

# Original Research

## Inter-Examiner Reliability of Leg Length Inequality Assessments

Mitzi Schwartzbauer, D.C.<sup>1</sup>  
John Hart D.C., MHSc<sup>2</sup>

1. Assistant Professor of Clinical Sciences, Sherman College of Chiropractic, Spartanburg, SC
2. Assistant Director of Research, Sherman College of Chiropractic, Spartanburg, SC

### Abstract

**Introduction:** Chiropractic leg length inequality (LLI) tests are used as a method of assessing, among other clinical aspects, the presence of some type of neurological disturbance thought to be related to vertebral subluxation. This study assesses inter-examiner reliability of four LLI procedures and hip extension procedure.

**Methods:** Two blinded examiners assessed the same 30 participants once for the five procedures. The kappa statistic was applied to determine the level of agreement. A kappa score of 0.40 or greater was considered as acceptable agreement.

**Results:** The prone hip/leg extension test exhibited a kappa score of 0.482 while the other LLI procedures showed kappa scores < 0.20.

**Conclusion:** In this study, only the prone hip/leg extension assessment revealed acceptable repeatability. Further research is warranted to verify these findings.

**Keywords:** *Leg length inequality, chiropractic, inter-examiner reliability*

### Introduction

In chiropractic practice, the use of leg length inequality assessments (LLI) is sometimes used to determine the presence of some type of neurological disturbance.<sup>1-3</sup> Determining whether or not the patient exhibits some type of neurological interference is of interest to many chiropractors. The objective of this type of chiropractic is to adjust a condition known as *vertebral subluxation* to remove the neurological disturbance.<sup>4</sup>

Techniques such as Thompson,<sup>1</sup> Activator,<sup>2</sup> and Direct Non-Force Technique (DNFT)<sup>3</sup> use LLI to typically theoretically determine *where* a person is subluxated. This leads to the question of whether different examiners would obtain the same LLI findings if they were to analyze the same patients. If LLI findings are not repeatable then the conclusion that a subluxation is present would be

questionable if such a conclusion was based entirely on this method of analysis.

The reliability of LLI has been studied with varying results. Previous studies have found good reliability for prone<sup>5-6</sup> and prone-knees-flexed.<sup>5</sup> Another study, that also assessed the prone, prone-knees-flexed, as well as LLI with head rotation tests found good reliability only with the prone LLI test.<sup>7</sup> Similarly, the supine LLI assessment has been found to have high reliability.<sup>8</sup>

The present study assesses inter-examiner reliability for four different LLI procedures and one hip extension procedure that are used in a chiropractic teaching facility.

### Methods

The study consisted of 30 relatively healthy student volunteers (13 females and 17 males) and three licensed

chiropractors as examiners, selected via the convenience sample method. The study received approval from the Institutional Review Board at Sherman College of Chiropractic and each participant signed a consent form to be enrolled in the study.

From the pool of three licensed chiropractors, two of the three blinded examiners, depending upon availability, each assessed 30 participants once over a four day period. The order of examiners was not randomized. Although the examiners were not given a training session prior to the study, they had studied and graduated from the same chiropractic college. They learned the same basic LLI methods, and therefore had the same basic background experience with the LLI procedures.

Two different chiropractic tables were used in the study: a hi-lo table and a stationary bench. For the hi-lo table, the participant was asked to stand in the middle of the platform of the table while it was in the upright position. Between supine and prone positions, the participant was brought back up on the table, repositioned, and then lowered with the table.

For the stationary bench, the participant was positioned so that he or she would be on the center of the table and then re-positioned for supine and prone positions. Before the participant was re-positioned between supine and prone positions, the second examiner provided the second examiner assessment.

The LLI procedures consisted of the following: prone, prone with left and right head rotation (PLHR, PRHR), prone knees flexed (PKF), prone hip extension (PHE), and supine LLI assessments.<sup>9</sup> (Figures 1-5) All LLI procedures were performed with the participants' shoes on. Further details of the LLI procedures are described in Table 1.

Agreement between examiners was assessed with the use of the kappa statistic in SPSS (Chicago, IL) with the following interpretation for the scores: < 0 = none, 0.0 – 0.2 – slight, 0.20 – 0.4 fair, 0.40 – 0.6 = moderate, 0.60 – 0.8 = substantial and 0.80 – 1.00 = near perfect.<sup>10</sup> A kappa score of 0.40 was considered to be minimally acceptable.

## Results

The raw data by examiner is provided in Table 2. Percent agreement and kappa scores by test between examiners were observed as follows: Prone: 8/30 agreements = 26.6% (kappa = -0.051, p = 0.3); prone knees flexed: 9/30 agreements = 30% (kappa = 0.022, p = 0.8); prone right head rotation: 14/30 agreements = 46.6% (kappa = 0.083, p = 0.3); prone left head rotation: 13/30 agreements = 43.3% (kappa = 0.097, p = 0.4); prone leg extension: 22/30 agreements = 73.3% (kappa = 0.482, p = 0.000); Supine: 13/30 agreements = 43.3% (kappa = 0.184, p = 0.07) (Table 3).

## Discussion

There was only one LLI procedure in this study that was

considered to have acceptable (statistically significant kappa) agreement between examiners, and that was the prone hip/leg extension assessment. The supine check came close to being statistically significant, with a p-value of 0.07. The reason that the prone leg extension tests was the only test that showed acceptable agreement could be based on the magnitude of difference between the left and right leg findings, in inches likely, rather than in fractions of inches in the case of the other leg checks.

The findings of low agreement for most of the assessments in this study is at variance with the findings of previous studies that found good reliability for the prone, prone with head rotation, and supine LLI assessments.<sup>5-8</sup> One likely reason for this difference is the lack of pre-study training which would have helped to ensure consistency of procedures between examiners.

Other limitations to our study are as follows: a) participants wore a variety of different shoes; b) the tables used were not they same style, one being a hi-lo style, the other being the stationary bench style; c) the order of examiners was not randomized, which could affect the repeatability of the findings; d) the amount of inferior-to-superior pressure applied by examiners may not have been consistent since no discussion on this point was undertaken prior to the study; e) a different pair of examiners among the three were included for the various sessions; f) the order of active procedures by participants (right and left head rotation; right and left hip extensions) was not randomized, and this could affect repeatability between examiners.

Future study should strive for greater consistency of LLI procedures, such as using the same table type, having the examiners meet for a refresher course prior to the study to ensure that each examiner performs the LLI procedures consistently, and have the same two examiners for all participants. Adding an objective tool to measure LLI, as Cooperstein et al have done<sup>11</sup> would also likely improve repeatability.

## Conclusion

In this study, the prone hip extension test was the only procedure showing acceptable agreement between examiners. Further study is warranted to verify or refute these findings.

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## Figures & Tables



Figure 1. Prone leg check



Figure 3. Prone left head rotation



Figure 2. Prone knees flexed



Figure 4. Supine leg check



Figure 5. Prone hip extension

<b>Table 1. Explanation of Procedures for Leg Length Inequality</b>	
<b>Assessment</b>	<b>Description of Procedure</b>
Prone	Participant in prone position. Examiner lifts both feet off of the table approximately two inches. The short leg, if present, is recorded.
PKF	Prone knees flexed. Participant in prone position while examiner passively flexes both legs simultaneously at the knees slightly beyond 90 degrees, noting which leg, if any, in the flexed position is short.
PRHR and PLHR	Prone right head rotation. Participant is prone while he or she turns head to the right (PRHR) and then to the left (PLHR), noting which leg, if either, is short.
PHE	Prone hip extension. Participant is prone while examiner stabilizes pelvis, and participant raises one leg at-a-time as high as possible, noting which leg, if either, raises less than the other according to the examiner's hand "marking the leg is space" and then examiner "eyeballs" the difference if any.
Supine	Participant in the supine position. Examiner removes any foot flare that might be present, noting which leg, if either, is short.

**Table 2. Raw data for Examiner 1 and Examiner 2**

Examiner 1 Raw Data						
Participant #	Prone	PKF	PRHR	PLHR	PHE	Supine
1	L	R	R	I	R	L
2	I	I	L	R	R	I
3	R	I	L	R	R	I
4	R	L	R	R	R	R
5	R	R	R	I	L	R
6	L	I	R	R	I	L
7	I	R	I	L	I	I
8	I	R	R	R	L	L
9	L	L	L	L	L	L
10	I	I	I	I	L	I
11	L	I	L	L	L	L
12	L	L	I	I	L	L
13	I	I	I	I	I	L
14	R	R	R	R	I	I
15	L	I	I	L	R	L
16	R	I	R	R	I	R
17	I	I	I	I	I	L
18	L	L	L	I	I	I
19	I	I	I	I	I	L
20	L	R	I	I	I	I
21	I	R	R	I	I	L
22	I	I	I	I	I	I
23	R	R	R	R	I	I
24	I	I	I	I	I	R
25	R	R	R	R	I	R
26	I	I	I	I	L	L
27	R	I	R	R	R	R
28	L	I	I	L	I	I
29	R	R	R	R	I	R
30	L	R	R	L	I	I

Examiner 2 Raw Data						
Partici pant #	Prone	PKF	PRHR	PLH R	PHE	Supine
1	R	R	R	I	R	R
2	R	I	L	L	I	L
3	R	R	R	R	I	R
4	R	L	R	R	I	R
5	R	R	R	I	L	R
6	R	L	L	I	I	R
7	R	I	R	I	I	R
8	R	I	R	R	I	L
9	R	L	I	R	I	L
10	R	R	R	R	I	L
11	R	L	R	I	L	L
12	R	L	R	R	L	L
13	R	R	R	I	I	L
14	L	R	R	I	I	R
15	R	L	R	R	R	L
16	R	L	R	R	I	L
17	R	L	R	I	I	R
18	R	I	R	R	I	L
19	R	R	R	R	I	L
20	R	L	R	R	L	L
21	R	R	R	L	I	R
22	R	R	R	I	I	R
23	R	I	R	R	I	R
24	R	I	R	R	I	R
25	R	L	R	R	I	R
26	L	R	I	L	I	R
27	R	L	R	R	R	R
28	R	L	R	R	I	R
29	R	L	R	R	I	R
30	R	L	R	I	I	L

PKF = participant prone while examiner passively flexes his or her knees. PRHR = participant prone while he or she performs right head rotation. PLHR = participant prone while he or she performs left head rotation. PHE = participant prone while he or she actively raises one leg at-a-time. L = short leg on the left. R = short leg on the right. I = indeterminate (legs even).

<b>Table 3 - Inferential statistics (kappa scores) by leg check procedure with statistically significant agreement noted in bold.</b>		
Assessment	Kappa	p value
Prone	-0.051	0.3
Prone Knees Flexed	0.022	0.8
Prone Right Head Rotation	0.083	0.3
Prone Left Head Rotation	0.097	0.4
<b>Prone Leg Extension</b>	<b>0.482</b>	<b>0.000</b>
Supine	0.184	0.07