DYNAMIC ASSESSMENT FOR CHIROPRACTORS

A Study Conducted by Active Education in Conjunction with Dr. Todd McDougle and the IN Chiropractic and Wellness Clinic using the McDougle Chiropractic Methods

ABSTRACT

Doctors of Chiropractic routinely diagnose and treat patients based on static measurements. This study evaluates dynamic assessment technology from Active Technologies, known as the Dynamic GaitForce™ Assessment. This technology captures an active gait cycle in the shoe. The result is a dynamic assessment that shows a map of the active foot pressures and the symmetry ratio of the patient all captured during a full gait cycle.

This study evaluates the technology by dynamically measuring the foot pressures and symmetry ratios of patients before and after chiropractic treatment. This study evaluated 18 patients in the offices of Dr. Todd McDougle, the owner of the IN Chiropractic and Wellness Clinic and the inventor of the McDougle Chiropractic Methods. In some cases, a second treatment during the same visit was applied to the lower extremities based on the doctor's opinions of the assessment results after the first treatment.

Dr. Todd McDougle, using the McDougle Chiropractic Methods (MCM), performed all treatments in this study.

INTRODUCTION

The purpose of this study is to:

(1) evaluate the usefulness of dynamic assessments in assessing and treating chiropractic patients
(2) evaluate dynamic assessments and its ability to diagnose leg length discrepancy (LLD)
(3) evaluate dynamic assessments and its ability to show the efficacy of ongoing chiropractic treatment

This study shows a direct correlation between the chiropractic treatment and improvement in the symmetry ratio as measured with the dynamic assessment. It also shows a direct correlation between the chiropractic treatment and the lowering of foot pressures. In some cases the post-treatment measurement suggested the need for another treatment or a specific ankle manipulation during the same visit. The technology assisted in guiding the adjustment process to maximize benefits to the patient.

Patient engagement also increased when patients could see improvements in their foot pressures and symmetry ratio post-treatment. Because of the correlations between treatment, foot pressures and the symmetry ratio, the conclusion is this technology is useful in assessing and treating chiropractic patients, diagnosing LLD and proving the efficacy of chiropractic treatment.

METHODOLOGY

Dr. McDougle and his staff conducted this study at the offices of the IN Chiropractic and Wellness Clinic. Dr. McDougle selected the patients to participate in the study based on patient history and other criteria including a previous diagnosis. Eighteen patients with a wide variation of physical dynamics related to leg length issues, scoliosis, and post surgical hardware were evaluated, which included a dynamic assessment prior to (pre-treatment) and after treatment (post-treatment) and a review of initial x-ray data as available.

Five patients required a second adjustment to the lower extremities on the same visit after Dr. McDougle reviewed the findings of post-treatment one. The study was conducted between August 3, 2015 and September 23, 2015. All findings are included in the results. When a patient was added to the study, the Active Technologies' system randomly generated the patient identification (Patient I.D.). Table 1.1 summarizes the patient profiles.

Table 1.1: Patient Profile

Patient I.D.	Gender	Age	Prior Visits	Patient I.D.	Gender	Age	Prior Visits
24	M	63	0	37	M	47	13
28	M	44	18	38	M	62	4
29	F	36	8	39	M	35	29
30	M	46	24	41	M	12	13
31	M	15	17	42	M	55	3
32	M	38	43	43	F	14	0
33	M	09	17	45	M	38	>44
35	M	31	29	46	M	20	6
36	M	43	15	48	F	44	>44

Except for two new patients, all the patients were under the ongoing treatment of Dr. McDougle. Patients were 17 percent woman and 83 percent male ranging in ages from nine to 63 years. Patients had prior visits from zero to >44. Patients represented an appropriate cross section of Dr. McDougle's practice.

The Dynamic GaitForce Assessment used in this study consisted of a pressure sensor array placed in the shoe of each patient. Each patient walked for 30 seconds and then switched the sensor to the other shoe until both feet were recorded. The same sensor was used for recording the pressures of each foot to eliminate variances from switching sensors. The system collected pressure readings, calculated total pressures for the fore foot, arch, heel, total area of each foot and calculated a symmetry ratio. The symmetry ratio was calculated by comparing the total pressures of both feet.

RESULTS

Table 2.1 summarizes the pre and post treatment symmetry ratios together with the percent change. In Table 2.1, the post-treatment column is after the final treatment, which for patients 29, 35, 42, 45, and 48 was a second treatment during the same visit.

Table 2.1: Symmetry Ratio Findings

Patient I.D.	Gender	Age	Prior Visits	Pre-Treatment Sym Ratio	Post-Treatment 1 Sym Ratio	Post-Treatment 2 Sym Ratio *	*Overall % Change Sym Ratio*
24	M	63	0	0.88	0.91	n/a	*3.3%*
28	M	44	18	0.97	1.00	n/a	*3.0%*
29	F	36	8	0.99	0.97	0.99	*0.0%*
30	M	46	24	0.97	0.99	n/a	*2.0%*
31	M	15	17	0.97	0.97	n/a	*0.0%*
32	M	38	43	0.94	0.99	n/a	*5.1%*
33	M	09	17	0.91	0.98	n/a	*7.1%*
35	M	31	29	0.99	0.94	0.95	*-4.2%*
36	M	43	15	0.96	0.99	n/a	*3.0%*
37	M	47	13	0.94	0.93	n/a	*-1.1%*
38	M	62	4	0.96	0.97	n/a	*1.0%*
39	M	35	29	0.99	0.96	n/a	*-3.1%*
41	M	12	13	0.98	0.93	n/a	*-5.4%*
42	M	55	3	0.91	0.90	0.95	*4.2%*
43	F	14	0	0.97	0.97	n/a	*0.0%*
45	M	38	>44	0.97	0.92	0.93	*-4.3%*
46	M	20	6	0.88	0.96	n/a	*8.3%*
48	F	44	>44	0.88	0.88	0.97	*9.3%*
						Mean:	**1.6%**

* After reviewing the post-treatment one assessment, the doctor determined another treatment during the same visit was needed.

Changes in symmetry ratios ranged from a negative 5.4 percent to a positive 9.3 percent with a mean of 1.6 percent. Positive scores represent improvements in the ratio post treatment. Overall, 55.5 percent of the participants recorded improvement in their symmetry ratio while 27.8 percent saw a decrease and 16.7 percent saw no change. It is noted that patient 37 had a torn meniscus at the time of the measurement.

RESULTS (continued)

Table 2.2 shows that 11.1 percent of the participants had an increase in both foot pressures post-treatment while 16.7 percent saw an increase in only one foot after treatment. The remaining 72.2 percent realized a reduction in pressures on both feet. The mean of the data set is a reduction in foot pressures between 6.6 and 7.3 percent.

Table 2.2: Foot Pressure Findings

Patient I.D.	Gender	Age	Prior Visits	Pre-Treatment Foot Pressure (PSI) Left	Pre-Treatment Foot Pressure (PSI) Right	Post-Treatment Foot Pressure (PSI) Left	Post-Treatment Foot Pressure (PSI) Right	*% Change Foot Pressure Left*	*% Change Foot Pressure Right*
24	M	63	0	171.6	195.3	98.2	108.0	*-42.8%*	*-44.7%*
28	M	44	18	131.6	128.0	126.6	126.7	*-3.8%*	*-1.0%*
29	F	36	8	137.5	136.4	135.6	136.4	*-1.4%*	*0.0%*
30	M	46	24	107.0	103.4	106.7	105.3	*-0.3%*	*1.8%*
31	M	15	17	66.4	68.3	58.0	56.4	*-12.7%*	*-17.4%*
32	M	38	43	88.1	93.6	76.9	78.0	*-12.7%*	*-16.7%*
33	M	9	17	40.3	44.5	42.3	41.6	*5.0%*	*-6.5%*
35	M	31	29	145.9	147.6	135.2	128.4	*-7.3%*	*-13.0%*
36	M	43	15	122.5	128.2	114.8	115.8	*-6.3%*	*-9.7%*
37	M	47	13	128.7	121.0	132.3	122.7	*2.8%*	*1.4%*
38	M	62	4	127.9	132.8	121.7	125.4	*-4.8%*	*-5.6%*
39	M	35	29	174.1	171.8	159.7	154.1	*-8.3%*	*-10.3%*
41	M	12	13	53.9	55.0	49.5	53.0	*-8.2%*	*-3.6%*
42	M	55	3	123.7	112.3	126.9	121.1	*2.6%*	*7.8%*
43	F	14	0	53.6	55.2	49.5	51.3	*-7.6%*	*-7.1%*
45	M	38	>44	111.7	116.9	121.4	112.9	*8.7%*	*-3.4%*
46	M	20	6	107.1	94.8	97.2	93.7	*-9.2%*	*-1.2%*
48	F	44	>44	76.5	67.1	67.4	65.2	*-11.9%*	*-2.8%*
							Mean:	***-6.6%***	***-7.3%***

Patient 37 had a torn meniscus at the time of the measurement.

The collective data presented in Tables 2.1 and 2.2 are shown in Table 2.3 that follows.

RESULTS (continued)

Table 2.3 presents combined data relating to overall change in symmetry ratios and the overall change in foot pressures.

Table 2.3: Combined Pressure and Symmetry Data

Patient I.D.	% Change Sym Ratio	% Change Foot Pressure Left	% Change Foot Pressure Right	*Improved Sym Ratio*	*Reduced Foot Pressures Left*	*Right*	*Both*
24	3.3%	-42.8%	-44.7%	*yes*			*x*
28	3.0%	-3.8%	-1.0%	*yes*			*x*
29	0.0%	-1.4%	0.0%	*no change*	*x*		
30	2.0%	-0.3%	1.8%	*yes*	*x*		
31	0.0%	-12.7%	-17.4%	*no change*			*x*
32	5.1%	-12.7%	-16.7%	*yes*			*x*
33	7.1%	5.0%	-6.5%	*yes*		*x*	
35	-4.2%	-7.3%	-13.0%	*no*			*x*
36	3.0%	-6.3%	-9.7%	*yes*			*x*
37	-1.1%	2.8%	1.4%	*no*			
38	1.0%	-4.8%	-5.6%	*yes*			*x*
39	-3.1%	-8.3%	-10.3%	*no*			*x*
41	-5.4%	-8.2%	-3.6%	*no*			*x*
42	4.2%	2.6%	7.8%	*yes*			
43	0.0%	-7.6%	-7.1%	*no change*			*x*
45	-4.3%	8.7%	-3.4%	*no*		*x*	
46	8.3%	-9.2%	-1.2%	*yes*			*x*
48	9.3%	-11.9%	-2.8%	*yes*			*x*

Table 2.3 shows the following results:

(1) A 88.9 percent positive correlation between foot pressures and chiropractic treatment
(2) A 72.2 percent positive correlation between symmetry ratio and chiropractic treatment
(3) A 94.4 percent positive correlation between symmetry, foot pressures and chiropractic treatment

Patient 37, who had a torn meniscus, is the only patient that did not realize either a reduction in foot pressure or an improved symmetry ratio, suggesting *at least* a 94.4 percent positive correlation between the treatment and the improvement.

RESULTS (continued)

The symmetry ratio reflects the balance between the sides of the body during an active gait cycle. Studies have shown there is a shift in the center of gravity towards the shorter leg resulting in higher pressures for the shorter leg. Based on this center of gravity shift, the symmetry ratio values obtained from the pre-treatment dynamic assessment were compared with pelvic tilt data obtained from initial visit x-rays of the patients.

Table 2.4 shows the results of the comparison of x-ray data with the dominant pressure.

Table 2.4: X-ray Pelvic Tilt Data Compared to Foot Pressure Balance

Patient I.D.	Gender	Age	X-rays Pelvic Tilt	Active Pressure Balance	Match	Notes
24	M	63	R	R	√	
28	M	44	L	L	√	
29	F	36	L	L	√	
30	M	46	R	L	X	
31	M	15	R	R	√	
32	M	38			n/a	No x-ray data
33	M	09	L	R	X	
35	M	31	R	R	√	
36	M	43	R	R	√	
37	M	47	R	L	X	Torn left meniscus
38	M	62	R	R	√	
39	M	35	R	L	X	
41	M	12	R	R	√	
42	M	55	L	L	√	
43	F	14	R	R	√	
45	M	38	R	R	√	
46	M	20	R	L	X	
48	F	44	L	L	√	

Table 2.4 indicates a 70.6 percent correlation of the symmetry ratios with the pelvic tilt data from x-rays. Further studies are suggested to minimize anatomical versus functional LLD considerations, effects of previous adjustments (treatment), and knee injuries (patient 37 had a torn meniscus) all of which can contribute to asymmetrical pressures.

CONCLUSIONS

The majority of the patients participating in the study were being treated on a regular basis. Still, over half of the patients improved their symmetry with an adjustment showing routine visits are a necessary part of treatment. Over 70 percent of the patients reduced foot pressures in both feet and 88.9 percent of the participants realized reduced foot pressures in at least one foot. It is also noted that in five situations, the doctor modified the focus of the adjustment based on the post-treatment one dynamic assessment result. This leads to the conclusion that the dynamic assessment is useful in assessing and treating chiropractic patients and can be used as a quick, practical guide for the doctor and lead to increased patient satisfaction.

The symmetry ratio values obtained from the pre-treatment assessment for each patient were compared with pelvic tilt data obtained from initial visit x-rays of the patients. This comparison resulted in a 70.6 percent correlation of the symmetry ratios and pelvic tilt data from x-rays. Further studies are suggested to minimize anatomical versus functional LLD considerations, effects of previous treatments, and injuries. It is clear from this study that there is a positive correlation between active foot pressures and leg length discrepancy, making it reasonable to conclude that this technology can be used to diagnose LLD.

All of the data considered a correlation between treatment and positive results. Except one, all of the patients were being treated on an ongoing basis. This study shows the dynamic assessment technology as a viable way to demonstrate the efficacy of ongoing chiropractic treatment. Further studies are suggested to understand the relationship between new patients not being treated and their pre-treatment symmetry ratio and active foot pressures.

OTHER RELEVANT STUDIES

1. Use of force platform variables to quantify the effects of chiropractic manipulation on gait symmetry. Robinson RO, Herzog W, Nigg BM University of Calgary, Biomechanics Laboratory/Research, Faculty of Physical Education, Alberta, Canada. Journal of Manipulative and Physiological Therapeutics [1987, 10(4):172-176].

   Results Summary: There was a distinct tendency towards improved gait symmetry after treatment in those cases where the gait was asymmetric prior to the treatment. This result indicated that force platform measurements may be used successfully to assess the effects of spinal manipulations on the gait of patients with sacroiliac dyskinesia.

2. Quantifying the effects of spinal manipulations on gait using patients with low back pain. Herzog W, Nigg BM, Read LJ University of Calgary, Biomechanics Laboratory/Research, Alberta, Canada. Journal of Manipulative and Physiological Therapeutics [1988, 11(3):151-157].

   Results summary: The clinical results suggest that chiropractic treatments reduce pain, increase mobility of the sacroiliac joint, and restore general functional ability of the patient. Force results obtained by using a force platform during gait of the subjects showed that external forces were significantly different for gait trials executed after chiropractic treatment compared to gait trials executed before chiropractic treatment. Force results were also significantly different for gait trials executed early in the rehabilitation process compared to those executed late in the rehabilitation process.

3. Gait Asymmetry in Patients with Limb-Length Inequality. Kaufman, K R Ph.D.; Miller, L. S. M.D.; Sutherland, D. H. M.D. Journal of Pediatric Orthopaedics:. March/April 1996 - Volume 16 - Issue 2 - pp 144-150. Limb-Length Discrepancy.

   Results summary: In general, a limb-length inequality >2.0 cm (3.7%) resulted in gait asymmetry that was greater than that observed in the normal population. However, the amount of asymmetry varied for each individual. A static examination can document an anatomic deformity, but this deformity may be compensated for by functional adaptations. An analysis of the patient's gait should be performed to identify asymmetries during ambulation. Dynamic gait findings, such as demonstrated in this study, are needed to support static measurements.

4. Gait asymmetry in patients with limb length discrepancy. J. R. Perttunen1, E. Anttila2, J. Södergård2, J. Merikanto3 andP. V. Komi1., Article first published online: 15 DEC 2003.

   Results summary: Bilateral comparison indicated that moderate limb length discrepancies resulted in asymmetrical gait patterns.

5. Improvement in Gait Parameters After Lengthening for the Treatment of Limb-Length Discrepancy. ANIL BHAVE, P.T.†; DROR PALEY, M.D., F.R.C.S.(C)†; JOHN E. HERZENBERG, M.D., F.R.C.S.(C)†, BALTIMORE, MARYLAND. J Bone Joint Surg Am, 1999 Apr; 81 (4): 529 -34 . **http://dx.doi.org/.**

   Results summary: This study shows that lengthening of the shorter limb of patients who have limb-length discrepancy can normalize symmetry of quantifiable stance parameters and eliminate a limp.

6. Asymmetric Limb Loading with True or Simulated Leg-Length Differences. White, Scott C PHD*; Gilchrist, Louise A PHD, PT*; Wilk, Bryan E MS†. Clinical Orthopaedics & Related Research: April 2004 - Volume 421 - Issue - pp 287-292. doi: 10.1097/01.blo.0000119460.33630.6d, SECTION II ORIGINAL ARTICLES: Research.

   Results summary: The shorter limb sustains a greater proportion of load and loading rates; therefore, equalizing leg lengths should be considered even with bilateral differences less than 3 cm.