THE AAO
FORUM FOR OSTEOPATHIC THOUGHT

JOURNAL

Official Publication of the American Academy of Osteopathy®

TRADITION SHAPES THE FUTURE VOLUME 16 NUMBER 3 SEPTEMBER 2006

One Heritage, Two Traditions; A Look to the Future

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Instructions to Authors

The American Academy of Osteopathy® (AAO) Journal is a peer-reviewed publication for disseminating information on the science and art of osteopathic manipulative medicine. It is directed toward osteopathic physicians, students, interns and residents and particularly toward those physicians with a special interest in osteopathic manipulative treatment.

The AAO Journal welcomes contributions in the following categories:

Original Contributions
Clinical or applied research, or basic science research related to clinical practice.

Case Reports
Unusual clinical presentations, newly recognized situations or rarely reported features.

Clinical Practice
Articles about practical applications for general practitioners or specialists.

Special Communications
Items related to the art of practice, such as poems, essays and stories.

Letters to the Editor
Comments on articles published in *The AAO Journal* or new information on clinical topics. Letters must be signed by the author(s). No letters will be published anonymously, or under pseudonyms or pen names.

Book Reviews
Reviews of publications related to osteopathic manipulative medicine and to manipulative medicine in general.

Note
Contributions are accepted from members of the AOA, faculty members in osteopathic medical colleges, osteopathic residents and interns and students of osteopathic colleges. Contributions by others are accepted on an individual basis.

Submission
Submit all papers to Anthony G. Chila, DO, FAAO, Editor-in-Chief, Ohio University, College of Osteopathic Medicine (OUCOM), Grosvenor Hall, Athens, OH 45701.

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Papers submitted to *The AAO Journal* may be submitted for review by the Editorial Board. Notification of acceptance or rejection usually is given within three months after receipt of the paper; publication follows as soon as possible thereafter, depending upon the backlog of papers. Some papers may be rejected because of duplication of subject matter or the need to establish priorities on the use of limited space.

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2. Submit original plus three copies. Retain one copy for your files.

3. Check that all references, tables and figures are cited in the text and in numerical order.

4. Include a cover letter that gives the author's full name and address, telephone number, institution from which work initiated and academic title or position.

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6. For human or animal experimental investigations, include proof that the project was approved by an appropriate institutional review board, or when no such board is in place, that the manner in which informed consent was obtained from human subjects.

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References
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2. For journals, include the names of all authors, complete title of the article, name of the journal, volume number, date and inclusive page numbers. For books, include the name(s) of the editor(s), name and location of publisher and year of publication. Give page numbers for exact quotations.

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The AAO Journal is the official publication of the American Academy of Osteopathy®. Issues are published in March, June, September, and December each year.

Third-class postage paid at Carmel, IN. Postmaster: Send address changes to: American Academy of Osteopathy®, 3500 DePauw Blvd., Suite 1080, Indianapolis, IN., 46268. Phone: 317-879-1881; FAX: (317) 879-0563; e-mail snoone@academyofosteopathy.org; AAO Website: http.//www.academyofosteopathy.org

THE AAO JOURNAL — FORUM FOR OSTEOPATHIC THOUGHT

Official Publication of the American Academy of Osteopathy®

TRADITION SHAPES THE FUTURE • VOLUME 16 NUMBER 3 SEPTEMBER 2006

A PEER-REVIEWED JOURNAL

The Mission of the American Academy of Osteopathy® is to teach, advocate, and research the science, art and philosophy of osteopathic medicine, emphasizing the integration of osteopathic principles, practices and manipulative treatment in patient care.

In this Issue:

American Academy of Osteopathy®

Calendar of Events

2006

Oct 15	One-day course – *Introduction to Osteopathic Medicine for the Non-physician Licensed Health Care Provider* in Las Vegas
Oct 15	AAO Leadership's Strategic Planning Session in Las Vegas
Oct 16	AAO Board of Trustees meeting in Las Vegas
Oct 16	AOBNMM Board Review Course in Las Vegas
Oct 16-20	*AOA Convention* in Las Vegas
Nov 3-5	*Prolotherapy: Below the Diaphragm* at UN-ECOM
Nov 18-19	AOBNMM Exams in Indianapolis
Dec 1	AOBNMM Application Deadline for 2007 Exams
Dec 1-3	*Visceral Manipulation: Membranes* in San Francisco

2007 Course Calendar

- Jan 11-14 - *Contemporary OMT at the Contemporary*, Ann L. Habenicht, DO, FAAO, Program Chair
- Feb 16-18 - *Diagnosis of Muscle Imbalance and Exercise Prescription The Greenman Protocol* at AZCOM, Brad Sandler, DO
- Mar 19-21 - *Visceral/Manual-Thermal* in Colorado Springs – Kenneth E. Lossing, DO, Program Chair
- Mar 21 – *Facilitated Positional Release* in Colorado Springs – Stanley Schiowitz, DO, FAAO, Program Chair **NEW 6-Hour Course**
- Mar 21-25 – *AAO Convocation* in Colorado Springs – George Pasquarello, DO, FAAO, Program Chair
- Apr 27-29 – *Osteopathic Treatment of Headache* at PCOM – Dennis J. Dowling, DO, FAAO
- Jun 8-10– *Introduction to Osteopathic Technique for Common Muscle Disorders* at PCOM/Georgia Campus - Walter C. Ehrenfeuchter, DO, FAAO and Edward K. Goering, DO
- Jul 13-15– *Three Masters of Osteopathy in the Cranial Field* at CCOM – Stephanie Waecker, DO
- Sep 29 – One-day course – *OMT without an OMT Table* in San Diego – Ann L. Habenicht, DO, FAAO
- Sep 30 – Oct 4 – *AOA Convention* in San Diego – John E. Balmer, DO, Program Chair
- Dec 1-3 – *Visceral Manipulation: Colon* in San Francisco - Kenneth Lossing, DO

View from the Pyramids

Anthony G. Chila

Palpation

A new academic year is beginning. At present, more than 20 colleges of osteopathic medicine are involved in the enrollment, training, and preparation of future osteopathic physicians. As indicated in the last issue of this column, the CORE COMPETENCY COMPLIANCE PROGRAM which began in July 2004 should have all of the competencies introduced over a period of three years. Assessment of the first two of these competencies (Osteopathic Philosophy and Osteopathic Manipulative Care; Medical Knowledge) began in January 2005.

The teaching of palpation, palpatory diagnosis and manipulative interventions is sophisticated in today's numerous osteopathic curricula. On-going discussion regarding this teaching occurs periodically throughout an academic year by the *Educational Council on Osteopathic Principles (ECOP).* Membership on this council is generally comprised of teachers of osteopathic theory, methods and practice from the various colleges. It was the work of this group that prepared the way for the publication of *Foundations for Osteopathic Medicine,* the major text resource for the osteopathic profession. Through two editions at present, this text has sought to portray the various methods of manipulative interventions with supportive discussions of basic and clinical research. The growth of the osteopathic profession and the teaching of its philosophy, science and art periodically need to pause and reconsider its path. Reference to a few of the profession's earlier teachers can be useful in this exercise.

The Principles of Palpatory Diagnosis and Manipulative Technique is the title of the American Academy of Osteopathy® Yearbook (1992). As indicated by the editor, Myron C. Beal, DO, FAAO:

"This Academy publication is devoted to materials dealing with the training of manipulative skills. It is designed to be a resource for students, teachers, and physicians in practice.

Included in this volume are the glossary of terminology, objectives for a core curriculum from the document by the Educational Council on Osteopathic Principles, the principles of psychomotor skills teaching, a discussion of practical examinations in osteopathic skills, osteopathic diagnosis and manipulative treatment, articles on osteopathic research, and a listing of textbooks on manipulation and other educational items."

In Section V, *Palpation,* articles published are those of Doctors Paul Van B. Allen and James A. Stinson; George V. Webster; Louisa Burns; J.S. Denslow; William J. Walton; Myron C. Beal. In today's teaching environment, not all of these names will be readily recalled by contemporary teachers. The titles alone suggest the breadth of teaching possible in this area: The Development of Palpation; The Feel of The Tissues; The Teaching of Osteopathic Skill; Palpation of the Musculoskeletal System; Palpatory Diagnosis of the Osteopathic Lesion; and Osteopathic Basics. A random selection of comments from these writings has great relevance to the contemporary osteopathic curriculum:

"Two essentials of successful practice of osteopathy are: the palpatory ability to 'find a lesion', and the mechanical skill to adjust or 'fix it'. To some of us it seems that these two fundamentals are not receiving proper attention. Not enough of either of them ever can be taught."

"It is upon this specialized sense of touch that the osteopath, by palpation, depends for a diagnosis of tissue tone and anatomic relationships."

"Teaching the principles upon which osteopathic practice is based is pedagogically simple. It is quite a different matter to train osteopathic fingers. To be really skillful, the hands of an osteopathic physician should act as though they had a part of the brain for their own control. Indeed this is almost anatomically true."

"While the experienced examiner uses a single palpatory procedure to secure, more or less simultaneously, information concerning tenderness, tissue tone, motion, and alignment, the student will study each element in the palpatory examination as though it were a separate procedure in itself; ultimately, of course, these elements will be blended into a single procedure."

"It always must be remembered that there is no valid substitute for skillful palpatory diagnosis in detecting the relatively minute structural changes—reflex or primary—that have drastic and widespread effects on the function of the tissues neurologically related to the disturbance."

"Fundamental to the basic skills is the development of a tactile sense. The degree of tactile sensitivity of the physician is often the decisive factor in his development of diagnostic and treatment skills."

Contributors

Wm. Thomas Crow. The Effects Of Manipulation On Ligaments And Fascia From A Fluids Model Perspective. This Scientific Paper/Thesis was submitted in partial fulfillment of requirements for Fellowship in the American Academy of Osteopathy. The author received status as Fellow in 2002. Readers are well aware of the emphasis placed on the fascia of the human body by Andrew Taylor Still. Clinical effects of manipulation on connective tissue are acknowledged, and expansion of the impact of such work via fluid mechanisms is carried to the cellular level of the body. **(p. 13).**

David C. Eland. Palpatory Evidence For Viscero-Somatic Influence Upon The Musculoskeletal System. The author is known for his contribution in completing the second edition of *Functional Methods* (American Academy of Osteopathy ®, 2005). This paper discusses work begun by the author with the late William L. Johnston in 2001. Applications of Local versus Regional Motion Input are considered. Specifically, differences between the two are considered as a means of determining whether viscero-somatic input is complicating the motion capacity of the dysfunctional segment. **(p. 21).**

Danielle Burkett and Russell G. Gamber. Larsen's Syndrome: A Case Report. Larsen et al. discussed multiple congenital dislocations associated with characteristic facial abnormality in 1950. Then and subsequently, this syndrome has been discussed with frequent emphasis on the pediatric patient. The authors emphasize expanded potential for treatment in this report of an adult patient. At issue are the structural and soft tissue complications to be found with advancing age. The use of Osteopathic Manipulative Treatment (OMT) can contribute to decreased pain, increased flexibility and improved ambulation. **(p. 25).**

Regular Features

DIG ON. Karen M. Steele is the Immediate Past-President of the American Academy of Osteopathy. Her challenging presentation *One Heritage, Two Traditions, A Look to the Future* was delivered during the 23rd International Symposium on Traditional Osteopathy in Montreal, Quebec, Canada (June 2006). Political and ideological differences around the world have been at play in the appearance and development of osteopathic practice in various areas of the world. Recognizing this, the World Health Organization has been working on a document to clarify understanding of the osteopathic profession. The *World Osteopathic Health Organization (WOHO)* is an outgrowth of the International Committee of the American Academy of Osteopathy. The American Osteopathic Association has established an organization of organizations, the *Osteopathic International Alliance (OIA).* All of these activities are accomplishing the building of better bridges for communication about the definition and role of the osteopathic profession in health care throughout the world. **(p. 7)**

FROM THE ARCHIVES. *The Practice of Osteopathy* (Carl Philip McConnell and Charles Clayton Teall, 1906) repeatedly places emphasis on *Osteopathic Re-Adjustment* as the key to osteopathic therapeutics. Appreciation of a distinctive etiology and pathology is necessary. **(p. 11).**

BOOK REVIEW. The ongoing analysis of the thought and work of Andrew Taylor Still and William Garner Sutherland has recently received significant consideration. R. Paul Lee has provided the contemporary student and practitioner with a major resource for the synthesis of contemporary knowledge having applicability to the Philosophy, Science and Art of osteopathic practice. **(p. 30).**

ELSEWHERE IN PRINT. Neuromuscular Synaptogenesis, Actin Discrimination and Arginylation have received recent attention in the journal *Science.* The summaries presented were chosen because of their relevance to concepts of motion particularly focused to the cellular level of activity. **(p. 31).**

CME CREDIT. In response to reader requests, *AAOJ* will offer CME Credit to readers completing the enclosed quiz. At this time, 1 Hour II-B Credit will be offered, with request for upgrade as *AAOJ* qualifications are reviewed by the *American Osteopathic Association.* **(p. 20).**

Dig On

One Heritage, Two Traditions; A Look to the Future

Karen M. Steele

On June 22, 1874, western medicine was forever changed when Andrew Taylor Still, MD “flung to the breeze the banner of osteopathy”.[1] Dr. Still was a medical reformer who observed that the musculoskeletal system was not only a source of much pain and disability, but also a window to the internal organs. He noted that musculoskeletal strains affected visceral functioning and visceral disease affected musculoskeletal functioning. Furthermore, by experimentation, he determined that by reducing strains in the musculoskeletal system he could affect internal functioning through affecting fluid and autonomic balance. By integrating the lay practice of bone setting with western medicine, Dr. Still created a new form of medicine. In so doing, he brought western medicine back to the roots from which it grew from the great Greek physician Hippocrates, who also included manual medicine in his care of patients.

Dr. Still had hoped that his vision of medicine would be adopted by the “allopaths” of his day. As we all know, this did not happen. The big usually tries to swallow up the small. And the small usually valiantly bands together to fight a good fight. In the case of Dr. Still’s child called “osteopathy”, the small was not only not swallowed up, but rather thrived on adversity. Osteopathy was strengthened by the Flexner report, when the eight osteopathic medical schools in the U.S. were deemed incapable of providing the stated curriculum to registrants due to insufficient faculty, equipment, clinical training, and a grave for-profit mentality of many of the school’s owners.[2] Osteopathy was strengthened when the global influenza pandemic, where 20 million persons died worldwide. U.S. osteopaths reported 15% less mortality in influenza patients with or without pneumonia, receiving osteopathic care as compared with statistics for those patients cared for by MDs.

Osteopathy was strengthened in the U.S. when its physicians were not allowed to serve in the military during WW II as physicians, and remained state-side to care for the women and children at home. When the MDs came back from the war, the osteopaths refused to go back to being marginalized, just like Rosie the Riveter did not go back home to be a housewife.

When the DOs were not allowed to admit patients to the existing hospitals, they built their own, and taxed themselves $10/day for each patient they admitted to their hospitals in order to keep them open. When the famed California merger occurred in 1961, and over 2000 DOs became MDs by paying $65, the profession lost one of its largest state osteopathic societies, one of its colleges and one of its largest clinical training sites, but had a cause around which it rallied to become even stronger.

The American Osteopathic Association (AOA) mandated instruction in “supplementary therapeutics” or pharmacology at all colleges of osteopathic medicine in 1929 so that osteopathic graduates would be able to campaign for full licensure.[3]

Osteopaths then campaigned state by state, and won the privilege for an unrestricted license to practice medicine, first in California in 1901 and lastly in Louisiana and Mississippi in 1973. DOs in the U.S. eventually won legal protection for their right to admit patients to hospitals, participate in national health care programs and serve in the military as physicians. This in turn, allowed osteopathic students to participate in military scholarships to help pay for their medical education. DOs, through their performance, began to be enticed into allopathic hospitals and training programs, and now half of all osteopathic medical students in the U.S. train in allopathic residency programs. This has allowed osteopathic students to train in their specialty of choice. It has also resulted in osteopathic students influencing allopathic medicine with their unique osteopathic approach to the patient.

There was a parallel development of osteopathy outside the U.S. when John Martin Littlejohn took osteopathy back to the United Kingdom. From there, osteopathy flourished in Europe and its protectorates, as a parallel health care system, living in various levels of comfort beside the allopathic system. In many countries, the osteopaths have achieved licensure and therefore legal protection of their practice. As osteopathy became world wide, some countries developed parallel educational systems for osteopathic training: both as a supplement to allopathic practice, and as a system of healing by non-physician manual medicine practitioners.

Whatever interpretation of osteopathy that each country has adopted has been in response to the answer of one central question. This question will be asked by each new generation of graduates, and answered again – for that moment.

It is: how much of western medicine do the osteopaths want to include into

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their training and licensure, in addition to training in osteopathic philosophy and osteopathic manipulative treatment? There is a cost and consequence to this decision, whichever way it is decided.

In the U.S., even in the early days, the profession was split on this question. Eventually, the "broads" won over the "lesionists" when the AOA mandated the inclusion of the teaching of pharmacology into the curriculum of all osteopathic medical schools. Now, nearly 80 years later, the osteopathic profession is firmly established in the U.S. as one of the two pathways for full physician licensure. The osteopathic schools in the U.S. continue to strive to find that balance between traditional and uniquely osteopathic curricular content. Practicing DOs continue to try to find the right integration of OMT into their practices, while working from the unique osteopathic perspective. The AOA diligently works to preserve this privilege for its members.

Whatever each group decides on this question, protection for the future lies in getting practice tradition recognized legally, curriculum standardized and licensure regulated.

There are heartening changes occurring at the AOA and at the World Health Organization that presents the time to commit to action now, and for osteopaths across the globe to secure their right to practice osteopathy in the world.

The World Health Organization is working on a document to clarify understanding of our profession. In this document, the words osteopath and osteopathic physician are defined as an osteopath being a non-physician osteopathic practitioner and an osteopathic physician being a physician who is also trained in osteopathy, either during their medical training or after. This document will define the recommended minimum curriculum and licensure requirements for each of the types of osteopathic practitioners. Osteopaths and osteopathic physicians from all over the world are giving input to this committee.

I would recommend YOU be involved in the process giving feedback as well. Your forum is through the World Osteopathic Health Organization or WOHO. The WOHO grew out of the International Committee of the American Academy of Osteopathy which met during the AAO Convocation for the last ten years, fostering understanding between sometimes warring osteopathic groups around the world. The WOHO is a group of individuals who are passionate about preserving traditional osteopathy, as you are here today, and who meet yearly to discuss issues of curriculum, legislation and licensure that affect DOs in every country.

How much of western medicine do the osteopaths want to include into their training and licensure, in addition to training in osteopathic philosophy and osteopathic manipulative treatment?

The American Osteopathic Association has created another international group, the Osteopathic International Alliance (OIA); an organization of organizations. Colleges, foundations, osteopathic organizations and supporting organizations of the profession can join for a fee. This organization is designed to promote the rights of osteopathic physicians to unlimited licensure in all countries. The benefit of the OIA to the College d'Etudes Osteopathiques de Montreal is that this group meets with osteopaths all over the world and with such a world-wide exposure comes conversation and understanding.

The final organization I would like to tell you about is the American Academy of Osteopathy, of which I am immediate past president. We in the Academy feel as you do, that we kept traditional osteopathy alive in the US at a time in the profession when it was devoting its energies to legal battles (the big tries to take over the small) and upgrading the medical curriculum. We do not care whether you in your country have chosen to add western medicine into your training and practice or not; we only care that you are passionate about what you have called "traditional osteopathy". Because we are a affiliate society of the AOA, only physicians can be voting members. There are categories of membership for international osteopaths, however. You are welcome at our courses, we love having your input, being infected with your zeal, and hearing your stories of healing that only come from someone who is dedicated to the practice of traditional osteopathy. We would love learning from you. Perhaps we can help you too, as you decide how to interpret osteopathy for your country, then work to see that vision happen.

Those before us made a choice in each of our respective countries about what scope of practice they wanted for osteopathy in their countries. Because of that choice, legislation occurred that recognized our right to practice either osteopathy or osteopathic medicine today in each of our countries. Those who enter practice behind us, such as our celebrated graduating class of 2006, will make choices that will determine how our profession exists in each country in the future.

What is the future for our profession in each of our countries? For my practice lifetime, living in the US, I expect to practice osteopathy as a physician. I, along with many other teachers in the U.S. strive to strengthen the integration of osteopathic philosophy and OMT into all aspects of the osteopathic medical education continuum so that American DOs will continue to provide care based upon the osteopathic principles and provide manual medicine to their patients. It is those students whom you and I are currently teaching, who will decide what the future of osteopathy will be in each of the countries in which they train and practice. The choice is up to them; but it is up to us to be sure they have grounding in this wonderful approach to health to make wise decisions on the future of our profession.

A great American poet, Robert Frost, wrote a poem entitled, "The Road Not Taken".[4] I believe it expresses what I would like to convey today.

There is one choice that must be made by osteopaths in every country, and that is whether they choose to include the whole of western medicine into their training and licensure, in addition to training in osteopathic philosophy and osteopathic manipulative treatment. That choice will make all the difference. Once that choice is made, osteopaths and osteopathic physicians will then need the strength to fight for legal protection to obtain and preserve the right to practice their profession for themselves and those that come behind them. Now is the right time to embark on this mission.

In closing, I would like to include Robert Frost's great poem for you.

Two roads diverged in a yellow wood,
And sorry I could not travel both
And be one traveler, long I stood
And looked down one as far as I could
To where it bent in the undergrowth;

Then took the other, as just as fair,
And having perhaps the better claim,
Because it was grassy and wanted wear;
Though as for that the passing there
Had worn them really about the same,

And both that morning equally lay
In leaves no step had trodden black.
Oh, I kept the first for another day!
Yet knowing how way leads on to way,
I doubted if I should ever come back.

I shall be telling this with a sigh
Somewhere ages and ages hence:
Two roads diverged in a wood, and I –
I took the one less traveled by,
And that has made all the difference.

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1. Still AT. Autobiography of Andrew T. Still Kirksville, MO 1908:94-95.
2. Gallagher RM, Humphrey FJ. Osteopathic Medicine: A Reformation in Progress Churchill Livingstone. New York: 2001.
3. Gevitz N. The D.O.'s: Osteopathic Medicine in America. The Johns Hopkins University Press, Baltimore. 1982;74.
4. Hollander J. Ed. *The Road Not Taken* Frost l997;136.

Accepted for Publication: July 2006

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Permission to Reprint poem by Robert Frost was received from Bartleby.com, Inc.

Letters to the Editor

Dear Editor

I found Dr. Jordan's article to be interesting and well-documented. The most important underlying themes to me were the need to understand the mechanics, anatomy and physiology relating to the sacrum and that altered tensions in overlying structures distort the mechanics relating to the sacrum and create a palpable asymmetry.

I concur that the apparent asymmetry during palpatory examination does not represent the actual displacement of position of the sacrum itself. Similarly, tension in the muscles or ligaments attaching to or interacting with the sacrum cause exaggerated asymmetry on palpation.

I agree with the author that many (structural) osteopathic techniques work by modifying the relative tension of the tissues that govern the mechanics of the SI joint and are not simply repositioning a displaced joint. Both the structure and function need to be considered. Unlocking the sacrum thus requires a knowledge of the anatomy which at minimum includes attachments of muscles and ligaments and a thorough understanding of the dynamic forces involved.

I reviewed the article by Tullberg et al in *Spine*, 1998. In my opinion, this article is of interest and raises the question of whether it would be reproducible or refuted by others, but I have concerns about the study design. The examiners included "two orthopaedic specialists and one physician with the most advanced qualifications in manual medicine available in Sweden." The article went on to state that "All three examiners had to agree on the diagnosis for a patient to be enrolled" and described the functional tests that were used. The subjects included ten women aged 21-53 with symptoms of unilateral SI joint dysfunction.

Many of the tests used were subjective and differ from the tests that we use to examine sacral function. The treatments described were nonspecific.

Though I agree with Dr. Jordan's summary statements. I question both the validity of the Swedish study and the validity of the multifidus measurement. Dr. Jordan indicates regarding the 1998 study that "from this study our concept of sacral subluxation appears to be an incorrect conceptual model even though our treatments fulfill the criteria for a valid treatment." I would suggest that the study itself warrants further evaluation and though that study would make it appear that our concept of sacral motion may be incorrect, it does not provide sufficient proof. Finally, axial MRI views of lumbar spine typically include more steeply angled views through the sacrum and overlying multifidi. Due to parallax, a 2.5 cm measurement on the resultant diagonal is unlikely to represent the true measure of muscle thickness.[2]

Additionally, the "point of view" which follows the *Spine* article by Tullberg et al., indicates that the study [by itself] has refuted that small displacements of the SI joint are altered by manipulation and further expands this by stating, "It seems unlikely that the reduction of subluxations occur after manipulation…". Those articles should provide fertile ground for osteopathic research.

Sincerely,

Daniel J. Kary, DO
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References:

1. Tullberg T, Blomberg S, Branth, and Johnsson R. Manipulation does not alter the position of the sacroiliac joint: a roentgen stereophotogrammetric analysis. *Spine*. 1998. 23(10): 1124-1129.
2. Jordan, Theodore R, DO. Sacroiliac mechanics revisited. *The AAO Journal*. June 2006 (11-12).❒

Dr. Jordan's Reply:

Dear Editor:

I was happy to receive Dr. Kary's response to my article "Sacroiliac Mechanics Revisited".

Regarding the measurement of the thickness of the multifidus of the 32 year-old female; this was taken from one of my cases years ago, and I could not locate the name of the subject to find the original films. I could not determine whether the MRI image was taken from an angled cut, or a straight axial image. Dr. Kary is correct that a straight axial image would show a falsely thickened multifidus due to parallax.

To answer this concern, I went to our hospital radiology department at Doctors Hospital, Columbus. I asked our neuroradiologist, Nicholas Peponis, DO, to select randomly recent lumbar MRI films. T1 weighted images were measured with angled cuts taken approximately parallel to the base of the sacrum, i.e. roughly perpendicular to the posterior surface of the sacrum, cutting through the PSIS. The first three random films that we examined had the following multifidus A-P thicknesses at

Subject	Age	Left	Right
1. Male	75 years	3.6cm	3.6cm
2. Female	31 years	3.1cm	3.2cm
3. Male	38 years	3.9cm	4.4cm

the level of the PSIS:

The third subject was a large man and not only demonstrated one multifidus of 4.4 cm thick, but also had a multifidus asymmetry of 0.5cm. This would easily be palpated as an asymmetry in sacral sulcus depth. All of our random samples had measurements exceeding the 2.5cm thickness of the petite female illustrated in my paper. In addition, to illustrate the thickness of this region, note that in order to inject the SIJ, a 3 1/2 – 5 inch needle is required.

Dr. Kary also questioned the validity of the paper by Tullberg, et al, "Manipulation Does Not Alter the Position of the Sacroiliac Joint" published in *Spine*. This is difficult for me to answer directly because I am not one of the authors. First, I would encourage everyone to read the entire study, if interested. The editors of the journal *Spine*, have stringent scientific requirements and a thorough peer review process. Manual medicine practitioners throughout the world read the paper, yet later editions of *Spine* do not contain criticisms of the Tullberg paper.

I agree that the methods of testing for SIJ dysfunction, and the methods of treatment in the Tullberg paper differ from the methods that American DO's teach routinely, but I do not feel that this invalidates the study in any way. We consider our own techniques valid if they correct the dysfunction; so that the positive tests prior to the procedure return to normal after the manipulation. The authors of this paper employed the same logic. In my opinion, the battery of tests employed in the Tullberg paper, and the fact that the tests changed from positive prior to manipulation, to negative after manipulation, speaks of the validity of the study. The question of exactly which tests are the most sensitive and specific for diagnosing SIJ dysfunction is another wide area of research. A literature search for sacroiliac test reliability will produce dozens of results.

Likewise the treatment may differ somewhat from the osteopathic methods that we widely use, but even within Osteopathy there are a multitude of techniques employed to correct SIJ dysfunctions. The techniques employed in the Tullberg paper are quite similar to some osteopathic techniques. Again, in my opinion, this does not invalidate this study at all.

The Tullberg paper was presented at the 3rd World Congress of Low Back Pain and Pelvic Pain, in Vienna, Austria. I was fortunate to have attended and seen their presentation. The presenter made it clear that these findings were a surprise. The whole experimental setup was designed to measure how much the sacrum moved after manipulation. No one expected that there would be no appreciable change in sacral position. Many experts in sacral mechanics at the conference were surprised at these results. In fact, one European expert quipped afterwards, "We don't know what the hell we're doing".

This Tullberg paper is changing the way many scientists and practitioners around the world view pelvic mechanics. I am encouraged by scientific studies that advance our knowledge, even though they might not exactly conform to our osteopathic models. My biggest concern is if we, as a profession, get entrenched in our models so deeply that we refuse to change them. A. T. Still himself frequently admonished his students to accept nothing he said, but to think for themselves.

Many great Osteopaths that came before us spent their lives creating conceptual models and treatment models to the best of their available knowledge. As scientific knowledge advances, we owe it to them to keep their models new and constantly updated. I strongly feel that if we fail this, we fail the Osteopathic profession.

Sincerely,

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From the Archives

Osteopathic Re-adjustment

"The Practice of Osteopathy", Carl Philip McConnell and Charles Clayton Teall.
Copyright 1906. pp 99-101

Readjustment or adjustment is many times, particularly emphasized in this work, as the key to osteopathic therapeutics.

If the theory of readjustment can not stand the most searching tests of science, osteopathy will have to be relegated to a most subservient place; on a par with massage, Swedish movements, and various medical gymnastics. Consequently, the readjustment theory is again referred to, and especially so when the subjects of osteopathic centers, stimulation, and inhibition are outlined.

No doubt, many stimulatory (so-called) and general treatments exert their greatest influence by inadvertently readjusting tissues. How much more effective would the readjustment treatment be if applied intelligently. In certain acute disorders, e. g., "colds," immediate relief is often obtained by relaxing muscles through either stimulation or inhibition. In reality, the final result, as far as the muscle is concerned, is one of readjustment. Likewise, in stretching and rotation of tissues and sections of the body, the effect may either be stimulatory or inhibitory, and still it may also be readjustive.

After all has been said, the ultimate physiological effect of any of these treatments, if of any therapeutic value, must be one of stimulation to a part or to the body generally. There is a vast difference between physiological stimulation and the one method of obtaining the same termed mechanical stimulation. It is not the purpose here to enter into anything like an exhaustive survey of stimulation and inhibition, but simply to outline a few practical hints on the relative values. Everyone is aware that over-stimulation is equal to inhibition, and even applying it to very delicate subjects the therapeutic end we may wish to obtain may be lost and as a consequence the patient exhausted. At the same time readjustment possibly could have been employed and real permanent effects secured.

We should, therefore, whenever possible, utilize the basic principle of our therapeutics and readjustment. This represents in the majority of cases, first, permanent results; second, a saving of much time, and third, less exhaustion on the part of both patient and physician.

McConnell[1] has shown in his series of laboratory experiments on animals the reality and potency of the readjustment fundamental. The effect of malaligned vertebra and ribs upon contiguous vascular channels and nervous tissues, not only affects immediate skeletal muscles (simple contractions or even produces interstitial myositis), but through narrowing of the intervertebral foramina and tension upon the fibrous tissue anchoring the spinal nerve in its exit, and through pressure and strain of the sympathetics in contact with the heads of the rib and secured thereby the parietal layer of the pleura, organs of corresponding cavities become diseased. Some of the diseases produced in the series of experiments were catarrhal and parenchymatous changes in the stomach and intestines, congestion of the liver and spleen, acute nephritis, goitre, inflammation of the lymphaties, edema of the cornea, and degenerations of nervous tissues.

The osteopath, as stated, may inadvertently correct osteopathic lesions. Vis medicatrix naturae undoubtedly corrects many osteopathic lesions; this is evident from the fact that many bodily strains, sprains, and injuries are overcome naturally or involuntarily, that is, without any voluntary assistance from an osteopath. On the other hand, all osteopathic lesions are not due to outside influences or forces, e. g., in pneumonia the severely contracted dorsal muscles often partially dislocate the vertebral ends of the ribs and thus increase the seriousness of the disease. This is true in many acute conditions wherein visceral changes will ref1exly contract spinal muscles and also through these contractions produce osseous lesions. Herein is where osteopathic treatment in acute diseases will not only correct the primary lesion but also these secondary ones and thus abort, or shorten, or lessen severity, or prevent complications of the disease. It should always be borne in mind that when certain disease processes occur it will take a definite time, at best, for curative changes to predominate. In other words pathological changes are just as real and potent as physiological facts or anatomical data and the character of the same should always be considered.

Consequently, in readjustment work, a distinctive etiology and pathology has to be taken into account. The color, contour (whether the lesion is simply a local one or there is a composite or group lesion), condition (irritation, debility, contractions, and tenderness), and movement of the several regions, and the spine as a whole should be noted. The student should always keep in mind the osseous vertebral lesion may be, (a) a twist between two vertebr (this generally means a rotation of one section of the spine on another section), (b) malalignment of several vertebrae (the composite or group lesion), and (c) the impacted or strained lesion , (this is a lesion that Clark attaches considerable significance to; wherein there is injury to the articular surfaces and ligaments without osseous derangement, followed by exudation and other inflammatory products, limited motion, etc.).

1. McConnell-The Osteopathic Lesion, *Journal of the American Osteopathic Association.* Sept. and Dec. 1905. May, 1906.

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The Effects of Manipulation on Ligaments and Fascia from a Fluids Model Perspective

Wm. Thomas Crow

Abstract

This paper looks at the literature concerning the effects of manipulation on ligaments and fascia from a fluids model perspective.

The osteopathic literature from Drs. Still to O'Connell discussed the clinical effects of manipulation of the fascia and ligaments. The basic science literature describes the effects of trauma to the fascia and other connective tissues. In animal research, there have been studies which look at the effects of immobilization of ligaments and fascia, as well as studies that look at the effects manipulation has on joints following trauma and immobilization. The current literature also reports that changes in the structure of the tissues of the body change the structure of the endoskeleton of the cell. Such endoskeletal changes actually alter gene expression and metabolism of the individual cell. By manipulating the connective tissues of the body we can bring about significant changes on all levels.

Connective Tissue

The connective tissue can be defined as a group of elements derived primarily from embryonic mesoderm, which makes up the mesenchyme – a detached subdivision of the mesoderm. During early embryonic development, mesenchymal cells are extremely active, multiplying rapidly, and migrate into all areas of the differentiating embryo insinuating themselves among the primordial parenchymal cells of other organs.[1] A considerable portion of the intercellular materials is secreted by the cells themselves, therefore, there is a wide spacing characteristic. Special properties are determined by precise compositions of intercellular substances. Classification of the connective tissues is based on characteristics of the intercellular substances as well.

Connective tissues play both structural and defensive roles. Looking at the structural component, the elements possess special mechanical properties. Defense is based upon the cells themselves.

By convention, connective tissues are divided into ordinary and special. The ordinary connective tissues are made up of six major cellular types: fibroblasts, macrophages, plasma cells, mast cells, fat cells and pigment cells.[2]

Connective tissue makes up about 16 percent of the body's weight and stores approximately 25 percent of the body's total water. It forms the biological building blocks of the skin, muscles, nerve sheaths, tendons, ligaments, fascia, blood vessels, joint capsules, periosteum, aponeuroses, bones, adipose tissue, cartilage, and the framework for the internal organs.[3] The essential anatomical role of connective tissue is to connect, support, bind, and pack together various tissues and organs. The fascia of the body is the connective tissue upon which various parts of the body depend for much of its support. It provides some of the stability for articulations, points of muscular attachments and has circulatory function involving not only the arteries and veins, but the lymph vessels as well.[4]

Fascia

A.T. Still looked to the fascia for the source of disease.[5] I know of no part of the body that equals the fascia as a hunting ground. I believe that more rich, golden thoughts will appear to the mind's eye as the study of the fascia is pursued than of any other divisions of the body. In every view we take of the fascia wonder appears. The part of the fascia surrounds each muscle, vein, nerve and all organs of the body. It has a network of nerves, cells and tubes running to and from it; it is scored and no doubt filled with millions of nerve centers and fibers which carry on the work of secreting and excreting fluids, vitals and destructive. By its action we live and by its failure we die.[6] Strains in the fascia not only change articular relationships and motion potential, and impinge on nerves, vessels, and lymphatics, but they also impede the flow of the interstitial fluid.

Disturbances in bony articulations are reflected in variations in the connective tissues; that pressure and tissue tension alter the quality and disposition of tissue fluids; that normalcy, especially in the delicate supports of the capillary and lymphatics systems, is the most important factor in the maintenance and restoration of physiological balance.[7]

The fascia supports various parts of the body providing stability to articulation points or muscular attachments, and has important circulatory functions for the arteries, veins, and lymphatics. It is provided with sensory nerves and many of these specializations are characterized by stress or tension bands of varying thickness.[8]

R.F. Becker, PhD states *…very simply that there are only three kinds of fascia, which wrap up all the soft parts of the body - namely, superficial, deep, and subserous. The first two are found everywhere as complete ensheathments from the base of the skull over face and neck, around the trunk, and around the limbs. The last rests innermost on the second anywhere there is a cavity.*

The dermis of the skin rests on superficial fascia (or hypoderm). The latter rests on deep fascia - the most complicated investment of the three, it is two layered with septa between. These septa from compartments for muscle masses and for some organs. In the face, neck and mediastinum, they form sheaths around nerves and vessels. Subserous fascia envelops thoracic and abdominpelvic organs, and it is faced over and covered by a mesothelial lining.[9]

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At the 1998 Cranial Academy Conference in San Diego, California, Dr. Frank Willard, anatomist, stated that the fascia should be defined and studied as a system unto itself and not simply as an obscuring material hiding more important tissues. Remember, from an embryological standpoint, fascia, bone and all the connective tissues arise from the mesenchyme.[10]

Ligaments

Ligaments are also part of the continuum of connective tissue. Both the fascia and ligaments arise from the mesenchyme. True ligaments are dense, regularly arranged white fibrous (collagenous) or elastic connective tissues. Ligaments bind the bones in the skeleton and the neuromuscular motor unit, which are activated by motion.

As Dr. Anne Wales writes, *Understanding of normal physiology in its mechanical physiology in its mechanical aspects is a necessary preliminary to a working knowledge of strains and subluxations of the body structure. The bones, ligaments and fascias of the body may be considered as an integrated system providing form, support, and stability. The neuromuscular system may be considered as an integration of motor units providing the major source of power for moving the body in response to the afferent impulses having origin in either the periphery or the cortex. The bony-ligamentous-fascial system and the neuromuscular system are so closely interrelated both anatomically and functionally that in many particulars one performs the function of the other. Yet the fundamental difference in nature and work performed remains. They have different rhythms and respond to different stimuli.*[11]

As Dr. Leon Page writes, *Alterations in ligamentous tension are important in lesion pathology. Ligaments are composed of organized fibrous connective tissue arranged in interwoven collagenous bundles. They are pliable but relatively inelastic and are able to withstand tensional stress.*

Sudden stretching of ligaments may produce laxity in the tissue permitting hypermobility of joints. In other cases continued or repeated strain upon ligamentous fibers may produce thickening with decreased elasticity which limits joint movement. Correction of articular lesions may be complicated by ligamentous flaccidity allowing hypermobility of the involved joint or by ligamentous thickening which makes restoration of normal mobility difficult.[12]

Electrical Functions

The fascia has certain properties like electrical function which has been written about by Dr. Judith O'Connell. (The reader is referred to her book, *Bioelectric Fascial Activation and Release* for further discussion.)[13] It effects fluids in the body. The fascia forms membranes through which osmotic processes of cellular nutrition and elimination takes place. Pressure and tissue tensions have a marked influence on the osmotic exchange of fluids. Elimination of cellular wastes depends on the delivery of metabolites into the filtering capillaries. The osmotic balance must exist between the blood and tissue fluids in order to preserve physiologic balance.[14]

Fascial Sheets

Every cell in the body is surrounded by fascia that fuse together to make bigger sheets of fascia. Eventually, these fuse together to form tendons and ligaments. When you look at the smallest fibers of a muscle, they are still surrounded by fascia. It is a series of "fascial sheets", which act somewhat like Ziplock® bags. These become "fascial bags" within "fascial bags." It is through pressure on these "fascial bags" that cause a change in the body. Pascal's principle states that, pressure applied to a liquid at any point is transmitted equally in all directions.[15]

The human body consists of many fascial bags like the Ziplock® bags that respond exactly as predicted by Pascal's principle, that is, an increase in the pressure of fluid in one of these fascial bags will distribute its pressure to other portions of the body. An example of this concept occurs when teaching students about the interconnection of the body. One person places a hand on the anterior cervical fascia (Sibson's fascia) on the right while another person places a hand on the left pelvic diaphragm. One presses while the other feels the pressure at the other end, and vice versa. The connection is very direct. This simple exercise illustrates the essence of Pascal's principle as applied to the human body.

Deformation of Tissues

Connective tissue, with a special emphasis on fascia and ligaments, has unique deformative characteristics. The fascia and ligaments derive their unique characteristics from their viscosity and elasticity, both of which are changed by manipulation to reinstate homeostasis in the body. Being viscoelastic in nature, the fascia has both permanent (viscous) and temporary (elastic) deformation characteristics.[16,17] In addition, fascia has a plastic component that allows for permanent elongation and a mechanical component that allows it to contract; thus, the fascia and bones deform in the same four ways. Wolff's law states, "Every change in form and function of a bone, or in its function alone, is followed by certain definite changes in its internal architecture and secondary alterations in its external conformations, for example, bone is laid down along lines of stress".[18]

This process also applies to the fascia and ligaments.[19] Evidence for this concept is derived from observations indicating an increase in fibrocyte number in areas of active precipitation of collagen; as for example, in the transformation of embryonic mesenchyma into connective tissue; in tissue culture experiments; and in the healing wound. In each instance, the first tissue formed is laid down in an irregular net showing no specific pattern. However, if pressure or stress is placed on this tissue, the cells line up along the line of stress is placed and subsequent collagen is deposited along these same lines.[20]

Crimping

If there are abnormal stresses present in the collagen that makes up the tendons and ligaments, then the tendons and ligaments will be deformed and their basic functions will be affected. Tendons attach muscle fibers to bones and transmit muscle forces, and the ligaments check excess motion of the joints and guide joint motion.[21]

Ligaments have a less consistent parallel arrangement of collagen than tendons.[22] The orientation of the ligament takes on an undulating configuration known as the crimp, which allows the ligament to work like a spring and which is an essential function of normal ligaments.[23] Upon injury to the ligament, the spring will be straightened, causing the ligament to function improperly.

Immobilization

Scientific studies have shown that fascia and connective tissue have certain biochemical and physiologic responses to immobilization. Most of the currently available research comes from animal studies, which may limit its application to the human population. Nevertheless, in the studies on animal connective tissues, laboratory animals were immobilized for various periods of time and then examined at different time intervals.[24]

The natural consequence of prolonged immobilization of a joint is restricted motion. This is due to capsular and pericapsular contractures. In human patients, stiffening of the knee following prolonged immobilization is a common clinical entity. There is a paucity of reports on direct observations of the intraarticular gross and especially histological pathological alterations nevertheless within such joints. Baker and associates explored joints between the articular processes. These joints showed various stages of spontaneous ankylosis, with histological findings similar to those produced in immobilized animals.[25]

It is known that reduction in specific muscle force after eccentric contractions is linked to muscle damage caused by mechanical forces imposed on the lengthening fibers and/or active strain of the cytoskeletal elements.[26,27,28] Muscle casted in a lengthened position was injured less than muscle immobilized in a shortened position. The reason for this is due to an increased concentration of connective tissue, a lower strain, and the alteration in the collagen structural arrangement.[29]

Biochemical Changes Secondary to Immobilization

Further change secondary to immobilization was fibrofatty infiltrates found in the capsular folds and recesses. The longer the joint was immobilized, the greater the amount of infiltration.[30] There was a loss of water and glycosaminoglycans in the ground substance, a lubricant found between the collagen fibers, which are the primary connective tissue fibers that compose the fascia. Collagen fiber lubrication is associated with the maintenance of a critical interfiber distance, which has to be maintained between the fibers in order for them to move smoothly. When this distance is not maintained, microadhesions form and new collagen is then laid down in a haphazard manner.[31]

Immobilization for greater than 12 weeks resulted in an overall loss of collagen since its rate of degradation exceeded its rate of synthesis under these circumstances.[32] Joint contracture occurs as the result of remodeling and shortening of connective tissues when connective tissue is immobilized in the presence of inflammatory exudates. When a limb is immobilized in the absence of inflammatory exudates, no contracture occurs. In addition, biochemical changes were noted.[33,34] These same changes were noted in studies done on human knees as well.[35]

Physiological Changes Secondary to Immobilization

The force needed to move an immobilized joint is ten times that of a normal joint. After several repetitive mobilizations, the amount of force required to move the immobilized joint is reduced to three times that of a normal joint. Over time, the joint will usually regain normal joint mobility. Manipulation of experimentally immobilized rat knees by either high velocity techniques or range of motion resulted in the rupture of macroadhesions and the restoration of partial joint mobility. Movement restores the normal histological makeup of the connective tissue, but the chances of obtaining optimum results decreases as the immobilization period increases.[36]

All periarticular connective tissues responded in the same manner. Ligament and capsule surrounding the fascia all have the same basic response to immobilization. Manual manipulation of the tissues causes a reversal of effects, provided manipulation was done within three months of immobilization.[37,38]

Research has shown that changes in the structure of the tissues of the body alters the structure of the endoskeleton of the cell,[39] which in turn can actually alter gene expression and cellular metabolism. Therefore, it is believed that one can bring about significant change on all levels by manipulating the tissues of the body.

The effects of the hydrodynamic fluctuation of body fluids restore motion and life to “dead spots,” or somatic dysfunctions, changing the structure of the tissues.

Ligamentous Articular Strains

Remember that humans develop from one cell and divide into two cells, four cells, and so forth. In the early stages of the embryo, the only circulatory system that is needed is the rhythmic motion of the interstitial fluid. When the embryo becomes too large to absorb or diffuse all of it as nutrients and waste products through its surface, it develops a cardiovascular system to carry the nutrition to the far reaches of its body and to carry the waste products away. The cardiovascular system coupled with the rhythmic motion of the interstitial fluid bathes equally every cell of the fetus. Later when the need for maintenance of the shape and form arises, the skeletal system develops. This eventually is followed by the need to bear weight, so the skeletal system develops to allow for the normal involuntary as well as voluntary motions of the body. Never lose sight of the fact that form and function are totally interrelated and that function dictates form.

The term “ligamentous articular strain” most accurately describes the somatic dysfunction that occurs in the ligamentous structures that surround a joint. The tension in all of its ligaments of a normal joint is balanced and is used to center adjacent bones in their articular grooves and spaces. This suspension system keeps the bones from being jammed too close together, pulled too far apart, shifted from one side to the other, twisted, or bent sideways. When an injury occurs, one bone in the joint becomes jammed beyond this physiologic position and some, if not all, of the ligaments become strained. Of the pair of opposing ligaments, the more lax ligament is usually the more strained ligament, while the tighter ligament is more normal.[40]

The goal of the treatments is to balance the tension in both ligaments and maintain that equal tension until the body recenters the bones by tightening the lax ligament. Once the joint is returned to its normal physiologic position, the ligaments can begin a three-month healing process, which is the time it takes for

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connective tissue to regenerate.[41] If the joint is not restrained during this process, further treatment of this joint is not required

Lippincott describes ligamentous articular strain as follows: *Osteopathic lesions are strains of the tissues of the body. When they involve joints, it is the ligaments that are primarily affected so the term "ligamentous articular strain" is the one preferred by Dr. Sutherland. The ligaments of a joint are normally on a balanced, reciprocal tension and seldom, if ever, are they completely relaxed throughout the normal range of movement. When the motion is carried beyond that range, the tension is unbalanced and the elements of the ligamentous structure that limits motion in that direction are strained and weakened. The lesion is maintained by the overbalance of the reciprocal tension by the elements that have not been strained. This locks the articular mechanism or prevents its free and normal movement. The unbalanced tension causes the bones to assume a position that is nearer than in which the strain was produced. That would be the case if the tension were normal, and the weakened part of the ligaments permits motion in the direction of the lesion in excess of normal. The range of movement in the opposite direction is limited by the more firm and unopposed tension of the elements which had not been strained.[42]*

Strains in muscles, tendons, and fascia are more correctly referred to as myofascial strains, and the methods used to correct them are myofascial release as well as muscle energy, counterstrain, etc.

Principles of Corrective Technique

The principles of corrective techniques are described in the Lippincott article as follows: *Since it is the ligaments that are primarily involved in the maintenance of the lesion, it is they, not muscular leverage, that are used as the main agency for reduction. The articulation is carried in the direction of the lesion, exaggerating the lesion position as far as is necessary to cause the tension of the weakened elements of the ligamentous structure to be equal to or slightly in excess of the tension of those that were not strained. This is the point of balanced tension. Forcing the joint to move beyond that point adds to the strain which is already present. Forcing the articulation back and away from the direction of lesion strains the ligaments that are normal and unopposed, and if it is done with thrusts or jerks there is definite possibility of separating fibers of the ligaments from their bony attachments.[43]*

Fluid Dynamics

As noted previously, in the embryo, the movement of the interstitial fluid precedes temporally the development of the cardiovascular system. I feel that this motion represents the equivalent of the cranial rhythmic impulse in the embryo. An additional goal of the treatments is to restore function to the dysfunctional areas that lack this fluid motion. When this has been accomplished, the motion of the cranial rhythmic impulse returns to the treated tissues.

The cranial rhythmic impulse was commonly called the tide by Dr. Sutherland because of its rhythmic ebb and flow. Although this rhythmic motion includes "cranial" as part of its name, it is present and can be felt throughout the entire body. This rhythmic motion of the interstitial fluid bathes all the cells so that the nutrients are carried from the capillaries to the cells and the waste products are carried from the cells to the capillaries. This tide ebbs and flows like the tides and waves of the ocean.

At a Dallas Osteopathic Study Group meeting in the mid-70s, one of the members of the study group asked Rollin Becker a question that had been bothering him since medical school. When looking at histology slides, he had wondered how the cells in the middle of the capillary bed got the same nutrition as those around the edges. Dr. Becker used the analogy of a seine lying flat on a beach with each capillary bed represented by a square in the seine, and the capillaries, arterioles, and venules represented by the strings of the seine. The waves bath the seine as they wash up over it and again as they flow back. Which one of the cells within any of those squares gets more or less nutrition and disposes of more or less metabolic wastes? Because of the seine-like structure, they are all equivalent. The capillaries, arterioles, and venules add nutrients and remove wastes from the interstitial fluid as it passes by. The cells within the capillary beds draw their nutrients from this fluid as it passes by and dump their wastes into it to be carried off. The waves of interstitial fluid ebb and flow at approximately 10 to 14 times a minute, which is similar to the rate of flow of waves in the ocean.[44] The tide, wave, or cranial rhythmic impulse all refer to the rhythmic motion of the interstitial fluids throughout the body. Sutherland referred to the motion that carried on cellular respiration as the "breath of life."

In other words, the capillary beds are hooked together into one big grid. Closer observation of this same histological section reveals that the individual cells are organized into a matrix, which creates channels by which the nutrient-rich fluids of the body travel to supply all the cells equally, even those farthest from the source. The primary respiratory mechanism pushes fluids into these matrices, creating fluid waves within the body. (The Primary Respiratory mechanism is a unit of physiological function, which includes the following five phenomena:

1) The inherent motility of the brain and spinal cord.
2) The fluctuation of the cerebrospinal fluid.
3) The mobility of the intracranial and intraspinal membranes.
4) The articular mobility of the cranial bones.
5) The involuntary mobility of the sacrum between the ilia.[45]

It is this hydrodynamic fluctuation that nourishes every cell. The cells depend on this tide to avoid the buildup of lactic acids, carbon dioxide, and other metabolic wastes around and in the cells. Twenty percent of the body weight is in the extracellular compartments, which contain approximately 14 liters of fluid that moves between cells and fascial planes.[46]

Lymphatics are greatly involved in the transport of fluids, proteins and synovial fluid.[47] Guyton suggests that the negative connective tissue pressure is created by low colloidal (osmotic pressure of the interstitium) which in turn, is due to removal of plasma proteins by lymphatics.[48] Slight tissue pressure changes are involved in the filling of initial lymphatics. The lymphatics have valves and some smooth muscles, but the muscles often seem less effective in propelling lymph than does manipulation, flexion of the joints or compression of surrounding muscles. Immobilization reduces synovial lymph flow increasing the synovial osmotic pressure volume. In the absence of lymph flow, plasma proteins accumulate.[49] This is what happens to the body in acute somatic dysfunction. Over time, the failure to remove protein causes chronic inflammation and fibrosis.[50] These are the hallmark of chronic somatic dysfunction. Rollin Becker, DO observed that studying the cadaver is like studying a telephone pole to find out how a tree works.[51] This is also true for histology and anatomy as it is taught in schools. One is looking at something dead, pickled, and without motion. What we are dealing with when treating patients, however, is living, so you have to look at the living anatomy. One has to look at the living human body to see what is really happening.

Visualize an area of dysfunction where the interstitial fluid is not moving. If the matrix is disturbed, the channels cannot function to supply those innermost cells. The individual cell within each capillary bed picks up only the nutrition that can diffuse to it from the capillaries, arterioles, and venules, and dispose of waste in a similar manner. The cells in this area of dysfunction are existing at a lower level of vitality than those in areas of normal function where the interstitial fluid is flowing properly. This area becomes a "dead spot," a place where the hydrodynamic fluctuation is not penetrating and an area where there is no motion. Therefore, somatic dysfunction develops at the cellular level. Those cells in the center are not getting sufficient nutrients and are not effectively eliminating their wastes, that is, a site of dysfunction. The pain in the area of dysfunction, therefore, results from the build-up of waste products, such as prostaglandins, nitrogenous waste, and hypoxia of the cells. By using manipulation to restore this fluid motion through the area of dysfunction, function can be regained and the stagnating spot revived.

We know that there is some cerebrospinal fluid uptake by the lymphatics.[52] As Dr. Still stated, *Cerebrospinal fluid is one of the highest known elements that is contained in the human body and unless the brain furnishes this fluid in abundance, a disabled condition of the body will remain.*[53]

Therefore, the cerebrospinal fluid can be used as a "penetrating oil", as Dr. Sutherland called it, and make changes on the cellular level using the CR1. I would like to call your attention to the benefits of managing the fluctuation of the cerebrospinal fluid when treating chronic lesion in the spinal column. I call it "penetrating oil" for use on old rusty lesions. When it has had time to work, a person takes only their fingers to turn the nut and bolt and does not injure either the threads of the nut or the bolt. By bringing the Tide (CR1) down to that short rhythmic period and to that important interchange between all the fluids of the body, one can lubricate chronic situations gradually so that they return to normal functional conditions. Fibrosis fades and normal muscle tissue reappears in due time.[54]

In *Osteopathy in the Cranial Field*, Harold Magoun described the circulation and the hydrodynamic action of the cerebrospinal fluid,[55] which is due in part to the inherent motility of the central nervous system. The cerebral spinal fluid is produced on the floor of the third ventricle of the brain and flows out through the nervous system. It then exits by way of Pacchionian bodies in the venous sinuses, out along the cranial and spinal perineural spaces, and also through the hollow collagen fibers of the fascia into the lymphatic system[56] to mix with the other interstitial fluids of the body. Thus, the entire body is moving with the "breath of life." The floor of the third ventricle is thus like a spring coming up in the floor of an ocean that is ebbing and flowing.

As Royder explained, the circulation of cerebrospinal fluid flows from its point of origin, in the choroid plexuses in the ventricles, around and through the brain and down the spinal cord. The cerebrospinal fluid not only moves down the spinal cord but also down the axons, contributing to the transneural axoplasmic flow.[57]

Palpable pulsations induced by the primary respiratory mechanism can thus produce extracellular fluid movement throughout the body. These pulsations appear to be ubiquitous. They propel the extracellular fluids into and across the semipermeable membranes of cells everywhere and deliver nutrients and remove metabolic waste products even from synovial spaces, bursae, and other nonvascular compartments. Every cell membrane of the body is continuously and rhythmically bathed with these essential fluids in a fashion similar to the ebb and flow of the ocean upon the beach.

In his book, *Contribution of Thought*, Sutherland wrote, Technic: *In all spinal technic it is my custom to have the patient exercise his own natural forces rather than the application of mine. There are no thrusts, no jerks nor the application of another or distal end of the anatomy as a lever. The principle ,that is used and taught by Dr. Still, is namely exaggerating the lesion to the degree of release and then allowing the ligaments to draw the articulations back into normal relationship. This same method is applied in sacroiliac technic.*[58]

Lippincott describes Sutherland's technique as, *Since it is the ligaments that are primarily involved in the maintenance of the lesion it is they, not muscular leverage, that are used as the main agency for reduction. The articulation is carried in the direction of the lesion position as far as is necessary to cause tension of the weakened elements of the ligamentous structure to be equal to or slight in excess of the tension of those that are not strained. This is the point of balanced tension.*

Forcing the articulation back and away from the direction of lesion strains the ligaments that are normal and unopposed, and if it is done with thrust or jerks there is definite possibility of separating fibers of ligaments from their bony attachments. When the tension is properly balanced, the respiratory or muscular cooperation of the patient is employed to overcome the resistance of the defense mechanism of the body to the release of the lesion.[59]

One very important mechanical function must not be overlooked even if it is seldom mentioned, namely, that of supporting and carrying the blood vessels, nerves and lymphatics."[60]

Cathie suggests we consider several things in dealing with fascial function and manipulative function. The contractile phase persists throughout life, but the elasticity decreases with age. The contractile phase not only persists but supercedes all other qualities of fascia. Fascial attachments have a tendency to shorten after a period of great activity followed by a period of inactivity. With advancing biologic age, the ligaments become thicker and tighter. Although the arc of forward bending is not expected to be very marked in the very aged person, the arc should not be limited at 20, 30, or 40 years of age as is so frequently seen. That part of treatment in which the fascia is to be important in our thinking must take advantage of that which is known regarding the properties and function of fascia.

1. It is provided with sensory nerve endings.
2. Its outstanding properties are contractility and elasticity.

→

3. It gives extensive attachment to muscles.
4. It helps regulate circulation, especially that of the venous and lymphatic systems.
5. Both gives support and is a stabilizer, helping maintain balance; the balance is suggestive of motion.
6. It assists in the production of motion, the control of motion and interrelation of motion of related parts.
7. In many of the conditions resulting deformities of a chronic nature, the degenerative disease characteristic of the aging process, fascial changes will precede the change found in cartilage and bone.
8. Fascial contraction and thickening predispose to chronic passive congestion.
9. Chronic passive congestion precedes the abnormal production of fibrous tissue. It is followed by an increase in the hydrogen concentration of articular and periarticular structures.
10. Many of the fascial specializations have special posturalfunctions. In these, definite stress bands can be demonstrated.
11. Sudden stress on fascial membranes will often be accompanied by a burning type of pain.
12. Fascia (connective tissue) is the arena for inflammation.
13. Infections and fluid often treck along fascial planes.
14. The dura mater is a connective specialization surrounding the central nervous system. In the skull, it is attached to the bone. Changes in its tension and structure are important in the production of headache and many disturbances in the brain.[61]

Conclusion

The relationship between fluid dynamics, joint physiology, fascia, and ligaments may look on the surface to be unrelated but, on a deeper level, are found to be closely connected. As osteopaths we are interested in continuously furthering our skills and studying the interrelatedriess of biomechanics. As one expands his/her knowledge of osteopathy, one will move from a view of the human body as a skeleton, with other tissues hanging on as it were, to a view of the body as a moving, living organism with a skeleton found within it. As a result, one's attention will move from bones and joints to the fascia and fluid dynamics. It is important to understand the scientific principles upon which these techniques are based in order to apply them most successfully. If you understand the principles, then you can create your own techniques. Look at a somatic dysfunction as an impediment to the flow of the interstitial fluid. Take that which you palpate as hard and make it soft. When you feel the flow come through the dysfunctional area, your treatment of that area is complete.

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Accepted for Publication: 2002. Revision, as necessary, done by the author.

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CME QUIZ

The purpose of the quiz found on the next page is to provide a convenient means of self-assessment for your reading of the scientific content in the "The Effects of Manipulation on Ligaments and Fascia from a Fluids Model Perspective" by William Thomas Crow, DO, FAAO and and "Palpatory Evidence for Viscero-somatic Influence upon the Musculoskeletal Systems: by David C. Eland, DO, FAAO. For each of the questions, place a check mark in the space provided next to your answer so that you can easily verify your answers against the correct answers that will be published in the December 2006 issue of the *AAOJ*.

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Publication: *Journal of the American Academy of Osteopathy*, Volume 16, No. 3, September 2006, pp 13-19

Questions 4-6
Name of Article: *Palpatory Evidence for Viscero-somatic Influence upon the Musculoskeletal Systems*
Author: ***David C. Eland, DO, FAAO***
Publication: *Journal of the American Academy of Osteopathy*, Volume 16, No. 3, September 2006, pp 21-24

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June 2006 AAOJ CME quiz answers:
1. D
2. B
3. E
4. C
5. A
6. E

CME QUIZ

Dr. Crow's Article:

1. How long does it take for connective tissue to heal?
a. 1 week
b. 1 month
c. 3 weeks
d. 3 months
e. 6 weeks

2. The orientation of the ligament takes on an undulating configuration known as:
a. the bounce
b. the clip
c. the crimp
d. the length
e. the spring

3. The pain in the area of dysfunction results from the build-up of:
a. nitric acids
b. oxygen
c. prostaglandins
d. red blood cells
e. T-lymphocytes

Dr. Eland's Article:

4. For the patient with a complex or difficult presentation, differences between the diagnostic findings using local motion input and regional motion input can be useful indicators of:
a. viscero-somatic considerations that may be a contributing factor.
b. inter-rater reliability issues as a focus of diagnostic concern.
c. lack of patient compliance with the therapeutic regimen.
d. a dysfunction of greater severity than one without the differences

5. 'Lack-of-Accord' and 'Linkage' are both indicators of:
a. contralateral somatic input at a specific segmental level.
b. viscero-somatic input at a specific segmental level.
c. inter-regional segmental problems of somatic origin.
d. a general regional problem, not a specific segmental problem.

6. A passive force applied by a physician through a region(s) of the body to induce motion, usually using a single elementary motion (sidebending, rotation, flexion/extension, translation right/left, etc.), to assess a monitored segment's response describes which approach to diagnosis?
a. local motion input
b. regional motion input
c. active segmental motion input
d. spassive regional motion assessment

Palpatory Evidence for Viscero-somatic Influence upon the Musculoskeletal System

David C. Eland

Practitioners using osteopathic diagnosis and treatment have experience with or exposure to many branches of the osteopathic tree. There are branches that focus upon the viscera. Jean-Pierre Barral has written and lectured extensively on palpatory evaluation and treatment of visceral dysfunction. This article will look at the various approaches used to assess the expression of viscero-somatic input in the musculoskeletal system. Chapman's reflexes are well known manifestations of visceral influence upon the musculoskeletal system. Osteopaths routinely look for somatic dysfunction at vertebral levels that correspond to the source of sympathetic innervation for a given viscus. Some identify associated characteristic tissue texture changes associated with viscero-somatic influence. William L. Johnston, DO, FAAO introduced compelling evidence for other specific indicators of visceral input affecting musculoskeletal function; 'Lack-of-Accord', 'Linkage', and certain chondral diagnostic characteristics. These elements are explored in detail in the second edition of *Functional Methods* by Johnston, Friedman, and Eland. There appears to be an additional relationship that suggests the presence of viscero-somatic input in relationship to any diagnosed dysfunction in the axial spine. When viscerosomatic input is present, there can be a lack-of-agreement between local motion input and regional motion input. This article will focus upon the concepts of local motion input vs. regional motion input and their implications for diagnosis and treatment.

Approaches to Viscero-Somatic Evaluation

Still, in his comments on the heart in *The Philosophy and Mechanical Principles of Osteopathy* writes: 'He should let his eyes rest day and night on the spinal column, to know if the bones articulate truly in all facets and other bearings…'.[1] Pottinger wrote about the 'viscerogenic reflex' in *Symptoms of Visceral Disease* the first edition published in 1919.[2] He described patterns of expression in dermal, muscular, and bony relationships via 'vegetative nervous system' reflex responses. Carter Harrison Downing in *Osteopathic Principles in Disease* (1935) states 'It is evident that sensory impulses from the viscera incite reciprocal activities in the skeletal structure applying to the same segment of the spinal cord and may act as corresponding pace makers for trophic, circulatory, and muscular reactions in the spinal structures.'[3] This line of analysis has seen continued emphasis through the years and into current Osteopathic literature as evidenced in *Foundations for Osteopathic Medicine*, 2nd Edition[4] with chapters on the 'autonomic nervous system' (chapter 6), 'neurophysiologic mechanisms of integration and disintegration' (chapter 7) and 'neuromusculoskeletal medicine and osteopathic manipulative medicine' (chapter 29). Specific vertebral relationships have been cited in the osteopathic literature through the years as evidence of the visceral and somatic relationships. These specifics are beyond the scope of this article but can be found in the referenced texts.

Charles Owens, DO recorded the work of Frank Chapman, DO in the text, *An Endocrine Interpretation of Chapman's Reflexes.*[5] These palpatory findings relate to specific organs. John Capobianco, DO, FAAO wrote a thorough review of the current understanding relating to these reflexes in a recent issue of the *AAO Journal*.[6]

In the spring issue, volume 15 of *Ohio Research and Clinical Review*, John Howell, PhD. and Frank Willard, PhD[7] present an article documenting the research on the peripheral effects of antidromic activity in sensory nociceptive neurons. This could represent a mechanism for the location and activation of Chapman's reflexes.

William L. Johnston, DO, FAAO and Joseph Vorro, PhD. explored the diagnostic process extensively during their years of collaboration at Michigan State University. Much of their research is contained in the American Academy of Osteopathy Yearbook dedicated to Dr. Johnston's research.[8] Dr. Johnston empirically found Accord/Lackof-Accord, 'Linkage' and chondral patterns of dysfunction. All three suggest viscerosomatic input at the vertebral/rib level of the empiric finding. All three rely upon the 'listening hand's' ability to sense changes in tissue and motion resistance in response to motion testing at the dysfunctional segment of interest.

Lack-of-Accord: Expresses the response of the patient to a regional motion input of sidebending using the shoulder/trunk to the introduce motion, then the head/neck to introduce the motion. This motion induces a response at the segment of interest, vertebral, or chondral. A dysfunctional segment that has viscero-somatic input will not respond to the sidebending test in the same way for each of the two tests, thus the term lack-of-accord. For example, monitoring T3 for response to shoulder/trunk sidebending left reveals ease while head/neck sidebending left reveals resistance at 13. This is termed Lack-of-Accord. Lack-of-Accord is apparent in testing of the vertebral column or testing of the chondral elements of the anterior rib cage. As such, viscero-somatic input can be detected and subsequently treated in the posterior thorax, as well as the anterior thorax. Testing and treatment principles are the same.

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Linkage: Expresses the relationship of the rib shaft to the associated vertebra. This does not include the rib's chondral element. The rib and associated vertebra respond to regional motion input in the same manner. They act as if they were 'welded together'. This can be interpreted as the nervous system's reorganizing response to visceral afferent input. It represents the attempt to make sense of the visceral input and, as effectively as possible, compensate for this new source of afferent information. In our example, monitoring right rib 3 for right rotation response reveals resistance. Linkage is present if T3 also exhibits resistance to right rotation.

Evidence of Viscero-somatic Input in Chrondral Dysfunction: Visceral input is expressed unilaterally for chondral dysfunction: central sternum and the left or the right chondral, but not both. For example, right chondral 5 exhibits resistance to left rotation, palpation of the sternum at the same level reveals the same response, but palpation at the left 5th chondral does not. Linkage at the same level and on the same side may or may not be present. When both chondrals exhibit the same asymmetric behavior as the sternum during motion input, that is evidence of somato-somatic input only. Comparison with the segment above and the segment below is the basis for assessing either form of chondral dysfunction.

The Musculoskeletal System and Dysfunction

In a mobile systems model, a mobile segment is the smallest fully responsive unit of organization within a mobile system, in this case, the musculoskeletal system. It consists of a bony structure with articular surfaces for segmental movement and its adnexal tissues. 'The tissues about a moving bony part constantly reflect its behavior, as they respond to the demands for movement and positioning of the whole system.'[9] Each mobile segment reflects coordinated activity, in concert with mobile segments surrounding it, in response to any command/challenge when it is functioning optimally. On the other hand, it displays behavior that is 'out of step' with surrounding mobile segments when dysfunction is present.

Pre-programmed sets of instructions allow movement to occur without conscious thought/control. This programming of movement – its initiation, timing and force – is disturbed by afferent feedback from stressed, fatigued, or dysfunctional mobile segments and can be disturbed by visceral afferent input. In turn, the expression and efficiency of the intended activity is disturbed. It is important to emphasize that dysfunction disturbs these program sets from the outset, that is, from the initiation/beginning of any given motion. Clinically, we see a central primary dysfunctional segment with asymmetric motor function, and adjacent segments with motion asymmetries that mirror or compensate for that central dysfunctional segment's limitations. These three segments can be envisioned as a 'fundamental unit of segmental dysfunction'.[9] As an example, if T3 tissues resist shoulder/trunk rotation to the right (showing increased tension with this motion), the same rotation to the left produces tissue ease. T2 and T4 exhibit the opposite behavior - increased tissue resistance with rotation left, ease with rotation right. These inter-segmental relationships can help us explore the presence of viscero-somatic input. This mobile systems model has a slightly different focus from that traditionally recognized in the osteopathic profession, that of the vertebral unit. The vertebral unit focuses upon one vertebra's movement upon the vertebra below it. That is particularly valuable when considering an articular model of dysfunction.

The Interdisciplinary Institute for Neuromusculoskeletal Research at Ohio University, a collaborative effort between the university's College of Osteopathic Medicine and Russ College of Engineering, is pioneering objective testing of this fundamental unit of segmental dysfunction. The investigators are exploring the compliance characteristics of segmental somatic dysfunction through objective measures. This project is an outgrowth of the Virtual Haptic Back project supported by a grant from the Osteopathic Heritage Foundation. See www.oucom.ohiou.edu/ITNIR for more information.

Defining Local and Regional Motion (Input)

There is a spectrum of methods in palatory diagnosis. Local and regional motion inputs are at opposite ends of that spectrum. Both identify dysfunctional segments and the asymmetric movement characteristics of those segments. The following definitions are offered for consideration in diagnosis and treatment of the axial skeleton, but can readily be extended to the appendicular skeleton.

Local motion input (testing) is an application of force by the physician directly to a segment to induce motion, usually using a single elementary motion (sidebending, rotation, flexion/extension), to assess the segment's response/capacity for that motion. Motion input is focused upon the isolated vertebral segment of interest. The patient is passive. The joint is most often the structure of interest. Local motion testing does not imitate or reflect real-life functional demands. For example, a seated or prone patient is evaluated at T3. The practitioner places the thumbs on the skin directly posterior to the transverse processes. Rotation is tested by alternately applying anterior pressure via the thumb to each transverse process. Differences in resistance are noted. This is an artificial motion the patient cannot consciously reproduce. As such, it introduces a unique set of afferent inputs, not necessarily recognized to be compatible with preprogrammed protocols within the nervous system.

Active regional motion input (testing) is also utilized by many practitioners. It has similarities to local motion input, i.e. the joint is most often the structure of interest. Unlike local motion input, however, it does imitate and reflect real-life functional demands. It uses active patient-generated motion. As such, the patient's own command/control system produces the motion. If T3 is palpated again with the same thumb position, is one transverse process posterior? Does that get more posterior or less when the patient flexes the head/neck? More posterior or less when extending the head/neck? Asymmetries are identified, and then evaluated within the context of directed patient activity.

Local motion input and active regional motion input are often combined when defining the motion asymmetries of a problem at a specific location like T3. This information is then utilized as a basis for treatment decisions. The body, however, may not be capable of integrating the treatment input when local motion inputs' results are utilized to guide treatment because treatment decisions are based upon assessment of motion characteristics the body cannot produce. A person cannot rotate only the 4th thoracic vertebra, for instance, but can rotate it along with adjacent segments. In such cases, the patterned stimulus (treatment) based upon local motion input as a guide for treatment is not recognized. As such, it is more difficult for the body to reorganize and normalize the aberrant motion of the dysfunctional segment. Mobilization with impulse (HYLA; thrust) uses this approach. Its effects may be transitory if the nervous system cannot integrate the change.

Regional motion input (testing) can be defined diagnostically as a passive force applied by a physician through a region(s) of the body to induce motion, usually using a single elementary motion (sidebending, rotation, flexion/extension, translation right/left, etc.), to assess a monitored segment's response to that regional motion. The motion introduced stays inside physiological motion. Increasing palpable ease or resistance is the result when dysfunction is present as compared to the segments above and below. The focus of interest is the mobile segment. The patient is passive. T3 is palpated with the thumb and finger of one hand over the transverse processes. The other hand introduces shoulder/trunk rotation via elbow contact (arms crossed in front of the body). Immediate change in tissue resistance at T3 is noted with motion introduction. This form of motion introduction addresses recruitment patterns from the very beginning. During treatment, it brings motion toward balance and ease, starting from a point where the segment can respond.

Local vs. Regional Motion Input - Applications

Often both approaches, local and regional motion input, yield the same information. For example, diagnostic testing reveals that the 4th thoracic vertebral segment prefers flexion, rotation right and side bending right. At Ohio University we teach both approaches to diagnosis. In theory, with the same patient, during the same examination, the results should be the same. There are times when the two approaches do not yield the same results, as in the example for the 4th thoracic: local, as noted in the example above; regional side bending left preferred instead of right side bending preference. In 2001, William L. Johnston, DO, FAAO and this author began to explore potential mechanisms that might explain differences in results between the two diagnostic approaches. Initial explorations of the relationship between the two approaches were done the thoracic region. Preliminary findings suggested viscero-somatic input at the diagnosed segment as a source of the divergence between the two approaches. Other previously validated indicators of viscero-somatic input were utilized to confirm this. The two indicators of viscero-somatic input used were 'Lack-of-Accord' and 'Linkage' (See Table 1). Given these results, it is reasonable to suggest that comparing a dysfunctional segment's responses to local vs. regional motion input could be a way to determine whether there is viscero-somatic input complicating the dysfunctional segment's motion capacity.

The Complex Patient

Making this local vs. regional motion comparison may yield valuable new information when the practitioner is dealing with a patient having a complex or difficult presentation. If, given an accurate diagnosis, the patient does not respond to the treatment or the treatment response is short-lived or there is no substantial improvement over the course of several treatments, then the body may not be capable of integrating otherwise appropriate treatment input due to viscero-somatic influences.

One solution in this patient population includes incorporation of the viscero-somatic considerations outlined in this article, local vs. regional differences, linkage or chondral dysfunction, with incorporation of extremity inputs during treatment. These considerations are expressed through a particular language of motion. They can best be addressed in the context of evaluation and treatment based upon regional motion input, as described. When positive indicators of segmentally related viscero-somatic input are present, evaluation consistently reveals asymmetric response at the segment of interest to ipsilateral lower extremity motion input.[9] This information is immediately transferable to treatment. Treating Linkage and/or Chondrals exhibiting viscero-somatic input through balancing the lower extremity asymmetry also has the benefit of reducing somato-visceral feedback to the troubled internal organ.

Treatment

Dysfunction is expressed as a complete motor asymmetry. Regional motion input is a language of motion that we can use directly. Treatment is accomplished by engaging the directions of ease/compliance for six degrees of freedom, plus respiration for the vertebral column and ribcage. Use of extremities in treatment requires those motions that are readily accomplished with that extremity. Whether using the extremity or the axial skeleton, the motion introduced stays inside physiological motion.

Treatment using regional motion input has the advantage that the practitioner uses the same cues (ease) and regional motions (those that produce ease) in the treatment as those used to elicit the diagnostic information. This information can be transferred directly to treatment without the need for imposing concepts of joint restriction, fascial restriction, or muscle hypertonicity/hypotonicity. It has been said that regional motion input links the physiological motion of the segment to the whole. Testing finds the motion that is permitted and stays inside that permitted movement during treatment. Thus, treatment is not positional. It is process-oriented. The patterned stimulus is recognizable to the body. Ease is the response for the primary segment and for the two segments compensating for it. Thus, regional motion input coordinates with and facilitates the patient's ability to respond therapeutically. For more detailed discussion of linkage, lack-of-accord or chondral diagnosis and treatment, see *Functional Methods*, 2nd Edition.

In summary, there are a number of useful approaches to assessing viscero-somatic input into the musculoskeletal system. The instances in which local and regional motion diagnosis findings do not agree has been presented as another clinically useful tool in diagnosis. It is one of several tools related to the regional motion diagnostic process. Other tests for viscero-somatic input include: accord / lack-of-accord, linkage, and tests for chondral manifestation of viscero-somatic influence. Treatment is accomplished with input through the ipsilateral lower extremity. These elements can be of great value in the complex patient. Viscero-somatic influence on the musculoskeletal systems takes many forms. The more tools we have to assess this influence, the

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more likely it is that we will be able to sort out each particular patient's responses and needs.

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Accepted for publication: April 2006

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Larsen's Syndrome - A Case Report

Danielle Burkett and Russell G. Gamber

Introduction

Clinical Manifestations

In 1950, Larsen, Schottstaedt, and Bost described six patient's cases exhibiting a pattern of multiple congenital dislocations of the major joints of the upper and lower extremity associated with facial abnormalities as well as deformities of the hands and feet. Characteristic malformations included in this original description were flattened facies with a prominent forehead, depressed nasal bridge, and wide-spaced eyes (hypertelorism); bilateral dislocations of elbows, hips, and knees; equinovarus or equinovalgus deformities of the feet; cylindrical fingers; occasional palate deformities; and spinal bifida. One patient also had a mitral systolic murmur. Another patient died following knee surgery from what was determined to be a respiratory anesthetic complication. Mixed hearing loss has been reported as well, with a possible association to cleft palate and otitis media, but perhaps related to middle ear ossification dislocation (Herrmann, et al., 1981). In a later case report, a Larsen syndrome patient with conductive hearing loss was found to have a deformity of the incus and stapes footplate fixation (Horn, 1990).

Larsen and his colleagues found the most dramatic manifestation to be the knee deformities. These may range from congenital hyperextension to total anterior dislocation of the tibia on the femur. There may be hip dislocation and foreshortening of the thighs. The feet most often exhibit equinovarus or equinovalgus deformities. The elbows also frequently display radiohumeral dislocation with possible webbing of the antecubital space and joint contracture in the case of total disruption of the radiocapitellar and humeroulnar joints. Further findings are noted in the hands and include a widened distal phalanx of the thumb ("spatulate thumb"), long cylindrical fingers which do not taper, and shortened metacarpals. The metacarpal joint of the thumb may also dislocate. Syndactyly is another reported manifestation of Larsen syndrome (Engber, 1979). Radiographically, a separate, additional ossification center for the calcaneous is usually found (Old et al., 1976). Extracarpal ossification centers have also been observed. These radiographic findings may aid in the diagnosis of Larsen syndrome.

Although not emphasized in original reports, spinal involvement is also a very common, and potentially serious, manifestation of the syndrome. Bowen, Ortega, Ray, and Mac Ewen (1985) made observation of the spinal involvement of eight patients with Larsen syndrome ranging in age from one to 28 years. They reported the cervical spine to be the most severely involved segment, with dysraphism and hypoplasia affecting most patients. Scoliosis was most common in the thoracic spine, while dysraphism, scoliosis, and spondylolysis were most consistent in the lumbar spine. Dysraphism was also present in the sacrum of several patients. While scoliosis of the thoracic spine rarely requires treatment, Neighbor and Asher (2000) did present a case of early development of severe thoracolumbar kyphoscoliosis that benefited significantly from a series of surgical corrections. Kyphosis of the lumbar spine and back pain have also been reported.

Spina bifida of the cervical spine may result in progressive kyphosis. Cervical kyphosis is possibly the most serious complication of Larsen syndrome due to the possibility of compression of the spinal cord leading to quadraperesis. Cervical kyphosis may be present in up to 60% of cases of the syndrome (Morrissy & Weinstein, 2000). As noted by Katz (2005), the course of this deformity is unpredictable and potentially fatal; therefore, correction must be aggressively pursued. The cervical spine may also exhibit atlantoaxial or subaxial instability and spondylolisthesis. Spina bifida can be seen in the thoracic spine and sacrum as well.

Ligamentous laxity may account for many of the complications of this syndrome. Patients are often described as hypotonic, which is associated with hyperelasticity and may contribute to developmental delays. One must be careful in attributing this "floppy" nature, however, to the hyperelasticity of Larsen's since it may also be an indication of cord compression (Herring, 2002). The ligamentous laxity that is present with Larsen syndrome puts the patient at risk for acquired lesions of the mitral valves and the aorta as it does in other diseases of hyperelasticity. It may also lead to respiratory complications and death due to the elasticity of the rib cage and the potential complications of tracheo- and laryngeomalacia. These compromising respiratory situations, along with the cervical malformation, may lead to poor outcomes during intubation and the administration of anesthesia.

Pathophysiology

The exact etiology of Larsen syndrome is unknown. In 1979, Italian researchers Cetta, Lenzi, Ruggeri, Tenni, and Boni published a report comparing the biochemical and structural features of connective tissue from a normal subject to that of a Larsen syndrome patient. Their report indicated an increase in the ratio of glucosamine to galactosamin in both the skin and cartilage along with ultrastructural abnormalities of collagen fibers and proteoglycan filaments in the tissue of the Larsen syndrome patient. They described the collagen in the dermis as resembling immature collagen. The filamentous structures in the cartilage, interpreted to be proteoglycans, were thinner in the Larsen syndrome cartilage than in the control case. This study, though, only examined the tissue of one patient with Larsen syndrome and therefore must be interpreted with caution.

The original observations of Larsen, et al. did not suggest a heritable condition. Family history was negative for similar conditions and the siblings were unaffected. However, in 1971, Harris and Cullen described a mother and a daughter who were both affected by the syndrome. Subsequently, multiple other authors have reported familial patterns. Both autosomal dominant and autosomal recessive forms have been proposed, though there is debate as to whether there are actually two distinct forms of the disease.

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In 1995, Vujic et al. described the localization of the gene for autosomal dominant Larsen syndrome, concluding the location to be chromosome region 3p21.1-14.1 in the proximity of, but distinct from the COL7A1 locus. In 2004, Krakow et al. identified heterogosity for denovo missense mutations in the FLNB gene of 4 individuals with sporadically occurring Larsen syndrome and one family with a dominantly inherited form of the disease.

The cause of the autosomal recessive variety is less clear. Although case reports seem to indicate that it is a separate entity, the genetic mutation has not been localized. Possible mosaic cases have also been described (Debeer et al., 2003; Frints, et al., 2000; Petrella et al., 1993). It has also been proposed that somatic mosaicism may account for the seemingly recessive inheritance patterns in certain families (Petrella et al., 1993).

Differential Diagnosis

Other hyperelasticity syndromes such as Marfan's syndrome and Ehlers-Danlos syndrome must be excluded when considering a diagnosis of Larsen syndrome. Unlike Larsen syndrome, however, these syndromes do not exhibit multiple joint dislocations. The contractures and extremity deformities present in Larsen's might also suggest arthrogryposis multiplex congenital or Beal's syndrome, but unlike these conditions, Larsen syndrome does not generally affect muscle mass. The abnormal facies in the presence of multiple joint dislocations is pathonumonic of Larsen syndrome. Family history may also be an aid in diagnosis since Larsen syndrome is typically autosomal dominant.

Treatments

Treatment of Larsen syndrome primarily involves early surgical intervention to correct the orthopaedic abnormalities. Tachdjian's Pediatric Orthopaedics recommends treating an infant in the following order: cervical kyphosis; congenital dislocation of the knee; congenital dislocation of the hip; and finally, the foot deformities. Cervical fusion is often used to treat cervical kyphosis. Knee dislocations are occasionally correctable by manipulation and casting, but generally require surgery to reduce the joints. This should be done by the age of two. Closed reduction is more successful in the hip, but open reduction may be necessary and is best performed around the age of one. Casting or stretching may succeed in correction of foot deformities, but these also require surgery quite frequently. Congenital dislocation of the elbow seldom requires treatment. Scoliosis in Larsen syndrome appears during late childhood or adolescence and is treated as any other juvenile onset idiopathic scoliosis, except that bracing must be done with caution to avoid deforming the highly plastic thoracic cage. Stapedotomy was used by Horn and associates (1990) to treat conductive hearing loss in a Larsen syndrome patient.

The Patient

History of present illness

MB, a 46-year-old white female, who had previously been diagnosed with Larsen syndrome, presented to osteopathic manipulative medicine clinic complaining of low back pain and right hip pain, She described the pain as severe (7/10), and explained that standing and walking exacerbated the condition. MB expressed concern that her scoliosis might be progressing. She further described the tendency for her hips to "pop apart," which she attributed to her hips being "open sockets", and stated that she could sense this instability in her lower back bilaterally. She also noted a weakening of her legs and a decrease in ambulatory ability. The patient' primary concerns were to decrease the pain and increase ambulation.

The patient was born with multiple musculoskeletal deformities and joint dislocations for which she underwent various surgeries of both knees, the left hip, and both feet between the ages of one and sixteen. An attempt was made to shorten her left femur due to a leg length discrepancy. Her scoliosis was first noted around ten years of age. She wore a Milwaukee brace for five years with reported success, after which she received no further treatment for her scoliosis. At the age of 25, she was told by an orthopaedist that her scoliosis was not progressing. Her most recent radiographic images are three years old, but do not indicate progression of her scoliosis since 1988. She reports that her scoliotic curves are in the range of 50 degrees each. In 1988 she had surgery on her left ear to correct hearing loss. She describes the bones of the ear as having been fused, and the surgery separated them. Hearing was not fully restored to the ear, but the patient reports that she no longer sounded like she was in a tunnel. Her hip pain began five years ago, at which time she sought advice from another orthopaedic surgeon regarding hip replacement surgery. His thoughts were that she was too young for replacement, though it might be needed in the future.

MB remained unsure of her diagnosis until 1988 when she sought genetic counseling to determine the probability of passing on her condition. She did not know if she had Larsen syndrome or nail patella syndrome. The consulting physician, based on physical exam and various x-rays, confirmed a diagnosis of Larsen syndrome. He advised MB that her condition was most likely autosomal dominant and could possibly be passed on to potential offspring.

Personal History/Social History

MB works as an in-office salesperson for a veterinary medical supply company. She does not smoke, but drinks about four alcoholic beverages per week. She is married, has no biological children, but has two adopted children. She does not exercise regularly.

Past Medical History

In addition to Larsen syndrome, MB's medical history is significant for hypothyroidism, for which she takes synthroid 0.1 mg per day. Her allergies include cat gut sutures and springtime grass. She fractured her right cheekbone after falling off a horse in 1976. She was also involved in a motor vehicle accident in 2003 which left her with short-term lower back pain.

Family History

MB is the oldest of five children. Family history includes diabetes and hypertension. No other family members have been diagnosed with, nor show signs of, Larsen syndrome. *Structural Evaluation*

Previous physical evaluation (1988) revealed scoliosis, dislocated knees and elbows, past evidence of metatarsus adductus with practically no heel on the left, an asymmetrical body, and spatulate nails. The face showed malar flatness, telecanthus, and hypertelorism of the eyes.

Current structural exam showed prominent C3 spinous process posteriorly, tenderness on the right, and range of motion decreased by about half of normal in the cervical spine. The upper thoracic region had a levoscoliosis while the lower thoracolumbar region displayed dextroscoliosis. Motion was restricted at the apex of these two curves. Levoscoliosis of the lumbar spine was also present. Tissue texture changes were noted in the left paravertebral musculature. Limited anterior and posterior motion was noted at the base of the sacrum. A tender point was located on the right sacrotuberous ligament. The left first rib was found in an elevated position. In the upper extremities, the elbows displayed full flexion but were restricted in extension to about 135 degrees. The left forearm showed markedly decreased ability to supinate. Bilaterally, knee flexion was limited to 90 degrees. The patient was unable to fully extend her right knee. The right hip was held in a flexed position, while the left hip showed decreased range of motion in external rotation with only about 5 degrees of motion. Additionally, multiple tender points were located along both left and right iliotibial bands. When she was standing, the patient's right leg is functionally shorter than the left due to joint contractures and the inability to fully extend the right leg.

Therapy

During the initial visit, manipulative therapy was applied to the cervical, thoracic, lumbar areas, as well as the sacrum, pelvis, ribs, and upper and lower extremities. The primary treatments employed were myofascial release of tissue and strainlcounterstrain to areas of tenderness and tissue restriction. The patient was instructed to swim daily, perform major muscle group stretches for fifteen minutes twice a day, and perform five minutes of computer operator stretches for every hour spent at the computer. In addition, the patient was given instructions to self-treat tender points at home with strain/counterstrain. Immediately following treatment, there was a visible improvement in joint range of motion in the elbows, hips, and knees. Tender points were relieved and paravertebral tightness was decreased.

The patient returned two weeks later for further treatment. She reported that her pain was improved following the first treatment, although some of the neck stretches had caused pain and her lower back had begun to hurt again. Her reported pain level was again a 7/10. She did not notice any increase in extension of her elbow. The lumbar and thoracic spine remained as they had been previously. Tight scalene muscles were found bilaterally in the neck. The sacrum was again restricted in anterior/posterior motion. There was increased tension in the right sacrotuberous ligament. Extremity findings were as previously reported. Similar treatments were again performed resulting in increased range of motion and decreased tenderness.

On third visit, the patient reported her pain level as 3 out of 10. She believed the pain in her neck to have been resolved but continued to describe an uncomfortable sensation in her lower back bilaterally. Myofascial release was applied to areas of restriction in the lower extremity, sacral and pelvic areas, and lower back. Muscle energy techniques were used to treat the hips, knees, elbows, and thoracolumbar areas. Ligamentous articular strain was applied to the knees and hips. The patient was advised to increase exercise and continue with home stretches, modifying them as needed for her structural limitation.

Discussion

Larsen syndrome encompasses a wide variety of congenital orthopaedic deformities and joint dislocations. The exact presentation varies widely between individuals, but initial treatment in all affected infants focuses primarily on correcting any life-threatening spinal deformities and creating functional joint and lower extremity mechanics to allow for ambulation. In adolescence, the onset of scoliosis may require surgical treatment or other corrective methods, if warranted, by the severity of the curve.

These treatment approaches, however, only address the pediatric patient. There is nothing written concerning the treatment of these individuals once the skeleton has fully matured. As is illustrated by our patient, the structural complications of Larsen syndrome continue to produce problems into adulthood. The question of how to approach the mature Larsen syndrome patient merits attention.

The goals of our therapy were to improve ambulation by increase joint range of motion, especially in the hips and knees, decrease pain caused by compensatory posture, and prevent further decompensation by maintaining flexibility. At this stage in the patient's life, there is little that can be done to dramatically correct the structural abnormalities, but much can be done to treat and maintain the soft tissue function and prevent further complications.

Manipulation has often been used as a treatment for scoliosis. Hyde and Cooper (1999) describe using osteopathic manipulation to treat the scoliotic curves of a 15 year old female with Cob angles of 30 degrees in the thoracic spine and 36 degrees in the lumbar spine. Techniques used included muscle energy, soft tissue, stretching, and high-velocity-low-amplitude to the pelvis, thoracolumbar junction, cervicothoracic junction, and ribs. Treatments occurred weekly for six weeks. After three months, the lumbar Cob angle had reduced to 28 degrees. The patient also reported decreased need for analgesia and fewer headaches.

Although most scoliosis literature is written about the skeletally immature patient, there is evidence that manipulative treatment benefits the skeletally mature patient with scoliosis. Hawes and Brooks (2001) treated a middle-aged woman with stable scoliotic curvature with manipulative medicine and traction over an eight-year period. They utilized high-velocity-lowamplitude thrusting, muscle energy, articulation, myofascial release, and counterstrain. At the end of the observation, they observed a 6 cm increase in resting chest circumference and a 7.5 cm increase in chest expansion, which were correlated with a reduction in respiratory infections.

It is reported that curves less than 30 degrees generally do not progress once skeletal maturity is reached, but with curves greater than 30 degrees, a progression of 1-2 degrees per year can be expected throughout life (Weinstein et al., 1981). A study by Tarola (1994) compared the outcome of two skeletally mature women with scoliosis following manipulative treatment over an eight year period. One woman received treatment palliatively for lower back pain while the other received routine treatment once to twice per month. The woman who received treatment as needed reported a decrease in acute back pain, and her scoliosis progressed at a rate consistent with the literature. The woman who received monthly treatments, however, experienced a reduction in frequency, duration, and intensity of back pain, but also experienced less curve progression than might have been predicted by previous studies of curve progression.

Because our patient has curves that exceed thirty degrees, it is reasonable to assume that without treatment her curvature may progress, which could lead to further pain or trouble with respiration. Although she does not have problems with respiration

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currently, it could complicate her condition should the scoliosis worsen. The use of osteopathic manipulative therapy (OMT) may very well decrease her chances of such complications by halting progression and improving respiratory mechanics.

We have already seen that OMT can reduce the severity of pain in this patient. After only two treatments, her self-reported pain level decreased from 7 out of 10 to 3 out of 10. By reducing this pain level, we may further allow her to pursue a more active routine of exercising and stretching to increase muscle strength and flexibility. These changes will improve ambulation and functionality. Although we have already produced some results, further treatment is still needed. Whether or not the patient should continue to be seen on a routine basis is yet to be determined, but as was illustrated by Tarola' s observations, it might be beneficial for her overall health and quality of life.

The leg length discrepancy in this patient also deserves treatment consideration. She complains of pain, especially with prolonged standing and walking, which is, at least in part, related to differences in her hip elevation. Although the majority of the difference in apparent leg length of our patient is due to her inability to fully extend her right leg, it still contributes to an unbalanced and contorted pelvis, compromising the mechanics of standing and walking. It also places further stress on her already delicate hip joints. Once we have dealt with the acute pain presentation, we will want to focus more attention on her ability to ambulate. She would most likely benefit from a heel lift to level the sacral base. The alignment of the pelvis could certainly reduce stress on the sacrum and lower back, not to mention, the hips. Postural x-rays, of course, will be required to assess the degree of sacral unleveling before determining the best method of treatment.

Summary

Larsen syndrome presents with a plethora of orthopaedic complications, many of which must be addressed surgically during infancy and childhood. However, the implications of the syndrome extend beyond the pediatric population. Scoliosis, joint contractures, and postural imbalance continue to place limits on movement and overall functionally and may also produce pain secondary to structural deformities and postural problems. OMT provides a means of treating the structural and soft tissue complications of the syndrome in the adult population to allow for decreased pain, increased flexibility and improved ambulation.

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Accepted for Publication: April 2006

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Component Societies' CME Calendar and other Osteopathic Affiliated Organizations

September 23-24, 2006
Annual Fall Seminar
Chapman's Reflexes: Past, Present and Future (An Osteopathic "Think Tank" Retreat and Seminar)
Arizona Academy of Osteopathy
MWU/AZCOM
OMM Laboratory
Glendale, AZ
CME: 13 Category 1A (anticipated)
Contacts: Amy Heady or Sharon Carey
aheady@midwestern.edu
scarey@midwestern.edu
623/572-3350

September 28 - October 1, 2006
Founders' Day at KCOM
Integrating OMM into Primary Care
KCOM of A.T. Still University
of Health Sciences
Kirksville, MO
Hours: 25 Category 1A (anticipated)
Contact: Rita Harlow
866/626-5266 (in Missouri)
800/428-3376 (outside MO)

October 27-28, 2006
OMT & Body Core Tender Points
Paul Rennie, DO, FAAO
South Pointe Hospital
Warrensville Heights, OH
CME: 14 Category 1A (anticipated)
Contact: Maureen Kendel
mkendel@cchseast.org
216/491-7235

October 27-29, 2006
Energetically Integrated Osteopathic Medicine (A Fulford Course)
Zachary Comeaux, DO, FAAO
Arizona Academy of Osteopathy
MWU/AZCOM
OMM Laboratory
Glendale, AZ
CME: 13 Category 1A (anticipated)
Contacts: Laura Jones
ljones@midwestern.edu
623/572-3351

November 2, 2006
OMT Update and Treatment Options for Low Back Pain
David Furrow, DO and
Brian Degenhardt, DO
Denver Osteopathic Foundation
Denver West Shgeraton
Lakewood, CO
CME: 7 Category 1A (anticipated)
Contact: Phyllis Ring
303/996-1140
www.DOFound.org

December 1-3, 2006
25th Annual Winter Update
Indiana Osteopathic Association
Marriott Downtown
Indianapolis, IN
CME: 20 Category 1A (anticipated)
Contact: Michael Claphan, CAE
317/926/3009
800/942-0501
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2007

January 17-20, 2007
18th Osteopathic Winter Seminar and National Clinical Update
Pinellas County Osteopathic Med. Soc.
Tradewinds Resort
St. Pete Beach, FL
CME: 27 Category 1A (anticipated)
Contact: Dr. Kenneth Webster
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February 21-25, 2007
Midwinter Basic Course in Osteopathy in the Cranial Field
The Cranial Academy
Orlando, FL
CME: 40 Hours Category 1A
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Book Review

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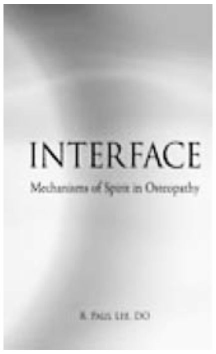

Lee, R. Paul: *Interface: Mechanisms of Spirit in Osteopathy*. Published by Stillness Press, LLC. ©2006. Hardcover, 300 pp, Price: 38.00. ISBN: 978-0-9675851-3-9. Order on-line: www.stillnesspress.com

The 21st Century has arrived and is now moving forward in its appointed course in time. While it may seem to some that the original thought process of Andrew Taylor Still is dated (19th Century), the advances in knowledge of the 20th Century have served to provide more challenge for explanation of this visionary's contribution, offered to the practice of medicine in general. This is the daunting task undertaken by the author.

Andrew Taylor Still often described his contribution as a Philosophy, Science and Art. A comparison of paradigms of thought before and after Still is shown to have significant overlap in categorizations of Energy, Matter and Life Form. It is in regard to the latter that early osteopathic students, teachers and authors expended great effort to grasp and continue the advancement of Still's original thought. It is on this point that one can better appreciate the significance of the work of William G. Sutherland.

A model is proposed which attempts to explain the accomplishment of physical phenomena through the primary respiratory mechanism. In its development, this model reviews and offers further analysis of Still's teaching. In addition, the elaborating work of Still's student, William G. Sutherland, is given a reappraisal in the light of contemporary cellular physiology.

An exhaustive analysis of studies which have bearing on the connective tissue system of the body helps appreciation of the complexity of Still's thought. In the process of synthesizing sources, the emergence of key considerations devolves to the behavior of water as a unit, the material importance of the connective tissue, and the interface of form and motion.

Motion is perceived as the special characteristic which produces Health. Water and electricity are the media which relate the dichotomy of the life form's energetic and physical realms. Osteopathic Manipulative Treatment is the means for addressing structural distortion, allowing the return of Health. Modalities of treatment aside, Health must be restored from within. The Tide then delivers Health.

The Tide is evaluated in its biochemical characteristics. In a detailed, practical and theoretical process, the author considers the entirety of contemporary cellular physiology. It is an outcome of this process that leads the practitioner to the necessity of recognizing the holistic value of working with a holographic system. The summation of this recognition comes with achievement of the stillness of oscillation, the transmuting effect of exchange between all fluid compartments of the organism. It is in the moment of exchange that metabolic power is reset.

The reader familiar with osteopathic theory and practice will appreciate the effort to bring a better level of scientific understanding to bear in the cognitive and experiential aspects of both. The reader not familiar with osteopathic theory and practice will perhaps be challenged to explore broader horizons of meaning in the practice of medicine. In reading this text, each will be asked to confront information with personal knowledge.

Elsewhere in Print

The Muscle Protein Dok-7 Is Essential for Neuromuscular Synaptogenesis
Okada, K; Inoue, A; Okada, M; Murata, Y; Kakuta, S; Jigami, T; Kubo, S; Shiraishi, H; Eguchi, K; Motomura, M; Akiyama, T; Iwakura, Y; Higuchi, O; Yamanashi, Y.

Motor neurons which contact muscle at the neuromuscular junction control skeletal muscle. The synapse uses acetylcholine, a neurotransmitter. A muscle-specific receptor kinase (MuSK) is required to orchestrate postsynaptic differentiation in formation of the neuromuscular synapse. This includes clustering of acetylcholine receptors. As innervation occurs, neural agrin activates MuSK. This establishes the postsynaptic apparatus. In the absence of neurotransmission, agrin-independent formation of neuromuscular synapses can occur experimentally. Dok-7 is a MuSK-interacting cytoplasmic protein. It is shown to be essential for MuSK activation in cultured myotubes. In particular, the phosphotyrosine-binding domain of Dok-7 and its MuSK target are indispensable.

This information arose from a search of databases for a previously unidentified member of the Dok-family of proteins having a PTB domain. The search yielded Dok-7 and cloned human cDNA encoding 504 amino acids. Using northern blot analysis of human tissues indicated preferential expression of Dok-7mRNA in skeletal muscle and the heart. Immunoblot analysis identified the presence of a 55-kD Dok-7 protein in thigh muscle, diaphragm and heart. This was not noted in the liver or spleen. Experimentation was conducted on generated mice.

SCIENCE 23 June 2006 Vol 312 1802-1805

Actin Discrimination
J. Chloë Bulinski

Actin is one of the main constituents of the dynamic cytoskeletal infrastructure of the cell. It is a most abundant and highly conserved protein. From birds to humans, 6 actin isoforms share 100% amino acid sequence identity across species. Tissue-specific sequence differences are shown with individual gene products. Sequence conservation between beta and gamma isoforms is unprecedented (differing in only 4 of 373 amino acid residues). Both isoforms are expressed in varying amounts in the same tissues throughout an organism. The localization of their encoding messenger RNAs is markedly different. This, therefore, differentiates their sites of synthesis. Beta-actin messenger RNA is concentrated near the leading edge of a moving fibroblast cell; Gamma-actin messenger RNA is concentrated throughout the central region of the cell. The suggestion, therefore, would be preferential interaction of beta-actin with myosin. Myosin is the force-generating protein partner of actin.

SCIENCE 14 July 2006 Vol 313 180-181

Arginylation of ß-Actin Regulates Actin Cytoskeleton and Cell Motility
Karakozova, M; Kozak, M; Wong, CCL; Bailey, AO; Yates III, JR; Mogilner, A; Zebroski, H; Kashina, A.

The work of these investigators provides the next step in developing understanding of the foregoing comments by Bulinski. In examining the role of protein arginylation regulation of a single protein target, the authors noted: **ß-actin is arginylated in vivo; Arginylation prevents actin filaments from clustering; Arginylation regulates cell motility.** Experimental mice were used, and a mathematical model of actin assembly in vitro and in vivo was developed. This model included the presence and absence of arginylation. In their discussion, the authors noted:

"We found that protein arginylation can produce global effects on the molecular and cellular levels by regulating a single protein target. Arginylation apparently constitutes a next step in actin N-terminal processing, shown to be important for actin function in vivo. Indeed, the absence of N-terminal Arg caused severe effects on actin polymerization and induced filament aggregation in vitro and ß-actin redistribution in vivo."

SCIENCE 14 July 2006 Vol 313 192-196

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