

Intradiscal Pressure Changes During Manual Cervical Distraction: A Cadaveric Study

M.R. Gudavalli, PhD,¹ T. Potluri, MS,² G. Carandang, MS,² R. Havey, BS,² L. Voronov, MD, PhD,² J. Cox, DC, DACBR,³ R. Rowell, DC, MS,¹ R. Kruse, DC,³ G. Joachim, DC,³ A.G. Patwardhan, PhD,^{2,4} C.N.R. Henderson, DC, PhD,¹ and C.M. Goertz, DC, PhD¹

¹Palmer College of Chiropractic, Davenport-Florida, USA; ²Hines VA Hospital, Hines, USA; ³Independent Clinicians, Fort Wayne-Homewood, USA; ⁴Loyola University Stritch School of Medicine, Maywood, USA Senior author contact email: Gudavalli_r@palmer.edu

BACKGROUND AND PURPOSE

Neck disorders are common musculoskeletal complaints. Conservative treatments such as spinal manipulation, spinal mobilization, and traction frequently are used alone or in combination with other physical therapies to treat neck pain.¹

Intervertebral disc pressure measurements are central to the investigation of conservative treatments for spinal problems.^{2,3}

The objective of this cadaveric study was to measure intradiscal pressure (IDP) changes in the lower cervical spine during a manual cervical distraction (MCD) procedure also known as flexion-distraction technique.

METHODS

- **Ethics approval:** No human subjects. Safety precautions for cadaveric specimens followed.
- **Design:** Cross-sectional cadaveric experiment.
- **Specimens:** Nine unembalmed cadavers with head, neck, shoulders, and trunk. 5 female and 4 male specimens ranging in age from 28-54 years old.
- **Clinicians:** Four doctors of chiropractic (DCs) experienced in MCD procedure. Procedures were performed with different clinician hand contacts as shown in Figures 1a and 1b.
- **Instruments:** Force plate (Model #2850-06, Bertec Inc, Columbus, OH), Intradiscal pressure sensors (Model 060, Precision Measurement Inc, Ann Arbor, MI) video fluoroscopy unit (OEC-9800, GE Healthcare Systems, Waukesha, WI) (Figure s 2 and 3).
- **Data Collection:** DCs performed 3 sets of 5 manual cervical traction cycles on the specimens in prone position with the headpiece in each of 3 configurations: i) fixed horizontal, ii) fixed flexed, iii) active flexion (Figure 3).
- **Statistical Analysis:** Descriptive statistics on intradiscal pressure changes and applied forces. Intra class correlation coefficients (ICCs) using Systat v10.2, Systat Software, Inc.

CONCLUSIONS

- Decreases in intradiscal pressures were observed at C4-C5, C5-C6, C6-C7, and C7-T1.
- Intra-correlation coefficients for decreases in IDP for all four DCs were good.
- There were differences in the forces delivered by the four DCs
- All four DCs had traction forces within the range of traction forces used during home traction therapy.



Figures 1a and 1b. Photographs showing clinician hand contact on a patient during MCD procedures



Figure 2. A videofluoroscopic image of the cervical spine with IDP sensors in the nucleus of C4-5, C5-6, C6-7, and C7-T1

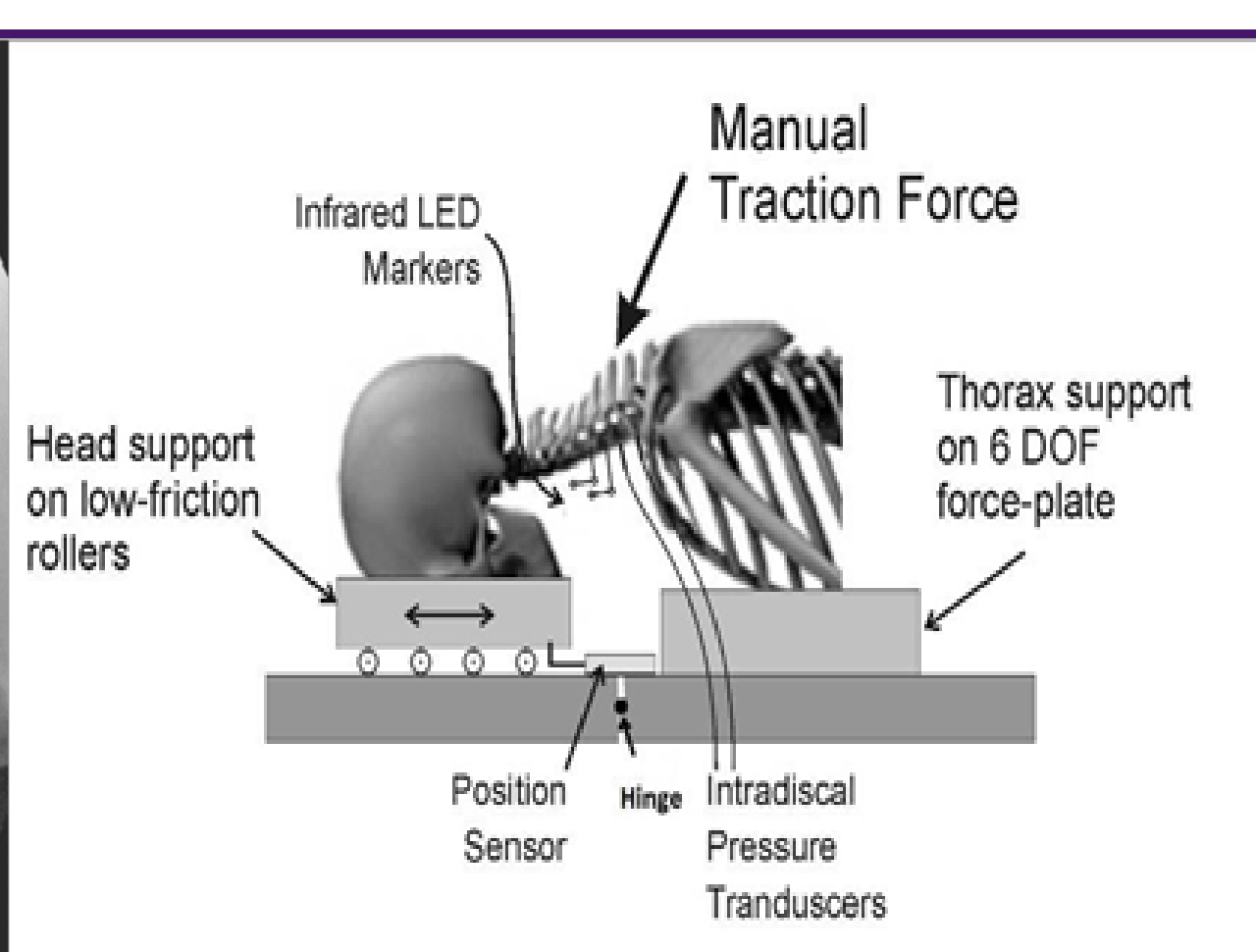


Figure 3. Schematic diagram of the experimental set-up

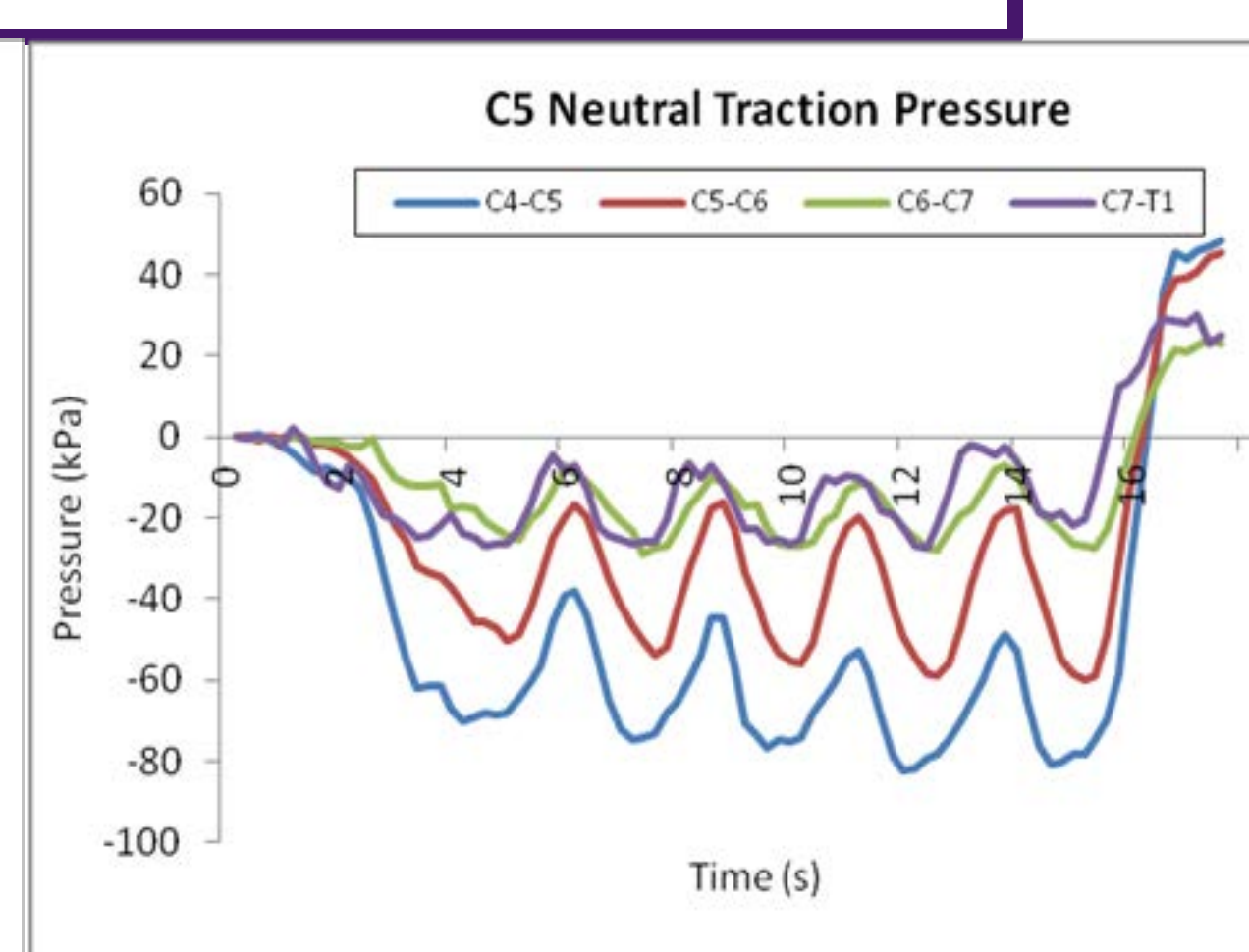


Figure 4. A typical graph showing changes in IDP as a function of the duration of MCD

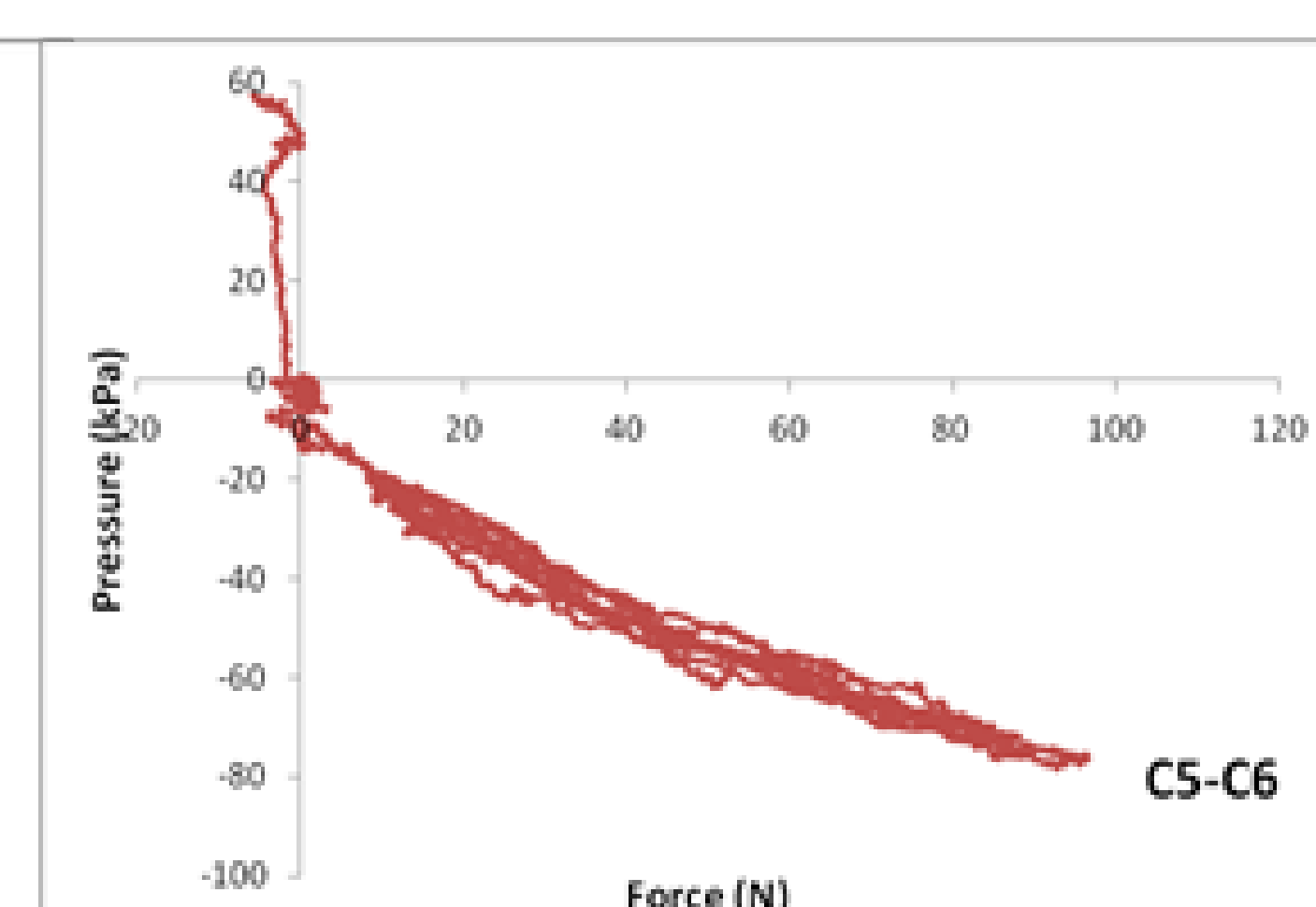


Figure 5. Pressure-Force Graphs – C6 Neutral Traction

RESULTS

- IDP decreases were observed during MCD procedure in prone position at all lower cervical levels C4-C5, C5-C6, C6-C7 for all DCs (Figure 4).
- Both decreases and increases were seen at C7-T1 level for three of the four DCs.
- Mean IDP decreases were as high as 168.7 KPa.
- Mean traction forces were as high as 119.2 N.
- Posterior-to-anterior forces applied during manual traction were as high as 82.6 N.
- Intra-clinician reliability for decrease in IDP were high for all four DCs (Table 1).
- Intra-clinician reliability for traction forces were high for two of the four DCs and were moderate for the remaining two DCs (Table 1).
- Magnitudes of applied traction forces varied among the four DCs.
- Pressures decreased linearly as a function of increased traction forces (Figure 5).
- Individual variations between specimens were high as observed by large standard deviation values.

Table 1. Intra-class correlation coefficients of DCs for IDP changes and traction forces

Doctor of Chiropractic	C4-C5 Pressure	C5-C6 Pressure	C6-C7 Pressure	C7-T1 Pressure	Traction Force
DC1	0.88	0.89	0.97	0.90	0.59
DC2	0.93	0.86	0.83	0.95	0.93
DC3	0.96	0.96	0.99	0.95	0.93
DC4	0.85	0.84	0.83	0.64	0.52

Reference List

1. Cox JM: *Neck, Shoulder, Arm Pain: Mechanism, Diagnosis, Treatment, 3rd Edition*, 3rd edn. 2004.
2. Li YK, Zhu QA, Zhong SZ: **The effect of cervical traction combined with rotatory manipulation on cervical nucleus pulposus pressures.** *J Manipulative Physiol Ther* 1998, **21**: 97-100.
3. Wu LP, Huang YQ, Zhou WH, Manas D, Zhao WD, Chen JZ *et al.*: **Influence of cervical spine position, turning time, and cervical segment on cadaver intradiscal pressure during cervical spinal manipulative therapy.** *J Manipulative Physiol Ther* 2012, **35**: 428-436.

Acknowledgments: This investigation was supported by grant # 1 U19 AT004663-01 from the National Center for Complementary and Alternative Medicine and conducted in a facility constructed with support from research facilities improvement program grant # C06 RR15443-01 from the National Center for Research Resources, National Institutes of Health.