# BIOMECHANICAL EVALUATION OF THE SPINAL MANIPULATIVE THERAPY: CASE REPORT

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## Introduction

The spinal manipulative therapy (SMT), varying in many kinds of form, has been regarded as a popular and effective nonsurgical treatment for chronic low back pain (LBP). But the biomechanical mechanism and evaluation of such manipulation is still unclear. No consensus had been drawn on the surface electromyography (sEMG) assessment of SMT. Furthermore, the majority of previous studies focused on the immediate response of manipulation, while barely any investigation on the long-term and dynamic effects had been made. Meanwhile, the kinematic measurement can also work as a valuable tool for the evaluation of SMT. This study aimed to find an effective biomechanical evaluation method for SMT and made it consistent with clinical improvement.

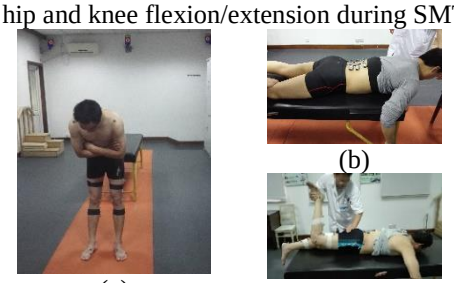
## Methods

15 patients diagnosed with chronic lumbar disc herniation – as a kind of specific LBP- were recruited from the hospital. The treatment course of a Chinese SMT lasted for 10 days. Before and after the whole course, biomechanical evaluation was performed. Participants were instructed with an audio guide to perform two active movements – the flexion-extension movement (FEM) described in [1], and the "acceptable maximum effort" (AME, as a replacement of maximum voluntary contraction) described in [2]. The patients then received one classic session (named as WPO) of the SMT in which the doctor pulled over the patients' waist and lowered limb to a certain extent.

Motion capture system was used to track the trunk and lower limb. The sEMG signals were recorded bilaterally at thoracic ES (L1), lumbar ES (L3), and multifidi (L5). 3D kinematic models were established to calculate the means of 3D angles of the joints. The raw sEMG data received rectification and filtered using a 5-500 Hz bandpass filter. Finally, the sEMG root mean square (RMS) of each phase of FEM were calculated to compare ratios of three stages. Statistical analyses of the bilateral difference as well as the pre- and post-course difference in the biomechanical parameters were conducted.

## Results

Before and after the course, flexion relaxation phenomenon (FRP) was absent in all the patients except for one's post data. Extension-flexion ratio (EFR) of painful side at lumbar ES showed statistical reduction from contralateral side for both the pre- ($P$=0.0305) and post- ($P$=0.0322) stage (here two subjects who claimed both their sides were painful were removed). There was no laterality difference. Figure 1 showed the compared range of joint motion (ROM, average value ± standard deviation) of trunk flexion/extension during FEM, as well as hip and knee flexion/extension during SMT.



(a) (b) (c)

*Figure 1: Tested motions. (a) FEM; (b) RVE; (c) WPO*

| ROM/° | FEM-trunk | SMT-Hip | SMT-Knee |
|---|---|---|---|
| Pre- | 54.9660 ±13.9741 | 26.9809 ±5.7907 | 76.6755 ±20.3464 |
| Post- | 62.2619 ±10.0821 | 31.14522946 ±7.3663 | 68.8921 ±18.4761 |
| *P* | 0.0071 | 0.0420 | 0.0239 |

*Table 1: Comparison of pre- and post- ROM of joints.*

## Discussion

For patients with chronic LBP, SMT relieves muscle tension progressively, and it often takes a long period to cure musculoskeletal diseases completely. Thus, the common criteria that uses the existence of FRP to judge the healthy people is not reliable in evaluating such evolutionary rehabilitation process. The significant difference in EFR ratio between painful and contralateral sides may serve as a quantitative assessment of the pathological muscles. Experienced doctors apply the traction force according to the level of spinal stiffness of patients. The statistical increased ROM of hip and decreased ROM of knee suggested relieved spasm and slacked adhesion, in accordance with a previous study indicating the ROM relationship between knee and hip during this WPO of SMT [3]. Hence, the passive ROM can reflect the progressive degree of rehabilitation.

## References

1. Lalanne et al., J Manip Physiol Ther, 32:203-209, 2009.
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