RELATIONSHIP OF BILATERAL SCALES

TO

POSTURAL ASSESSMENT

By

Connie L. Dunn

Lori P. Huffman

Garrett L.Willison

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Advisor: Donna Mannello, D.C.
Logan College of Chiropractic

ABSTRACT

Objective: To assess the validity of replacing a subjective finding, visual postural analysis, with a more objective finding, bilateral weight distribution.

Design: Experimental study.

Setting: Trimester 2 Logan Basic Class of Logan College of Chiropractic, Chesterfield, Missouri.

Subjects: Thirty-seven consecutive chiropractic student volunteers.

Intervention: Subjects were marked (iliac crests and second sacral tubercle), posturally analyzed using a Spinal Analysis Machine (SAM), and weighed on bilateral scales.

Main Outcome Measures: Kappa statistical analysis of the relationship of bilateral weight scale readings to iliac crest height, shoulder height, and right/left body lean.

Results: Poor to slight relationship was determined to exist with regard to weight-bearing on bilateral scales and assessment of right/left body lean, high iliac crest, and high shoulder.

Conclusion: The research suggests that objective findings of bilateral weight scale readings cannot replace subjective postural analysis findings.

Key Indexing Terms: Chiropractic, Bilateral Scales, Postural Assessment, Weight-Bearing

Relationship of Bilateral Scales to Postural Assessment

INTRODUCTION

Abnormal posture has long been recognized by chiropractors, either to be a result of abnormal relationships within the body, or to be a contributing cause of abnormal relationships. Postural analysis provides the doctor with a general impression of biomechanical adaptations/alterations that have occurred in response, either to stresses in the patients' environment, or to their genetic composition. In either case, postural assessments can provide essential information and input for developing a treatment plan to remove the cause of patients' dis-ease, restore optimum function, and monitor progression/success of treatment. Postural analysis can also be incorporated into patient education (3,6,7). However, visual postural analysis tends to be somewhat subjective and difficult to quantify.

Bilateral scales have been proposed as a relatively inexpensive tool that can be used to quantify weight-bearing aspects of patient posture and to assess the progress of treatment (1).

Postural analysis of iliac crest height, shoulder height, and right/left body lean has often been performed by subjective visualization with questionable inter-examiner reliability. Objective weight distribution changes on bilateral scales would be more easily demonstrated to the patient than subjective postural changes to treatment. This would be a valuable tool in patient education and patient compliance.

Therefore, this study was undertaken to determine if an objective finding of bilateral weight could replace a subjective finding of postural analysis.

MATERIALS AND METHODS

There are many approaches to postural analysis which utilize various anatomical landmarks. A simplified approach is to compare the patient's right side to left side using the heights of the shoulders and iliac crests to determine if a difference exists. To distinguish right/left body lean, a plumb line is aligned with the patient's second sacral tubercle. When viewed from the posterior, with the patient looking straight ahead, body lean is evaluated by the relationship of the external occipital protuberance (EOP) to the plumb line. The criteria below is utilized to evaluate this finding:

Even (no lean)	The plumb line passes through the EOP
Right Lean	The EOP is to the right of the plumb line
Left Lean	The EOP is to the left of the plumb line

This study was initially designed with the intent of using of a Spinal Analysis Machine (SAM) with built in bilateral scales. This would have allowed assessment of posture and weight simultaneously. Due to the unavailability of that specific SAM unit at Logan College of Chiropractic, alterations in our materials and methods were necessary which resulted in limitations. The study's limitations are addressed later in this paper.

The SAM used in this study was comprised of a metal framework, with attached heel guides to aid in correct positioning of the patient, and wire lines that could be set parallel (at the levels of the shoulders and the iliac crests) and perpendicular to the floor (at the second sacral tubercle) for assessment of weight-bearing standing posture.

Two spring loaded scales secured in a single platform served as our bilateral scales. Scale calibration and accuracy were verified by the use of known weights. Two twenty-five pound weights were placed on each scale. The scales were further tested by adding thirteen increments of five pounds (sixty-five pounds) on each scale. Thus, each scale was evaluated up to one hundred fifteen pounds.

Three stations and equipment were set up the night before. The stations were behind screens within a twelve foot length.

Volunteers were consecutively selected from the Logan College of Chiropractic Trimester Two Logan Basic Class in accordance with the ethical standards of the Committee of Human Experimentation of Logan College. This class was selected based on time of day and because the students were already gowned. A total of thirty-seven students participated. After each subject read and signed an informed consent form, (s)he proceeded to station one where marks were made with a wax pencil at the iliac crests and the second sacral tubercle.

At the second station, the subjects were instructed to back in against the SAM, with their heels in the heel guides, hands at their sides, and looking straight ahead. Using the adjustable wire lines, postural assessment was made. Recorded information included shoulder and iliac crest height (high right, high left, even), and body lean (right, left, or even).

The subjects then proceeded to the third station and were instructed on how to mount the bilateral scales, where to place their feet on each scale, and to stand with arms at their sides looking straight ahead. Weight readings were recorded from both scales as soon as the needles stopped moving. The subject was asked to dismount. The scales were then reread to verify that they both reset to zero.

RESULTS

Using Kappa statistics, only poor to slight relationships were found to exist between side of weight dominamce (right, left, or even) and any of our three postural references, shoulder height, iliac crest height, or body lean (right, left, or even).

As a side note, relationships between shoulders and iliac crests, between shoulders and body lean, and between iliac crests and body lean were also shown have a poor to slight relationship.

Table I is a summary of the data and Kappa statistical analysis. Table II interprets the Kappa values.

DISCUSSION

" ... health and good posture are almost synonymous" (4). Chiropractic offers a wholistic approach to health with emphasis on wellness, patient education, and encouragement for patients to take an active role in the maintenance of their health. Instead of offering localized treatment restricted to the area of patient complaint, the doctor of chiropractic is trained to examine the entire patient, including postural assessment. Patient examination provides an opportunity to inquire about history (medical, family, social), living habits, and work conditions that may have either a direct or indirect influence on the patient's posture, and therefore biomechanical and physiological states.

There is a significant amount of literature on the subject of posture and the relationship of abnormal posture to bodily dysfunction. Postural analysis and the concepts of somatovisceral and viscerosomatic reflexes are taught in chiropractic colleges and are widely accepted within the profession. Much has also been published on methodologies of postural examination and assessment.

The earliest reference to bilateral scales appears to be by Hugh B. Logan, D.C., in his discussion of "effect of abnormal weight distribution on the health of the body." He reasoned that half of the total body weight should be evenly distributed through each foot, but in the majority of cases, this even distribution of body weight is not found because of postural distortions (7).

More than twenty-five years after Logan's work, P. L. Aiken, D.C., used bilateral weight measurements as part of his standard office protocol (1). According to Aiken, an increase in weight is maintained on the high side of the foundation in acute patients and on the low side in chronic patients. He found most patients have chronic postural alterations and thus, weight-bearing, possibly, may be used to predict length of treatment time required. Aiken also states that a change in weight differential following an adjustment is an indicator that a corrective effort has been applied and that progress can be charted using bilateral scales. Aiken recommended the use of electronic scales as they "register the bilateral weight difference without allowing the patients to feel their usual equalization effort that spring scales make obvious." He noted a two to five pound shift back and forth and states that the weight should be taken in the "middle of this excursion (1)."

In 1973, Murray and Peterson published a study on shifting during normal standing posture. Subjects were told to "Stand as you normally do, looking straight ahead, with arms at your sides." The study demonstrated that quiet standing is a dynamic event as is consistent with other studies. Weight shifting is random and variable in amplitude both within given test periods and among the various subjects. None of their one hundred sixty observations showed equal average weight-bearing between the two feet. Ninety-five percent of the normal sample ranged from 13.4 kilograms more weight on the right to 12.6 kilograms more on the left. They felt that the differences were probably not due to unequal weights of the right and left portions of the body, although some effect may be from asymmetrical arrangements of thoracic and abdominal viscera. Interestingly, only fifty-four percent of the observations had greater weight-bearing on the dominant side thus dominance could not be used as a weight predictor (9).

They concluded that "the average weight distribution between the first and last fifteen seconds of each test period of one minute showed no statistically significant differences." They noted that all subjects had a "slow but incessant reciprocal shifting of weight from one foot to the other" with many having a "gradual progressive lateral drift" throughout the test (9). This study was important for us in that we felt recording the subject's weight immediately would not compromise our study.

In support of our landmarks for postural assessment, we referred to an article published in the Digest of Chiropractic Economics in 1983. Dr. E. V. Brown compared radiographic visualization to surface visualization of postural assessment landmarks. In comparing relative positions of the sacrum and the "neck center line", he concluded external anatomical landmarks are "valid structures to determine ... position (2)."

The medical profession has also been interested in posture and weight-bearing studies. Two articles in particular relate postural alteration due to leg length inequality (LLI) with weight distribution.

G. N. Ronstrom, M.D., an Associate Professor of Anatomy, Louisiana State University School of Medicine, published a study comparing leg length and weight-bearing. This study was prompted by frustration in treating chronic low back pain patients. Sixty-seven medical students were tested for LLI by measuring the distance from the anterior superior iliac spine to the medial maleoli while in a supine position. Two of the subjects had a deficiency of one inch or greater. Nineteen subjects had roughly a one-half inch deficiency. The remaining forty-six subjects had a negligible deficiency. Dr. Ronstrom concluded "A definite group stood with both the greater weight and greater leg length on the same side (11)."

R. K. Mahar, M.D., published an article in 1985 in Archives of Physical Medical Rehabilitation, on leg length discrepancy and its effect on center-of-pressure. Fourteen subjects stood on a force platform with data recorded and stored in a computer. Each subject was tested with no lifts and then with one, two, three, and four centimeter lifts to simulate leg length discrepancies. The study showed "A simulated leg-length discrepancy of one centimeter produced a statistically significant shift in the mediolateral position of the center-of-pressure toward the longer leg. Increasing the discrepancy did not produce a proportionally greater shift." Noted in the article was the phenomenon that "raising one side of a rigid object shifts the center-of-pressure to the low side" but the "opposite occurred" in their subjects. The conclusion was drawn that compensation does occur (8).

We did not examine LLI in our subjects. One would, however, expect LLI to be reflected in iliac crest height. The scope of our study was limited to recording bilateral weight, right/left or even body lean, right/left or even shoulder height, and right/left or even iliac crest height.

The following conditions, encountered during our study, produced limitations that impacted this study:

1. The SAM used in our study did not have built in scales. Subjects had to walk three feet from the marking station to the SAM and another three feet from the SAM to the bilateral scales. We would have preferred to do all measurements simultaneously.
2. Although every effort was made to verify the accuracy of the scales, some problems were noted. After the study was completed, a male student returned to be weighed on a single scale. His weight did not equal the sum of his bilateral scale readings. When he again stepped on the bilateral scales, his readings were different but weight-bearing dominance remained the same. The same was done with a female student where the sum of the bilateral readings did equal the unilateral reading and side of dominance was consistent with the initial reading.
3. Noted by Murray and Peterson (9) was side to side variability in weight distribution and shifting during normal standing posture. In order to limit this influence, weight was read as soon as possible.

4. The SAM had a loose horizontal wire for shoulder height. Many of the shoulder heights were visualized without the aid of the SAM.

Recommendations to improve further attempts at this study include the use of digital scales rather that spring loaded scales as suggested by Aiken (1). The scales should be incorporated into the platform of the SAM so that simultaneous weight-bearing and postural analysis could be accomplished. It is imperative that the SAM be in proper working order with no loose wires.

Recommendations for related study would be to establish whether or not individual subjects demonstrate a consistent dominant side of right/left body lean, shoulder height, and iliac crest height when measured repetitively over a brief period of time. If an individual consistency was demonstrated, then it would be interesting to determine if chiropractic adjustment would have a significant effect on the established patterns of dominance.

CONCLUSION

Using Kappa statistical analysis, a poor to slight relationship was determined to exist with regard to weight-bearing on bilateral scales and assessment of body lean, shoulders, and iliac crests. Based on this study, the objective findings of bilateral weight scale readings cannot replace subjective postural analysis findings.

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Table I

Data and Kappa Statistical Analysis

	Weight vs Body Lean			
Weight	Body Lean			
	Right	Left	Even	Totals
Right	5	5	10	20
Left	5	8	3	16
Even	0	1	0	1
Totals	10	14	13	37

n = 37

Po = 0.351

Pc = 0.319

Kappa = 0.047

	Weight vs High Shoulder			
Weight	High Shoulder			
	Right	Left	Even	Totals
Right	6	15	0	21
Left	5	9	1	15
Even	0	1	0	1
Totals	11	25	1	37

n = 37

Po = 0.405

Pc = 0.443

Kappa = - 0.068

	Weight vs High Iliac Crest			
Weight	High Iliac Crest			
	Right	Left	Even	Totals
Right	3	4	13	20
Left	2	9	5	16
Even	1	0	0	1
Totals	6	13	18	37

n = 37

Po = 0.324

Pc = 0.253

Kappa = 0.095

Table I

(Continued)

	High Shoulder vs Body Lean			
High Shoulder	Body Lean			
	Right	Left	Even	Totals
Right	1	6	3	10
Left	8	8	10	26
Even	0	1	0	1
Totals	9	15	13	37

n = 37
Po = 0.243
Pc = 0.360
Kappa = - 0.183

	High Iliac Crest vs Body Lean			
High Iliac Crest	Body Lean			
	Right	Left	Even	Totals
Right	1	3	2	6
Left	3	5	5	13
Even	5	6	7	18
Totals	9	14	14	37

n = 37
Po = 0.351
Pc = 0.356
Kappa = - 0.008

	High Shoulder vs High Iliac Crest			
High Shoulder	High Iliac Crest			
	Right	Left	Even	Totals
Right	2	2	6	10
Left	4	10	12	26
Even	0	1	0	1
Totals	6	13	18	37

n = 37
Po = 0.324
Pc = 0.304
Kappa = 0.029

Table II

Kappa Interpretation

Kappa Value	Meaning
< 0	Poor
0.00 - 0.20	Slight
0.21 - 0.40	Fair
0.41 - 0.60	Moderate
0.61 - 0.80	Substantial
0.81 - 1.00	Almost Perfect