In 1993, the US Supreme Court directed federal judges to examine the method or reasoning underlying the admission of expert evidence and to admit only evidence that was reliable and relevant (Daubert v. Merrell Dow Pharmaceuticals, Inc.). Daubert set forth a non-exclusive checklist for courts to use in assessing the reliability of scientific expert testimony. The effect of this decision was that judges presiding over technically complicated cases have assumed a new gatekeeping function, screening expert evidence to ensure that what was admitted was both relevant and reliable. Below are points concerning the admissibility of fluoroscopy whether the court adheres to Daubert, Frye, or state standards.

**Question 1:** **Whether x-ray and fluoroscopy have been generally accepted.**

Since 1897, fluoroscopy and x-ray have been widely accepted in the field of radiology and are today considered a standard part of healthcare. Fluoroscopy is nothing more than many X-ray images put together to make a video. Advancements in radiology have allowed for instant imaging and reduced patient exposure to radiation.

A fluoroscopic system consists of an x-ray machine capable of operating at low (1/4 to 5) milliamperage settings, an x-ray tube assembly, an image intensifier tube, a camera, a VCR, DVD recorder or hard drive, and a monitor. The image intensifier is used instead of intensifying screens and film as an image receptor, this permits imaging at very low radiation exposure to the patient.

A static x-ray is analogous to a picture taken with a film loaded camera, you have to develop the film and the image quality is variable. A digital x-ray is comparable to using a digital camera, there is better picture quality and the image can be seen instantly. A digital motion x-ray or fluoroscopy is analogous to using a camcorder, the picture is viewed instantly and a video is taken instead of a still picture.

Fluoroscopy is also known as videofluoroscopy, cineradiography, c-arm, fluorovideo and most recently as dynamic motion x-ray (DMX). Fluoroscopy is a form of low dose x-ray which is recorded like a video. In the early days the recording medium used was movie film, thus it was termed cineradiography. With the advances in video capture and storage the term video fluoroscopy has become popular. Regardless of what you call it, fluoroscopy is nothing more than many x-rays put together to make a video. The doctor uses a switch to control an x-ray beam that is transmitted through the patient. The X-rays then strike a fluorescent plate that is coupled to an "image intensifier" that is (in turn) coupled to a television camera. The doctor can then watch the images in motion "live" on a TV monitor.

Today, virtually every hospital in the United States owns, uses or relies on studies produced by fluoroscopy on a daily basis. Structure and function are studied for pathology in various body systems. Fluoroscopy is used during kidney stone manipulation, the pinning of a broken hip, general surgery, abdominal surgery, urology, neurosurgery, discography, orthopedic surgery, gastrointestinal procedures, pain management, vascular, and neurovascular studies. Gastroenterologist study the mobility of upper and lower gastrointestinal tract. Cardiologist study blood flow and use fluoroscopy during surgery. Pain specialist use fluoroscopy during invasive injection techniques such as spinal facet blocks. Orthopedic surgeons use the technology during surgical procedures to determine if joint replacements are installed and are functioning properly. Discography, angiography and barium contrast studies are special applications of x-ray imaging, where an x-ray video camera allows the imaging of structures in motion or augmented with a contrast agent. Chemicals are injected, swallowed or otherwise administered into the body of the patient to help delineate certain parts of the body such as the blood vessels, disc material and the gastrointestinal tract. These contrast materials, which strongly absorb X-ray radiation, also help to demonstrate dynamic processes, such as the motion of the digestive tract. GE and Ziehm are two of the largest makers of fluoroscopy equipment.

Fluoroscopy is based upon sound and accepted scientific principles established over 100 years ago. Fluoroscopic evaluation of the cervical spine is referenced to in Pain Management. A Practical Guide for Clinicians, Sixth Edition, written by The American Academy of Pain Management, a division of the American Medical Association, pages 395-396, “Plain radiographs are of limited diagnostic value in painful pathology of the connective tissue... Videofluoroscopy or digital motion radiography is currently a valuable diagnostic method in evaluating painful hypermobility and instability due to posttraumatic and degenerative pathology of capsular and axial ligaments.”. The Council on Chiropractic Guidelines and Practice Parameters, International Chiropractors Association, and American Chiropractic Association each have guidelines accepting the use of cervical fluoroscopy. The Florida Supreme Court has recognized that fluoroscopy is generally accepted in the medical community to diagnose injuries in the cervical spine since their opinion published in 1976 in the Hughes case, (Hughes v. Denny's Restaurant, 328 So. 2d 830).
Question 2:  The relationship between fluoroscopy and more established techniques.

"In fluoroscopy, the same physical principals apply as in radiography, except that the images are displayed on a TV screen instead of films." The Adult Spine Principles and Practice, second edition, page 417, volume 1, published by Lippincott- Raven 1997, editor-in-chief John W Frymyer, MD.

A German physicist named Wilhelm Roentgen discovered X-rays in 1895, for this discovery he would later receive the 1901 Nobel Prize in Physics. In 1895 Roentgen began experiments at the University of Würzburg with an electric current flow in a partially evacuated glass tube (known as a cathode-ray tube). He noticed that whenever the tube was in operation, a piece of barium platinocyanide in line with it gave off light. He theorized that the interaction of electrons striking the tube's glass wall formed an unknown radiation that caused the fluorescence. He called this phenomenon X radiation, or X-rays. Further experiments revealed that X radiation produces an image on photographic plates and penetrates many materials such as paper, wood, certain metals, and living tissue. Roentgen place his hand between an x-ray source and a fluorescent screen, and was shocked to see the bones of his hand on the screen. For the first time physicians had a nonsurgical tool to see inside the body. His achievement revolutionized the age of modern physics and transformed medical practice.

After the discovery of X-rays, one of the first imaging improvements was the fluoroscope. Shortly after Roentgen's discovery, Thomas Edison announced that calcium tungstate would fluoresce brighter than the original barium platinocyanide. One year later fluoroscopic screens became available, and the technique was employed for "real time", observation of human structures. Thomas Alva Edison, a master inventor, is credited with designing and developing the first commercially available fluoroscope. Fluoroscopy is a constant flow of x-ray that results in a moving picture. Electronic image intensification systems became readily available in the 1950’s. Using electronic image intensification, the fluoroscopic image is amplified, resulting in an improvement in image quality and a reduction in radiation levels.

Static X-rays
* Image must be developed before viewed.
* Films must be retaken if poor quality exists.
* If patient is not properly positioned films must be retaken.
* More x-rays will be taken if pathologies are found.
* Patient is still for one shot.
* Static observation of bony structure.

Motion X-rays
* See image instantly on monitor.
* Image quality can be instantly assessed and corrected.
* Patient positioning can be instantly assessed and corrected.
* Problem areas can be immediately focused on for further evaluation.
* Patient is moving and many frames are taken (2700 for 90 seconds).
* Fluoroscopy evaluates the structure and function of the cervical spine.

Planes of motion for fluoroscopic evaluation of the cervical spine:
- **Lateral** - neutral, flexion, extension, and the lateral upper cervical nodding.
- **Anterior to posterior** - neutral, right lateral flexion, left lateral flexion, right rotation and left rotation.
- **Anterior to posterior open mouth** - neutral, right lateral flexion, and left lateral flexion.
- **Oblique** - right neutral, right flexion, right extension, left neutral, left flexion and left extension.

With fluoroscopy, the cervical spine can be evaluated in all aspects of motion, not just the end ranges. If a static x-ray machine was to try and obtain only the basic information, only at the end ranges of motion 18 separate static films would need be taken. This basic evaluation would miss many important aspects of cervical range of motion and expose the patient to unnecessary radiation. At 30 frames per second for 90 seconds over 2700 static x-rays would be needed to produce a 90 second video. When the x-ray beam stops the tape is still recording which allows the
doctor to change contrast, time to observe the image, better position the patient, or zoom in on the image with no additional radiation exposure to the patient. In practice it is not uncommon for 1 to 2 minutes of x-ray exposure to result in a 10 minutes of video.

Question 3: Whether there has been peer review of fluoroscopy.

A) Pain Management, A Practical Guide for Clinicians, Sixth Edition written by the American Academy of Pain Management, a division of the American Medical Association. Pages, 395-396. Which states,"Plain radiographs are of limited diagnostic value in painful pathology of the connective tissue..... Videofluoroscopy or digital motion radiography is currently a valuable diagnostic method in evaluating painful hypermobility and instability due to posttraumatic and degenerative pathology of capsular and axial ligaments. Evaluation of certain axial and peripheral joints in motion affords a noninvasive opportunity to identify specific segments responsible for nociception. At the upper cervical levels, this technology is capable of identifying excessive motions at atlanto occipital, lateral and median atlantao axial joints, and indirectly, pathology, of their respective fibrous articular capsules and periarticular ligaments. Capsule-related pathology with hypo- and hypermobility can be identified and documented in caudally situated cervical zygapophyseal articulations. The integrity of the posterior ligamentous complex contributing to listhesis-related pathology can be documented. Small avulsion fractures of articular pillars as well as vertebral bodies or spinous processes can be identified. The pathology of TMJs is visualized and correlated with audio/video captioning. Painful instability of peripheral joints such as shoulder, elbows, wrists, knees, and ankles has also been identified and documented (Antos, et al., 1990; Buonocore, et al., 1996; Fielding, 1957, 1963; Jones, 1967; Tacharski, et al., 1981). Such studies must be performed with high-quality digitized equipment by well trained technologists to produce film quality contrast resolution and to be diagnostic value, as currently available from VF Works, Inc. Combined with computerized range of motion studies, this technology may afford the opportunity to objectively document progress after RIT/prolotherapy, or other procedures directed toward the stabilization of axial and peripheral articulations such as facets, shoulders, knees and TMJs.."


Videofluoroscopy
Sub-Recommendation

Videofluoroscopy may be employed to provide motion views of the spine when abnormal motion patterns are clinically suspected. Videofluoroscopy may be valuable in detecting and characterizing spinal kinesiopathology associated with vertebral subluxation.

Rating: Established (Accepted as appropriate for use in chiropractic practice for the indications and applications stated.)

Dr. Christopher J. Connelly 770-469-7330 Atlanta Spine and Motion X-ray Center
Evidence: E, L
(E: Expert opinion based on clinical experience, basic science rationale, and/or individual case studies. Where appropriate, this category includes legal opinions.)
(L: Literature support in the form of reliability and validity studies, observational studies, "pre-post" studies, and/or multiple case studies. Where appropriate, this category includes case law.)

D) International Chiropractic Association Committee on Chiropractic Practice Guidelines and Protocols, Chapter 15 page 299 www.chiropractic.org/guidelines

15.1.1. Rating: Strong Positive Recommendation
Strength: I, L
Videofluoroscopy

The first known fluoroscopic image was produced by Roentgen in 1895. Roentgen placed his hand between an x-ray source and a fluorescent screen, and was astonished to see an image of the bones of his hand on the screen. One year later fluoroscopic screens became available, and the technique was employed for ‘real time’, observation of human structures. In the 1950’s, electronic image intensification systems became readily available. Using electronic image intensification, the fluoroscopic image is amplified, resulting in an improvement in image quality and a reduction in radiation levels. When the image is recorded on motion picture film, the procedure is termed cineradiography. If a video recording is made, the term videofluoroscopy is employed.

In chiropractic, a leading pioneer in spinal fluoroscopy was Earl Rich. Fred Illi employed the technique in studying spinal biomechanics. Joseph Howe conducted fluoroscopic studies of the spine, and reported instances where the technique revealed abnormalities not demonstrated on plain films. Current chiropractic interest in fluoroscopy is evidenced by the formation of the Joint Motion Study Research Society, and the offering of certificate courses in videofluoroscopy by CCE accredited chiropractic colleges.

TECHNIQUE
A videofluoroscopic system consists of an x-ray generator capable of operating at low (1/4 to 5) milliamperage settings, an x-ray tube assembly, an image intensifier tube, a television camera, a VCR, and a monitor. The heart of the system is the image intensifier tube. This tube permits imaging at very low radiation levels. It is used instead of intensifying screens and film as an image receptor. An image intensifier tube consists of four key components in an evacuated glass envelope:
1. Input phosphor and photocathode. The input phosphor is similar to the intensifying screen used in conventional radiography. It emits light when energized by x-rays. When light from this screen strikes the photocathode, electrons are emitted.
2. Electrostatic focusing lens. A series of electrically charged plates focus the electron beam as it flows toward the output phosphor.
3. Accelerating anode. This positively charged electrode is located in the neck of the tube. It accelerates the electrons toward the output screen.
4. Output phosphor. The output phosphor produces light when energized by electrons. It is coupled to a television camera. The signal from the video camera is fed to a monitor and VCR, where it can be observed and recorded.

CLINICAL APPLICATIONS
In considering the use of any examination employing ionizing radiation, the clinician should ask:
1. Does the potential yield of information justify the exposure?
2. Will the outcome of the study affect the care or management of the case?
3. Are less hazardous, equally reliable techniques available?

Several authors have addressed these issues. Observational and case studies have appeared in the literature.
comparing the diagnostic yield of fluoroscopic studies vs. plain films. In addition, studies have been published reporting abnormalities detected by fluoroscopy which could not be appreciated on plain films.

Bland states, "Clearly, cineradiography is the best method for the study of biomechanics and dynamics of motion in the cervical spine. . .The determination of normal motion, sites of greatest and least motion, contribution by joints, discs, ligaments, tendons, and muscles to motion (and their limitations), and the biomechanics of normal motion of the occiput-atlas-axis complex all have been studied very successfully through cineradiography."

According to Ochs, "Cineradiography, using film or videotape, is shown in a study of 34 painful or injured necks to be a valuable clinical tool. It is useful in fracture management, analysis of instability and demonstration of solid healing. A video tape system featuring instant replay, clear image and low radiation exposure was found to be ideal for routine use."

Buonocare, Hartman, and Nelson examined the cervical spines of 107 patients using cineradiography, including 57 who sustained flexion-extension injuries. They concluded, "The ability to demonstrate localized abnormal motion in the cervical spine allows one to predict soft-tissue injuries and the quality of spinal fusions, spinal stability, and early subluxation of the cervical spine-conditions that may not be identified on static roentgenograms nor at physical examination."

Jones studied abnormalities of the upper cervical spine using cineradiography, and concluded,"Cineradiography has been used to detect instability not ascertainable by routine roentgenograms obtained in flexion and extension....." In a case study of abnormal atlanto-axial motion, Tasharski noted, "Interpretation by means of standard static radiographs failed to disclose the nature of the functional post-traumatic disorder. Cinefluorographic visualization of the articulation in motion demonstrated abnormal mobility."

Woesner and Mitts also concluded that fluoroscopic studies often revealed abnormalities undetected on plain films. They stated, "There were, however, a significant number of instances in which cinerointentgenography demonstrated abnormal motion not detected on conventional roentgenograms. Cinerointentgenography is, therefore, a valuable adjunctive technique and its continued utilization in the analysis of cervical spine motion is justified."

Numerous applications for spinal fluoroscopy have been reported in the medical literature. These include recording the effects of cervical spine traction, evaluating cervical spine stenosis, laminectomies, examining athletes presenting with pain, to assist in surgical planning, evaluating atlanto-axial rotatory fixation, examining the effects of cervical collars, characterizing joint disorders in the cervical spine, studying degenerative disease of the cervical spine, and determining the effects of occipitalization and odontoid hypoplasia on spinal motion.

In addition to the studies cited, applications for fluoroscopy in chiropractic have been reported in chiropractic trade publications, indexed peer reviewed literature, and presented at chiropractic symposia. Gillet, Henderson, Dorman and Howe used fluoroscopy to study cervical spine kinetics. Shippel and Robinson described a case where fluoroscopy and magnetic resonance imaging were used to evaluate cervical spine instability. Leung used fluoroscopy to evaluate the cervical spine and concluded, "Cineradiography has been found to be the method of examination that conveys most functional abnormalities. The diagnostic value of cineradiography is substantiated. The effect of chiropractic adjustment in removal of cervical fixations was proven with cineradiography."

Chiropractors Foreman and Croft in their textbook Whiplash Injuries state, "This motion study of the spine may be quite useful in detecting abnormal biomechanics secondary to ligamentous damage that may be unappreciated with plain film radiography. Cineradiography or fluorovideoradiography plays an important role in the diagnosis of aberrant spinal biomechanics that may be secondary to chronic muscle contracture, scar tissue formation, or ligamentous instability."

Antos, Robinson, Keating and Jacobs presented the results of an interexaminer reliability study of cinefluoroscopic detection of fixation in the mid-cervical spine. Two examiners reviewed fifty videotapes of fluoroscopic examinations of the cervical spine. The examiners achieved 84% agreement for the presence of fixation, 96% agreement for the
absence of fixation, and 93% total agreement. The Kappa value was .80 (p<.0001). Only the C4/C5 level was examined. The authors concluded, “The current data indicate that VF determination of fixation in the cervical spine is a reliable procedure.”

Other chiropractic authors have described applications for fluoroscopy. Taylor and Skippings used the procedure to study paradoxical motion of the atlas in flexion. Betge described applications for fluoroscopy in the analysis of dysfunctions of the cervical spine. Masters and Mertz both used fluoroscopy to evaluate spinal motion. Robinson and Sweat have also published articles concerning chiropractic applications for fluoroscopy.

In addition to patient evaluation studies, fluoroscopy has also been used to study normal motion in the spine. Bronfort and Jochumsen used cineradiography to evaluate intermediate stages and extremes of intervertebral motion in the lumbar spine. Fielding and Howe described normal motion of the cervical spine based on cineradiographic examinations.

Persons critical of the use of videofluoroscopy to evaluate joint motion, particularly in the cervical spine, appear to be applying a more burdensome standard than that required of other imaging techniques. It is suggested that such critics consider the following:

Videofluoroscopy is not a new procedure. Fluoroscopic studies of the spine have been reported in the medical literature for several decades. Numerous observational and case studies have been published in indexed peer reviewed journals. At least one chiropractic study concluded that fluoroscopy was a reliable technique for evaluating fixation in the mid-cervical spine. Many investigators have reported that fluoroscopic studies revealed abnormalities (some potentially lethal) that could not be appreciated on plain films.

An evaluation of diagnostic procedures for spinal disorders published in Spine concluded that cineradiology’s usefulness - in conditions where radicular compression was presumed, spinal stenosis was confirmed, and in symptomatic post-surgical patients, has been demonstrated in non-randomized controlled trials. The same report noted that it was common practice to use the technique in cases of localized spinal pain and pain radiating to an extremity. Diagnostic imaging is by its very nature an “observational” procedure requiring a skilled examiner to interpret the findings.

Imaging studies are one part of the data set used by a clinician to make a diagnosis and formulate a care plan. The findings of any imaging study must be integrated with the history, physical, and laboratory findings in a given case. Thus the claim that fluoroscopy is not “...a diagnostic entity unto itself” could be applied to any imaging technique.

THE ISSUE OF RADIATION EXPOSURE
Critics of videofluoroscopy frequently express concern for the radiation exposure produced by the procedure. According to Robinson, 60 seconds of videofluoroscopy is equivalent to 2 to 7 plain films. Pierce states that videofluoroscopy of the cervical spine can be performed at 1/4 MA. This would result in radiation levels even lower than those reported by Robinson. Howe states that “The radiation dose to the patient is not significantly higher than that incurred in plain film studies.” The issue of radiation exposure is clouded by authors claiming that fluoroscopy is “…a functional study only…” and that “…it is quite possible to miss subtle pathology.” The assumption is made that a full complement of plain films will be taken in addition to the fluoroscopic study. If, however, up to 60 seconds of low milliamperage fluoroscopy is substituted for the static flexion/extension views normally taken in a Davis series, the radiation burden to the patient will be roughly equivalent, and the potential diagnostic yield far greater. Even if fluoroscopy is used in addition to a full Davis series, the diagnostic yield may justify the exposure in cases where the plain films fail to demonstrate an abnormality which is suspected clinically.

INDICATIONS FOR VIDEOFLUOROSCOPY
Any technique involving exposure to ionizing radiation should be used judiciously. Several authors have suggested indications for videofluoroscopic studies. They include:

1. Flexion-extension injuries
2. Direct injury
3. Postoperative evaluation
4. Assessment of hypermobility associated with subluxation when such information cannot be obtained by other more cost-effective means
5. Suspected ligamentous instability
6. Presumed radicular compression
7. Spinal stenosis
8. Scoliosis, structural and functional curvature evaluation.

TECHNICAL CONSIDERATIONS, For chiropractors employing videofluoroscopy:
1. Fluoroscopic studies should not be routinely employed. The decision to order a fluoroscopic study should be based on demonstrated clinical need.
2. All fluoroscopy should be performed with electronic image intensification.
3. The beam should be collimated to the smallest possible size which will demonstrate the area of clinical interest.
4. Gonad shielding should be employed when it will not obliterate the structures under examination.
5. The fluoroscopic image should be recorded on videotape or other appropriate medium to enable the chiropractor to review the study without requiring excessive repetition of a given movement.
6. "Beam on" time should be kept to the minimum necessary to characterize the abnormality. Chiropractors performing videofluoroscopic studies should have training in fluoroscopic technique and interpretation.

Technical Considerations
1. Machine selection: General guidelines provide for the use of recently manufactured equipment which is capable of low dose image acquisition.
2. Factor selection: Optimum factors should be selected as per manufacturer's specifications.
3. Shielding: General guidelines provide for the use of shielding to eliminate patient dose over radiosensitive areas outside of the area in interest.

Analysis
Stress study similarity: Although similar to the analysis of plain film stress studies, which are generally taught in the chiropractic curriculum, the interpretation of videofluoroscopy should be done by a doctor trained in the specific analysis of this type of study.

Series
1. Adjunctive procedure: Videofluoroscopy should be used as an adjunctive procedure to plain film studies, and not as a replacement for those studies.
2. Repeat studies: Due to the dangers inherent in radiation exposure, repeat studies should only be used as clinically required.


Stress Radiography
Stress views are often of value in the assessment of degenerative, traumatic or post-surgical instabilities with the exception of those that carry the risk of neurologic injury. They provide unique diagnostic information.
Rating: Established
Evidence: Class I, II, III
Consensus Level: 1

I. Videofluoroscopy (cinefluoroscopy)
For kinematic and other biomechanical purposes.
Rating: Promising
Evidence: Class II, III
Consensus Level: 1

Class II: Evidence provided by one or more well-designed uncontrolled, observational clinical studies such as case control, cohort studies, etc.; or clinically relevant basic science studies that address reliability, validity, positive predictive value, discriminability, sensitivity and specificity; and published in refereed journals.

Class III: Evidence provided by expert opinion, descriptive studies or case reports.

F) **International Chiropractic Association Policy Statement on Videofluoroscopy page 43**

*Definition*: Videofluoroscopy, Dynamic Spinal Visualization or Cineradiography is the specific, chiropractic, radiographic procedure, study, and interpretation of the dynamics and kinetic properties of the spinal column and its immediate articulations.

The International Chiropractic Association officially recognizes videofluoroscopy to be an acceptable part of chiropractic care for the Doctor of Chiropractic who is trained in this procedure.

**Question 4:** Whether there are standards for the application of fluoroscopy.

**Protocol For the Use of Spinal Videofluoroscopy**, published by American Chiropractic College of Radiology. The American Chiropractic College of Radiology (ACCR) and the council on Diagnostic Imaging’s (CDI) committee on Scientific Affairs have determined that the utilization of Videofluoroscopy is a useful imaging modality for the demonstration of spinal intersegmental joint dysfunction.

The guideline and standards recommended herein presuppose that an appropriate patient history, clinical examination, plain film radiographs and additional diagnostic modalities have been performed to exclude pathology.

**Radiographic Signs of Intersegmental Joint Dysfunction:**
The following signs may be helpful in the selection of patients for Spinal Videofluoroscopy in those cases with persistent signs and symptoms following an appropriate conservative management (12 weeks):

a. hypermobility  
b. hypomobility  
c. aberrant motion  
d. instability  
e. aberrant coupling  
f. paradoxical motion  
g. evaluation of spinal arthrodesis

**Contraindications:**

1. Sufficient information regarding the intersegmental joint dysfunction has been obtained by other diagnostic procedures to establish appropriate case management.
2. Pregnancy.
3. Instances where motion is detrimental to the patient’s well being:
   a. recent fractures  
   b. dislocation  
   c. pathological processes that weaken restraining structures or osseous architecture.  
   d. severe neurological deficit  
4. Restrictive muscle spasm.
Relative Contraindications:

Patient’s inability to cooperate due to physical or mental impairment.

Caution and certain avoidances must nonetheless be observed with the use of Videofluoroscopy. Among these are those ill-adviced practices which include, but are not limited to the following:

1. Spinal Videofluoroscopy is never appropriate in clinical practice to visualize the spinal adjustment of manipulation, nor is it efficacious to employ Videofluoroscopy as a “pre and post” manipulation.
2. Spinal Videofluoroscopy must never be performed without videotaping of the procedure. This ensures accurate recording of pertinent information and time of exposure.
3. Spinal Videofluoroscopy serves only as an ancillary diagnostic imaging procedure.
4. Spinal Videofluoroscopy shall never be utilized as a replacement for static radiographic procedures.
5. Spinal Videofluoroscopy shall never be employed as a screening or cursory imagining device.

Question 5: Whether evidence of fluoroscopy has been admitted in other cases.

A recent case in the Colorado Court of Appeals examined the admissibility of this procedure when used by the chiropractic profession (Tran v. Hillburn, 21 Colorado Journal 545 Colo.App 1997. No 95 CA 1662). During the Tran v. Hillburn case, A fluoroscopy study demonstrating ligamentous injury was admitted over objection. After significant monetary award, the defendant appealed alleging the admissibility of fluoroscopy was in error.

The Colorado Court initially applied the Frye Test and then noted that the US Supreme Court favored the Federal standard (Daubert, Rule 702). The plaintiff offered the testimony of a chiropractic orthopedist who testified that fluoroscopy had been in use by chiropractors since 1910, that he knew of no better technique for diagnosing a torn ligament and that his office was the only chiropractic facility using the procedure. A second witness concurred with the chiropractic orthopedist. The defense brought a TMJ specialist, a orthopedic surgeon and a chiropractor. The defense experts essentially claimed that the procedure was not routinely used in their professions.

The appeals court ruled that despite conflicting evidence, there was support for the conclusion that fluoroscopy is accepted within the field of chiropractic and that any dispute between it and the medical profession goes to the weight, not the admissibility of evidence.

Other cases that support the admissibility of fluoroscopy:
Hughes v. Denny’s Restaurant, 328 So. 2d 830 (Fla. Supreme Court 1976)
The Florida Supreme Court has recognized fluoroscopy is generally accepted in the medical community to diagnose injuries in the cervical spine since their opinion published in 1976 in the Hughes case.
Cognata, et.al. v. Weishaupt, et.al., BC243305 (Ca. Los Angeles County Superior Court 2002)

Question 6: Whether fluoroscopy has been tested for reliability and rate of error.

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Just as with x-ray, the images produced by fluoroscopy are read by a radiologist and/or doctor. As seen from the references below there is a high degree of interexaminer reliability and agreement between examiners. Radiologist and/or doctors reading fluoroscopy studies should have advance studies in cervical fluoroscopy imagery.

The doctor or technician performing the fluoroscopy should also have special studies in patient positioning, what each view is observed for and the patients clinical history. A good patient work up before the fluoroscopy evaluation will increase reliability and reduce the rate of error. Clinical correlation is important for any positive findings.

**Council on Chiropractic Practice Clinical Practice Guidelines, 1998**
Reliability has been addressed in a number of studies. Additionally, in a study evaluating the interexaminer reliability of fluoroscopic detection of fixation in the mid-cervical spine, two examiners reviewed 50 videotapes of fluoroscopic examinations of the cervical spine. The examiners achieved 84 percent agreement for the presence of fixation, 96 percent agreement for the absence of fixation, and 93 percent total agreement. The Kappa value was .80 (p < .001). The authors concluded, “The current data indicate that VF determination of fixation in the cervical spine is a reliable procedure.”


**Question 7:** The existence of specialized literature dealing with fluoroscopy.

Findings from the fluoroscopy evaluation fit well with the Guides to the Evaluation of Permanent Impairment 5th Edition published by the AMA. There are four areas of spinal impairment or DRE categories that are important when assessing a patient when using fluoroscopy. This is discussed in greater detail in chapter 4.

A. DeCastro was the first to state that cineradiography provides a means of documenting fluoroscopic examinations and storing them for later reviews at real time, slow motion and freeze frame speeds. De Castro JM. Fundamental principles in the application of cineroentgenography as an auxiliary method to roentgen diagnosis. American J. Roentgen 1947;57:103-14


C. Jones was the first to apply cineradiography to investigations of cervical spine complaints following automobile accidents. He concluded the “cine” is of benefit in demonstrating with excessive or decreased mobility. Bard G. Jones MD. Cineradiographic analysis of laminectomy in the cervical spine. Archives of Surgery 1968;97:672-7

Cervical Spine Cineradiography After Traffic Accidents, published in Archives of Surgery, Volume 85, December 1962, by Dr. Malcom D. Jones, M.D.


D. Referring to fluoroscopy, This method revealed information not observable on static x-ray because motion occurred at various stages within the range, not at the end stage. Taylor M. Skipping R, Paradoxical Motion

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E. Skippel & Robinson advocated the use of videofluoroscopy for evaluation of hyperextension and hyperflexion injuries because they believe such motion study can most accurately assess soft tissue damage and ligamentous instability. The article also points out that one of the greatest advantages of using fluoroscopy is its ability to show the joint in motion throughout the entire range of motion. Skippel AH, Robinson GK. Radiological and magnetic resonance imaging of cervical spine instability: a case report. JPMPT 1987;10:316-22

F. Stanley Paris reached the conclusion that cineradiography is superior, stating that the static radiographs are not helpful in identifying instability because they cannot capture true motion. They also stated that what happens within the normal range of motion is “considerably more valuable because subjects normally function within the first 50% of their movement, rarely at the end of their range.” Paris SV, Physical signs of instability, SPINE 1985; 10:277-9

G. Video Fluoroscopy, or its equivalent, cineroentgenography for the analysis of spinal biomechanics and has been shown to be of value in clinical diagnosis. Robinson GK, Lantz C. Videofluoroscopy in Chiropractic Management of Cervical Syndromes. Journal of Chiropractic Research and Clinical Investigations; Vol. 6, Number 4 January 1991.


I. “The stability of the cervical spine depends on bony structures only to a minor degree; stability depends to a major degree on the ligamentous structures.” Bland describes in his text the superiority of cineradiography over all other imaging modalities in determining spine motion. Bland JH. Disorders of the cervical spine diagnosis and medical management. Philadelphia, PA: WEB, Saunders 1987:134

J. A comparison study of 40 randomly selected patients who had roentgenographic investigation of the cervical spine by both cineradiography and conventional lateral roentgenograms in flexion, neutral position, and extension was made for the analysis of motion. In 14 of the 40 patients, abnormal motion was detected in the spine that was not seen on the plain roentgenograms. Woesner ME, Mitts MG, The Evaluation of the Cervical Spine Motion Below C2: A comparison study if Cinerentgenographic and Conventional Roentgenographic Methods. American Journal of Roentegen, 1972; 115:148-54.

K. Stokes and Frymoyer have described the inherent difficulty of recording movement (within range of motion) characteristics from static flexion/extension films. They acknowledge that motion radiography is superior to static plain films in obtaining such information. Stokes IAF, Frymoyer JW. Segmental motion and instability. Spine 1987; 12:688-691


L. “This motion study of the spine may be quite useful in detecting abnormal biomechanics secondary to ligamentous damage that may be unappreciated with plain film radiography.”. Whiplash Injuries, The Acceleration/ Deceleration Syndrome, Second Edition, pages 143-145, Foreman and Croft

Other special literature for the use of cervical fluoroscopy:

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Buoncore E. Hartman JT, Nelson DL, Cineradiograms of the cervical in the diagnosis of soft issue injuries, JAMA 1966; 143-7;


Taylor M, Skipping R. Paradoxical motion of atlas in flexion a fluoroscopic study of chiropractic patients. European Journal of Chiropractic 1987; 35; 116-134;


Reynolds R. Cineradiography by the indirect method. Radiology 1938; 31:177-82.


White AJ, Panjabi MM. The basic kinematics of the human spine: a review of past and current knowledge. Spine


**Question 8: Experts, who should testify in cervical fluoroscopy cases**

Federal Rules of Evidence 702 and 703: These rules do not require that a test be accepted by the general scientific community, only that the opinion rendered would be of a type reasonably established by experts in a particular "field" or sub-specialty. An example would be a doctor or expert who has never touched, utilized, interpreted or received formal training or certification in fluoroscopy, commenting or testifying about the procedure contrary to the testimony of someone who has established knowledge, skill, training and experience with fluoroscopy.

Rule 702: Testimony by Experts

If scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion or otherwise, if (1) the testimony is based upon sufficient facts or data, (2) the testimony is the product of reliable principles and methods, and (3) the witness has applied the principles and methods reliably to the facts of the case.

Rule 703: Bases of Opinion Testimony by Experts

The facts or data in the particular case upon which an expert bases an opinion or inference may be those perceived by or made known to the expert at or before the hearing. If of a type reasonably relied upon by experts in the particular field in forming opinions or inferences upon the subject, the facts or data need not be admissible in evidence. Facts of data that are otherwise inadmissible shall not disclose to the jury by the proponent of the opinion or inference unless the court determines that their probative value in assisting the jury to evaluate the expert's opinion.

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substantially outweighs their prejudicial effect.

The Court in Kumho held that these factors might also be applicable in assessing the reliability of non-scientific expert testimony, depending upon "the particular circumstances of the particular case at issue." 119 S.Ct. at 1175.

In *Kumho Tire Co. v. Carmichael* (97-1709, 1999), the U. S. Supreme Court ruled that expert testimony need not be based on scientific knowledge or methods, but may rely on the training, experience, education, and other qualifications of the witness.