therapy; prescription
S subjective
sac sacrum
SCJ sternoclavicular joint
sev  severe
SI  sacroiliac
sl  slight
SLP short leg, prone
SLS short leg, supine
SLR straight leg raise
SMT spinal manipulative therapy
SO suboccipital
SP  spine (-ous) (-al)
spondy spondylolisthesis
Spr sprain
str strain
stim stimulate (-tion)
sup supine, supination
Sx  symptoms
T  thoracic; transverse
TD  temperature differential
TTD  total temporary disability
T-L thoracolumbar
TMJ temporomandibular joint
TP  trigger point
TPT trigger point therapy
TTF "taut-tender fibers"
Trx traction
Tx  treatment
U  upper
UC upper cervical
UT  upper thoracic
vert vertebral
vis  visible, visual
VS vital signs
w/  with
w/o  without
wk  week
WNL within normal limits
WR  work restriction
/w  per week
x  times
yest yesterday
∅  none, no, restricted

Adjustment Grades (follow listing as a superscript, e.g., L5 PRS ++):
-  no joint movement
+ less than the appropriate movement
++ appropriate or good movement
+++ over adjusted

Pain Abbreviations:
Pn  pain
D  dull
S  sharp
B  burning

Pain Grades Visual Analog Scale (VAS) (1–10):
1  very mild
10  excruciating

Mobilization and Manipulation Grades:
Grade 1: Small amplitude movements performed at the beginning of the range of motion of an articulation
Grade 2: Large amplitude movements that do not reach the limit of the range
Grade 3: Large amplitude movements performed up to the limit of the range
Grade 4: Small amplitude movements performed at the limit of the range
Grade 5: Movement into the paraphysiologic range

APPENDIX 4B. Index of Tests

*Accommodation Reflex*

Description—Patient is asked to focus on practitioner’s thumb that is held at arms length. Practitioner’s thumb is brought close to the patient’s nose to create eye convergence.

Significance—Positive; If pupils fail to constrict once eyes converge.

Indication—Afferent II, Efferent III, Center; occipital cortex.

*Adam’s*

Description—Patient is standing and flexes forward. Observe the spine.

Significance—Positive; Scoliosis remains with hump on side of thoracic convexity.

Indication—Pathology, altered morphology, subluxation.

*Adson’s*

Description—While the patient is sitting palpate the radial pulse while the patient’s neck is rotated to the affected side, elevating the chin and holding the breath for 10–15 seconds.

Significance—Positive; Pain, paresthesia, decreased pulse.

Indication—Scalenus anticus syndrome, cervical rib, compression of brachial plexus, subluxation.
Allis

Description-Patient is supine with knees flexed to 90 degrees and toes kept level and equidistant caudally.

Significance-Disparity in knee height in cephalad-caudal plane indicates a short tibia. Disparity in lateral plane indicates short femur.

Indication-True short leg.

Anal Reflex

Description-Contraction of external anal sphincter, on stimulation of perineal skin.

Significance-Positive; No contraction

Indication-Lower motor neuron disorder; S2, S3, S4.

Ankle Clonus

Description-While the patient is supine the practitioner vigorously dorsiflexes the patient’s ankle, then holds it in dorsiflexion.

Significance-Positive; Repeated, rapid, involuntary dorsiflexion of the ankle.

Indication-Upper motor neuron disorder; Central nervous system disease.

Apley’s Compression

Description-Patient prone, with knee at 90 degrees flexion. Compression is applied to the plantar surface of the foot. The tibia is internally then externally rotated on the femur.

Significance-Positive; If pain is experienced on the medial aspect of the knee with external rotation, or lateral pain with internal rotation.

Indication-Medial or lateral Meniscus respectively.

Apley’s Distraction

Description-Patient as above with practitioner’s knee resting on patient’s posterior thigh to hold femur to couch. Foot distracted and rotated on the femur.

Significance-Positive; If pain is experienced on the medial aspect of the knee with external rotation, or lateral pain with internal rotation.

Indication-Medial or lateral coronary ligaments. NOT meniscus.

Babinski Foot Sign

Description-While the patient is supine, stroke the lateral aspect of the plantar surface of the patient’s foot from the heel to the big toe.

Significance-Positive; Extension of the large toe and flaring of the small toe.

Indication-Upper motor neuron disorder from central nervous system disease.

Babinski Pronation Sign

Description-Patient has eyes closed while sitting, arms elevated and forearm’s supinated. Tap hands three times from underneath.

Significance-Positive; One or both hands pronate on downward movement.

Indication-Upper motor neuron disorder.

Beevor’s Sign

Description-Patient sits up from a supine position.

Significance-Positive; When the naval deviates to one side.

Indication-Lower motor neuron disorder, T10-T12.

Bowstring Sign

Description-S.L.R. test is performed until pain is reproduced. Flex the knee and rest the lower limb on practitioner’s shoulder. Place thumb in popliteal fossa over sciatic nerve. Apply firm pressure.

Significance-Positive; If the patient experiences pain in the back or down the leg.

Indication-Nerve root tension; Space occupying lesion; Nerve root compression.

Chaddock’s

Description-Stroke down the ulnar side of the patient’s forearm to the wrist.

Significance-Positive; Wrist flexion with flaring and extension of fingers.

Indication-Upper motor neuron disorder.

Compression Cervicals

Description-While the patient is sitting, apply downward pressure on the head.

Significance-Positive; Pain local or radiating.

Indication-Disc, Nerve root compression, Facet lesion, Arthritis, Adhesions, Altered morphology, Subluxation.
Consensual Light Reflex
Description-Shine light into one eye and wait for pupil of other eye to constrict.
Significance-Positive; If pupil of other eye fails to constrict.
Indication—Afferent II, Efferent III

Cough
Description-Patient holds breath and coughs.
Significance-Positive; Pain in the area of the space occupying lesion.
Indication-Disc, Space occupying lesion.

Cremasteric
Description-Superficially stroke medial aspect of thigh in a caudal direction.
Significance-Positive; If scrotum fails to elevate.
Indication-Lower motor neuron disorder.

De Kleyn’s
Description-Patient is supine, neck is extended and rotated and held in that position for 15–30 seconds.
Significance-Positive; Nystagmus, loss of balance, nausea.
Indication-Basilar insufficiency.

Eden’s
Description-While sitting the patient undergoes full active neck flexion with active shoulder depression and scapula approximation. Patient holds breath for 10–15 seconds.
Significance-Positive; Pain, paresthesia, decreased radial pulse.
Indication-Costoclavicular syndrome.

Fabere
Description-Patient lies supine with hip flexed, externally rotated and abducted to rest the lateral malleoli on the contralateral knee.
Significance-Positive; Pain in the hip.
Indication-Degenerative joint disease, Hip pathology, Subluxation.

Gaenslen’s
Description-The patient is supine. Flex one knee and hold it to the patient’s chest. Extend and drop the other leg over the side of the couch.

Significance-Positive; Pain in the sacroiliac region.
Indication-Sacroiliac lesion.

Glabellar Reflex
Description-Rapidly tap the supraorbital ridge several times.
Significance-Positive; The patient continues to blink when the tapping ceases.
Indication-Upper motor neuron lesion, VII CN.

Gordon’s Squeeze
Description-Squeeze the patient’s calf.
Significance-Positive; Extension of the large toes, and flaring of the small toes.
Indication-Upper motor neuron lesion from central nervous system disease.

Gower’s Sign
Description-The patient is instructed to stand from prostrate to erect position.
Significance-Positive; When hands used step by step by pushing on legs as support.
Indication-Muscular dystrophy.

Hautant’s
Description-The sitting patient’s upper limbs are in an abducted forward position with both hands supinated. Eyes are closed, the neck is extended and rotated and held for 20–30 seconds.
Significance-Positive; If one or both arms drop into pronation.
Indication-Basilar insufficiency.

Hoffman’s
Description-While the patient is sitting, the practitioner holds the patient’s hand, which is supinated. The practitioner flicks the distal phalans of the index finger into flexion.
Significance-Positive; Clawing of fingers and thumb.
Indication-Upper motor neuron disorder, Stroke, Parkinsonism.

Homan’s
Description-Patient lies supine. The practitioner applies;
1. Forced dorsiflexion of the patient’s foot.
2. Thumb pressure between medial and lateral gastrocnemius muscle.
Significance-Positive; Pain.
Indication-Deep Venous Thrombus (when accompanied by edema, heat). Subluxation of the tibio-fibula proximal joint.

Hoover’s Sign
Description-1. Place palms under the patient’s heels and ask the patient to press down. 2. The palm under the normal leg is placed on the dorsum of the foot and the patient is asked to lift that leg.
Significance-Positive; 1. Relatively little pressure is felt under the paralyzed leg in both tests (true organic paralysis as in hemiplegia). 2. Increased downward pressure is felt in the paralyzed leg as the normal leg is raised (Hysterical paralysis).
Indication-Upper motor neuron disorder.

Kemp’s
Description-While the patient is standing, the lumbar spine is hyperextended in a posterolateral direction both left and right.
Significance-Positive; Gives pain in either the low back, buttocks or legs.
Indication-Disc; Synovial entrapment, Subluxation, Facet imbrication.

Lasegue’s Rebound
Description-While lowering the patient’s leg from a positive SLR, allow the limb to drop, forcing the patient to initiate a sudden active, instead of passive, limb lowering.
Significance-Positive; Causes a marked increase in pain.
Indication-Disc suspected.

L’Hermitte’s Sign
Description-Soto Hall test in which a patient develops a sudden transient electric shock into the upper and lower extremities.
Indication-Spinal cord injuries, Cord degeneration, Multiple sclerosis.

Light Reflexes
Description-Shine light directly into one eye and wait for reflex.
Significance-Positive; If pupil fails to constrict.
Indication-Afferent II, Efferent III, Cortex, mid brain.

Lindner’s
Description-While the patient is supine, the occiput is held and used as a lever to forcefully flex the neck, cervico-thoracic spine and upper thoracics. The patient is stabilized with the practitioner’s caudal hand on the lower costo-sternal junction. The trunk is rounded into a large C shape curve.
Significance-Positive; If radicular pain is reproduced.
Indication-Space occupying lesion, Nerve root compression, Disc, Subluxation, Dural lesions, Fracture.

Maigne’s
Description-The patient is sitting with the neck held in extension and contralateral rotation for 30 seconds on each side.
Significance-Positive; Nystagmus, loss of balance, nausea.
Indication-Basilar ischemia.

Mennell’s
Description-1. The patient lies in the lateral decubitus position, with the inferior leg straight. The practitioner stands behind the patient and pulls the superior leg into forced hip extension with the caudal hand while the sacroiliac joint is stabilized with the cephalad hand. 2. Repeat the above procedure while the knee of the inferior leg is held to the chest.
Significance-Positive; 1. Pain in the sacroiliac joint, or lumbar spine. 2. Pain in the sacroiliac spine.
Indication-Sacroiliac joint or lumbar spine subluxation.

Minor’s
Description-Patient rises from sitting position.
Significance-Positive; When the patient’s weight is supported on the uninvolved side by placing the hand on the knee. The other hand is placed on the back on the involved side, while the hip joint is extended.
Indication-Sacroiliac subluxation, Disc, Fracture.

Oppenheim’s Stroke
Description-The practitioner strokes the medial aspect of the patient’s tibia.
Significance-Positive; Gives extension of the big toe and flaring of the small toes.
Indication-Upper motor neuron lesion from a central nervous system disease.

Patella Clonus
Description-With the patient’s leg in extension, the practitioner rapidly and repeatedly pushes the patella distally.
Significance-Positive; Rapid involuntary contractions of the quadriceps giving rise to proximal distal movements of the patella when the stimulus ceases.

Indication-Upper motor neuron disorder due to central nervous system disease.

Phalan's
Description-While in a seated position, the patient approximates the dorsal aspects of both wrists to create forced, passive wrist flexion with active finger movements.
Significance-Positive; Pain, paresthesia or numbness in the median nerve distribution.
Indication-Carpal tunnel syndrome.

Romberg's
Description-Patient stands with feet together. First with eyes open then with eyes closed.
Significance-Positive; When patient sways and cannot right him or herself or falls to one side when both eyes are closed.
Indication-Cerebellar disorder, Posterior column, Atherosclerosis, Subluxation.

Scapular Approximation
Description-1. Bilateral abduction of arm to 90 degrees with extension from abducted position to create scapula approximation. 2. Flex neck to maximum.
Significance-Positive; Gives interscapular pain radiating to the axilla.
Indication-Thoracic subluxation.

Schaffer's Squeeze
Description-Squeeze the Achilles tendon.
Significance-Positive; Gives extension of the big toe.
Indication-Upper motor neuron disorder from a CNS disease.

Sign of the Buttock
Description-While the patient is supine, the hip is fully flexed while the knee is flexed. This is repeated with the knee extended (S.L.R.).
Significance-Positive; Gives pain when the knee is extended and pain when the knee is flexed.
Indication-Buttock lesion.

S.L.R. with Braggard's
Description-S.L.R. with forced dorsiflexion of the foot, at the leg position just below the level that elicits pain.
Significance-Positive; Gives an increase in pain.
Indication-Nerve root tension.

S.L.R. with External Rotation
Description-S.L.R. with external rotation of the femur. Externally rotate the femur at the level of onset of pain with a normal S.L.R.
Significance-Positive; If there is a decrease in the level of sciatic pain.
Indication-Piriformis syndrome.

S.L.R. with Kernig's
Description-S.L.R. with neck flexion. Flex the patient's neck at the leg position just before the onset of pain with a normal S.L.R.
Significance-Positive; Gives an increase in pain.
Indication-Space occupying lesion.

S.L.R. (Lasègue's)
Description-Supine: The patient raises an extended leg and bears the full weight of the limb. Hold the heel and maintain extension of the knee.
Significance-Positive; Gives pain in the back. Pain can be experienced in the buttock, hip or posterior thigh.
Indication-Sciatica; lumbosacral lesion; disc disease; spondylolisthesis; adhesions; intervertebral foraminal occlusion; subluxation.

Snout Reflex
Description-The practitioner gives a sharp tap to the patient's upper lip.
Significance-Positive; Gives a pouting of the lips.
Indication-Upper motor neuron lesion (C.N. VII).

Soto Hall
Description-While the patient is supine, the head and neck is passively flexed by the practitioner's cephalad hand. Flexion of the thoracic spine is prevented by the practitioner's caudal hand creating a slight downward pressure on the patient's sternum.
Significance-Positive, if pain occurs.
Indication-Fracture; disc disease; sprain; strain; subluxation.
Tandem Gait
Description-The patient is instructed to walk heel to toe, both forward and backward directions. The gait is observed for abnormality.
Significance-Positive; Abnormal balance
Indication-Cerebellar disease; posterior column; atherosclerosis; multiple sclerosis; CNS tumor; subluxation.

Trendelenberg
Description-The patient stands on one leg while the other leg is flexed at both the hip and knee to ninety degrees.
Significance-Positive; If the hip on the raised leg side drops lower than the standing leg side.
Indication-Hip disease; Gluteus medius weak on the weight-bearing leg.

Trommer's
Description-While the patient is sitting, the practitioner gives a sharp upward tap to the supinated middle finger and ring finger.
Significance-Positive; Finger flexion occurs.
Indication-Possible upper motor neuron disorder.

Underburger's
Description-The patient is instructed to march on the spot with both arms outstretched, eyes closed, and the head extended and rotated.
Significance-Positive; Loss of balance.
Indication-Basilar ischemia.

Valsalva
Description-The patient is instructed to hold their breath and bear down. This increases the pressure in the spinal canal, shunt-
ing the blood back to the paraspinal plexus, increasing the pressure near the space occupying lesion.
Significance-Positive; Gives pain in the area of the space occupying lesion.
Indication-Disc disease or other space occupying lesion.

Vertebral Artery Occlusion
Description-The patient lies supine with the neck in extension, rotation and lateral flexion.
Significance-Positive; If the patient turns pale, becomes dizzy, nauseated or suffers blurred vision within thirty seconds.
Indication-Basilar insufficiency.

Well Leg Raise
Description-S.L.R. with foot dorsiflexion on the asymptomatic side of a sciatic patient.
Significance-Positive; Reproduces pain on the symptomatic side.
Indication-Disc syndrome; space occupying lesion; sciatic nerve root involvement.

Wright's
Description-While the patient is sitting, abduct their arm above the head. Palpate the radial pulse through the arc of 180 degrees.
Significance-Positive; Decrease or obliteration of radial pulse.
Indication-Pectoralis minor involvement.

Wrist Clonus
Description-The practitioner vigorously applies quick, repeated extensions of the patient's wrist, then holds it in extension.
Significance-Positive; repeated, rapid, involuntary flexion/extension of the wrist.
Indication-Upper motor neuron lesion.
Since their contemporaneous discoveries in 1895, chiropractic and roentgenology have been linked in many of their technologic and applied advances (1,2). With the use of plain film radiography, chiropractic examination procedures changed from reliance solely on symptomatology and palpatory findings to include viewing of representations of underlying spinal and soft tissues. This new found ability advanced the science and art of chiropractic serving as an important tool in evaluating various clinical and theoretical approaches.

In 1932, Sauesser, a chiropractor, took the first 14" × 36" anterior-to-posterior (AP) full spine radiograph. He later produced a 20" × 72" full body film in 1935 (3,4). The first X-ray machine west of the Mississippi was brought to Davenport, Iowa by B.J. Palmer in September of 1910. His X-ray research at the Palmer Research Center used thousands of patients and concluded that 64% of palpatory findings were in error, when compared to radiographic discoveries (5).

Gonstead (6) furthered the use of x-ray by developing a system of marking and analyzing the spine and pelvis for biomechanical misalignments. This system depends on strict patient positioning (7–9).

Today’s chiropractors use radiographs to evaluate the acceptability of a patient for chiropractic care, uncover contraindications to chiropractic treatment, discover information that will alter the type, frequency, or force of treatment, assess the kinesiopathologic components of the vertebral subluxation complex and provide a teaching tool for patient education (Fig. 5.1).

Many texts (2,10) adequately cover the study and detection of those conditions that require allopathic intervention or alter the preferred biomechanical treatment. The purpose of this chapter is not intended to duplicate previous work, but instead to focus on the evaluation of the kinesiopathologic components of the vertebral subluxation complex through the appropriate use of plain film radiography.

Kinesiopathologies of the subluxation complex include positional dyskinesia, fixation dysfunction, hypermobility, instability, and changes in the axis of motion (11). As previously discussed (See Chapter 3), kinesiopathologic findings are only one component of the vertebral subluxation complex. The primary function of the doctor of chiropractic is the location and treatment of these biomechanical irregularities and their subsequent manifestations. It is imperative that examinations be performed with the highest degree of accuracy. The chiropractor should use all the readily available tools of inquiry to gain the most cost effective information to best evaluate each case.

When the findings of the history and physical examination indicate a need for an evaluation of the integrity and interrelationships of spinal structures, a roentgenologic examination should be performed.

The plain film radiograph is still the procedure of choice, in both time and cost effectiveness, for examinations of the skeleton (2). This is especially true when the diagnostic inquiry calls for a biomechanical analysis.

**Risks of Ionizing Radiation**

The relative risks of ionizing radiation must be considered whenever selecting the appropriate views for each radiographic examination. It has been well documented that there are potential negative biologic effects of human exposure to ionizing radiation (1,12). Because the biologic consequences of irradiation are cumulative, it is important to consider the risks and make every reasonable attempt to minimize exposure without sacrificing the quality of information obtained (1).

Biologic effects are both dosage and tissue dependent. The radiosensitivity of different tissues necessitates safety standards during a radiographic examination. Tissues that are more differentiated, more mature, and less likely to divide are less radiosensitive than those that are primitive, nondifferentiated, and more likely to divide. The biologic effects of radiation can be divided into two categories: somatic and genetic.

**SOMATIC**

Somatic effects can be subdivided into two groups, local and general. Local injuries were more common early in the study of diagnostic x-rays as experimentation using multiple exposures on various body parts were performed. The frequency of these injuries was reduced as proper usage of radiographic equipment became the norm (2).

Few general effects of exposure have been docu-