Inter-examiner Agreement for C1 and C2 Static Alignment Analysis Using Analog and Digital Radiographic Technologies: A Pilot Study

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ABSTRACT

Objective: This pilot study reports inter-examiner agreement during analysis of the static alignment of the upper cervical spine seen on radiographic images.

Methods: Three interns with advanced radiographic training were asked to analyze the same digital images and the same conventional analog radiographs utilizing the HIO film marking process. Four categories were predetermined for analysis comparisons.

Results: Higher inter examiner agreements were observed in two of the four categories when the digital images were utilized. Conventional analog films showed a higher inter examiner agreement in one category.

Conclusion: This feasibility study showed how these two radiographic technologies can be compared, how students can be involved in research as examiners, and that digital technology showed a slightly greater inter-examiner agreement.

Keywords: Digital radiography, radiography, chiropractic, inter-examiner reliability

Introduction

The chiropractic profession is in a constant state of change. A key reason is because there is an acute awareness of the variations within the profession concerning the historical objective of subluxation correction. The lack of congruency in determining what, when, where, and how to adjust among practitioners shows a deficiency in the scientific understanding/agreement regarding the “subluxation” that we claim to address.

This conundrum dictates that we strive to better understand not only what we do but the way we educate, deliver care, and run our business/profession. Innovation in education can ultimately improve the care we provide to patients, ease the delivery of this care for the practitioner, enhance business practices, and minimize environmental impact.

One of the many educational advances employed at Sherman College is in the area of radiographic imaging. Digital imaging capability and analysis were implemented into the educational and health center curriculum in 2007.

While there was a sizeable initial investment financially, the technology affords many benefits. The benefits include:
1. The ability to influence the films contrast through window and leveling software to zoom in on desired structures. This minimizes the call for retakes, enhances analysis points, and improves pathology reporting.

2. There is no need for a dark room. The common errors that occur there include but are not limited to light leaks, errors in processing due to improper solution temperatures, chemical exhaustion, and incorrect labeling. Advances in technology have eliminated these variables.

3. No need for film storage space which also diminishes the misplacement of films.


5. There are no developing solutions to dispose of therefore ultimately decreasing pollution.

Objective

While the aforementioned benefits are sound reasons to implement digital technology, the purpose of this pilot study is to assess inter-examiner agreement between x-ray interns for static listing film analysis.

Other health care professions have completed studies comparing various aspects of conventional radiography and digital radiography. These studies range from digital mammography and screen-film mammography in breast cancer screening,1 comparative assessments of digital and analog radiography for diagnostic accuracy, cost analysis and quality of care,2 and which is better for dental radiography.3 The present study appears to be the first study comparing digital and conventional radiography inter-examiner agreement among interns for vertebral alignment.

Methods

Three X-ray Interns, XRI, were randomly selected from a pool of six willing to participate in this study. XRI’s are interns who have chosen to ‘specialize’ in radiographic procedures during their clinical internship. In addition to the rigorous radiographic program that all students go through, XRI’s must complete additional training in radiographic procedures.

XRI’s must take and pass the Applications of Clinical Radiology elective course with a grade of ‘B’ or higher. This course provides the XRI with advanced knowledge and clinical experience needed to perform radiology department duties well under reduced supervision.

XRI’s work directly with lower quarter interns and patients in the x-ray department, and are responsible for supervising and coordinating x-ray department procedures. They are also required to tutor students and lower quarter interns in various radiology topics, including x-ray analysis and x-ray positioning.

Cervical radiographic sets included AP Open Mouth and Lateral films. Ten cervical radiographic sets were given to each intern. Five of the sets were digital images and five were conventional analog radiographs. They were labeled one through five for both digital and conventional images.

The sets were selected in alphabetical order from x-rays that were previously deemed appropriate for use in the health center. They were not screened for exceptional quality.

The interns were instructed to follow established guidelines following the HIO film marking process. The lead instructor of the cervical x-ray analysis course met with the interns before and during the process to verify that standard procedures and markings were utilized.

Four categories were predetermined for analysis comparison:


Two of the categories for comparison, atlas tilt and atlas laterality had three possible conclusions each. When analyzing the lateral film atlas was either going to be tilted superior, inferior, or be in a neutral position when compared to the occiput . When analyzing the a-p open mouth film atlas would be right, left or neutral when compared to the foramen magnum

In the third category axis could be posterior or not when compared to C3 on the lateral film for a conclusion possibility of two.

The fourth category of overall axis listings had the possibility of 15 differing conclusions. Analysis was made of the a-p open mouth film comparing C2 to the foramen magnum, C2 could be neutral or have one of the following HIO listings: ESR/ESL, ESR-SR/ESL-SL, ESR-BR/ESR-BL, BPSR/BPSL, CPBR/CPBR, SPBR/SPBL, PRI/PLI.

Digital and Analog Films

Both the digital and analog films were taken using the same procedures standardized in the Sherman College Health Center X-ray Department. These procedures are published in The Sherman System Manual.

Atlas tilt analysis and axis posterior movement analysis were performed on a standard lateral cervical view taken at a FFD of 72". The central ray was perpendicular to the film and focused on the transverse process of C1.

Atlas laterality analysis and axis overall listing analysis were performed on a standard A-P open mouth view which was taken at a FFD of 40". The tube angle was set at approximately 18.5 degrees cephalic with the central ray focused on the occiput/atlas/axis joint complex.

The tools discussed for analysis for each type of image were the same. The digital technology used the “same” tools but within the digital technology arena. Table 1 provides details on how the different types of misalignment were assessed.

Results

When comparing the digital sets for atlas tilt, the interns were in 100%, 15/15, agreement for all five sets compared to 86.7%, 13/15, agreement for the analog sets. There was 73.3%, 11/15, agreement for both the digital and the analog sets when comparing atlas laterality.
When comparing the digital sets for axis posterior movement, the interns were in 66.7%, 10/15, agreement for all five sets compared to 86.7%, 13/15, agreement for analog sets. When comparing the digital sets for overall axis misalignment, the interns were in 80%, 12/15, agreement for all five sets compared to 73.3%, 11/15, agreement for analog sets.

Discussion

Advanced technology holds many benefits for our students, patients, and profession. The data obtained from this study will be of increased value as the pool of information grows. These preliminary findings show a slight advantage for digital images categorically but an over all equal percentage of agreement between the two technologies when all three categories are combined (Table 2).

A larger sample size, along with inferential statistics (e.g., kappa analysis), is required before generalization to other settings can be made.

Several questions still need to be addressed. One question is at what point do the advanced viewing capabilities of the digital images come into play with this type of analysis? Had the conventional films been of a lesser quality, as are often seen in the field, then it is reasonable to assume that the margin of inter-examiner agreement using digital films (with our ability to adapt the image contrast, zoom, and pan) would have been higher.

This pilot study shows that a larger study is feasible.

Conclusion

Many in our profession use the static listing systems for a variety of upper cervical techniques. This study shows that skilled interns analyzing both digital and analog films have similar agreement levels for static alignment analysis. As more data is gathered, we will know more certainly if the advantages afforded us by advanced technology has an appreciable effect on inter-examiner agreement between interns. The main finding of our feasibility study here is that a larger study is do-able.

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References


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