



FUNDED RESEARCH PROJECTS

Outcomes

FEDERALLY HRSA FUNDED STUDY #1 OUTCOMES

ABSTRACT FROM THE PROCEEDINGS OF THE INTERNATIONAL SOCIETY FOR THE STUDY OF THE LUMBAR SPINE, SINGAPORE 1998

Intervertebral Disc Pressure Changes During The Flexion-Distracton Procedure for Low Back Pain

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Introduction: One type of conservative procedure used in the treatment of low back pain applies flexion and traction motions to the lumbar spine. In this procedure the prone patient's head and thorax are supported by the fixed portion of a special treatment table. The legs rest on the movable section of the table with the ankles attached by straps. The doctor positions the patient in such a way that the vertebral joint of interest is over the fulcrum of the movable section. The doctor contracts the spinous process of the superior vertebra of the joint with one hand and moves the caudal section of the table downward with the other hand, thus creating traction and flexion motions at the joint of interest. The treatment is based on the hypothesis that the intradiscal pressure decreases during the procedure and may provide an opportunity for the disc bulge to reduce. The purpose of the present study was to measure the changes in the intradiscal pressures in the lumbar spines of unembalmed cadavers during the flexion-distracton procedure.

Methods: Five unembalmed whole cadavers (four male and one female; age range 43-75 years) were frozen at -20°C immediately after death and thawed at room temperature prior to experimentation. An anatomy consultant dissected some of the paraspinal musculature to permit accurate insertion of the needle (17 Gauge Touhy epidural needle with stylette) into the nucleus of the disc (either L2-L3, L3-L4, or L4-L5). With the cadavers in a prone position similar to that for a patient, we removed the stylette and inserted the miniature pressure transducer so that the sensor was exposed to the nucleus. We connected the pressure transducer to a computer through a signal amplifier and analog-to-digital converter. The treatment procedure consisted of five cycles of table motion in approximately twenty seconds. We monitored the intradiscal pressures during the procedure under two conditions: (1) discs unpressurized and (2) discs pressurized with water. The intradiscal pressures were monitored during three separate trials with thirty minute intervals between each trial. Mean values of the pressures before each cycle of the treatment procedure, pressures in the distracted position, and the changes in the pressures were computed for all fifteen cycles (three trials, five cycles per trial) for each cadaver.

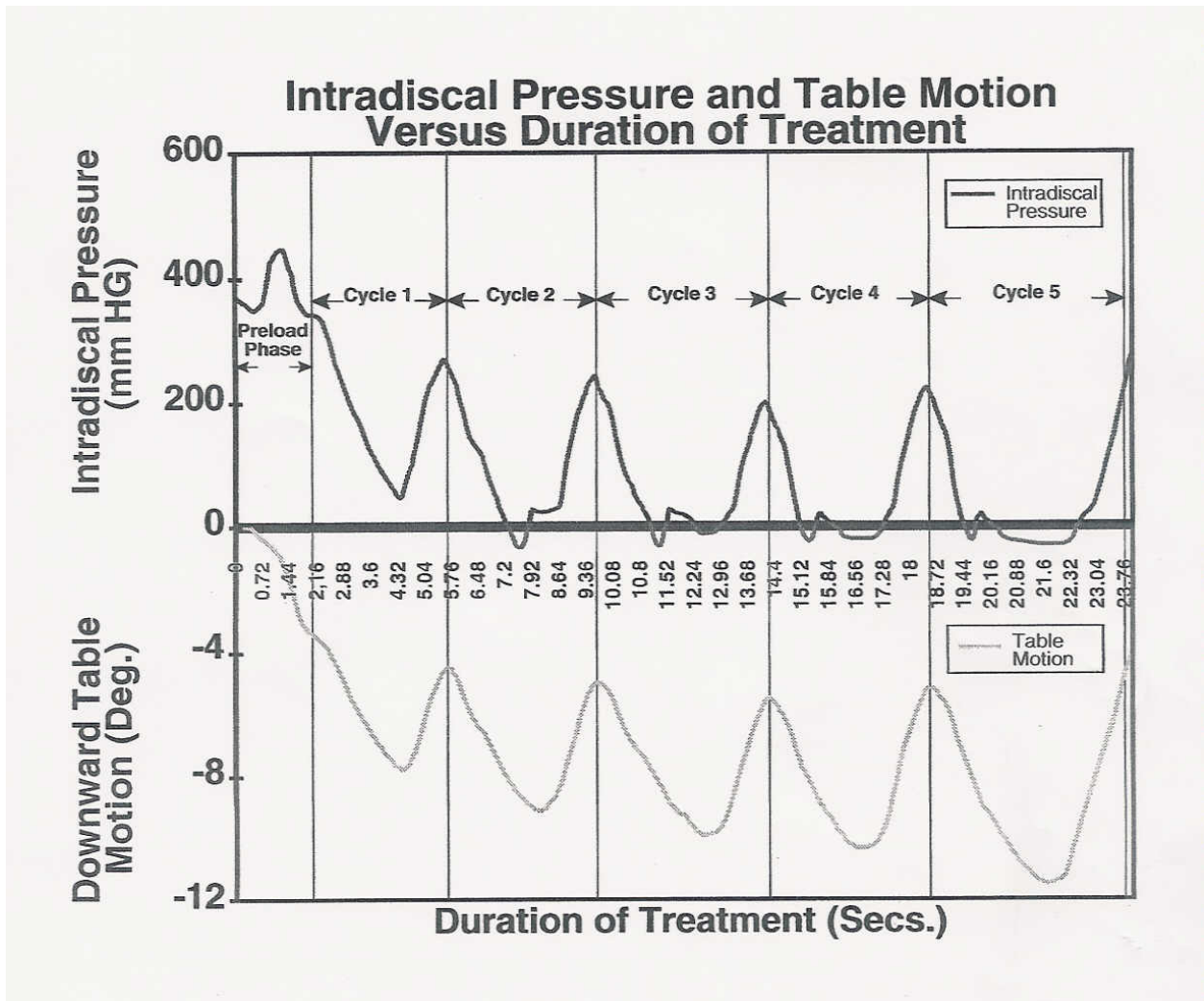
Results: Figure 1 shows a typical plot of the change in the intradiscal pressure at an L4-L5 disc during five, four-second applications of the procedure. The same graph also shows the downward table motion. The downward table motion and the decreases in intradiscal pressure changes are in phase. The flexion-distracton procedure significantly decreased the intradiscal pressure in both the unpressurized and pressurized discs. In the unpressurized discs, the pressure went into the negative range at the distracted position corresponding to the extreme downward motion of the table. The decrease in intradiscal pressure varied from 39-192 mm Hg among the four discs tested in unpressurized mode (mean: 88.6, S.D. 64.2), and the decrease was statistically significant ($p < 0.01$). Injection of water in the disc raised the initial disc pressure to a mean value of 456 mm Hg (S.D. 227) in the prone position. The decrease in pressure ranged from 117-720 mm Hg (mean: 330, S.D. 222) during the procedure and the decrease was statistically significant ($p < 0.01$).

Discussion: Cyriax, Quillette, and Kramer hypothesized that as the vertebrae in the spine are distracted, a negative pressure develops in the disc, and sucks back a protrusion. The present study shows that the decrease in the intradiscal pressures may provide the opportunity for the reduction in the disc bulge during the flexion-distracton procedure. Ramos et al. reported decreases in the intradiscal pressures during Vertebral



increases in the intradiscal pressures at L3-L4 disc on four volunteers during active and passive traction. A possible reason for the increase in the intradiscal pressures could be that the muscles of the in vivo subjects could have been contracting while under active and passive traction. Work is in progress to monitor the muscle activity during in vivo situations of treating the patients using the flexion-distraction procedure.

Acknowledgement: The authors acknowledge the financial assistance of the Health Resources and Services Administration (HRSA) through a grant #1 R18 AH10001-01A1, financial donations from numerous chiropractic physicians, and Williams Healthcare Systems Incorporated for donating the flexion-distraction table.





FEDERALLY HRSA FUNDED STUDY #1 OUTCOMES

ABSTRACT FROM THE PROCEEDINGS OF THE BIOENGINEERING CONFERENCE, PHOENIX

Intervertebral Disc Pressure Changes During a Chiropractic Procedure

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Introduction:

Some of the treatments for low back pain use traction as the loading mechanism to the spine. One such treatment protocol used by chiropractic physicians in the treatment of low back pain is the Cox flexion-distraction procedure (1). The Cox procedure consists of placing the patient in a prone position on a flexion-distraction table and then creating traction and flexion motions at the joint of interest. The treatment is based on the hypothesis that the intradiscal pressure decreases during the procedure and may provide an opportunity for the disc bulge to reduce. However, no data exist to support this hypothesis. The purpose of the present study was to measure the changes in the intradiscal pressures in the lumbar spine on unembalmed cadavers during the flexion-distraction procedure.

Materials And Methods: Two miniature pressure transducers (Model#SPR-524) were purchased from Millar Instruments, Houston, Texas, for this study and calibrated with specially built devices that can be pressurized or create a vacuum. We procured five unembalmed whole cadavers for the purpose of the study (four male and one female; age range 43-75 years). The cadavers were frozen at -20°C immediately after death and thawed at room temperature prior to experimentation. An anatomy consultant dissected some of the paraspinal musculature to permit accurate insertion of the needle and pressure transducer. We inserted a Touhy epidural needle with stylette (17 Gauge) into the nucleus of the disc (either L2-L3, L3-L4, or L4-L5). We then removed the stylette and inserted the miniature pressure transducer so that the sensor was exposed to the nucleus. We connected the pressure transducer to a computer through a signal amplifier and analog-to-digital converter. We placed the cadavers in a prone position on the flexion-distraction table, similar to the positioning for a living patient. The treatment procedure consisted of five cycles of table motion in approximately twenty seconds. The discs were pressurized with water using a Cornwall continuous pipetting outfit (B-D #3052) connected by flexible tubing to a second needle in the disc of interest. LUER-LOK stopcocks allowed air to be bled from the system before pressurizing.

We monitored the intradiscal pressures under two conditions: (1) the discs unpressurized and (2) the discs pressurized with water. The pressures were monitored during three separate trials with thirty-minute intervals between each trial. Mean values of the pressures before each cycle of the treatment procedure, pressures in the distracted position, and the changes in the pressures were computed for all fifteen cycles of the three trials.

Results: Figure 1 shows a typical plot of the change in the intradiscal pressure at an L4-L5 disc during five, four-second applications of the flexion-distraction procedure. The same graph also shows the downward table motion. Tables 1 and 2 list the means and standard deviation values of the intradiscal pressures before the treatment cycle and in the distracted position.

Discussion And Conclusions: We observed a significant decrease in intradiscal pressure during the flexion-distraction procedure for low back pain. When the discs were not pressurized, the pressures went below 0 mm Hg. When the discs were pressurized, the decrease in the intradiscal pressures was much larger, suggesting that in patients with higher intradiscal pressures, the decrease may be much higher during the treatment. The pressures returned to their original values when the spine was brought back to the initial prone position. Quillette(2), and Kramer (3) hypothesized that as the vertebrae in the spine are distracted, a negative pressure develops in the disc, and sucks back a protrusion. Ramos et al. (4) reported on the intradiscal pressure during Vertebral Axial Decompression (VAD) procedure on three patients measured intraoperatively. The results showed that the disc pressures reduced during the VAD therapy. They demonstrated that the disc pressures can go as low as -160 mmHg. The results of the present study are in general agreement with the study reported by Ramos and Martin (4). Anderson et al. (5) reported the intradiscal pressures at L3-L4 disc on four volunteers during standing, lying, active traction, and passive traction. The findings showed an increase in the disc pressure during both active and passive traction. The results from the present study do not agree with the



situations of treating the patients using flexion-distraction procedure.

Acknowledgments: The authors acknowledge the financial assistance of the Health Resources and Services Administration (HRSA) through a grant # 1 R18 AH10001-01A1. We acknowledge Williams Healthcare Systems Incorporated for donating the flexion-distraction table. Also the partial financial assistance of numerous chiropractic physicians is greatly acknowledged.

References

1. Cox, J.M. Low Back Pain: Mechanism, Diagnosis and Management, Williams and Wilkins. 1990.
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3. Kramer J. Intervertebral Disc Diseases: Causes, Diagnosis, Treatment, and Prophylaxis. Year Book Publishers 1981: 164-166.
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Note for tables below: For cadaver #5, two joints were monitored using two transducers without pressurization. The numbers in parentheses represent standard deviation values for N=15 cycles.)

Mean Intradiscal Pressures (mm Hg) During the Flexion-Distraction Procedure – Discs Not Pressurized

<u>Cadaver No.</u>	<u>Joint</u>	<u>Pressures in Initial Prone Position</u>	<u>Pressures in Distracted Position</u>	<u>Decrease in Pressure</u>
3	L3-L4	27 (22)	-165 (37)	192 (37)
4	L2-L3	24 (7)	-15 (2)	39 (9)
5	L3-L4	13 (13)	-48 (2)	61 (12)
	L4-L5	-87 (37)	-150 (11)	63 (10)

Mean Intradiscal Pressures (mm Hg) During the Flexion-Distraction Procedure – Discs Not Pressurized

<u>Cadaver No.</u>	<u>Joint</u>	<u>Pressures in Initial Prone Position</u>	<u>Pressures in Distracted Position</u>	<u>Decrease in Pressure</u>
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	L4-L5	-87 (37)	-150 (11)	63 (10)



FEDERALLY HRSA FUNDED STUDY #1 OUTCOMES

ABSTRACT FROM THE PROCEEDINGS, DALLAS

Intervertebral Disc Pressure Changes During Low Back Treatment Procedures

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Introduction: Some of the treatments for low back pain use different motions to the spine. One such treatment protocol used by chiropractic physicians in the treatment of low back pain is the Cox flexion-distraction procedure (1). The Cox procedure consists of placing the patient in a prone position on a flexion-distraction table and then creating distraction, flexion, extension, lateral flexion, and circumduction motions at the joint of interest. Gudavalli et al. (2) reported decreases in intradiscal pressures during the combined motions of flexion-distraction motions. However, no data exist during other motions of the table. The purpose of the present study was to measure the changes in the intradiscal pressures during all the maneuvers of the treatment protocols.

Materials and Methods: Miniature pressure transducers (Model #SPR-524) were purchased from Millar Instruments, Houston, Texas, for this study and calibrated with specially built devices that can be pressurized or create a vacuum. We procured one unembalmed whole cadavers for the purpose of the study (male; age 72 years old). The cadaver was frozen at -20°C immediately after death and thawed at room temperature prior to experimentation. Some of the paraspinal musculature was dissected to permit accurate insertion of the needle and pressure transducer. We inserted a Touhy epidural needle with stylette (17 Gauge) into the nucleus of the disc (L3-L4). We then removed the stylette and inserted the miniature pressure transducer so that the sensor was exposed to the nucleus. We connected the pressure transducer to a computer through a signal amplifier and analog to digital converter. We placed the cadavers in a prone position on the flexion-distraction table, similar to the positioning for a living patient. The discs were pressurized with water using a Cornwall continuous pipetting outfit (B-D #3052) connected by flexible tubing to a second needle in the disc of interest. LUER-LOK stopcocks allowed air to be bled from the system before pressurizing. We monitored the intradiscal pressures under the following table motion: (1) flexion (2) extension (3) lateral flexion and (4) circumduction. The pressures were monitored during four cycles of the table motions. Mean values of the pressures from the neutral position of the table to the treatment positions is various were computed.

Results: Table 1 lists the mean values of the intradiscal pressures before the treatment cycle and in the distracted position. Figure 1 shows the changes in the intradiscal pressures for different motions of the treatment procedure.

Discussion and Conclusions: We observed a significant decrease in intradiscal pressure during the flexion-distraction procedure for low back pain. The pressure has increased during extension motion of the table. The pressures have increased during right lateral motion whereas the pressures have decreased during the left lateral motion. During

Table 1 – Mean Intradiscal Pressures (mm Hg) during the low back treatment procedures (Joint L3-4)

Table motion	Pressure in Initial Prone Position	Pressure in Distracted Position	Change in Pressure
Flexion	228	-19.5	247.5
Extension	228	1250	1022
Right lateral flexion	226	747	521
Left lateral flexion	226	-151	377
Right lateral circumduction	240	530	290



circumduction the pressures have decreased during the left lateral and flexion motions, where as they have increased during right lateral and flexion combined motions. In all of the motions the pressures returned to their original values when the spine was brought back to the initial prone position. One of the reasons for the increase and decrease during lateral motions is due to the fact that the transducer was inserted some what right laterally from the center of the disc. The results clearly show that the pressures are affected during different motions of the spine associated with the motions of the table. Even though the present study is limited to one cadaver, the results are very interesting and studies with more number of cadavers and studies on animals can give further insight into the changes in the pressures at different regions of the spine.

Acknowledgments: The authors acknowledge the Health Resources and Services Administration (HRSA) for the grant # 1R18 AH10001-01A1, Williams Healthcare Systems Incorporated for donating the flexion-distraction table, and partial financial assistance of numerous chiropractic physicians.

References:

1. Cox, J.M. *Low Back Pain: Mechanism, Diagnosis and Management*, Williams and Wilkins. 1990.
2. Gudavalli, M.R., Cox, J.M., Baker, J.M., Cramer, G.C., and Patwardhan, A.G. "Intervertebral Disc Pressure Changes During a Chiropractic Procedure". *Advances in Bioengineering*, Vol. 36, 1997 pp. 215-216



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Also see the “Appendix” in *Low Back Pain*, 6th edition, by James M. Cox (1999) for more BIOMECHANICAL and ANATOMICAL graphics and outcomes.



FEDERALLY FUNDED STUDY #2 (Comparison Study) OUTCOMES:

INTERNATIONAL SOCIETY FOR THE STUDY OF THE LUMBAR SPINE

- Presented June 2004
- Portugal
- Click here to view the [Abstract from the Proceedings of the International Society for the Study of the Lumbar Spine \(Portugal 2004\)](#)
- Note: Dr. Gudavalli made this presentation “from the platform” before the assembly attending medical physicians, surgeons, chiropractic physicians, therapists, researchers and other interested parties from around the world.

EUROPEAN SPINE JOURNAL

- Published 12/8/05 online and JULY 2006 in print copy
- Outcomes of the randomized clinical trial comparing chiropractic flexion-distraction vs. medical conservative (physical therapy) care of low back pain. *Congratulations Dr. Gudavalli and team!*
 - DECEMBER 2005
 - Online Abstract: <http://www.springerlink.com/openurl.asp?genre=article&id=doi:10.1007/s00586-005-0021-8>
 - Full text article of the online (2005) article (PDF): [click here](#)
 - JULY 2006
 - Full text article of the print (2006) article (PDF): [click here](#)

Osteopathy & Chiropractic

- Published August 2006
- The follow-up outcomes of the above mentioned comparison study.
- Click here to view the report: <http://www.chiroandosteo.com/content/14/1/19>