ORIGINAL RESEARCH

Reduction and Maintenance of Scoliotic and Sub-Scoliotic Curvatures: A Follow-Up Study on Children with Idiopathic Scoliosis Undergoing Subluxation Correction with Pierce Results System™

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Abstract

Objective: The purpose of this study is to add to the lack of follow-up research on chiropractic-managed scoliosis by reinvestigating a previous case series on AIS patients under the Pierce Results System[TM].

Methods: This study was reviewed and approved by the institutional review board of the Foundation for Vertebral Subluxation. All original 36 subjects were restudied. The subject was included in this study if they were currently under care and had an additional 'post' AP lumbopelvic X-ray. Twenty subjects (10 in the scoliosis group and 10 in the sub-scoliosis group) met criteria and their latest film was measured using the Cobb-Lippman method.

Results: As in the previous study, these patients had continued care under the Pierce Results System[TM], which only focused on correcting vertebral subluxation. For the 20 included subjects, the mean curve size decreased an additional 12.9% since initial care was given. The total correction was 46.8%, which was statistically significant ($p<0.05$). In the scoliosis group, there was a 14.4% decrease initially, followed by an additional 7.6% reduction. Final results totaled to 31.5% correction in scoliosis size since beginning chiropractic care. The sub-scoliosis group initially had a 61.5% decrease, followed by an additional 18.2% reduction. The final results totaled to a 62.1% correction in curve size.

Conclusions: These results suggest that: 1) the Pierce Results System[TM] may provide a way to reduce scoliotic curvatures by removing vertebral subluxation without the aid of other interventions; 2) specific adjusting of vertebral subluxations could help decrease scoliotic curves with minimal risk of curve regression. However, more follow-up research is needed on chiropractic management of scoliosis.

Keywords: *Pierce Results System, Adolescent, Scoliosis, Chiropractic, Subluxation, Adjustment, Manipulation*

Introduction

Idiopathic scoliosis (IS) is the largest category of scoliosis, and its progression and correction has been explored for several decades.[1] Research shows that the prevalence of adolescent idiopathic scoliosis (AIS) affects 2-4% of children between the ages of 10-16 years.[1-4] Necessity of scoliosis correction has been demonstrated in several long-term studies that link this enigmatic disorder to significant curve progression, cardiovascular diseases, respiratory failure, increased back pain, increased spinal degeneration, psychosocial limitations, disability, negative perception of health and increased mortality.[2,5-8] In regards to mortality, Nilsonne and Lundgren found that mortality of non-treated IS

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patients was twice that of the normal population, and that the danger significantly increased after the age of 45.[5] Phersson et al confirmed this risk to be between the ages of 40-50,[6] while another study claimed an increased in mortality by only 15%.[7]

The associated increase in health risks has spurred investigations into treatments that will slow the progression of curves, reduce scoliosis and maintain corrections. For scoliosis that are less than 35 degrees, non-surgical and conservative treatments are preferred. The most common forms of these non-surgical treatments are bracing, exercise, electrical surface stimulation and chiropractic adjustments.[9-24] Various and numerous studies have demonstrated that correction can be obtained by using one or a variety of these methods, but few in comparison have examined the long-term maintenance of that correction. Currently, bracing has been the most researched of the treatments when examining long-term affects.[3,9-13]

Long-term studies on bracing and other conservative treatments

Danielsson and Nachemson did a follow-up study on 127 AIS patients who underwent bracing more than 20 years ago. The brace treatment group had on average 7.9 degrees of deterioration in their curves since the end of the treatment, and 39 of those subjects experienced a greater than 10 degree increase in their Cobb angles. It was also pointed out that these AIS patients had significantly worse back function compared to the participants in the control.[9]

Another follow-up study on AIS subjects treated with the Milwaukee brace revealed that corrected spinal curves were maintained two years following the end of treatment. However, during the 5-12 years that followed brace treatment, the Cobb angle increased between 6 to 17 degrees.[10]

In comparison, Hassan and Biekreim studied the progression of scoliosis treated with a plaster jacket and/or Milwaukee brace. The follow-up study of each patient averaged 10.6 years, and the curves were found to have increased the most during the first four years following treatment. Seventy percent of those scoliosis increased during 16-20 years of age, while 60% increased after age 20.[12]

Results from Boston brace treatment found an average increase of 6.2 degrees over a 12-year period, indicating the final curve size to be on average one degree larger than what it was prior to treatment.[13] Brace treatment in general has been determined to be effective initially, but the progression of curve size following treatment has been found to be equivalent to that found in the natural history.[11]

There are very few long-term studies examining other conservative interventions to scoliosis correction. Of these studies, one investigated individuals that had one or a combination of non-operative interventions 10-60 years earlier. Haefeli et al. examined 81 patients who had undergone bracing, physiotherapy, and electrical stimulation. The researchers found that thoracic curves increased by a mean of 19.1 degrees, thoracolumbar curves increased by a mean of 6.7 degrees, and lumbar curves increased by a mean of 12.3 degrees.[14]

Chiropractic and Adolescent Idiopathic Scoliosis

As for other treatments, there is disagreement as to whether chiropractic adjustment can reduce scoliosis angles.[15] Certain techniques, such as CBP and Pettibon have provided the most research through case studies or a case series.[15-18] In one case study, Dr. Morningstar observed a 15 degree reduction of scoliosis in a 20 year old,[16] while he and other researchers observed an average of 13.5 degree reduction in scoliotic curves of four patients under Pettibon care.[17] A case series of seven subjects under CBP found 28% correction in lateral flexion curvatures and 54% correction in lateral translations.[15] As for other techniques, upper cervical technique studies have seen 27-28% reduction in the Cobb angle,[19,20] while a study of a patient under the Pierce Results System™ witnessed a 62% reduction in the Cobb angle.[4]

Larger studies have found conflicting results as to whether chiropractic adjustments can reduce lateral curvatures. In support of correction, one group of 22 patients saw a 60% decrease on average in curvature.[21] Additionally, another group of 36 subjects revealed a 52% decrease in curve sizes less than 10 degrees and a 26% reduction in scoliotic curves that were between 10-30 degrees.[2] Lantz and Chen's observations differed from these larger studies. They observed 40 subjects to have on average less than a degree of reduction in their scoliosis after a year of chiropractic adjustments, heel lifts, and postural/lifestyle counseling.[22]

Regardless of the study size, the fact remains that these studies are all short term, and they do not investigate the long-term effects of chiropractic care. Currently, there is only one follow-up study that has been published regarding adolescent idiopathic scoliosis. Morningstar reported on a 14-year-old female with a scoliosis comprising of a 24 degree lateral thoracic curve and a 17 degree lateral lumbar curve. After the initial care of 17 months, her curvatures decreased by 9 and 11 degrees respectively. At a four-year follow-up, there was an additional reduction of scoliosis, respectively a 3 and 2 degree decrease in curvatures. These results reveal a 50% correction of the thoracic curvature and a 76% correction of the lumbar curvature since beginning chiropractic care. This study suggests that a patient can continue to see improvement in scoliotic curves managed with chiropractic. Morningstar pointed out the lack of long-term follow-up research with chiropractic care, defining a follow-up as "at least six months following conclusion of clinical treatment."[23] This absence is even more evident when compared to the number of studies following brace-treated-AIS patients.[9-13] This study's goal is to add to this lack of research by reinvestigating a previous study on AIS patient under the Pierce Results System™.[2]

Methods

Literature Review

A search of the long-term effects of non-treated and conservatively treated AIS was performed of PubMed and Index to Chiropractic Literature in November 2011. Searches in Index to Chiropractic Literature used the key words *scoliosis* combined with *correction, long-term,* and *follow up*, producing 14, 8, and 9 hits respectively. An additional search was made using the key-words *Pierce* AND *Results, scoliosis* AND

biophysics, scoliosis AND *pettibon,* which produced 24, 4, and 6 hits respectively. Searches in the Pub-med were made using the key-words *adolescent idiopathic scoliosis* combined with either *long term*, *NOT surgery*, and *chiropractic.* This produced 192, 531, and 18 hits respectively. To focus on information more pertinent and related for this study, an article was excluded if 1) treated subjects were adults, 2) curve correction was not measured, 3) surgical intervention was given prior to or during conservative treatment, or 4) were duplicated in other searches.

Design

This study was reviewed and approved by the institutional review board of the Foundation for Vertebral Subluxation. In the previous study, thirty-six subjects were studied and placed into one of two categories: a scoliosis group and a sub-scoliosis group. The eligibility of the patient for inclusion in the scoliosis group was determined by the following: 1) Had started care between 10/30/2010 and 2005, 2) age 0-18 years 3) Had a 'pre' lumbar film exhibiting scoliosis of at least 11 degrees as measured by Cobb-Lippman method and 4) Had a 'post' A-P lumbar film after at least 2 weeks of care. The sub-scoliosis group adhered to criteria 1, 2 and 4, but had curvatures between 7 to 10 degrees.[2] This study re-examined those same individuals and studied those that met the following additional criteria: 1) Had continued care after 10/30/2010 and 2) Had at least one additional 'post' lumbar film taken prior to 11/20/2011.

Of the original 36 patients, 24 continued care after the first 'post' film and 20 met both additional criteria. Ten were from the original scoliosis group and 10 were from the original sub-scoliosis group. Five of these 20 subjects were found to have multiple 'post' lumbar films; in these cases, the most recent film was selected for study. The Cobb-Lipmann method was used to measure the most recent progress of the curve so that a comparison could be made between the new values and the 'pre' and 'post'-film measurements observed in the previous study. All values were recorded into an Excel spreadsheet and each column was analyzed individually. Items recorded were age, sex, number of adjustments, duration of care prior to the latest film, and the absolute and percent change of the curve. To examine the maintenance and potentially additional scoliosis correction, the absolute and percent change was calculated from 1) the 'pre' lumbar film to the latest 'post lumbar film and 2) the first 'post' lumbar film to the latest 'post' lumbar film.

Intervention

All patients in the study were under care of the Pierce Results System[TM.] The system was designed to correct vertebral subluxation permitting proper spinal structure and motion restoration.[2,4] Normal spinal structure is understood to be straight with the head centered directly over the pubic symphysis in the anterior to posterior view, while four curves (two lordotic and two kyphotic) should be seen in the lateral view.[2,4,24] In regards to restoring motion, Danbert explained that scoliosis is a biomechanical problem that deserves a biomechanical treatment advanced by a chiropractic specialist.[25] The system is designed to analyze the abnormal structure, biomechanical dysfunction, and most importantly, the vertebral subluxation. The analysis involved a combination of tools: X-ray, videofluoroscopy and full spine paraspinal

thermography (measured by the Titron C-5000 in this study).

The intervention varied for each patient over the course of care in order to address each individual's unique structural and biomechanical dysfunction. Over the duration of the care, the use of these tools dictated where, when and how the adjustments were to be delivered. The type adjustment varied as the subject progressed through care. In the system, adjustments by hand, instrument, and pressure are all used to reduce and correct the vertebral subluxations. Hand adjustments involved the use of a drop table (the Zenith 230 Hilo drop table) and the instrument adjustments were delivered by the S.M.A.R.T. Adjuster SA201 or the VF Adjuster[TM] by Sigma Instrument Inc. At the beginning of care, hand adjusting was utilized first; however as care progressed, the instruments and/or pressures delivered the majority of adjustments.

Results

Scoliosis Group

The age range of the subjects was 7-16 years of age and included 10 subjects: 3 males and 7 females. The average span of time between the 'pre' lumbar film and the most recent 'post' lumbar film was 462.6 days (approximately 1.26 years), and the average number of adjustment given during that time was 17.6. At the time of the first 'post' film, the average initial improvement in the scoliotic curvature was 14.4%. There was an additional 7.6% improvement witnessed after the first post-film, and the average percent of total correction was 31.45%. A Two-Tail T-Test of these changes provided the following values of 0.31, 0.45, and 0.18 respectively; thus these corrections were not statistically significant ($p< 0.05$). Four subjects showed gradual improvement in their curve; two subjects showed an increase in their scoliosis over time; three showed regression after initial correction; and one showed an increase in scoliosis size following initial care before improvement was observed (Table 1).

Sub-scoliosis Group

The age range of the subjects was 4-17 and included 10 subjects: 3 males and 7 females. The average span of time between the 'pre' film and the most recent 'post' film was 618.5 days (approximately 1.7 years); and the average number of adjustments given during that time was 18.7. The initial improvement in the sub-scoliotic curve at the first 'post' film was 61.5%. On average, there was an additional 18.2% improvement seen after the first 'post' film, with an average total of 62.1% correction. A Two-Tail T Test of these changes provided the following values of 0.001, 0.78, and 0.00 respectively. Consequently, the initial changes and the changes seen over the course of entire care were statistically significant ($p<0.05$). Seven subjects showed continual improvement in their curves; two showed a regression after initial correction; and one showed a regression in their sub-scoliosis following initial care before improvement was observed (Table 2).

Both Groups

When all 20 subjects were combined, the mean initial decrease in curve size was 37.9%. There was an average 12.9% of additional reduction at the time of the first 'post' film, which

totaled to a mean of 46.8% correction over the course of care. The change observed after initial treatment and over the entire course of care was found to be statistically significant at 0.003 and 0.004 respectively (p<0.05).

Discussion

Of the 36 subjects included in the original study, 24 continued care and of those, only 20 had an additional film taken. During the time between the first 'post' film and the latest 'post' film, there was a 7.6% reduction on average for scoliotic curves, and a further 18% decrease for sub-scoliotic curves. The subjects had been receiving chiropractic care for 1 to 4 years with the average being approximately 1.5 years. At that time, the total decrease on average was 31.5% in the scoliosis group and 62.1% in the sub-scoliosis group. However, the results in the scoliosis group were not statistically significant. These concerns are addressed later in *limitations.*

These findings are similar to those found in Morningstar's case study. He witnessed not only initial correction, but also continual correction over the course of four years.[23] This trend was also observed in this study, and demonstrates the possible long-term benefits of chiropractic care on scoliosis. In comparison to bracing research, the long-term benefits of chiropractic have barely been explored, but the existing bracing research highlights issues of regression following the initial treatment of scoliosis. In Cochran's and Nachemson's study on Milwaukee bracing, bracing treatment resulted in an average 20% decrease in scoliotic curves. At the end of treatment (i.e after brace weaning), however, there was a 24% regression in the curve.[10] It appears that bracing is effective in decreasing scoliotic curves during treatment, but cannot be permanently maintained.

Further, Maruyama's literature review of long-term bracing studies suggested that regression during brace weaning is a likely phenomenon. He cites a study by Mellencamp et al., where on average a 40% correction was achieved during treatment, while a 17% regression occurred during the weaning process. Another study by Heine and Gotze in 1985 was cited, which observed 37% correction during bracing, but saw a 48% regression at the end of treatment. Maruyama reviewed Kumano's study in 1992, which saw a complete regression of curve size after the weaning period ended. In 2001, Danielsson and Nachmemson observed 28% correction with a 15% regression before the end of treatment. Though Maruyama concluded these studies a success for various other reasons,[11] the regression of curve size is probable during the weaning period of brace treatment; an explanation may be that bracing only addresses abnormal structure and fails to address biomechanical dysfunction.[25]

Chiropractic care in general implements a similar "weaning process," where patient visits will decrease in frequency as care progresses. As stated by Morningstar in the development of his treatment goals, it was very important that any spinal corrections were made without further compromising the patient's level of stability.[23] Stability is an important concern in AIS patients, and should be carefully assessed to avoid creating spinal hypermobility.[1,25] In this study, a decrease in patient visit frequency was noted as care progressed. Under the Pierce Results System, the scoliosis group would visit on average once every 9 days, while the sub-scoliosis group visited on average once every 16 days. Following the first 'post' film, a scoliosis patient on average made a visit once every 30 days, while the sub-scoliosis patient visited once every 43 days. It is important to note that as the frequency of visits decreased, the average curve size did not increase. Perhaps this finding, in comparison to brace weaning results, suggests a lasting correction that can be maintained despite a reduction in treatment. A much later follow-up would need to be done to explore this possibility.

This study may also reveal insight into using only chiropractic adjustments to reduce scoliosis. Morningstar explained that due to the combination of modalities used in the treatment plan, it was impossible to know which procedures had the biggest impact on her outcome.[23] In this study, the only intervention was the Pierce Results System[TM], which focuses on removing vertebral subluxation with specific adjusting only. Since no other modalities were used, this study suggests that chiropractic care alone could possibly be an effective means to conservatively treat idiopathic scoliosis.

The Pierce Results System

Detection of Subluxation

Even though the focus of this study presents data on structural correction of AIS, it is important to point out that the Pierce Results System[TM] intent is to correct vertebral subluxations, permitting proper structure and correcting biomechanical dysfunction. Dr. Walter V. Pierce created a normal spinal model of both structure and motion to illuminate the presence of vertebral subluxation.[4,24,26] The structural 'normals' in the lumbopelvic region are defined as the following: 1) heart-shaped pelvic opening, 2) almond shaped obturators, 3) level sacral base, femur heads and iliac crest 4) the coccyx sitting 1.5 inches directly above the pubic symphysis, 5) both ilium the same width from side to side, 6) no lumbar body rotation, 7) a lateral lumbar curve from +19-24+cm, 8) ischial tuberosities same distance from bottom of film, and 9) the film can be folded left over right and superimpose.[27] Dr. Pierce's observation and research of the videofluoroscopy defined the biomechanical 'normals,' which is used in combination in X-ray to determine where an adjustment may be delivered. It is the implementation of paraspinal thermography that determines the presence of a subluxation and dictates where and when an adjustment should occur.

Pierce was the first to develop and incorporate infrared paraspinal thermography into chiropractic analysis via creation of the derma-therm-ograph (DTG).[24] Since then, several other infrared thermographs have been developed. McCoy conducted an extensive literature review on paraspinal thermal scanning and its use to characterize vertebral subluxation. He concluded instrumentation to be a reliable and objective outcome measurement. However, more research is needed regarding the clinical interpretation and the relationship its has with health outcomes.[28]

As stated by Souza, scoliosis management is not a simple process where one can simply push on the apices that curve, or level out the base on which the spine sits. The picture is more complicated.[1] Dr. Vern Pierce acknowledged spinal intricacy and defined the differences between a misalignment, a fixation

and a subluxation, explaining how each was different and required the use of all tools to properly distinguish.[25] In particular, these tools thoroughly examine two components of earliest vertebral subluxation complex model: kinesiopathology and neuropathology.[2,4,24,29]

The Types of Adjustments

There are three categories of adjusting: hand adjustments, instrument and pressures. The hand adjustments are referred to as a "toggle-set" which is performed on a drop table, but does not utilize the recoil seen in traditional adjustments. Turo[24] and Jasewski[4] described this adjustment in more detail in their case studies of the system. The system is conservative in the use of these adjustments and thus more instrument and pressure adjusting is performed. The S.M.A.R.T. Adjuster SA201 or the VF Adjuster[TM] by Sigma Instruments Inc. are the instruments of choice, and the force, frequency and re-load can be altered to deliver more precise adjustments,[24] Pressure adjusting is based upon the Nimmo-Receptor Tonus Technique, which utilizes ischemic compression to remove myofacial trigger points that are due to metabolic waste stasis that irritates nerves and produces pain.[4] These are believed to exacerbate the vertebral subluxations,[23] and are shown to change patterns when addressed.[4,24]

Limitations

As pointed out in previous studies, there are limitations to using the Cobb-Lippman angle. Scoliosis is three-dimensional condition involving a combination of lordosis, rotation and lateral deformity that cannot be accounted for with a two dimensional measurement. In addition, there are validity and reliability measurements when using the method.[2,30] However in order to effectively compare our data and draw conclusions to Smith's study[2] and other previous studies,[3-24] this method was selected.

As in the previous study, patient compliance was again not thoroughly examined. Some speculations were made utilizing a feature in 'Platinum' chiropractic software system that notes the number of missed appointments. It is interesting that the three patients who had an increase in their scoliotic curve, revealed a higher number of missed appointments in comparison to others. Unfortunately, missed appointments alone are not a valid measurement of compliance, but this finding should be further explored. Detailed notes were not made concerning compliance, which is a limitation to this retrospective case study.

Despite the marked average decrease in the Cobb-Lippman angle of the scoliosis group (31%), the change was not found to be statistically significant. In fact, the initial correction was not statistically significant either, which was not the case in the previous study. It is possible that this finding may be linked to the difference in sample size. A further investigation compared the initial correction (i.e. the change seen between the 'pre' film and first 'post' film) seen in the original scoliosis group to the amount of change observed in the follow-up scoliosis group. The initial correction seen in this study was on average 12% less than the change observed in the original group. This detail points out that the four excluded patients may have had improvements in care that made the average correction higher

in the original scoliosis group; therefore, a subject's progress in care may have led to an inadvertent selection bias.

Of the original scoliosis group, two patients were found to fail inclusion criteria #1; meaning, they discontinued care prior to this study. It is noteworthy that both excluded subjects saw a 55% decrease in the size of their scoliosis. Though the true reasoning is unknown, perhaps the initial improvements in spinal biomechanics and nervous system function led the subject to believe they no longer needed care. Also, it was found that the other two excluded subjects had met inclusion criteria #1, but failed #2; meaning, they had continued care, but did not have an additional 'post' film to study. These patients also saw a 53% and 58% reduction in their scoliotic curve. In the Pierce Results System[TM], the use of videofluoroscopy is often utilized to perform a 'quick check-up'. The use of the equipment is ideal for this purpose, because one can monitor the majority of structural and biomechanical progress, while exposing the patient to less radiation.[2,24,26,31] Reasons for taking an additional post-film may be a new history of trauma or a sudden and unexplained pattern.[27] This would mean that the system itself decreases the opportunity to take additional films in cases that showed success initially. This is the limitation of a retrospective study, and a solution is mentioned later. Whether the patient failed one or both criteria, each case had seen at least 53% improvement in their initial curve; the remaining subject only averaged 14.4%. The decrease in sample size may have skewed the data and changed the significance in our results.

Future Research

This study demonstrates a need for more research on the long-term impact chiropractic care has on scoliotic curves. Bracing has shown that scoliosis may regress towards the original Cobb angle measurement when treatment decreases or has ended.[10,11] A longer follow-up on AIS cases would reveal the potential of regression under chiropractic care. Also, health out-comes have been shown to be improved after total compliance with brace treatment. Future studies on the long-term affects of chiropractic should examine not only the curve angles, but also the quality of life and physiological function of AIS patients. Finally, a prospective case series should be done to avoid selection bias from patient compliance, discontinuation of care, and X-ray re-evaluation.

Conclusion

This is the first retrospective case series to follow-up on chiropractic management of idiopathic scoliosis. During chiropractic care, which ranged anywhere from one to four years, a continual trend of structural improvement was observed. This trend was not only observed for the group overall, but also in each group. The whole group (20 subjects) was observed to have an additional 12.9% decrease in curve size following initial care. This resulted in a 46.8% mean decrease over the course of care, which was found to be statistically significant (p<0.05). Furthermore, the curve size of the scoliosis and sub-scoliosis group also decreased over the course of care. The 10 subjects in the scoliosis group had a mean total of 31.5% of correction, while the 10 subjects in the sub-scoliosis group had a mean total of 62.1% correction.

Only the correction seen in the sub-scoliosis group was found

to be statistically significant ($p<0.05$). The literature on bracing frequently pointed out regression of scoliotic curves during weaning period and following the end of treatment.[9-13] Further investigation in this study revealed that while the frequency of patient visits decreased following initial care, the mean curve size did not increase.

These results suggest that: 1) the Pierce Results System[TM] may provide a way to reduce scoliotic curvatures by removing vertebral subluxation without using other interventions and 2) specific adjusting of vertebral subluxations could help decrease scoliotic curves with minimal risk of curve regression. The limitations of this study due to the inclusion criteria, patient compliance, and sample size are evident.

When compared to the amount of long-term research that has been done on bracing,[1-14] this study alone does not provide any absolute conclusions. As Morningstar stated, there is a need for more follow-up research on chiropractic management of scoliosis.[23] This study highlights the potential implication that subluxation-based chiropractic may have on the AIS population.

Acknowledgements

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Tables

Patient #	Initial % Change	% change since 1st 'post' film	Total % change	Length of Initial Care (Days)	Length of Total Care
1	0.0	28.6	28.6	15	346
2	4.2	8.3	13.0	19	672
3	0.0	-72.7	-72.7	44	392
4	-20.0	-70.0	-75.0	50	463
5	-45.5	33.3	-27.3	81	1014
6	-15.0	-35.3	-45.0	30	345
7	-81.8	100.0	-63.6	35	371
8	-13.3	-46.2	-53.3	35	367
9	3.7	50.0	44.4	4	303
10	24.1	-72.4	-63.6	80	353
Average	-14.36	-7.64	-31.45	39.30	462.60
TTESTs	0.312956129	0.45750859	0.184368856		

Table 1. Summary of correction seen in scoliosis group (curves between 10-30 degrees).

Patient #	Initial % Change	% change since 1st 'post' film	Total % change	Length of Initial Care (Days)	Length of Total Care
11	-44.4	-16.7	-44.4	96	363
12	-42.9	-75.0	-85.7	52	1652
13	-88.9	0.0	-88.9	54	335
14	-100	100.0	0.0	158	533
15	-100	50.0	-50.0	42	378
16	-44.4	-80.0	-88.9	380	1101
17	-88.9	-100.0	-100.0	163	714
18	-100	0.0	-100.0	99	338
19	-14.28	-33.3	-42.9	32	462
20	9.1	-27.3	-20.0	26	309
Average	-14.36	-7.64	-31.45	110.20	618.50
TTESTs	0.001189773	0.786591378	0.000407283		

Table 2. Summary of correction seen in sub-scoliosis group (curves less than 10 degrees).