A Retrospective Study assessing change between Pre and Post Cervical lateral radiographs after Chiropractic Manipulation

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Abstract

Background: "Chiropractors more than any other health care discipline have been proponents for the claim that static spinal intersegmental disarthrias and postural changes in either the coronal or sagittal planes are clinically relevant and serve as evidence that a patient may require spinal manipulative therapy."[1]

Objective: The intent is to determine if there is alteration in the cervical curve following complete chiropractic care, and if change is documented, mensuration will be utilized to determine what changed.

Design: The method of approach will be a retrospective study utilizing neutral lateral pre and post intervention cervical radiographs.

Subjects: There were 64 cases entered into the first phase of the study. The cases were selected from files, which contained pre and post cervical neutral lateral radiographs, from four field Doctors.

Methods: Neutral lateral radiographs were measured in two phases. Phase one data consists of Angle of Cervical Curve measured on pre and post intervention radiographs and broken into two groups; those with any measurable change and those without any measurable change.
All radiographs with any measurable change between the pre and post intervention then proceeded to phase two where a modified Penning Analysis was performed to distinguish any inter segmental change between all individual cervical segments between C1 and C7 on the pre and post intervention radiographs. All data from phase one and phase two was compiled and comparative analysis of change versus no change was performed on the pre and post intervention radiographic data.

Results: Of the 64 cases included in Phase one, 13 were discarded due to inability to observe necessary anatomy, and 1 was discarded due to a time period greater than one year. Out of the remaining 50, 30 showed a positive increase in the angle of cervical curve, 3 showed no measurable change, 17 showed a decrease in the angle of cervical curve. The percentages of cases that entered into phase 2 of the study are as follows: 60% showed a positive increase in angle of cervical curve (AOCC), 34% showed a decrease in AOCC, and 6% showed no change in AOCC (See Figure 1).

Conclusion: There is a strong correlation between a change in cervical lordosis and complete Chiropractic treatment of the cervical spine.

Key indexing terms: Lordosis, chiropractic, orthopedic, manipulation, cervical vertebrae, and radiograph.

Introduction

Chiropractic is a branch of the healing arts that is based upon the understanding that good health depends, in part, upon a normally functioning nervous system (especially the spine, and the nerves extending from the spine to all parts of the body). "Chiropractic" comes from the Greek word Chiropraktikos, meaning "effective treatment by hand."[12] Chiropractic stresses the idea that the cause of many disease processes begins with the body's inability to adapt to its environment. It looks to address these diseases not by the use of drugs and surgery, but by locating and adjusting skeletal areas of the body, that relate to dysfunctional regions in the body.
Chiropractic has demonstrated over the years that posture and proper curves in the spine are essential for good biomechanics, health, and an individual's overall well-being. In the past, many studies have revealed that there is multiple factors that contribute to altered cervical curves. [(1-11)]
Researchers agree that a natural lordosis exists within the cervical spine. There are many factors that can reduce the cervical curve, such as: trauma and various degenerative processes, which have an altering effect on the cervical lordosis. Chiropractic research has suggested the restoration of motion in the cervical spinal region aids in preventing and inhibiting the progression of these disorders. This study deals exclusively with the cervical spine between C1 through C7. The intent is not to determine whether or not chiropractic care is effective. The intent is to determine if there is alteration in the cervical curve following complete chiropractic care, and if change is documented, mensuration will be utilized to determine what changed.

Background

"Chiropractors more than any other health care discipline have been proponents for the claim that static spinal intersegmental disarthrias and postural changes in either the coronal or sagittal planes are clinically relevant and serve as evidence that a patient may require spinal manipulative therapy."[1] Leach reports "reverse cervical curves in the cervical spine may cause nerve root irritation, which may trigger a protective reflex muscle spasm and involuntary contraction of the muscles that straighten the neck (cervical spine vertebra)."[2]

A Pubmed, Mantis and Chiroaccess search was performed using the following key words: lordosis, chiropractic, orthopedic, manipulation, cervical vertebrae, and radiograph. The search located 421 articles pertaining to this subject. When narrowed, the search identified articles dealing with chiropractic and restoration of the normal cervical lordosis. Eight articles were indexed under refereed literature that deals with methods of enhancing or restoring the cervical lordosis. The reviewed authors found a range from "no comparative changes to 13.2 correction following chiropractic manipulation in the restoration of the cervical lordotic curve."[3]

A small but important group of studies have been performed which discuss the ability of specific techniques to assess the cervical curve. Many chiropractors have used pre and post intervention plain films to demonstrate that chiropractic is capable of making changes in the cervical spine. The literature reveals a lack of consistency between studies, with regard to technique, palliative treatment, duration of treatment, and whether or not the doctors used correct double-blind methods. There is a lack of standardization in Chiropractic research assessing effectiveness in changing the curvature of the cervical spine.

Historical background

Leach (1983) performed a retrospective radiographic study on 35 subjects' pre and post intervention radiographs. The measurements were performed in a nonblinded study, which used the Hildebrandt method of mensuration without establishing marking reliability. Twenty of the patients received supine PA diversified manual type adjustments with an accumulative 4.55 of correction. Nine patients received specific short lever high velocity, PA thrusts in supine position and were provided with a cervical pillow for home use and achieved an average correction of 2.22. Six patients received rotary type manipulation, which was not aimed at correcting the lordosis and resulted in an average improvement of 1.0. The frequency and duration was ambiguous in the reported article.[2]

Plaugher et al. (1990) performed a retrospective study on 49 subjects utilizing pre and post intervention radiographs. The Cobb angle of mensuration was used and assessed for reliability. The Gonstead Technique was applied and an average of 6.5 adjustments were given to each subject. The results revealed no pre and post comparative changes.[1]

McAlpine (1991) performed a prospective study on 10 subjects using seated pre and post intervention radiographs. Ruth Jackson's angle of mensuration was performed to obtain lordotic measurements. The adjustments performed utilized grostic procedure with a Laney hand-held adjusting instrument. One adjustment was given to each patient and the result was an average improvement of 7.82 per patient.[4]

Wallace et al. (1994) performed a prospective study on 38 subjects with inclusion on 31 in the final statistical analysis. Ruth Jackson's angle applied to mark the pre and post radiographs. The Pierce System of analysis was used before the modified toggle adjustments were performed. Patients were evaluated twice a week for twelve weeks, no specific number of adjustments were mentioned. The authors noted an average improvement of 6 in the subjects who previously demonstrated lordotic curves and no net change when all subjects were included.[5]

Harrison et al. (1994) performed a retrospective study, which included 35 subjects who were randomly selected from 200 consecutive cases. Again, Ruth Jackson's angle was used for pre and post intervention radiographs in this blind study. The adjusting technique used was CBP with extension-compression traction. Patients were adjusted/tractioned an average of 5 times per week for 12 weeks. The result was an average improvement of 13.2 correction in cervical lordosis and 75% of subjects who initially presented with kyphotic deformities returning to their normal lordosis.[6]

Yeomans (1992) assessed the changes in cervical intersegmental spinal mobility before and after the use of spinal manipulative therapy. The 58 subjects consisted of 36 females and 22 males selected in a nonrandom fashion from the patient population of two private practices. The parameters included all patients under age 50 who had not received spinal manipulative therapy six months prior to the initial presentation date. Subjects were selected from a bank of patients whose signs and symptoms included one of the following: headaches, objective nerve root findings, and soft tissue oriented problems. The Henderson method of mensuration was used to demonstrate an increase in cervical intersegmental mobility. Results revealed an increase in Post-SMT mobility and no other information given.[7]

Methods and Materials

The radiographs will be obtained from four field practitioners who use chiropractic treatments in resolution of cervical spine injuries. Dr. Charles Russell, Dr. Edward Bickmeyer, Dr. Gary Hauser, and Dr. Michael Wittmer provided the radiographic studies. Each of these Chiropractors has an independent private Chiropractic office within the St. Louis, Missouri metropolitan area. Each doctor was sent a survey focusing on primary, secondary and any prescribed home care (see appendix A). Logan College of Chiropractic radiology department was the location of the study. The method of approach will be a retrospective study utilizing neutral lateral pre and post intervention cervical radiographs.

The cases were selected from files, which contained pre and post cervical neutral lateral radiographs, from the above-mentioned field Doctors. Each case had to contain films with less than one year between pre and post radiographic studies. Initial selection criteria were satisfied with more than 50 cases included.

There were 64 cases entered into the first phase of the study, which contained multiple steps. The first step was performed in a double-blind method of marking the Angle of cervical curve measurement. This is discovered by drawing two lines, "one through and parallel to the [superior] endplate of the seventh cervical body, the other through the midpoints of the anterior and posterior tubercles of the atlas (atlas plane line). Perpendiculars are then constructed to the point of intersection, and the resultant angle is measured." [11] Films, which were unable to be marked due to technique or absence of necessary landmarks, were discarded. Phase two segregated those cases with change in cervical lordosis from those without change. The third phase focused on the utilization of a modified Penning method of measurement to obtain intersegmental angulations at each vertebral level. The Penning method is composed of superimposition of two films representing the cervical spine in the end positions of the movements of flexion/extension. The marking consists of placing dots upon all four corners of the vertebral bodies and then matching the corresponding flexion segment onto its own extension segment. There is a line drawn at the top of the radiograph for each intersegmental angle and the angle is calculated. The authors chose the modified Penning method because the focus of the study is not to compare and contrast flexion and extension, but to address the change between pre intervention and post intervention cervical neutral lateral radiographs. This method allows for determination of significant change that corresponds to films taken before and after Chiropractic treatment. Modified Penning method was performed by placing dots on all four corners of each cervical vertebra C3 - C7, the anterior and posterior tubercles of C1, and the inferior endplate corners of the C2 vertebral body. The post intervention radiograph was placed on top of the pre intervention radiograph. The corresponding vertebral body levels were aligned by utilizing the dots on the corners of each vertebral body. Using the edge of the film, a line was created for each vertebral level. A comparative angle was measured from these lines to evaluate intersegmental angulations. The data was compiled and statistically analyzed. The instrumentation required was a rolling marking ruler, viewbox, radiological protractor, and other assorted marking tools. Patient positioning and radiographic protocol will be assumed to follow the procedures taught in a recognized college of chiropractic. At the same time, examiners noted consistency between radiographs.

Measuring tools are consistent from one tool to another. Measurements were performed as accurately as possible by each technician.

Data Collection

The analysis of the data was performed, by creating a Microsoft Excel spreadsheet (Appendix B). The following columns were included: Case #, Date, Pre and Post Angle of cervical curve measurement, Measured change in Cervical Lordosis, Modified Penning Method measurements at each segment from C1/C2 through C6/C7, Median measurement of all segments, average measurement of all segments, standard deviation of all segments, and the days between pre and post radiographic studies. The equations above were formatted according to macro programming of Microsoft Excel.

Discussion of Data

The survey from the Chiropractors who submitted radiographs for study did reveal that diversified adjusting technique was the most prominent form of treatment. Thompson adjusting technique was also used as a secondary technique. As secondary care in the office, interferential, Intersegmental traction, counter stressing traction, and ultrasound was used. Home care prescribed included; moist heat, Cryotherapy, Home traction, Cervical exercises (See appendix A). Raw data has been compiled and shown in appendix B. Of the 64 cases included in Phase one, 13 were discarded due to inability to observe necessary anatomy, and 1 was discarded due to a time period greater than one year. Out of the remaining 50, 30 showed a positive increase in the cervical lordosis, 3 showed no measurable change, 17 showed a decrease in the cervical lordosis. The percentages of cases that entered into phase 2 of the study are as follows: 60% showed a positive increase in cervical lordosis (CL), 34% showed a decrease in CL, and 6% showed no change in CL (See Figure 1). When the change in CL was measured against the time between pre and posts radiographs there was an average increase in CL of 6.2 degrees from day 22 through day 195. From day 1 through day 19 there was an average decrease in CL of 3.8 degrees. From day 201 through day 346 there was an average decrease of 1.18 degrees (See Figure2). Figure 3 represents the average intersegmental change of each vertebral level using the modified Penning method. The degree of change is most significant in the mid cervical spine specifically noted at C3/C4 and C4/C5. The graph also notes standard deviation. Standard deviation was calculated using the macro program of Microsoft Excel. Standard deviation is useful because it determines if the statistics noted is significant (see Figure 3).

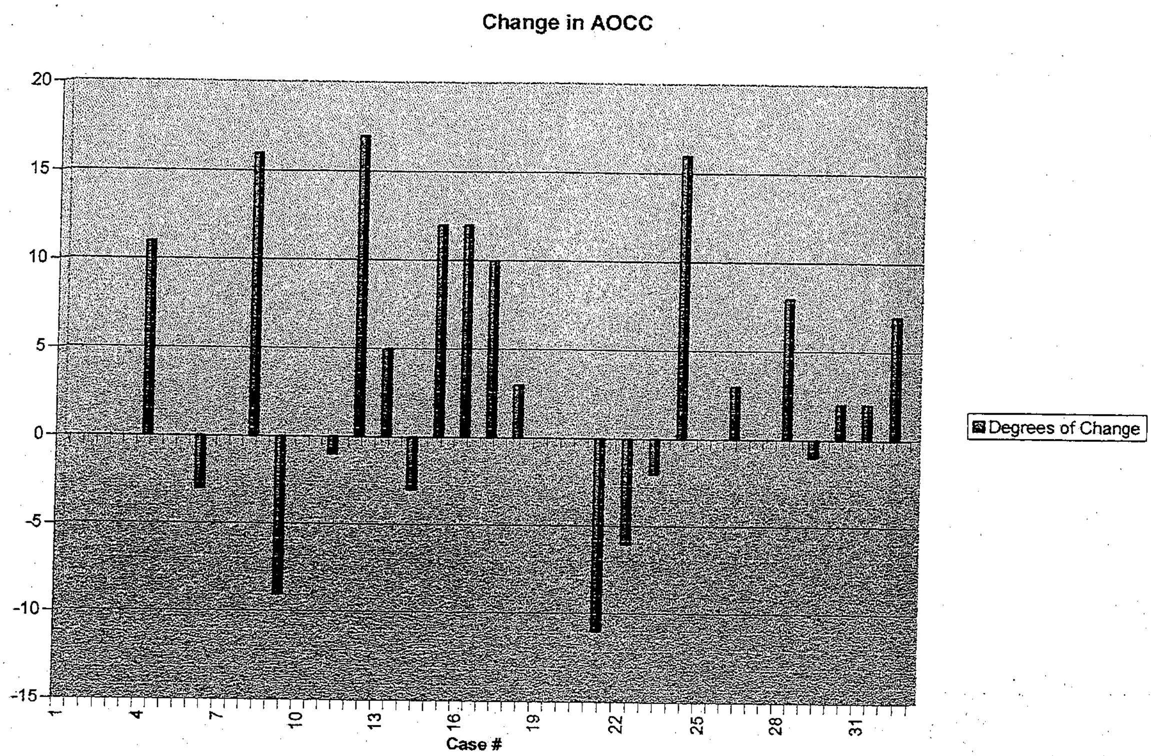

Figure 1A. Change in Angle of Cevical Curve for Case # 1-32

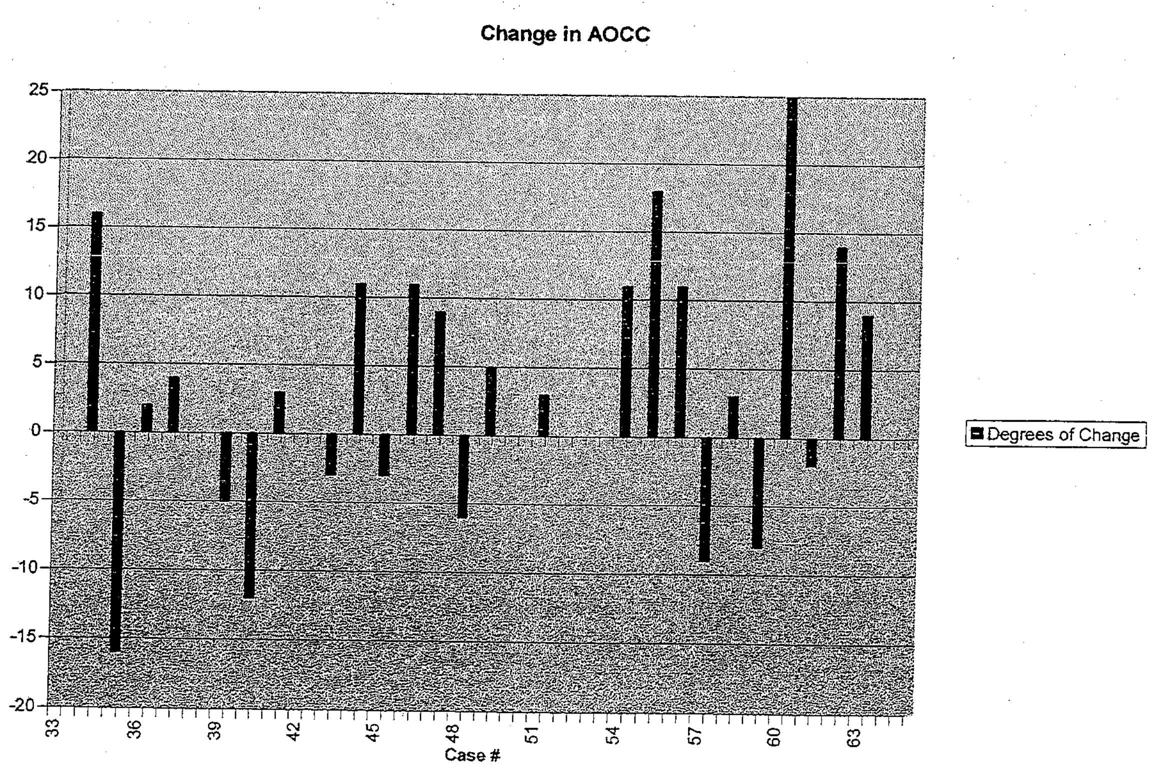

Figure 1B. Change in Angle of Cervical Curve for Case #33-64

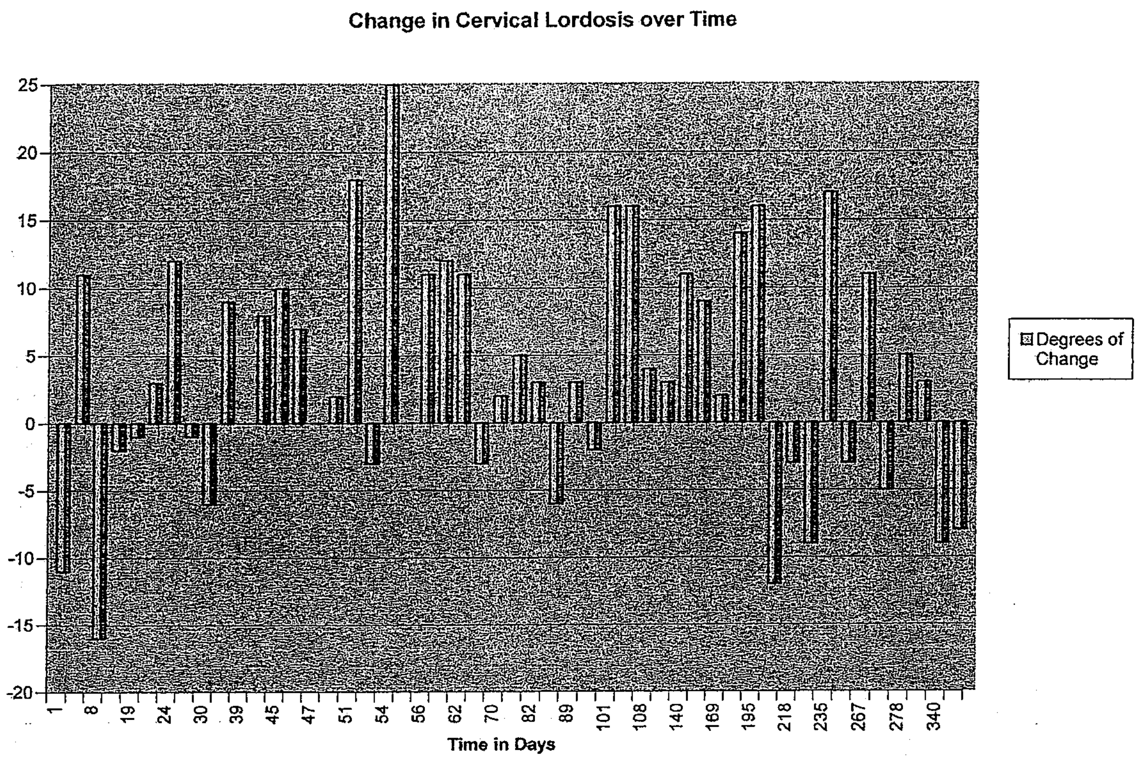

Figure 2. Change in Angle of Cervical Curve Over Time.

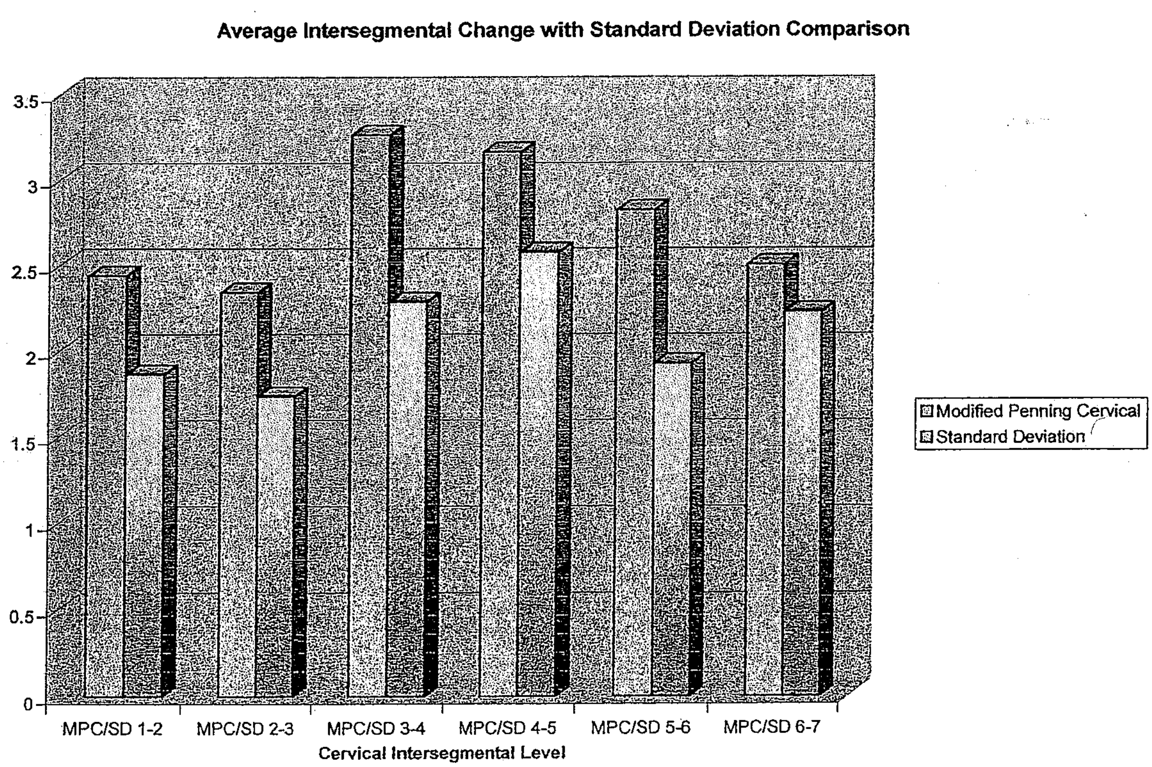

Figure 3. Modified Penning Cervical Analysis with Standard Deviation.

	Case #	Date	CL	CL dif.	MP 1-2	MP 2-3	MP 3-4	MP 4-5	MP 5-6	MP 6-7	Median	Average	Stan. Dev.	Time (Days)
	Pre 1	No C7												
1	Post 1	No C7												
	Pre 2	No atlas												
2	Post 2	No atlas												
	Pre 3	No C7												
3	Post 3	No C7												
	Pre 4	8/2/93	18											
4	Post 4	12/22/93	29	11	1	2	3	4	2	6	2.5	3	1.788854	140
	Pre 5	3/13/96	46		1	1	3	1	4	1				
5	Post 5	5/8/96	46	0							1	1.833333	1.32916	55
	Pre 6	4/24/87	41		4	0	4	2	3	2				
6	Post 6	1/11/88	38	-3							2.5	2.5	1.516575	257
	Pre 7	Dates over 1 year												
7	Post 7													
	Pre 8	11/4/98	20		2	2	4	5	5	2				
8	Post 8	5/19/99	36	16							3	3.333333	1.505545	195
	Pre 9	5/29/98	32		0	1	1	4	6	2				
9	Post 9	1/24/99	23	-9							1.5	2.333333	2.250926	235
	Pre 10	8/14/98	22		5	1	1	0	3	0				
10	Post 10	9/23/98	22	0							1	1.666667	1.966384	39
	Pre 11	3/17/86	49		2	1	4	8	4	0				
11	Post 11	4/6/86	48	-1							3	3.166667	2.857738	19
	Pre 12	3/11/98	25		8	0	2	3	4	4				
12	Post 12	11/6/98	42	17							3.5	3.5	2.664583	235
	Pre 13	12/18/96	45		7	6	3	1	5	1				
13	Post 13	3/3/97	50	5							4	3.833333	2.562551	75
	Pre 14	4/29/92	45		1	5	6	1	3	2				
14	Post 14	12/7/92	42	-3							2.5	3	2.097618	218
	Pre 15	4/23/96	35		2	1	5	8	1	6				
15	Post 15	5/17/96	47	12							3.5	3.833333	2.926887	24
	Pre 16	4/2/99	35		2	1	9	2	5	1				
16	Post 16	6/2/99	47	12							2	3.333333	3.141125	60
	Pre 17	2/11/99	33		0	4	1	2	3	5				
17	Post 17	3/26/99	43	10							2.5	2.5	1.870829	45
	Pre 18	6/21/93	38		1	6	6	1	2	3				
18	Post 18	9/20/93	41	3							2.5	3.166667	2.316607	89
	Pre 19	No C7												
19	Post 19	No C7												
	Pre 20	No C7												
20	Post 20	No C7												
	Pre 21	2/27/96	40		4	4	2	1	1	2				
21	Post 21	2/28/96	29	-11							2	2.333333	1.36626	1
	Pre 22	4/1/93	51		0	2	2	3	0	1				
22	Post 22	5/1/93	45	-6							1.5	1.333333	1.21106	30
	Pre 23	11/30/93	45		1	3	2	4	0	2				
23	Post 23	3/2/94	43	-2							2	2	1.414214	92
	Pre 24	7/23/93	41		1	1	9	5	2	5				
24	Post 24	11/11/93	57	16							3.5	3.833333	3.125167	108
	Pre 25	No C7												
25	Post 25	No C7												
	Pre 26	5/2/95	36		1	3	1	1	0	0				
26	Post 26	7/24/95	39	3							1	1	1.095445	82
	Pre 27	No C1 Post. Arch												
27	Post 27	No C1 Post Arch												
	Pre 28	2/2/98	46		1	3	7	2	3	2				
28	Post 28	3/11/98	54	8							2.5	3	2.097618	39
	Pre 29	8/24/92	56		6	4	4	12	2	9				
29	Post 29	9/22/92	55	-1							5	6.166667	3.710346	28
	Pre 30	1/14/94	40		1	1	1	2	1	1				
30	Post 30	3/24/94	42	2							1	1.166667	0.408248	70
	Pre 31	3/11/99	23		0	1	3	1	3	3				
31	Post 31	8/30/99	25	2							2	1.833333	1.32916	169
	Pre 32	8/6/95	42		3	3	4	1	4	1				
32	Post 32	9/21/95	49	7							3	2.666667	1.36626	45
	Pre 33	No C7												
33	Post 33	No C7												
	Pre 34	11/24/98	40		2	6	4	6	2	1				
34	Post 34	3/5/99	56	16							3	3.5	2.167948	101
	Pre 35	3/6/96	64		2	4	4	11	2	4				
35	Post 35	3/14/96	48	-16							4	4.5	3.331666	8
	Pre 36	1/28/93	31		1	1	2	2	1	1				
36	Post 36	3/16/93	33	2							1	1.333333	0.516398	48
	Pre 37	10/3/88	36		4	1	2	5	2	7				
37	Post 37	1/21/89	40	4							3	3.5	2.258318	108
	Pre 38	No C7												
38	Post 38	No C7												
	Pre 39	4/30/97	60		2	1	1	2	2	4				
39	Post 39	1/30/98	55	-5							2	2	1.095445	270
	Pre 40	7/28/92	43		0	4	2	0	3	4				
40	Post 40	2/19/93	31	-12							2.5	2.166667	1.834848	201
	Pre 41	9/1/92	34		2	1	2	4	2	5				
41	Post 41	7/3/93	37	3							2	2.666667	1.505545	302
	Pre 42	9/14/98	28		3	1	2	0	3	6				
42	Post 42	10/31/98	28	0							2.5	2.5	2.073644	47
	Pre 43	9/4/97	33		4	1	1	1	4	0				
43	Post 43	11/10/97	30	-3							1	1.833333	1.722401	66
	Pre 44	8/24/98	51		4	1	2	5	5	8				
44	Post 44	8/25/98	62	11							4.5	4.166667	2.483277	1
	Pre 45	11/22/95	21		1	2	2	1	1	1				
45	Post 45	1/15/96	18	-3							1	1.333333	0.516398	53
	Pre 46	2/27/92	37		5	5	8	2	3	0				
46	Post 46	11/24/92	48	11							4	3.833333	2.786874	267
	Pre 47	2/16/00	32		4	3	3	4	5	1				
47	Post 47	3/20/00	41	9							3.5	3.333333	1.36626	34
	Pre 48	5/8/95	31		1	4	0	5	0	1				
48	Post 48	7/31/95	25	-6							1	1.833333	2.136976	83
	Pre 49	1/2/95	17		5	1	5	1	1	3				
49	Post 49	10/10/95	22	5							2	2.666667	1.966384	278
	Pre 50	No C7												
50	Post 50	No C7												
	Pre 51	11/8/96	24		1	1	4	3	1	5				
51	Post 51	3/1/97	27	3							2	2.5	1.760682	113
	Pre 52	Marker block C1												
52	Post 52	Marker block C1												
	Pre 53	No C7												
53	Post 53	No C7												
	Pre 54	9/29/99	21		1	5	5	2	1	1				
54	Post 54	12/1/99	32	11							1.5	2.5	1.974842	62
	Pre 55	6/7/00	35		2	6	5	4	8	2				
55	Post 55	7/28/00	53	18							4.5	4.5	2.345208	51
	Pre 56	7/22/98	42		3	1	1	5	3	0				
56	Post 56	9/18/98	53	11							2	2.166667	1.834848	58
	Pre 57	9/2/98	47		5	2	0	3	4	1				
57	Post 57	8/12/99	38	-9							2.5	2.5	1.870829	340
	Pre 58	10/2/97	45		3	1	3	2	1	1				
58	Post 58	10/24/97	48	3							1.5	1.833333	0.983192	22
	Pre 59	5/20/93	45		2	3	2	1	5	2				
59	Post 59	5/6/94	37	-8							2	2.5	1.378405	346
	Pre 60	6/13/95	34		3	2	9	5	9	3				
60	Post 60	8/7/95	59	25							4	5.166667	3.125167	54
	Pre 61	12/16/93	40		4	2	1	2	2	1				
61	Post 61	1/3/94	38	-2							2	2	1.095445	17
	Pre 62	7/9/93	40		2	2	4	4	3	1				
62	Post 62	12/30/93	54	14							2.5	2.666667	1.21106	171
	Pre 63	7/13/95	32		2	0	2	4	2	1				
63	Post 63	12/15/95	41	9							2	1.833333	1.32916	152
	Pre 64	No C7												
64	Post 64	No C7												
	Averages		39.13	3.58	2.44	2.34	3.26	3.16	2.82	2.5	2.44	2.753333	1.891808	112.02

Appendix B.

Case #	Date	CL	CL dif.	MP 1-2	MP 2-3	MP 3-4	MP 4-5	MP 5-6	MP 6-7	Median	Average	Stan. Dev.	Time (Days)
Pre 1	No C7												
Post 1	No C7												
Pre 2	No atlas												
Post 2	No atlas												
Pre 3	No C7												
Post 3	No C7												
Pre 4	8/2/93	18											140
Post 4	12/22/93	29	11	1	2	3	4	2	6	2.5	3	1.788854	
Pre 5	3/13/96	46		1	1	3	1	4	1				55
Post 5	5/8/96	46	0							1	1.833333	1.32916	
Pre 6	4/24/87	41		4	0	4	2	3	2				257
Post 6	1/11/88	38	-3							2.5	2.5	1.516575	
Pre 7	Dates over 1 year												
Post 7													
Pre 8	11/4/98	20		2	2	4	5	5	2				195
Post 8	5/19/99	36	16							3	3.333333	1.505545	
Pre 9	5/29/98	32		0	1	1	4	6	2				235
Post 9	1/24/99	23	-9							1.5	2.333333	2.250926	
Pre 10	8/14/98	22		5	1	1	0	3	0				39
Post 10	9/23/98	22	0							1	1.666667	1.966384	
Pre 11	3/17/86	49		2	1	4	8	4	0				19
Post 11	4/6/86	48	-1							3	3.166667	2.857738	
Pre 12	3/11/98	25		8	0	2	3	4	4				235
Post 12	11/6/98	42	17							3.5	3.5	2.664583	
Pre 13	12/18/96	45		7	6	3	1	5	1				75
Post 13	3/3/97	50	5							4	3.833333	2.562551	
Pre 14	4/29/92	45		1	5	6	1	3	2				218
Post 14	12/7/92	42	-3							2.5	3	2.097618	
Pre 15	4/23/96	35		2	1	5	8	1	6				24
Post 15	5/17/96	47	12							3.5	3.833333	2.926887	
Pre 16	4/2/99	35		2	1	9	2	5	1				60
Post 16	6/2/99	47	12							2	3.333333	3.141125	
Pre 17	2/11/99	33		0	4	1	2	3	5				45
Post 17	3/26/99	43	10							2.5	2.5	1.870829	
Pre 18	6/21/93	38		1	6	6	1	2	3				89
Post 18	9/20/93	41	3							2.5	3.166667	2.316607	
Pre 19	No C7												
Post 19	No C7												
Pre 20	No C7												
Post 20	No C7												
Pre 21	2/27/96	40		4	4	2	1	1	2				1
Post 21	2/28/96	29	-11							2	2.333333	1.36626	
Pre 22	4/1/93	51		0	2	2	3	0	1				30
Post 22	5/1/93	45	-6							1.5	1.333333	1.21106	
Pre 23	11/30/93	45		1	3	2	4	0	2				92
Post 23	3/2/94	43	-2							2	2	1.414214	
Pre 24	7/23/93	41		1	1	9	5	2	5				108
Post 24	11/11/93	57	16							3.5	3.833333	3.125167	
Pre 25	No C7												
Post 25	No C7												
Pre 26	5/2/95	36		1	3	1	1	0	0				82
Post 26	7/24/95	39	3							1	1	1.095445	
Pre 27	No C1 Post. Arch												
Post 27	No C1 Post Arch												
Pre 28	2/2/98	46		1	3	7	2	3	2				39
Post 28	3/11/98	54	8							2.5	3	2.097618	
Pre 29	8/24/92	56		6	4	4	12	2	9				28
Post 29	9/22/92	55	-1							5	6.166667	3.710346	
Pre 30	1/14/94	40		1	1	1	2	1	1				70
Post 30	3/24/94	42	2							1	1.166667	0.408248	
Pre 31	3/11/99	23		0	1	3	1	3	3				169
Post 31	8/30/99	25	2							2	1.833333	1.32916	
Pre 32	8/6/95	42		3	3	4	1	4	1				45
Post 32	9/21/95	49	7							3	2.666667	1.36626	
Pre 33	No C7												
Post 33	No C7												

Pre 34	11/24/98	40		2	6	4	6	2	1				
Post 34	3/5/99	56	16							3	3.5	2.167948	101
Pre 35	3/6/96	64		2	4	4	11	2	4				
Post 35	3/14/96	48	-16							4	4.5	3.331666	8
Pre 36	1/28/93	31		1	1	2	2	1	1				
Post 36	3/16/93	33	2							1	1.333333	0.516398	48
Pre 37	10/3/88	36		4	1	2	5	2	7				
Post 37	1/21/89	40	4							3	3.5	2.258318	108
Pre 38	No C7												
Post 38	No C7												
Pre 39	4/30/97	60		2	1	1	2	2	4				
Post 39	1/30/98	55	-5							2	2	1.095445	270
Pre 40	7/28/92	43		0	4	2	0	3	4				
Post 40	2/19/93	31	-12							2.5	2.166667	1.834848	201
Pre 41	9/1/92	34		2	1	2	4	2	5				
Post 41	7/3/93	37	3							2	2.666667	1.505545	302
Pre 42	9/14/98	28		3	1	2	0	3	6				
Post 42	10/31/98	28	0							2.5	2.5	2.073644	47
Pre 43	9/4/97	33		4	1	1	1	4	0				
Post 43	11/10/97	30	-3							1	1.833333	1.722401	66
Pre 44	8/24/98	51		4	1	2	5	5	8				
Post 44	8/25/98	62	11							4.5	4.166667	2.483277	1
Pre 45	11/22/95	21		1	2	2	1	1	1				
Post 45	1/15/96	18	-3							1	1.333333	0.516398	53
Pre 46	2/27/92	37		5	5	8	2	3	0				
Post 46	11/24/92	48	11							4	3.833333	2.786874	267
Pre 47	2/16/00	32		4	3	3	4	5	1				
Post 47	3/20/00	41	9							3.5	3.333333	1.36626	34
Pre 48	5/8/95	31		1	4	0	5	0	1				
Post 48	7/31/95	25	-6							1	1.833333	2.136976	83
Pre 49	1/2/95	17		5	1	5	1	1	3				
Post 49	10/10/95	22	5							2	2.666667	1.966384	278
Pre 50	No C7												
Post 50	No C7												
Pre 51	11/8/96	24		1	1	4	3	1	5				
Post 51	3/1/97	27	3							2	2.5	1.760682	113
Pre 52	Marker block C1												
Post 52	Marker block C1												
Pre 53	No C7												
Post 53	No C7												
Pre 54	9/29/99	21		1	5	5	2	1	1				
Post 54	12/1/99	32	11							1.5	2.5	1.974842	62
Pre 55	6/7/00	35		2	6	5	4	8	2				
Post 55	7/28/00	53	18							4.5	4.5	2.345208	51
Pre 56	7/22/98	42		3	1	1	5	3	0				
Post 56	9/18/98	53	11							2	2.166667	1.834848	56
Pre 57	9/2/98	47		5	2	0	3	4	1				
Post 57	8/12/99	38	-9							2.5	2.5	1.870829	340
Pre 58	10/2/97	45		3	1	3	2	1	1				
Post 58	10/24/97	48	3							1.5	1.833333	0.983192	22
Pre 59	5/20/93	45		2	3	2	1	5	2				
Post 59	5/6/94	37	-8							2	2.5	1.378405	346
Pre 60	6/13/95	34		3	2	9	5	9	3				
Post 60	8/7/95	59	25							4	5.166667	3.125167	54
Pre 61	12/16/93	40		4	2	1	2	2	1				
Post 61	1/3/94	38	-2							2	2	1.095445	17
Pre 62	7/9/93	40		2	2	4	4	3	1				
Post 62	12/30/93	54	14							2.5	2.666667	1.21106	171
Pre 63	7/13/95	32		2	0	2	4	2	1				
Post 63	12/15/95	41	9							2	1.833333	1.32916	152
Pre 64	No C7												
Post 64	No C7												
Averages		39.13	3.58	2.44	2.34	3.26	3.16	2.82	2.5	2.44	2.753333	1.891808	112.02

Appendix B.

Conclusion

While the authors realize that this study was generalized in nature, the authors feel that the foundation has been implemented for further studies. It is also recognized that further study and narrowing of selected cases by; treatment time (time between radiographic studies), the number and type of treatments, as well as, more attention to patient positioning, could be included in follow up studies. The number of plain films available for the study limits the project. There are obvious difficulties in plain film mensuration with regard to interexaminer reliability. There is always the possibility of inter operator error between patient position and X-ray protocol from patient to patient. However, it is evident, that there is a strong correlation between a change in cervical lordosis and chiropractic treatment of the cervical spine.

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Appendix A.

Survey for Research Project

Please fill out the following survey in order for us to document the general treatment methods used for care. **Please apply the answers to the following questions towards cases involving the cervical region only.**

1) Please identify the adjusting techniques used in the office? (most used to least used)

____

____

____

____

2) What are your secondary methods of treatment in the office? (Physical therapy, acupuncture etc.)(most used to least used)

____

____

____

3) What are your homecare recommendations?(most used to least used)

____

____

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