57th AOA Annual Research Conference

Program Chairs:
Stanley E. Grogg, DO, FACOP, FAAP
Leigh Goodson, PhD

2:40 p.m.-3:10 p.m.
The Science and Clinical Application of Manual Therapy
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Department of Family Medicine Residency Program
University of Wisconsin

KNOW THE SCIENCE, Practice the Art

SEPT. 30 - OCT. 4
LAS VEGAS
The Science and Clinical Application of Manual Therapy: Implications for an Osteopathic Research Agenda

Hollis H. King, DO, PhD, FAAO
DO Residency Program Director

Las Vegas, NV
September 30, 2013
Objectives – Main Ideas Presented

1. Research on OMM/OMT in systemic disorders – update
   A. Gastrointestinal system
   B. Cardiovascular system
   C. Vestibular system
   D. Nervous system

2. Viscerosomatic Interactions – A major contribution of osteopathic medicine to healthcare
The Science and Clinical Application of Manual Therapy is a multi-disciplinary, international reference book based on work by the top basic science researchers and clinicians/researchers in the area of Manual Therapy and Manual Medicine. The first book to bring together research on the benefits of Manual Therapy/Manual Medicine (MT/MM) beyond the known effects on musculoskeletal disorders, represents evidence of the benefits of MT/MM in treating systemic disorders.

The book makes a powerful case for how MT/MM affects the central nervous system and the autonomic nervous system (the circulatory, respiratory, gastrointestinal systems, and all organs) which impact on a person’s health. It covers how MT/MM works and details the conditions such as chronic skeletal and visceral pain diseases, asthma, pneumonia, and cardiovascular dysregulation... that can benefit from it. Longstanding theoretical models of MT/MM mechanisms are critically assessed in the light of current understanding of physiological and neurophysiological functions, and the influence of psychological and cortical processes on the effects of MT/MM are explored.

The book consists of four main sections:
- Peripheral and visceral-cerebro mechanisms.
- Supra-axial mechanisms (including those of the forebrain).
- Clinical applications of MT/MM.
- Critical assessment of the impact of research in basic and clinical science on clinical practice and research funding.

This book will appeal to osteopathic physicians, chiropractors, physical therapists and massage therapists as well as allbody workers/health practitioners who use their hands in healthcare. It will appeal to all practitioners involved in treatment of chronic pain disorders as well as those involved in basic and clinical research in the field.
Gastrointestinal System

[Postoperative – is the uncomplicated ileus that occurs after surgery and generally resolves spontaneously in 2 to 3 days.]


Update

Herrmann (1965)
- Used paraspinal inhibition before surgery. *Reduced the incidence of post-op ileus by 7.3 %.* Hastened the patient’s recovery from ileus once ileus had occurred. OMT = 317; control = 92.

Crow & Gorodinsky (2009)
- retrospective chart review of patients with postoperative ileus: 331 patients had undergone abdominal surgery, 172 received OMT and 139 did not. Analysis revealed that patients who received OMT had statistically significant shorter hospital stays (11.8 vs. 14.6 days; *P*= .029).

### Table 1.
Characteristics and Outcomes in General Surgical Patients Who Did or Did Not Receive Postoperative OMT (n=55)

<table>
<thead>
<tr>
<th>Characteristic or Outcome</th>
<th>Mean (SD)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OMT Group (n=17)</td>
<td>Non-OMT Group (n=38)</td>
</tr>
<tr>
<td>Age, y</td>
<td>60.3 (17.7)</td>
<td>62.1 (15.8)</td>
</tr>
<tr>
<td>ASA Physical Status Class&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.5 (0.6)</td>
<td>2.7 (0.7)</td>
</tr>
<tr>
<td>Time to Flatus, d</td>
<td>3.1 (0.6)</td>
<td>4.7 (0.4)</td>
</tr>
<tr>
<td>Time to Clear Liquid Diet, d</td>
<td>4.6 (3.8)</td>
<td>5.6 (7.0)</td>
</tr>
<tr>
<td>Time to Bowel Movement, d</td>
<td>4.8 (2.3)</td>
<td>5.8 (4.9)</td>
</tr>
<tr>
<td>Postoperative Hospital LOS, d</td>
<td>6.1 (1.7)</td>
<td>11.5 (1.0)</td>
</tr>
</tbody>
</table>

*Physical status was classified on a scale of 1 to 6, with 1 being healthy and 6 being brain dead.*

**Abbreviations:** ASA, American Society of Anesthesiologists; LOS, length of stay; OMT, osteopathic manipulative treatment; SD, standard deviation.

**Figure 2.**
Mean (standard deviation) postoperative days to flatus and postoperative hospital length of stay (LOS) for general surgical patients who did or did not receive postoperative osteopathic manipulative treatment (OMT).
Cardiovascular System


Update

Intervention 1: OMT

- Soft Tissue
  - Kneading
  - Stretching

- Sub-Occipital Decompression

Giles 2006
Intervention 2: Sham

- No Soft Tissue Treatment
- Similar Finger Placement
- Light Touch
- Controlling for Human Touch
Intervention 3: Time Control

- No Treatment
- No Contact
- Subject Lay quietly for same amount of time as interventions 1 and 2.
- Controlling for Time of treatment
HRV: Time Domain

SDNN (sec)

OMT

Sham

Time Control

p = 0.005*

p = 0.922

p = 0.113
This study described the immediate effects of postoperative manipulative treatment (OMT) on cardiac hemodynamics after coronary artery bypass graft surgery, while patients remained **sedated** and **pharmacologically paralyzed**. Assessments of blood distribution (thoracic impedance), oxygen content of blood (mixed venous oxygen saturation, and cardiac output (cardiac index) all demonstrated the immediate physiological benefit of OMT.
**SvO$_2$** – An indicator of peripheral oxygen saturation

![Graph showing mean SvO$_2$ levels pre and post OMT]

*P value represents paired t test comparing pre-OMT mean with post-OMT mean.*

*P < .005*
*P value represents unpaired t test comparing change in mean for OMT group with change in mean for control group.
Thoracic Impedance – An indicator of central blood volume

*P value represents paired t test comparing pre-OMT mean with post-OMT mean.
Cardiac Index – An indicator of cardiac function

*P value represents paired t test comparing pre-OMT mean with post-OMT mean.
*P value represents unpaired t test comparing change in mean for OMT group with change in mean for control group.

**Figure 1.**

**Figure 2.**
These results are interesting to report as the trends are in the hypothesized direction, none were statistically significant at the $P < .05$ level.

<table>
<thead>
<tr>
<th>Response Variable</th>
<th>OMT Group (n=17)</th>
<th>Placebo Group (n=18)</th>
<th>Control Group (n=18)</th>
<th>F Test $P$ Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discharge to home, d</td>
<td>6.1 (1.4)</td>
<td>6.3 (1.5)</td>
<td>6.7 (3.0)</td>
<td>.72</td>
</tr>
<tr>
<td>Discharge to home, d&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6.1 (1.4)</td>
<td>6.3 (1.5)</td>
<td>6.1 (1.8)</td>
<td>.94</td>
</tr>
<tr>
<td>Time to Bowel Movement, d</td>
<td>3.5 (0.9)</td>
<td>4.0 (0.8)</td>
<td>4.0 (0.9)</td>
<td>.19</td>
</tr>
<tr>
<td>FIM score on day 3&lt;sup&gt;b&lt;/sup&gt;</td>
<td>19.3 (6.7)</td>
<td>15.4 (7.3)</td>
<td>18.6 (6.5)</td>
<td>.22</td>
</tr>
</tbody>
</table>

<sup>a</sup> For this set of data, n=17 for the control group. Data were recalculated excluding the outlying results of 1 patient in the control group, whose time to discharge home was 16 days.

<sup>b</sup> Each task was rated on a 7-point scale, with a total FIM score of 28 representing the greatest functional independence.

Abbreviations: CABG, coronary artery bypass graft; OMT, osteopathic manipulative treatment; SD, standard deviation.
On a more positive note

Balance and Equilibrium
Effects of Comprehensive Osteopathic Manipulative Treatment on Balance in Elderly Patients: A Pilot Study

Daniel Lopez, DO; Hollis H. King, DO, PhD; Janice A. Knebl, DO; Victor Kosmopoulos, PhD; DeRaan Collins, BS; and Rita M. Patterson, PhD

N = 40, Healthy elders age ≥ 65 years old
OMT Group N = 20
No OMT N = 20

Each group had 4 OMT or No OMT visits in which balance was measured.
Measurements

Center of Pressure (COP) average of the pressure between the feet.

- AMTI Model #OR6-7-2000, Advanced Mechanical Technology, Inc., Watertown, MA
- They were barefoot in a self-chosen foot position (not wider apart than the distance between their hip joints).
- Their chosen foot stance was traced on paper to ensure subsequent balance trials maintained similar foot positioning.

3 balance tests:

- Eyes open,
- Eyes closed
- With arms extended 90 degrees in front of them and their eyes closed (modified Rhomberg).
Use of the SMART Balance Master to Quantify the Effects of Osteopathic Manipulative Treatment in Patients With Dizziness

Marcel Fraix, DO; Ashlynn Gordon, OMS IV; Victoria Graham, PT, DPT, OCS, NCS; Eric Hurwitz, DC, PhD; and Michael A. Seffinger, DO
Table 1. Conditions Used in the Sensory Organization Test Performed to Evaluate Balance on the SMART Balance Master

<table>
<thead>
<tr>
<th>Condition</th>
<th>Visual Surroundings</th>
<th>Surface</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Eyes open</td>
<td>Fixed</td>
</tr>
<tr>
<td>2</td>
<td>Eyes closed</td>
<td>Fixed</td>
</tr>
<tr>
<td>3</td>
<td>Moving visual surroundings</td>
<td>Fixed</td>
</tr>
<tr>
<td>4</td>
<td>Eyes open</td>
<td>Movable</td>
</tr>
<tr>
<td>5</td>
<td>Eyes closed</td>
<td>Movable</td>
</tr>
<tr>
<td>6</td>
<td>Moving visual surroundings</td>
<td>Movable</td>
</tr>
</tbody>
</table>

Figure 1.
SMART Balance Master (NeuroCom) being used to measure the effect of osteopathic manipulative treatment in patients with dizziness. The SMART Balance Master is a validated instrument that provides graphic and quantitative analyses of sway and balance.
Table 3. Demographic Characteristics in 16 Patients with Dizziness Receiving Osteopathic Manipulative Treatment

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex, No. of Patients</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>2</td>
</tr>
<tr>
<td>Female</td>
<td>14</td>
</tr>
<tr>
<td>Age, mean (range), y</td>
<td>49 (13-75)</td>
</tr>
<tr>
<td>Duration of Symptoms, mean (range), mo</td>
<td>84 (8-420)</td>
</tr>
</tbody>
</table>
Table 4.  
Statistical Analysis of Composite Scores for 16 Patients With Dizziness Receiving Osteopathic Manipulative Treatment (OMT)

<table>
<thead>
<tr>
<th>Timing*</th>
<th>Composite Score, %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean  (SD)</td>
</tr>
<tr>
<td>Before OMT</td>
<td>63.9 (13.8)</td>
</tr>
<tr>
<td>Immediately After OMT</td>
<td>74.8 (9.8)</td>
</tr>
<tr>
<td>1 wk After OMT</td>
<td>77.4 (8.0)</td>
</tr>
</tbody>
</table>

* The difference between pre- and post-OMT composite scores was statistically significant both immediately and 1 week after OMT (both P<.001); there was no significant difference between the immediate and 1-week post-OMT scores (P=.20).

Abbreviation: SD, standard deviation.
Figure 4.
Mean composite scores (CSs) for all 16 study participants before, immediately after, and 1 week after osteopathic manipulative treatment (OMT). The CS is a measure of balance and postural control. The mean increase in overall balance and postural control was 10.9% immediately after OMT and 13.5% 1 week later. The difference between pre- and post-OMT CSs was statistically significant both immediately and at 1 week (both $P<.001$).
Nervous System Effects

Sleep Latency and Length
Cranial Manipulation Can Alter Sleep Latency and Sympathetic Nerve Activity in Humans: A Pilot Study


ABSTRACT

Objective: To determine if cranial manipulation is associated with altered sleep latency. Furthermore, we investigated the effects of cranial manipulation on muscle sympathetic nerve activity (MSNA) as a potential mechanism for altered sleep latency.

Design: Randomized block design with repeated measures.

Setting: The Integrative Physiology and Manipulative Medicine Departments, University of North Texas Health Science Center, Fort Worth, TX.

Subjects: Twenty (20) healthy volunteers (12 male, 8 female; age range, 22–35 years) participated in this investigation.

Interventions: Subjects were exposed to 3 randomly ordered treatments: compression of the fourth ventricle (CV4), CV4 sham (simple touch), and control (no treatment).

Outcome measures: Sleep latency was assessed during each of the treatments in 11 subjects, using the standard Multiple Sleep Latency Test protocol. Conversely, directly recorded efferent MSNA was measured during each of the treatments in the remaining 9 subjects, using standard microneurographic technique.

Results: Sleep latency during the CV4 trial was decreased when compared to both the CV4 sham or control trials ($p < 0.05$). MSNA during the CV4-induced temporary halt of the cranial rhythmic impulse (stillpoint) was decreased when compared to prestillpoint MSNA ($p < 0.01$). During the CV4 sham and control trials MSNA was not different between CV4 time-matched measurements ($p > 0.05$). Moreover, the change in MSNA prestillpoint to stillpoint during the CV4 trial was different compared to the CV4 sham and control trials ($p < 0.05$). However, this change in MSNA was similar between the CV4 sham and control trials ($p > 0.80$).

Conclusions: The current study is the first to demonstrate that cranial manipulation, specifically the CV4 technique, can alter sleep latency and directly measured MSNA in healthy humans. These findings provide important insight into the possible physiologic effects of cranial manipulation. However, the mechanisms behind these changes remain unclear.
FIG. 2. Comparison of total percent sleep between CV4, CV4 sham, and control groups (n = 11). CV4 = compression of the fourth ventricle; CV4 sham = simple touch; control = no treatment.
Nervous System Effects

Alpha Rhythm Enhancement
10 Subjects as own control, random order of receiving CV4, sham (head resting on hands, no treatment intent or head contact by fingers), control (no contact). Only CV4 application showed statistically significant increase in Alpha Power (µV^2).

Figure 4 - Mean and standard deviation of absolute alpha power (µV^2) at occipital electrodes O1-Oz-O2 for each experimental condition at pre and post treatment. The figure illustrates the combination among occipital electrodes. The statistical analysis revealed a main effect of electrode (p=0.0002).
Viscero-Somatic Interactions
Long a part of osteopathic research and clinical consideration

The Journal
-OF-
The American Osteopathic Association

VOL. 7. AUBURN, N. Y., OCTOBER 1, 1907. No. 2.

VISCERO-SOMATIC AND SOMATO-VISCERAL SPINAL REFLEXES.

Louisa Burns, M. S., D. Sc. O.
Department of Physiology, Los Angeles.

Results to be Attained.

In the study of the physiology of the sympathetic nervous system it was noted that a lack of clearness was especially evident concerning the locality in which the viscero-sensory impulses affect the viscero-motor nerves. It occurred to me that a study of viscero-somatic and somato-visceral spinal reflexes might assist in determining whether this co-ordination takes place chiefly in the sympathetic ganglia, or chiefly in the spinal cord. It is evident that viscero-somatic reflexes would be impossible if viscero-sensory nerves did not
In dogs and cats, “For the experiments upon the abdominal viscera, the abdominal wall was cut, and the viscera exposed to view with as little manipulation as possible. The stimulation of the inner wall, the muscular coat and the peritoneal covering of the cardiac end of the stomach or of the fundus was followed by the contraction of the spinal muscles near the sixth to the ninth thoracic vertebrae.” p. 54
“The stimulation of the tissues near the fifth to the eighth thoracic vertebrae was followed by muscular and secretory activity in the stomach, and stimulation near the eighth to the twelfth thoracic vertebrae was followed by activity of the intestines.” p. 55
Sushruta (Around 600 BCE) was an ancient Indian surgeon and is the author of the book *Sushruta Samhita*, in which he describes over 300 surgical procedures and 120 surgical instruments and classifies human surgery in 8 categories.

Sushruta also described “Hritshoola,” which literally means “heart pain,” (cardiac ischemia perceived as somatic pain.)*

Korr IM. The spinal cord as organizer of disease processes: the peripheral autonomic nervous system. JAOA 1979;79:82-90.

Fig 1. Diagrammatic view of brainstem and spinal cord, representing origins of the ANS; that is, the location of the cells of origin (preganglionic neurons) in the central nervous system. These neurons are subject to a vast variety of presynaptic influences. In this and in all the diagrams the sympathetic division is in the center and the parasympathetic is at the top and bottom. Roman numerals represent parasympathetic cranial nuclei. Arabic numerals indicate cervical, thoracic, lumbar, and sacral segments of the spinal cord, and the segmental origins (intermediolateral cell columns) of the sympathetic division (T1 to L2), and the sacral portion of the parasympathetic division (S2 to S4). Fig 2. Paravertebral chains of sympathetic ganglia and the preganglionic fibers (leaving the spinal cord via the ventral roots and white rami between T1 and L2). Encircled pairs or groups of ganglia indicate fusions that are commonly found. Fig 3. Visceral structures are represented within the human figure in four main groupings: those of head and neck; thoracic; abdominal; pelvic and genital. Only the parasympathetic innervation is shown. In this and the remaining figures solid lines represent preganglionic axons and interrupted lines represent postganglionic axons.
Viscerosomatic Reflexes

- Autonomic Nervous System (ANS) is an efferent system.
- Visceral afferents: carry impulses from the organ to the cord.
- Usually uses the same pathways as that organ’s sympathetic innervation, and synapse in spinal cord at the level of sympathetic innervation.
In fact, this is what we teach in USA OPP classes.

Attempt to standardize sympathetic nervous system with regard to organ innervation.
Referred Visceral Pain Organ Specific

• Visceral peritoneum is innervated by autonomic afferent nerves & poorly localized, sometimes being referred to distant locations
“Spinothalamic system and viscerosomatic motor reflexes: functional organization of cardiac and somatic input”
Robert D. Foreman • Chao Qin • Chuan-Chau Jerry Jou
in King, Jänig, Patterson 2011

Make the scientific case for the mechanisms underlying the long held idea of viscerosomatic interactions.

Figure 7.1 Diagrams of the general area of referred pain (A) and change in the tonicity of paraspinal muscles (B) resulting from patients experiencing angina pectoris. In B palpatory techniques were used in patients with ischemic heart disease to determine changes in paraspinal muscles. The abscissa is the number of cases and the ordinate is the spinal segment level from cervical segment 1 (C1) to thoracic segment 12 (T11). The arrows from the graph to the human figure indicate the location of the equivalent segments. B is adapted from Beal (1985).
When a Viscero-somatic Reflex Turns into a Facilitated Segment

T 3-4 dermatome “Hritshoola”
Spinal Facilitation

1. The maintenance of a pool of neurons (e.g. premotor neurons, motor neurons or preganglionic sympathetic neurons in one or more segments of the spinal cord) in a state of partial or subthreshold excitation; in this state, less afferent stimulation is required to trigger the discharge impulses.

2. Facilitation may be due to sustained increase in afferent input, or changes within the affected neurons themselves or their chemical environment. Once established, facilitation can be sustained by normal central nervous system (CNS) activity.
I suggest that osteopathic research emphasize our strong suit of demonstrating OMT impact on physiologic function and systematic disorders where we can appeal to this well known mechanism of action of VS/SV visceral interactions.

Maybe start with diabetes.