SPINAL MANIPULATION

EFFECTS & EFFICACY

Definitions

- Efficacy – Benefits of an intervention as tested under controlled experimental conditions, usually with a control group in a randomized clinical trial (RCT)
- Effects – Benefits of an intervention as tested under "real world" conditions, often using quasi-experimental methods

Portney and Watkins 3rd edition

Effects

- Mechanical/Articular
- Neurophysiological
- Genetic
  - RNA expression
- Immunological
  - Enzyme activity
- Endocrine
  - Endorphin release
- Psychological
  - Manual contact, placebo

HYPOTHESES:
Suggested Effects of Manipulation

Mechanical/Articular:

- reduce a joint fixation
- capsule/muscle stretch
- tear adhesions/scars
  - **capsule**
  - **ligament**
  - **segmental muscle**
- Increase ROM - alter joint position
- release entrapment
  - **meniscoid**
  - **synovial fold**
  - **capsule**
- shift annular disc fragment
- relieve pressure on nervous system

Mechanical Neck Pain- ROM

- Rachel Martinez-Segura et al in a RCT study in 2006 demonstrated an increased in cervical ROM and decreased pain after a single cervical high velocity, low amplitude manipulation (HVLA) in subjects presenting with mechanical neck pain

- Rachel Martinez-Segura et al, Journal of Manipulative and Physiological Therapeutics, Sept. 2006

Rachel Martinez-Segura et al, Journal of Manipulative and Physiological Therapeutics, Sept. 2006

Table 1. *Characteristics of each group at the beginning of the study*

	Control group	Experimental group	*P*
No. of subjects	37	34	
Sex (male/female)	13/24	13/21	.7
Age (mean ± SD)	39 ± 10	35 ± 10	.2
Length of neck pain	4.5 ± 4.6	4 ± 3.4	.6
Neck pain at rest	5.5 ± 1.5	5.7 ± 1.5	.4
Cervical flexion	43 ± 9	45 ± 7	.2
Cervical extension	55 ± 7	57 ± 9	.2
Left lateral flexion	35 ± 7	37 ± 6	.2
Right lateral flexion	33 ± 6	34 ± 7	.4
Left rotation	56 ± 7	57 ± 10	.8
Right rotation	53 ± 6	55 ± 9	.3

Scores are expressed as means ± SD.

Rachel Martinez-Segura et al, Journal of Manipulative and Physiological Therapeutics, Sept. 2006

Within group changes show a sig. improvement in both neck ROM and pain at rest post-cervical HVLA

Table 2. *Within pre-post values and effect sizes (Cohen's d) of each group for each outcome measure*

	Manipulative group					Control mobilization group				
	Pre-int	Post-int	Pre-post	*P*	Within-group Cohen's *d*	Pre-int	Post-int	Pre-post	*P*	Within-group Cohen's *d*
Neck pain at rest	5.7 (1.5)	2.2 (1.5)	3.5 (1.2)	<.001	2.9	5.5 (1.7)	5.1 (1.9)	0.4 (0.6)	<.01	0.6
Cervical flexion	45 (7)	52 (7)	7 (5)	<.001	1.4	43 (9)	44 (9)	1.5 (2.5)	<.01	0.6
Cervical extension	57 (9)	65 (9)	8 (7)	<.001	1.2	55 (7)	56 (8)	1.4 (3.3)	<.05	0.4
Left lateral flexion	37 (6)	42 (6)	5 (4)	<.001	1.2	35 (7)	36 (6)	0.8 (1.5)	<.01	0.5
Right lateral flexion	34 (7)	39 (7)	5 (4)	<.001	1.2	33 (6)	33 (6)	0.8 (1.6)	<.01	0.5
Left rotation	57 (10)	66 (9)	9 (5)	<.001	1.8	56 (7)	56 (6)	0.3 (0.8)	NS	0.4
Right rotation	55 (9)	65 (8)	10 (5)	<.001	2	53 (6)	53 (6)	0.4 (1.5)	NS	0.3

Scores are expressed as mean (SD).
P value is based on an intragroup comparison (based on the paired Student *t* test). NS indicates not significant.
Pre-int, preintervention; *Post-int*, postintervention.

Mechanical Neck Pain

- Cesar Fernandez-de-las Penas et al in a case series study in 2005 demonstrated immediate changes in lateral flexion range of motion on X-Ray

C. Fernandez-de-las Penas et al International Journal of Osteopathic Medicine 8 (2005)

Table 2
Pre-post-radiological measurements of each patient

Patient	Inter-vertebral motion at the dysfunctional segment measured on contralateral side flexion to the hypomobile side (mm)		
	Pre-treatment	Post-treatment	Improvement
1	16	20	4
2	18	20	2
3	20	22	2
4	22	23	1
5	20	22	2
6	17	19	2
7	18	20	2
8	17	17	0
9	17	18.5	1.5
10	19	21	2
11	18	19	1
12	23	25	2
13	18	20	2
14	19	20	1
15	22	23	1
Total score	Mean 18.9 (SD 2.1)	Mean 20.6 (SD 2.1)	Mean 1.7 (95% CI 2.1–1.2)

P value = 0.01 (based on two-tailed Wilcoxon signed rank test).

Mechanical Neck Pain

- Pilar Mansilla-Ferragut et al demonstrated immediate effects on Active Mouth opening and pressure pain sensitivity in women with mechanical neck pain

- Pilar Mansilla-Ferragut et al, Journal of Manipulative and Physiological Therapeutics, February 2009

Pilar Mansilla-Ferragut et al, Journal of Manipulative and Physiological Therapeutics, February 2009

Table 1. *Pre-post and within intervention differences for both groups*

Active mouth opening			
	Preintervention	Postintervention	Mean difference
Experimental	35.4 (95% CI, 33.3-37.4)	38.8 (95% CI, 36.6-41.1)	3.5 (95% CI, 2.4, 4.6)
Control	36.2 (95% CI, 34.3-38.2)	35.9 (95% CI, 33.7-38.0)	−0.3 (95% CI, −0.4, 1.2)
PPTs			
	Preintervention	Postintervention	Mean difference
Experimental	0.8 (95% CI, 0.6-0.9)	0.9 (95% CI, 0.7-1.0)	0.1 (95% CI, 0, 0.2)
Control	0.8 (95% CI, 0.7-0.9)	0.7 (95% CI, 0.5-0.9)	−0.1 (95% CI, −0.2, 0.1)

CI indicates confidence interval.

Gapping of the lumbar zygapophysial joint during HVLA manipulation

- Gregory D. Cramer et al in a RCT study in 2002 demonstrated increased separation (gapping) of the lumbar "z" joints in a side posture position during a HVLA manipulation

- Cramer G et al, Spine Volume 27, Number 22, 2002, p.2459

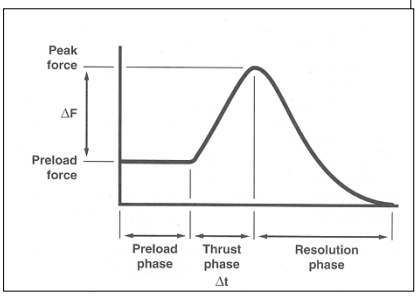
Cramer G et al, Spine Volume 27, Number 22, 2002, p.2459

Table 5. Summary of Gapping Differences* by Z Joint

Z Joint	Group 1 mm (SD)	Group 2 mm (SD)	Group 3 mm (SD)	Group 4 mm (SD)
L L3–L4	0.80 (0.66)	0.15 (0.65)	1.03 (1.17)	0.06 (0.43)
L L4–L5	0.96 (0.95)	0.15 (0.46)	1.51 (1.31)	−0.08 (0.56)
L L5–S1	1.04 (0.92)	−0.27 (0.51)	1.41 (0.85)	−0.02 (0.49)
Ave Diff L (SD)	0.93 (0.84)	0.01 (0.57)	1.32 (1.12)	−0.01 (0.49)
R L3–L4	−0.64 (1.27)	0.22 (0.45)	−0.80 (1.12)	−0.12 (0.49)
R L4–L5	−0.52 (1.03)	−0.05 (0.60)	−0.97 (1.37)	−0.09 (0.62)
R L5–S1	−1.07 (1.42)	−0.20 (0.48)	−0.90 (1.30)	−0.09 (0.51)
Ave Diff R (SD)	−0.74 (1.24)	−0.01 (0.51)	−0.89 (1.23)	−0.10 (0.52)

* Measurement from second MRI minus measurement from first MRI.

Mechanics of Spinal Manipulation



Schematic of force-time history of Spinal manipulation treatment and selected definitions of force parameters Herzog, 2000

Forces exerted during spinal manipulative therapy
Herzog et al, Spine, Vol. 18, number 9, 1993

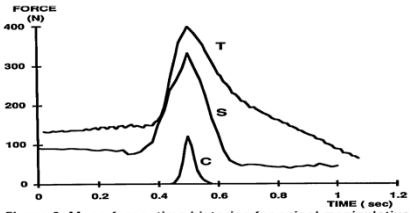
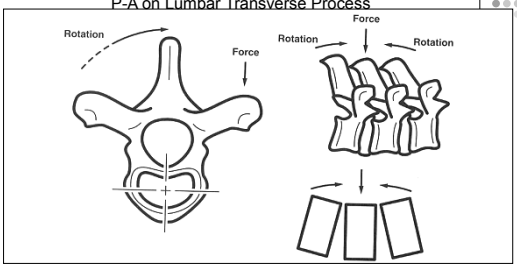


Figure 9. Mean force–time histories for spinal manipulative therapy on the cervical (C) and thoracic spine (T), and the sacroiliac joint (S). Mean curves for the cervical and thoracic spine were obtained from all treatments performed in this investigation. The mean curve for the sacroiliac joint treatments was obtained from 18 treatments performed by the same physician who administered all treatments on the thoracic spine.

W. Herzog, 2000, Clinical Biomechanics of Spinal Manipulation, Churchill Livingstone, Philadelphia
P-A on Lumbar Transverse Process



Likely to cause anterior displacement and axial rotation of the target vertebrae. Adjacent vertebrae will undergo sagittal rotation. Herzog, 2000

Suzanne J. Snodgrass et al, Forces Applied to the C-Spine during P-A Mobilization, Journal of Manipulative Therapy and Physiological Therapeutics, September 2008

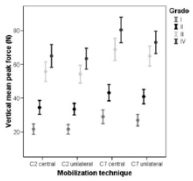


Fig 1. *Vertical mean peak mobilization forces (95% CI) applied by physiotherapists (n = 116) for each technique and grade. The mean vertical forces applied for each grade were significantly different (Bonferroni-adjusted pairwise comparisons; P < .001).*

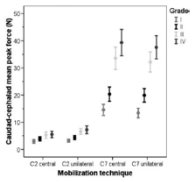
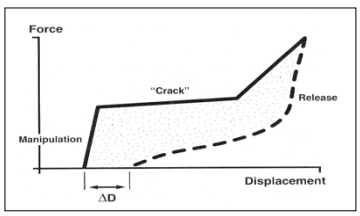


Fig 2. *Caudad-cephalad mean peak mobilization forces (95% CI) applied by physiotherapists (n = 116) for each technique and grade. The mean caudad-cephalad forces applied were significantly different between all grade pairs (Bonferroni-adjusted pairwise comparisons, I and III, I and IV, II and III, II and IV, P < .001; I and II, P = .012), except for grades III and IV (P = .063).*

Cavitation

Walter Herzog, Journal of Manipulative and Physiological Therapeutics, 1996 demonstrated that chiropractic patients and asymptomatic subjects demonstrated the same reflex response to a HVLA thrust to T6 whether a cavitation was recorded or not



Herzog, 2000

Cavitation

- Timothy Flynn et al, Journal of Manipulative and Physiological Therapeutics, 2006 demonstrated that a perceived audible pop many not be relate to improved outcomes from HVLA thrust
- JK Ross et al, Spine, 2004 demonstrated that the cavitation and location to the HVLA thrust did not always correlate (only 50% of the time in the lumbar region)

HYPOTHESES:

Suggested Effects of Manipulation

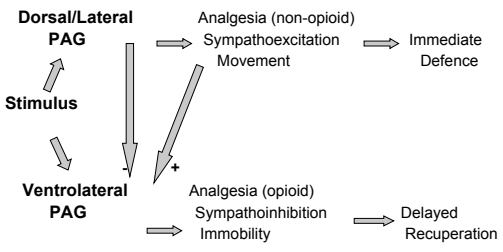
Neurophysiological:

- alter muscle reactivity
  - segmental
  - distant
- pain - spinal gating
- segmental facilitation
- indirectly effect mobility

through:

- articular receptors
- muscle spindle
- GTO
- sympathetic nervous system
- proprioception

Descending Pain Inhibitory Systems (DPIS) (Wright A., 1995)



Spinal Mobilization/Manipulation Produces Immediate Hypoalgesia

- Sterling et al, 2001a, 2001b
- Vicenzino et al,1995a, 1995b, 1996, 1998,2000
- Vernon et al, 1984,1990
- Fernandez-De-Las-Penas et al, 2007

Immediate Effects on Pressure Pain Threshold Following a Single Cervical Spinal Manipulation in Healthy Subjects – Fernandez-De-Las-Penas et al, JOSPT, 2007

PREINTERVENTION-POSTINTERVENTION DATA FOR PRESSURE PAIN THRESHOLD (PPT) FOR EACH INTERVENTION CONDITION*

	Preintervention	Postintervention	Preintervention-Postintervention Differences
Manipulative intervention			
PPT ipsilateral elbow	2.1 ± 0.5	2.9 ± 0.6	0.8 (0.5/1)
PPT contralateral elbow	2.2 ± 0.5	2.8 ± 0.6	0.5 (0.3/0.8)
Placebo intervention			
PPT ipsilateral elbow	2.3 ± 0.4	2.3 ± 0.5	0.003 (−0.04/0.01)
PPT contralateral elbow	2.3 ± 0.5	2.3 ± 0.6	0.006 (−0.08/0.07)
Control intervention			
PPT ipsilateral elbow	2.2 ± 0.5	2.2 ± 0.4	0.003 (−0.01/0.01)
PPT contralateral elbow	2.3 ± 0.5	2.3 ± 0.5	0.005 (−0.01/0.02)

*Scores are expressed as mean ± SD for preintervention and postintervention data, and as mean (95% confidence interval) for preintervention-postintervention differences. Pressure pain thresholds are expressed as kg/cm².

Altered Muscle Activity and Segmental Facilitation

- Ferreira et al, Manual Therapy, 2007
- Grindstaff et al, Manual Therapy, 2009
- Lehman et al, Clinical Biomechanics, 2001
- Sung et al, Spine, 2005

Spinal Manipulation causes variable spine kinematic and trunk muscle electromyograhphy responses
(Lehman et al Clinical Biomechanics, 2001)

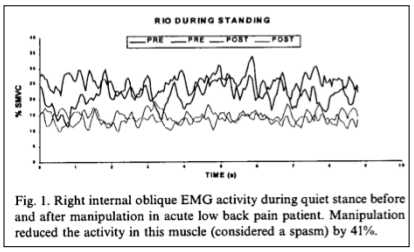


Fig. 1. Right internal oblique EMG activity during quiet stance before and after manipulation in acute low back pain patient. Manipulation reduced the activity in this muscle (considered a spasm) by 41%.

decrease in EMG amplitude

Other Researched Neurophysiological Effects

SNS system
- generalized excitatory response
- skin temperature
- mechanical pain thresholds

CNS system
- H reflex
- proprioception
- endorphins
- immune system response

H- Reflex and Motor Evoked Potentials

- Mazzocchio et al, J Spinal Disorder, 2000
- Dishman and Burke, Spine J, 2003
- Suter, McMorland and Herzog,J Manipulative Physiol Ther, 2005
- Dishman et al, J Manipulative Physiol Ther, 2008

Proprioception

- Heikkila et al. Manual Therapy, 2000
- Strunk et al. Journal of Chiropractic Medicine, 2009
- Smith et al. International Journal of Osteopathic Medicine, 2008

Summary of Researched Effects

- The overall literature on the effects of manipulation range from weak to moderately strong
- Clinical expertise in manipulation is helping to inform and guide the current research related to the effects of manipulation

Efficacy of Lumbar Spine Manipulation

Difficulties:

- many poorly designed
- use of manipulation vs manual techniques often unclear

Findings:

- generally more recent, higher quality studies show positive outcome
- especially short term superiority
- most recent Cochrane Review
  - no evidence that spinal manipulation was superior to other standard treatments for patient's with acute or chronic LBP
- multimodal treatment superior

Patient profile of those patients that did well with lumbar manipulation:

- acute (< 1 mo)
- central distribution
- spinal mobility
- SLR > 60
- few neuro signs
- no previous manipulation
- no pending litigation

** these were the inclusion criteria for the positive studies

Indications

Predictors for favourable response in lumbar spine

1. No symptoms distal to the knee
2. Recent onset of symptoms (<16days)
3. Low FABQ score (<19)
4. Hypomobilty of the lumbar spine (P/A)
5. Hip I.R ROM >35° for at least 1 hip

Fritz et al, JOSPT, 2007

Efficacy of Cervical Spine Manipulation

- not as many studies
- poorly controlled
- often compared to other modes of manual therapy

Findings:

- manipulation is mild to moderately effective in:
  - decreasing pain
  - increasing ROM
  - improving proprioception
  - dizziness
  - intensity, duration and frequency of CHA
- generally manipulation is not superior to other forms of manual therapy
- better result when combined with exercise

Indications

Predictors for favourable response in cervical spine

1. Intermittent neck pain
2. Neck pain <30 days
3. Work status
4. No prior history of neck pain
5. Higher education
6. Expectation that the treatment would be helpful

Rubinstein et al, Spine, 2007

- THANK YOU FOR LISTENING!!!!!!

jsadi2@uwo.ca

References

- Carol Kennedy FCAMT, Beverly Padfield FCAMT, Lenerdene Levesque – power point slides
- Julie M. Fritz et al, JOSPT, June 2007
- Sidney M. Rubenstein et al, Spine, Oct. 2007
- W. Herzog, 2000. Clinical Biomechanics of Spinal Manipulation, Churchill Livingstone, Philadelphia
- W. Herzog, 1996. "On sounds and reflexes", Journal of Manipulative and Physiological Therapeutics, 19 (3):216-218
- Rachel Martinez-Segura et al, Journal of Manipulative and Physiological Therapeutics, Sept. 2006
- Timothy Flynn et al, "The audible pop from HVLA thrust manipulation and outcome in individuals with low back pain", Journal of Manipulative and Physiological Therapeutics, January, 2006
- JK Ross et al, "Determining cavitation location during lumbar and thoracic spine manipulation". Spine, 2004
- Lehman & McGill, Clinical Biomechanics, 2000
- Christopher J. Colloca et al, Biomechanics, Oct.2005
- Yuh Liang Tseng et al, Manual Therapy, 2006
- Sung P.S et al, Spine, 2005
- Anthony Wright, "Hypoalgesia post-manipulation: a review". Manual Therapy, 1995

References

- Sterling et al, Cervical mobilization: concurrent effects on pain, sympathetic nervous system activity and motor activity, Manual Therapy 2001a;6:72-81
- Heikkila et al, Manual Therapy, 2000
- Strunk et al, Journal of Chiropractic Medicine, 2009
- Smith et al, International Journal of Osteopathic Medicine, 2008
- Mazzocchio et al, J Spinal Disorder, 2000
- Dishman and Burke, Spine J, 2003
- Suter, McMorland and Herzog,J Manipulative Physiol Ther, 2005
- Dishman et al, J Manipulative Physiol Ther, 2008
- Ferreira et al, Manual Therapy, 2007
- Grindstaff et al, Manual Therapy, 2009
- Suzanne J. Snodgrass et al, Journal of Manipulative Therapy and Physiological Therapeutics, September 2008
- Herzog et al,Forces exerted during spinal manipulative therapy, Spine, Vol. 18, number 9, 1993

References

- Portney and Watkins 3rd edition, Foundations of Clinical Research: Application to Practice
- C. Fernandez-de-las Penas et al, International Journal of Osteopathic Medicine 8 ,2005
- Pilar Mansilla-Ferragut et al, Journal of Manipulative and Physiological Therapeutics, February 2009
- Cramer G et al, Spine Volume 27, Number 22, 2002, p.2459
- Sterling et al, 2001a, 2001b
- Vicenzino et al,1995a, 1995b, 1996
- Fernandez-De-Las-Penas et al, 2007