Pro Adjuster Inter-Rater Reliability of Vertebral Segment Analysis

Corey M. Priest.
M. Travis Sizemore
Jessica A. Barding
Jason R. Whitacre

August 15, 2001
Senior Research Paper

TO:
Dr. Ralph Barrale, D.C.
Dr. John L. Gutweiler, Ph.D.

ABSTRACT

Objective: To determine the inter-examiner reliability of vertebral segment analysis using the Pro-Adjuster.

Design: Randomized patient selection with 5 different skilled examiners

Methods: A graphical interpretation of the analysis scan of 34 randomly selected subjects, selected from examiner #1 practice was obtained. 5 different skilled examiners independently read each patient's analysis scan. Each of the examiner's results was compared to the other examiners'.

Results: With a maximum of 3 vertebrae to be selected, 41% accuracy rating for all examiners selecting at least 2 of the same vertebrae or the same vertebra if only one is selected; 73% accuracy rating for all examiners selecting at least 1 of the same vertebra; 76% accuracy rating for 4/5 examiners selecting at least 2 of the same vertebrae; 100% accuracy rating for 4/5 examiners selecting at least 1 vertebra the same; 97% accuracy rating for 3/5 examiners selecting at least 2 of the same vertebrae. 3 of the 5 most common examiners to agree on at least 2 vertebrae resulted in examiner #1, #2, and #3 having the most agreement on which vertebrae to correct at 100%, 91%, 91% respectively. This corresponds to the amount of training obtained.

Conclusion: It was demonstrated that there is a statistical significance in the inter-rater reliability of the Pro-Adjuster; concluding the Pro-Adjuster analysis is significant enough to be used within the profession as a standardized method of spinal analysis.

Key Indexing Terms: Pro-Adjuster, Vertebral Segment Analysis, Vibratory Frequency, Inter-examiner Reliability of Pro-Adjuster

INTRODUCTION

It has long been a goal of practitioners and schools in the field of chiropractic to develop a method of standardization for vertebral segment analysis. Some forms of standardization have been developed through various techniques within the chiropractic profession, such as the use of leg checks, muscle testing, motion palpation, and static palpation. However, this standardization has not been universally objective between doctors.

In order to establish the information needed for this study, a random group of 34 patient vertebral analysis graphs from the Pro-Adjuster will be obtained from examiner #1's office.

The purpose of this study is to test the inter-rater reliability of vertebral segment analysis and to determine the potential for universal objective findings using the Pro-Adjuster. As a group, testing the Pro-Adjuster in this manner for the first time, we are seeking to obtain a method for standardizing vertebral segment analysis regardless of the practitioner's technique of choice. This will simply indicate to the practitioner which segments are the most vital for correction.

MATERIALS (Equipment Background)

According to Sigma Instruments the Pro-Adjuster is an advanced technical instrument for spinal segment mobility analysis, spinal segment adjuster, trigger point therapy, Golgi tendon organ therapy and joint mobilization therapy. In the analytical mode, a mild percussive impulse is transmitted through a piezoelectric sensor and into a vertebral segment. Vertebral segment mobility and resonance are calculated from each waveform generated by the testing head. The electronically

sensed information compiled during the testing process is stored and analyzed by specialized software and then displayed in an easy to understand format on a computer monitor. The Pro-Adjuster in the analytical phase will be measuring the joint mobility of each segment in question. It has the ability to do this without going past the paraphysiological space. In determining joint mobilization the user places a force transducer against the integument overlaying a patients spine and releases a force impulse through a force sensor to the underlying spinal segments. The response of the force impulse meeting the resistance and consistency of the underlying tissue is displayed as a waveform. The waveform from each test point is recorded and analyzed. The peak amplitude of the waveform is an indication of the stiffness or the compliance of each spinal segment. The shape of the wave may be analyzed for muscle spasm or tissue sponginess.

The Pro Adjuster uses a non-invasive impulse transmitter and a piezoelectric sensing head for accurately and precisely imparting a single test impulse and measuring the response through a sensor. The testing head of the Pro Adjuster contains an impulse hammer, an anvil, and a piezoelectric sensor. It is equipped with various testing probes for this evaluation.

Sigma Instruments has performed a study to test the accuracy and precision of these instruments. They concluded that the Pro Adjuster is an accurate device as tested with varying configurations of known and unknown densities. Assuming an accuracy of 98.2% and a precision of 99.2% in the normal human test range, the device itself should not introduce any error higher than +/- 1.29% of full scale within 99% confidence limits. They also performed a study to determine operator-induced error using the Pro Adjuster on an extremity. They concluded from this study that the

Pro Adjuster is an accurate instrument for measuring joint mobility. The examiner-induced error is within the expected 99% confidence limits. As minute as this examiner-induced error is, we will eliminate this factor by exclusively allowing examiner #1 to perform the patient vertebral segment scans. A study Sigma Instruments performed were of empirical tests of data representation (measured values vs. scaled data). This study was designed to explain the difference in the representation of data for the purpose of identifying joint stiffness with instruments that use piezoelectric sensors. In this study they concluded that the Scaled Values model has some significant limitations. For larger variations between data points, this method can show less discrimination than the other two methods. The results of a tight distribution of small values can produce results that are inconsistent with what the practitioner might expect from a mobility standpoint and could produce the same graph for different profiles of actual values.

After evaluating the test methods and watching the performance of multiple examiners, Sigma Instruments summarized their conclusion as follows:

> It is possible to construct a practical piezo sensing system for use on human subjects in a clinical setting.
>
> The instrument test method for clinical use is more accurate and precise and more functional than motion palpation.
>
> The instrument in a clinical setting is certainly subject to operator technique errors but, with just a few minutes of instruction, an examiner can become proficient and reasonably precise in the technique for applying diagnostic force impulses into human subjects.

In the clinical setting with multiple practitioners the test method precision decreased, as one would expect, but retained an inter-practitioner reliability impressively higher than the 90% that we established as desirable for practical clinical application.

When the measuring technique was demonstrated for several examiners, they were all able to repeat the technique successfully after a few minutes of practice.

All of the clinical tests for inter-examiner reliability were necessarily performed on one subject and on the same spinal segment. The repeated incidences of applying even a very low force test impulse to one vertebral segment certainly had an effect on the mobility of that segment. The effect was predictable and a method was devised for mathematically factoring out the change of segmental mobility during the testing phase.

We conclude from this group of studies and observations that an analytical device with a piezo sensor for measuring the relative mobility of vertebral segments is not only practical but exceeds the requirements of accuracy and precision of a physical testing device for use on human subjects. We also concluded that the display of actual test values is necessary for proper treatment decisions and for meaningful and objective outcome assessments.

METHODS

The patients are obtained from examiner #1's office. Age, gender, and race were not relevant or important in this study. Thirty-four patients were randomly

selected. A vertebral segment scan of their cervical spine is obtained from them with a graph printed out of each patients scan. The graph will include amplitude bars, individual sine graphs for each of the cervical vertebrae, along with an individual blow up graph of the waveform for each vertebrae. A worksheet is established that has each patient labeled by a number 1 – 34 along the Y-axis and each vertebrae labeled C1a, C1b, C2, C3, C4, C5, C6, and C7. Each of the 5 examiners will each have a worksheet to mark which vertebrae they will address. Each of the graphs for each patient will be laid out for each examiner to read. The stepwise method for reading and analyzing the graphs for the Pro-Adjuster Oscillatory Analysis are as follows:

Step 1 – Evaluate the amplitude bars. If the amplitude bar is highlighted this is indicating that particular vertebrae which has the most abnormal physics. This would the vertebrae that should be selected for correction.

Step 2 – If no amplitude bars are highlighted look for the amplitude bars that are taller or lower than the others. The taller the amplitude bar the greater the fixation of that specific segment. If 2 amplitude bars are taller than any others or if one is clearly taller than the others than those are the ones to be selected for correction. If one is unable to make a clear distinction between several amplitude bars, evaluate each individual segments waveforms. With the evaluation of the waveforms, a left shifted peak is indicative of a fixed vertebra; a right shift of the waveform indicates a hypermobile vertebra.

Step 3 – If necessary, look at the blown up waveform graphs for greater in depth analysis. The area to peak should be 50%.

Once all examiners have filled out their worksheets data compilation will begin.

RESULTS

Of the five examiners, examiner #1 had the most experience of 1.5 years and is a certified trainer (Table 1). Examiners #2 and #3 had the second most experience with 6 hours training (Tables 2 and 3, respectively). Examiner #4 has 4 hours of training and examiner #5 has the least experience with only 1.5 hours of training (Tables 4 and 5, respectively). In this study of 34 patients, 41% of the time all examiners selected at least 2 or more of the same vertebrae to adjust (unless only one was chosen by all examiners), 73% of the time all examiners selected at least 1 or more of the same vertebrae to adjust, 76% of the time 4/5 examiners selected at least 2 or more of the same vertebrae to adjust, 100% of the time 4/5 examiners selected at least 1 or more of the same vertebrae to adjust, and 97% of the time 3/5 examiners selected at least 2 or more of the same vertebrae to adjust. Data then is compiled to assess which examiners agreed most of the time in relation to experience and training. Examiner #1, with the most training was in agreement 100% of the time on 2 or more vertebral segments with two other examiners. Examiners #2 and #3 agreed 91% of the time on two or more segments with two other examiners. Examiner #4 agreed 82% of the time on two or more segments with two other examiners. Examiner #5, with the least amount of training agreed 1% of the time with two other examiners on at least two vertebral segments (Table 6).

Table 1

Pro Adjuster Analysis Sheet for an individual examiner 1 (1.5 years experience)

	C1A	C1B	C2	C3	C4	C5	C6	C7
Patient 1	x		x					x
Patient 2	x				x			x
Patient 3		x						x
Patient 4	x			x				x
Patient 5	x	x				x		
Patient 6					x		x	
Patient 7	x	x						x
Patient 8			x					
Patient 9	x	x			x			
Patient 10			x			x		
Patient 11				x				x
Patient 12	x		x					x
Patient 13	x	x					x	
Patient 14				x			x	
Patient 15					x	x		x
Patient 16				x				x
Patient 17		x				x		x
Patient 18		x	x					
Patient 19				x			x	
Patient 20	x			x				
Patient 21		x		x	x			
Patient 22				x				
Patient 23		x	x					
Patient 24		x	x				x	
Patient 25				x		x	x	
Patient 26	x				x	x		
Patient 27				x			x	x
Patient 28					x	x	x	
Patient 29	x				x		x	
Patient 30	x	x		x				
Patient 31			x	x			x	
Patient 32			x		x		x	
Patient 33	x						x	x
Patient 34		x		x	x			

Table 2

Pro Adjuster Analysis Sheet for an individual examiner 2 (6 hours training)

	C1A	C1B	C2	C3	C4	C5	C6	C7
Patient 1	x		x					x
Patient 2	x				x			x
Patient 3		x						x
Patient 4	x			x				x
Patient 5	x	x				x		
Patient 6				x	x		x	
Patient 7	x							x
Patient 8			x					
Patient 9	x		x	x				
Patient 10			x			x		
Patient 11		x		x				x
Patient 12	x							x
Patient 13	x	x					x	
Patient 14				x			x	
Patient 15					x	x		x
Patient 16				x				x
Patient 17		x				x	x	
Patient 18		x			x			
Patient 19				x			x	
Patient 20	x			x				
Patient 21				x	x			
Patient 22				x				
Patient 23		x	x					
Patient 24		x	x				x	
Patient 25						x	x	
Patient 26	x				x			
Patient 27	x			x		x		
Patient 28					x	x	x	
Patient 29	x						x	
Patient 30	x	x		x				
Patient 31			x	x			x	
Patient 32			x		x			
Patient 33	x						x	x
Patient 34		x			x			x

Table 3

Pro Adjuster Analysis Sheet for an individual examiner 3 (6 hours training)

	C1A	C1B	C2	C3	C4	C5	C6	C7
Patient 1	x		x					x
Patient 2	x				x			x
Patient 3		x						x
Patient 4	x			x				x
Patient 5	x	x				x		
Patient 6					x		x	
Patient 7	x	x						x
Patient 8			x					
Patient 9	x	x			x			
Patient 10		x	x			x		
Patient 11				x	x			x
Patient 12	x							x
Patient 13	x	x					x	
Patient 14				x			x	
Patient 15					x	x		x
Patient 16				x		x		x
Patient 17		x				x		x
Patient 18		x	x					
Patient 19			x			x		x
Patient 20	x			x	x			
Patient 21	x			x	x			
Patient 22				x				
Patient 23		x	x					
Patient 24		x	x				x	
Patient 25				x		x	x	
Patient 26	x				x			
Patient 27	x			x			x	
Patient 28				x	x			x
Patient 29			x		x		x	
Patient 30	x	x		x				
Patient 31			x				x	
Patient 32			x					x
Patient 33	x						x	x
Patient 34		x		x	x			

Table 4

Pro Adjuster Analysis Sheet for an individual examiner 4 (4 hours experience)

	C1A	C1B	C2	C3	C4	C5	C6	C7
Patient 1	x		x					x
Patient 2	x				x			x
Patient 3		x						x
Patient 4	x			x				x
Patient 5	x	x				x		
Patient 6					x		x	
Patient 7	x	x						x
Patient 8			x					
Patient 9		x			x			
Patient 10		x	x			x		
Patient 11				x				x
Patient 12			x					x
Patient 13	x	x					x	
Patient 14				x			x	
Patient 15					x		x	x
Patient 16				x				x
Patient 17		x				x		x
Patient 18		x	x					
Patient 19				x			x	
Patient 20				x	x			
Patient 21		x			x			
Patient 22				x				
Patient 23		x	x				x	
Patient 24		x						
Patient 25				x			x	
Patient 26					x		x	
Patient 27				x			x	x
Patient 28					x		x	
Patient 29						x	x	
Patient 30			x	x				
Patient 31			x	x			x	
Patient 32			x				x	
Patient 33	x						x	
Patient 34				x	x			

Table 5

Pro Adjuster Analysis Sheet for an individual examiner 5 (2 hours training)

	C1A	C1B	C2	C3	C4	C5	C6	C7
Patient 1	x		x					x
Patient 2	x				x		x	
Patient 3		x						x
Patient 4				x				x
Patient 5	x	x						x
Patient 6		x			x		x	
Patient 7	x						x	x
Patient 8			x		x			x
Patient 9	x	x					x	
Patient 10			x			x	x	
Patient 11				x				x
Patient 12			x				x	
Patient 13		x					x	
Patient 14					x			x
Patient 15			x		x		x	
Patient 16				x				x
Patient 17		x						x
Patient 18		x		x				
Patient 19				x			x	
Patient 20				x				
Patient 21		x		x	x			
Patient 22			x			x		
Patient 23		x				x		x
Patient 24		x		x				
Patient 25		x				x		
Patient 26	x					x		
Patient 27				x			x	x
Patient 28			x		x		x	
Patient 29	x				x		x	
Patient 30	x	x					x	
Patient 31			x	x			x	
Patient 32		x			x		x	
Patient 33	x				x		x	
Patient 34			x		x			x

Table 6

Data compilation for the Pro-Adjuster Analysis

Patient	All examiners selected at least 2 of the same vertebrae or the same vertebra if one	All examiners selected at least 1 of the same vertebrae	4/5 examiners selected at least 2 of same vertebrae	4/5 examiners selected at least 1 of the same vertebrae	3/5 examiners selected at least 2 of same vertebrae	3 of the 5 Most common examiners to agree on at least 2 vertebrae
1	x	x	x	x	x	1,2,3,4,5
2	x	x	x	x	x	1,2,3,4,5
3	x	x	x	x	x	1,2,3,4,5
4	x	x	x	x	x	1,2,3,4,5
5	x	x	x	x	x	1,2,3,4,5
6	x	x	x	x	x	1,2,3,4,5
7	x	x	x	x	x	1,2,3,4,5
8	x	x	x	x	x	1,2,3,4,5
9			x	x	x	1,3,5
10	x	x	x	x	x	1,2,3,4,5
11	x	x	x	x	x	1,2,3,4,5
12				x	x	1,2,3,4
13	x	x	x	x	x	1,2,3,4,5
14			x	x	x	1,2,3,4
15		x	x	x	x	1,2,3,4,5
16	x	x	x	x	x	1,2,3,4,5
17		x	x	x	x	1,2,3,4,5
18		x		x	x	1,3,4
19			x	x	x	1,2,4,5
20		x		x	x	1,2,3
21		x	x	x	x	1,2,3,4,5
22				x		1,2,3,4
23		x	x	x	x	1,2,3,4
24		x		x	x	1,2,3
25			x	x	x	1,2,3,4
26			x	x	x	1,2,3
27		x	x	x	x	1,3,4,5
28		x	x	x	x	1,2,4,5
29		x		x	x	1,2,3,5
30			x	x	x	1,2,3,5
31	x	x	x	x	x	1,2,3,4,5
32				x	x	1,2,4,5
33	x	x	x	x	x	1,2,3,4,5
34		x		x	x	1,2,3,4
Percentage	41%	73%	76%	100%	97%	examiner 1 = 100% examiner 2 =91% examiner 3 = 91% examiner 4 = 82% examiner 5 = 71%

DISCUSSION

Due to frustration trying to obtain the same objective vertebral segment findings from other doctors, when we were introduced to the Pro-Adjuster, we saw an opportunity for universally standardizing objective vertebral segment analysis. To our knowledge this is the first study comparing the inter-examiner reliability of analysis using the Pro-Adjuster amongst different skilled examiners. It was the goal to determine how reproducible/interpretable the objective findings are with the Pro-Adjuster. In designing this study, we felt using 5 examiners of different skill levels would help to demonstrate the true ease/reliability of the analysis aspect of the Pro-Adjuster. From the results of table 6, this does indeed indicate the ease/reliability of the analysis using the Pro-Adjuster with different training levels. Even with intense minimal training there is 71% accuracy/reliability rating in comparison to a certified trainer (examiner #1). Furthermore, 4 out of the 5 examiners selected at least 2 of the same vertebrae 76% of the time, showing a statistically significant reliability. More impressive is the fact that 3 out of the 5 examiners selected at least 2 of the same vertebrae 97% of the time, which again shows an astoundingly significant reliability.

The relationship between training and increased percentage of inter-rater reliability was directly proportional. In future studies equal training/experience should be used to reduce the number of variables giving a more accurate reliability assessment for the analysis of the Pro-Adjuster. In order to increase the significance of the study, future studies should include the entire spinal column. One source of limitation of the study is a maximum of selecting 3 vertebrae was set, resulting in the possible misinterpretation by the minimally trained to assume 3 vertebrae had to be

selected. In some cases more than 3 vertebrae may have needed to be selected leaving the examiner the feeling of picking the 3 most important vertebrae to be corrected.

CONCLUSION

Our results show that there is a statistically significant amount of inter-examiner reliability assessing a patient's cervical spinal column using the Pro-Adjuster with a 97% accuracy rating from 3 out of 5 examiners. It is hypothesized the same high accuracy rating will be more common amongst equally skilled examiners than 3 out of 5 for further studies. Therefore, there is a great need for further investigation on the inter-examiner objective analysis of a patients' spine. This will only help to unify the profession by giving it a method of standardizing objective findings. From this study we conclude the inter-examiner reliability of the Pro-Adjuster analysis is significant enough to be used within the profession as a standardized method of spinal analysis.

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