Provider biomechanical strategies during the delivery of lumbar high-velocity low-amplitude spinal manipulation

Andrew Y.W. Wong[1], Martha Funabashi[1], Lindsay Gorrell[2], Samuel Howarth[1]
[1]Human Performance Laboratory, Canadian Memorial Chiropractic College, Toronto, Canada
[2]Balgrist University Hospital, University of Zürich, Zürich, Switzerland
Email: showarth@cmcc.ca

Summary

While kinetic outcomes are well-established for chiropractors delivering spinal manipulation (SM), the biomechanical strategies they utilize have yet to be explored. Kinematics of chiropractic students were measured to assess the influence of recipient size on their biomechanical strategies. Manipulating a smaller recipient necessitated the provider to adopt greater glenohumeral internal rotation of their non-dominant arm, in addition to greater lumbar flexion. Developing a better understanding of chiropractors' occupational demands will support efforts in mitigating their risk for injury.

Introduction

Nearly 3 in every 5 chiropractors report experiencing occupational musculoskeletal disorders (MSDs), with the most highly reported sites of MSD at the lower back, shoulder, and wrist/hands [1]. Performing SM and positioning the participant for manipulation are commonly cited occupational tasks that cause upper extremity and low-back MSDs in chiropractors [2]. Spinal manipulation is an intervention that is frequently delivered by chiropractors and other rehabilitation specialists such as physiotherapists, naprapaths and osteopaths. While the force-time characteristics of delivering high-velocity low-amplitude spinal manipulation (HVLA-SM) have been thoroughly studied [3-5], there is a lack of understanding of the strategies adopted by providers to perform the complex motor task of HVLA-SM. Understanding the physical demands from delivering HVLA-SM can significantly improve injury prevention for these professionals.

Methods

A descriptive observational design was used. Third- and fourth-year students at the Canadian Memorial Chiropractic College performed HVLA-SM to the low-back of a small (1.61 m, 43 kg) and a large (1.94 m, 114 kg) recipient who were in a side-lying position. Whole body three-dimensional kinematics were recorded at 240Hz using a 10-camera optoelectronic motion capture system (Vero 2.2, Vicon Motion Systems Inc., Centennial, CO, USA). Force-time characteristics of each HVLA-SM trial were monitored at a rate of 2,400Hz by a force plate (OR6-7, AMTI Inc., Watertown, MA, USA) embedded in a chiropractic treatment table. All data were imported to Visual3D (C-Motion Inc., Germantown, MD, USA). Kinematic data were used to create participant-specific rigid linked segment models and calculate segment and joint kinematics. Data between the start and end of the manipulation were isolated for each trial using the HVLA-SM force-time characteristics. Glenohumeral internal rotation and lumbar flexion were extracted at the instant of peak HVLA-SM force. Dominant and non-dominant upper extremities were defined by the participant's hand contacts on the recipient's low-back and upper torso, respectively. Sample means and 95% confidence intervals for angular differences between small and large recipients were calculated.

Results and Discussion

Twenty-five students (17 female) participated in the study. Dominant glenohumeral internal rotation was not influenced by recipient anthropometry (small-large difference = -1° [-10,7]); however, greater non-dominant glenohumeral internal rotation (small-large difference = 22° [14,30]) and lumbar flexion (small-large difference = -7° [-10,-5]) were observed when performing SM on the smaller recipient (Figure 1).

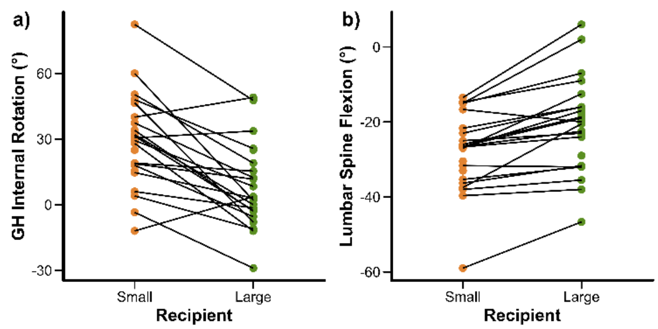

Figure 1: Provider's kinematics when delivering high-velocity low-amplitude spinal manipulation. a) Non-dominant glenohumeral internal rotation is greater for the smaller recipient. b) Greater lumbar spine flexion when adjusting the smaller recipient.

Conclusions

When performing SM, the recipient's anthropometry influences the provider's kinematics—and possibly the risk for developing MSDs.

Acknowledgments

We would like to thank the Centre of Research Expertise for the Prevention of Musculoskeletal Disorders (CRE-MSD) for supporting the study with a Seed Grant; Daphne To and Steven Tran for their help with data collection; and the Ontario Chiropractic Association for their ongoing support.

References

[1] Hansen et al. (2018). *Chiropr Man Therap,* **26**: 4.
[2] Howarth et al. (2020). *Chiropr Man Therap,* **28**: 55.
[3] Funabashi et al. (2021). *Clin Biomech (Bristol);* **89**:105450
[4] Mikhail et al. (2020). *Chiropr Man Therap,* **28**: 57.
[5] Thomas et al. (2022). *J Appl Biomech*, **38**: 39-46.