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Prolotherapy goes HIGH TECH

IN THIS ISSUE

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Authors

DONNA ALDERMAN, DO

Donna Alderman, DO is a graduate of Cornell University in Ithaca, New York, where she received her Bachelor of Science degree in Nutrition. She completed her pre-med requirements at the University of California, San Diego in La Jolla and attended medical school at the Western University of Health Science in Pomona, California where she received the Doctor of Osteopathic Medicine degree. Dr. Alderman completed her internship in family medicine at Pacific Hospital of Long Beach, and is a member of the American Academy of Orthopedic Medicine. She has been a clinical instructor for students at the Family Practice clinic residency program for Pacific Hospital of Long Beach, and does clinical training for premedical students from University of California, Berkeley. Dr. Alderman has also done numerous postdoctorate courses in Prolotherapy and uses it daily in her practice at Hemwall Family Medical Center, 1740 Broadview Dr., Glendale, CA 91208; Tel: 818.957.3000; www.thefamilydr.com.

GLEN M. BATSON, DC

Glen M. Batson, DC received his Doctorate in Chiropractic from Palmer College of Chiropractic in 1988. Upon graduation, Dr. Batson has lectured and taught Chiropractic procedures and video-flouroscopic imaging through the continuing education department of Palmer College. Dr. Batson developed and sponsored the video fluoroscopic imaging certification course through Palmer College certifying Doctors of Chiropractic in the protocol and interpretation of video fluoroscopic spinal motion imaging. Dr. Batson is certified in video fluoroscopy imaging, radiographic imaging, chiropractic manipulative procedures, and physiotherapy. Dr. Batson has been in private practice in Illinois since 1988 specializing in specific spinal analysis and manipulation. Dr. Batson may be reached at his office in Willowbrook, Illinois at 630.323.1181 or by e-mail at backbonedr@aol.com.

CHRISTOPHER J. CENTENO, MD

Christopher J. Centeno, MD is a double boarded certified physician in both Physical Medicine and Rehabilitation as well Pain Medicine. He is the medical director of The Centeno-Schultz Clinic. Dr. Centeno earned his MD from the University of South Florida and completed his residency at the Institute for Rehabilitation Research, Physical Medicine and Rehabilitation at the Baylor College of Medicine. He is a founding member and medical director of the International Cellular Medicine Society. Through ICMS, Dr. Centeno has worked with other stem cell experts to produce International Guidelines for stem cell use as well as an International Re-implantation Registry. Dr. Centeno published the world's first clinical case reports on the use of mesenchymal stem cells in orthopedic patients. He has cared for thousands of patients in chronic pain and has authored over 20 medical publications that are indexed in the US national library of medicine. He has also treated hundreds of patients with Prolotherapy. Dr. Centeno may be reached at 403 Summit Blvd, Suite 201, Broomfield, CO 80021; Tel: 303.429.6448; www.centenoschultzclinic.com.

GARY B. CLARK, MD, MPA

Gary B. Clark, MD, MPA is currently the Medical Director of the Center for Healing Injury and Pain and Boulder Prolotherapy in Boulder, Colorado. Dr. Clark earned a BA and MD from University of Colorado, interned in Pediatrics at Yale-New Haven Hospital; and completed his residency and board certification in Pathology and Neuropathology at Walter Reed Army Medical Center and Armed Forces Institute of Pathology. Dr. Clark also earned a Masters Degree in Public Administration with Special Study in Organizational Development at George Washington University. He retired from the US Army in 1991 after 23 years of active duty. To contact Dr. Clark: 1790 30th Street, Suite 230, Boulder, Colorado 80301; Tel: 303.444.5131; www.doctorclark.com.

CHRIS FERRIGNO, MS, PT

Chris Ferrigno is a physical therapist in Chicago, Illinois where he works in outpatient orthopedics. He received his Masters of Physical Therapy in 1999 from the Medical College of Georgia and his Bachelors of Science in Education in 1995 from the University of Georgia. Chris is an avid athlete. His athletic accomplishments include finishing the Ironman Triathlon and winning Team Gauntlet's "Athlete of the Year" in 2007.

JOERN FUNCK, MD

Dr. Funck grew up in Luebeck, Germany. After receiving his M.D. from the University of Hamburg in 1968 he completed his trauma surgery and orthopedic surgeon training in Hannover and Braunschweig, Germany. After finishing his clinical education he left the operating branch and switched to muscoloskeletal medicine, as well as manual therapy, opening his own private office in Luebeck in 1975. In Bremen, Germany, Dr. Funck took up studies in orthopedic medicine, focusing on Cyriax diagnosis and treatment of soft tissues. He studied manual therapy with Prof. Tilscher from Vienna who first introduced him to Prolotherapy for low back pain patients. From 2000 to 2006 Dr. Funck has treated 1500 cases with Prolotherapy. He was successful in 88.3 % of them. Dr. Funck may be reached at Fackenburger Allee 22-24 23554 Lübeck, Germany; Tel: 0451.411.20; www.proliferationstherapie.de.

MARION A. HAUSER, MS, RD

Marion A. Hauser, MS, RD received her Bachelor of Science in Nutrition from University of Illinois and her Master of Science in Nutrition and dietetic internship from Eastern Illinois University. Marion is the CEO of Caring Medical and Rehabilitation Services in Oak Park, Illinois and owner of Beulah Land Nutritionals. As a registered dietitian, Marion is also a well-known speaker and writer on a variety of topics related to natural medicine and nutrition. Marion has recently released *"The Hauser Diet: A Fresh Look at Healthy Living."* Marion co-authored the national best seller entitled *"Prolo Your Pain Away! Curing Chronic Pain with Prolotherapy"* along with a four-book mini series of Prolotherapy books, as well as a comprehensive sports book discussing the use of Prolotherapy for sports injuries. Marion Hauser may be reached at 715 Lake St. Suite 600, Oak Park, IL 60301; Tel: 708.848.7789; www.caringmedical.com.

ROSS A. HAUSER, MD

Ross A. Hauser, MD received his undergraduate degree from University of Illinois. He graduated from the University of Illinois College of Medicine in Chicago and did his residency at Loyola/Hines VA in Physical Medicine and Rehabilitation. Dr. Hauser is the Medical Director of Caring Medical and Rehabilitation Services in Oak Park, Illinois and is passionate about Prolotherapy and natural medicine. Dr. Hauser and his wife Marion, have written seven books on Prolotherapy, including the national best seller *"Prolo Your Pain Away! Curing Chronic Pain with Prolotherapy,"* now in its third edition, along with a four-book topical mini series of Prolotherapy books. He also spearheaded the writing of a 900-page epic sports book that discusses the use of Prolotherapy for sports injuries, *"Prolo Your Sports Injuries Away! Curing Sports Injuries and Enhancing Athletic Performance with Prolotherapy."* Dr. Hauser may be reached at 715 Lake St., Suite 600, Oak Park, IL 60301; Tel: 708.848.7789; www.caringmedical.com.

RODNEY S. VAN PELT, MD

Rodney S. Van Pelt, MD received his medical degree from Loma Linda University Medical School and completed his family practice residency in Florida. He practiced family medicine for several years until falling in love with the specialty of Orthopedic Medicine which uses all the different modalities for pain with conservative treatments. Dr. Van Pelt then received specialized training in the Cyriax technique of Orthopedic Medicine, taking some of his training in Oxford, England. He is one of the few American physicians who is a member of the Society of Orthopedic Medicine of London, England. Dr. Van Pelt practices full time Prolotherapy in northern California. Dr. Van Pelt may be contacted at Orthopedic Wellness Center Plaza Del Sol, 776 S State St., Ukiah, CA 95482; Tel: 707.463.1782; www.sfpmg.com.

GREAT NEWS CORNER

It Isn't About Pain Management, It Is About Pain Resolution

Ross A. Hauser, MD

Welcome to our fourth *Journal of Prolotherapy* issue! Wow, it is packed! We have received a wonderful array of great comments from our readers. I wanted to share a few of these emails/correspondences. Scott Greenberg, MD, was nice enough to send us this:

"Why can't conventional medicine find your pain? Pain is often misunderstood and mismanaged in traditional medical settings.

While many of us hurt or have hurt to various degrees during our lifetime, there is no traditional test to 'quantify' our pain, nor does the series of happy and sad faces to describe our pain level aid in finding adequate relief from our symptoms.

What we have lost in medicine is our ability to examine the patient, correlate the examination with the patient's symptoms, and lastly consider the diagnostic tests. Instead, we as patients enter the system of pain treatment, done almost as a mass production protocol involving first a trial of anti-inflammatory medication and then physical therapy. If these 'conservative' measures fail to provide relief, it's off to see the surgeon, where the decision is made to have either surgery or pain management.

As a physician, I never wanted to manage pain, nor would want, as a patient, to have my pain managed. Having suffered with pain myself, I could not even imagine living the rest of my life in chronic pain. So why are we so far off the mark with treatment of pain? I think that the answer lies in two important factors. First, we are overly reliant on diagnostic tests. Secondly, we have lost the art of physical examination.

Take, for instance, the case of lower back pain. It is one of the most common causes of pain and disability in the world, but often misunderstood. Why? Because most cases are due to musculoskeletal conditions such as sacroiliac joint dysfunction, pyriformis syndrome, or facet joint arthropathy. Such problems are not seen on MRI, CT, or X-rays, thus a clinician without expertise in curing these conditions will not be able to effectively manage them.

Even though we have access to the greatest diagnostic tests in the world, we as physicians need to use our clinical judgment to determine their significance. For example, the majority of healthy people who do not have any back pain at all will have degenerative, bulging, or herniated discs in their lumbar spine. But if you do have pain, the job of your physician is to determine the relevance of your test results. It is not a black and white issue in what may be causing your pain.

So how do we determine what the best treatment courses are for our patients? First we must listen to our patients and ask the right questions—where is the pain, where does it travel, is there any numbness or weakness? What makes it better and what makes it worse? Are there any ominous signs like loss of bowel and bladder function, fever, chills, weight loss, and so on. From our questions alone, the skilled physician should be able to determine 85% of the diagnosis, and then confirm it with physical examination.

The examination is key to determine and confirm the root cause of pain, and unfortunately it is becoming a lost art. Many of my patients have told me they were recommended to undergo surgery with either a very brief exam or no exam at all. I find this to be a disservice to patient care that can only lead to bad outcomes. The physical exam is not without its faults, and to be reliable must be performed with experienced hands. Palpation of ligaments, tendons, and joints is a skill and an innate gift to those that possess the ability to acquire its skill. Skilled hands have the ability to determine damaged, weak, and painful joints from those that are normal. This critical tool allows us to incorporate all of the information about a patient's condition and formulate a treatment plan.

There is no one size fits all formula to treat a pain condition. However, most pain and sports injury conditions are curable, in the right hands, with reconstructive and regenerative treatments such as Prolotherapy. I found my way to a complete cure after suffering for over 10 years, and I wish you the best in finding your solution, as it exists. If not then hold on tight as we are working on new solutions and treatment options to cure pain and arthritis, all without ever going under the knife." Well said Dr. Greenberg!

Obviously, one of the messages we are trying to promote here at *JOP* is that pain can be resolved, whereas just managing the pain by other methods will leave the underlying disease process untouched, free to continue to worsen. Prolotherapy is one method of treatment that has the potential to stop and reverse the underlying degenerative process. The net result is pain resolution, not pain management!

One recent story Marion (my wife) received was the testimony of Ken Allen regarding **the power of the human body to heal itself!** We are reprinting his correspondences with his permission:

First email: *I just wanted to say thanks for your article online about the detrimental effects of RICE treatment and NSAIDs on ligament and tendon healing. I came across your article after suffering terrible extensor tendonitis in my right foot, while ramping up mileage too quickly in marathon training. I followed your advice, skipped the ice and ibuprofen, healed up 100% in 5 weeks, and just finished my first half-marathon 3 weeks ago with ZERO PAIN in my foot whatsoever! I just let my foot heal naturally and didn't interfere. If I followed current standard advice, at best I'd have a weaker foot and at worst I'd never run again without pain. I'm telling everyone who will listen, don't use ice and NSAIDs if you want to heal! –Best wishes, Ken*

Second email: *I finished the Kaiser 1/2 Marathon in San Francisco in 1 hour 26 minutes. Not too bad for a guy that couldn't even walk 3 months earlier due to a sports injury. I learned a lot from the experience—especially to listen and be nicer to my body. And I really credit your article for helping me heal completely. Thanks again and good luck in your next race! –Sincerely, Ken*

Third email: *My age group is 35-39. I was something like 25 in that group, and I placed 143 out of about 5000 overall. I've really only been training for several months, and I'd like to get quicker over time. Please feel free to use my email however you like. The more people that get your message the better. I'm so happy my foot healed as well as it did! I messed it up really bad by trying to run through serious pain and I just kept pushing. Unfortunately, I didn't know better.*

I was having ankle pain in both legs from running too much too soon, and a guy at a local shoe store recommended stability shoes for me. I don't have pronation issues though, so the shoes rotated my feet out. Gradually I started getting pain on the top of my right foot. Pushing things further, I tried a long 18 mile run and had to limp home after 14 miles. I couldn't bear weight for several days, and it was a month before I could even consider light running again. But I learned from my mistakes, went back to neutral shoes, and now I listen very closely for any hint of pain during and after runs. My foot has been completely pain free, which is awesome! –Ken

Thank God for the power of the internet! What a great way for people like Ken and others to receive information on how to heal themselves!

We also received four letters from *JOP* reader, Clive Sinoff, MD:

Letter #1: *Dr. Hauser and the entire publication staff should be congratulated on achieving the publication of this important journal. For reasons which I cannot comprehend, Prolotherapy has been ignored and greeted with hostility. This publication takes an important step in furthering the knowledge and use of this highly effective therapy. In the article by Hauser and Cukla[1] the X-ray changes are dramatic. It would be useful if the authors could provide more detail as to how the injections were done. What was injected and was the target directly into the subchondral area, ligaments and/or into the joint space? –Clive Sinoff M.D.*

1. *Hauser RA and Cukla JJ. Standard clinical X-ray studies document cartilage regeneration in five degenerated knees after Prolotherapy. J Prolo 2009;1:22-28.*

Editor's Comments: Dear Dr. Sinoff, We at *JOP* appreciate your comments and questions. To answer your questions: 2IU of HGH was injected into the joint space. With each treatment the medial and lateral collateral ligaments were also injected with normal Prolotherapy solution.

Letter #2: *What a tour de force! Dr. Hauser's review of the effects of corticosteroids was comprehensive and thoroughly documented.[1]*

1. *Hauser RA. The deterioration of articular cartilage in osteoarthritis by corticosteroid injections. J Prolo 2009;2:107-123.*

Editor's Comments: Thank you for your comments. The treatment of osteoarthritis with corticosteroid injections has to stop! Clearly one of the main causes of the "bone-on-bone" phenomenon leading to hip and knee replacements is the corticosteroid injections the patients are receiving.

Letter #3: *I have two questions to ask the Prolotherapy community. Many authors, including Dr. Van Pelt [1], recommend the use of human growth hormone (HGH) as a growth factor. My understanding is that HGH is released in the pituitary and acts on the liver to produce somatomedin. Is there any evidence for a direct effect locally? It would seem more logical to use a cytokines such as granulocyte stimulating factor (G-CSF) or fibroblast growth factor (FGF) which have been shown to attract inflammatory cells. Does anyone know of scientific or clinical evidence to support such growth factors? – Clive Sinoff M.D.*

1. *Van Pelt RS. Hip arthritis Prolotherapy injection technique. J Prolo 2009;1:101-103.*

Editor's Comments: Wow, what a topic, growth factors and Prolotherapy! As you know the day will arrive where doctors will inject fibroblastic growth factor or granulocyte stimulating factor into injured structures, but unfortunately that day is not here. Here are some items for you to ponder:

1. There are growth hormone receptors on mesenchymal cells including human growth plate chondrocytes.[1]
2. Pituitary growth hormone acts directly on many cells in the body. As a matter of fact, most of the effects

attributed to Growth Hormone action appear to be the result of a direct effect of GH on cells in different peripheral tissues, including cartilage. Not on IGF-1.[2]
3. Growth Hormone has direct anabolic effects on "old"cartilage cells.[3]
4. Yes, there are estrogen receptors on cartilage cells also![4]
5. Chondrocytes (cartilage cells) can produce their own sex hormones![5]

What it all means is that cartilage cells are somewhat under the control of hormones. From a Prolotherapy standpoint if we can make cartilage physiology more anabolic there will be a good chance that the chondrocytes will make more cartilage which will ultimately help the patient!

Letter #4: *Does anyone have experience with the use of Prolotherapy in true rheumatoid arthritis (as opposed to osteoarthritis misdiagnosed as rheumatoid arthritis)? –Thank you, Clive Sinoff M.D., 22200 Halburton Rd, Beachwood, OH 44122*

Editor's Comments: As you know, not every joint pain in a rheumatoid arthritis (RA) patient is due to RA. From a Prolotherapy standpoint in treating the RA patient, you should do the following: assess the condition of their RA and evaluate the painful area like you would with any other patient. If someone has active synovitis at the time of the Prolotherapy evaluation, we (Caring Medical) would inject a solution of sterile water and procaine (anywhere from a total of 0.4% to 1.0% procaine) into the painful areas to cool it off (versus steroids) and treat the rheumatoid arthritis with a natural medicine program. Once the RA is under control, meaning no heat in the joint, hands, wrists, or feet, then Prolotherapy could be done to the joint or structures involved assuming they have injuries that typically respond to Prolotherapy. As you know, rheumatoid arthritis by definition destroys joints. What is one of the best treatments to repair joints? Prolotherapy. So yes, Prolotherapy can be done in folks with RA, but just make sure the RA is under good control. If you inject the typical Prolotherapy solutions into joints with active synovitis you run the risk of increasing the pain quite a bit, but the good news is, the increase in pain is temporary.

Some of the highlights of this fourth issue of *JOP* include articles focused on the cervical spine, and on shoulder pain. From personal experience, I can tell you one of the most horrific cervical conditions is cervical radiculopathy. Glen Batson, DC and Chris Ferrigno, PT join me in a three part article on treating cervical radiculopathy from the experience of a Physiatrist, a Chiropractor, and a Physical Therapist. In *Teaching Techniques* we begin to explore the high-tech world of Prolotherapy with Christopher Centeno, MD, as he discusses the use of C-arm fluoroscopy in his Prolotherapy practice. Our *Teaching Techniques* columnist, Rodney Van Pelt, MD, teaches the shoulder injection technique.

The American College of Osteopathic Sclerotherapeutic Pain Management is *In the Spotlight*. Donna Alderman, DO takes us on a trip through time with the oldest Prolotherapy organization. It really is a *Wide Wide World* when it comes to Prolotherapy. We hear from Joern Funck, MD, from Germany, on his professional switch from orthopedic surgery to Prolotherapy. Our *Literature Review* columnist, Gary Clark, MD, reviews whiplash literature and presents the intriguing case study of General George S. Patton. He also reports on the fortieth anniversary of the Hemwall Honduran program, which hosts the largest Prolotherapy training course of its kind. It is great to see Dr. Hemwall's legacy continuing with such gusto!

Last, but not least, Marion and I present a retrospective study on chronic shoulder pain. We are always pleased to see the final statistics in these reports that we've presented in the *journal* because it continues to show that Prolotherapy works! By stimulating the natural healing mechanisms of the body, via injecting simple, safe solutions into and around damaged structures, Prolotherapy re-ignites the body to heal itself. The net result is not pain management, but **pain resolution.** Ultimately, that should be the goal of all clinicians who see patients in chronic pain. ■

Until the next injection,

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IN THE SPOTLIGHT

A History of the American College of Osteopathic Sclerotherapeutic Pain Management, the Oldest Prolotherapy Organization

Donna Alderman, DO

ABSTRACT

Modern Prolotherapy evolved from the insights and courage of a few doctors in the early part of the 1900s. These pioneers would then form groups to teach others, share knowledge, and improve techniques. The earliest record of such a group started as the American Society of Herniologists in 1926, now known as the American College of Osteopathic Sclerotherapeutic Pain Management. This fascinating article reviews the history of these courageous men and how their hard work and efforts developed into an organization that not only promotes and teaches state-of-the-art Prolotherapy, but is on the cutting edge of musculoskeletal medicine.

Journal of Prolotherapy. 2009;4:200-204.
KEYWORDS: American College of Osteopathic Sclerotherapeutic Pain Management, Prolotherapy, Sclerotherapy, herniologists, Osteopathy.

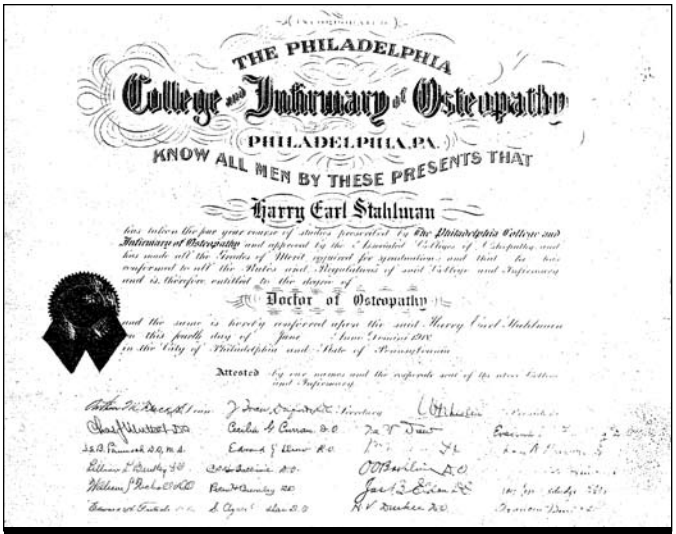
The day was like any other for Dr. Earl Gedney, an osteopathic surgeon at the Osteopathic Hospital in Philadelphia. It was 1936. Dr. Gedney prepped for surgery, as usual, but this time when he went through the electric doors to the operating room, the doors closed prematurely on his hand, pulling his thumb joint so far that it hung limp off his hand. After checking with several colleagues and getting X-rays, Dr. Gedney learned there was no fracture, no correctable dislocation, only a very severe stretching of the ligaments and tendons at the thumb joint. He suffered in pain and could barely move his thumb. Far worse, he was told by the best surgeons he knew that there was nothing that could be done for him and that he would have to retire from doing what he loved most, being a surgeon. (*See Figure 1.*) Dr. Gedney was not the type of person to give up. He was resourceful and intelligent. Gedney had been pondering the problem of the hypermobile joint since 1925 when, as a medical student, he heard a lecture on restricted motion in lumbar segments. At that time the young Gedney asked the speaker, the late Dr. Charles Muttart, the question: "What about treatment of the vertebra that is too freely mobile?" Dr. Muttart answered: "That, my young man, is the problem for your generation to solve." Gedney took this to heart.

Faced with the situation of his own hypermobile joint, Gedney put his thoughts together. He had recently attended a lecture discussing sclerosing (irritating) solutions for abdominal hernias (muscle weakness or tears) and knew of a group of physicians who had been doing this for years. These physicians were known as "herniologists." The idea behind the herniologists' method of treatment was that irritating injections would stimulate repair and scar tissue formation, making muscular tissue at the hernia site thicker and stronger. This was in the days before modern surgery when surgical risk was quite high, so a non-surgical approach was popular for hernia repair. The first organization for hernia sclerosing methods was formed in 1923 and became the American Society of Herniologists in 1926. By the early 1930s, such procedures were declared a success in the treatment of hernias. The American Osteopathic Society of Herniologists was formed in 1938 for the injection of hernias, veins and hemorrhoids. One of its early Presidents was Dr. Harry Earl Stahlman, a 1918 graduate of the internship program at the Philadelphia College of Osteopathy. (*See Figures 2-4.*)

Figure 1. Earl Gedney, DO.

What happened next set the stage for modern Prolotherapy. Dr. Gedney extrapolated his knowledge of non-surgical hernia repair to the non-surgical repair of joints, ligaments and tendons. Reasoning he had little to lose by being a guinea pig for his theory, he started injecting his thumb with the sclerosing solutions and had a dramatically successful result. Before long, he was back working as a surgeon. However, Gedney took it a step further. Excited about his result,

Figure 2. Harry Stahlman, DO.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PHILADELPHIA, PA.
KNOW ALL MEN BY THESE PRESENTS THAT
Harry Earl Stahlman
Doctor of Osteopathy

Figure 3. Diploma of Harry Earl Stahlman, 1918 internship class Philadelphia College of Ostepathy.

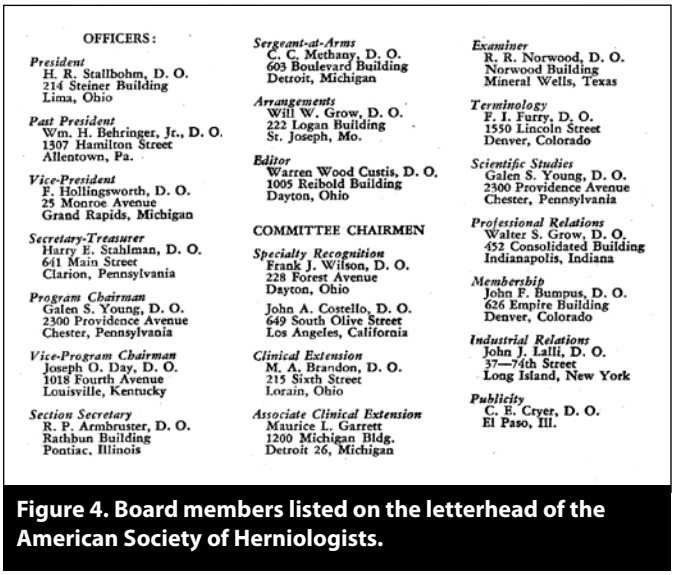
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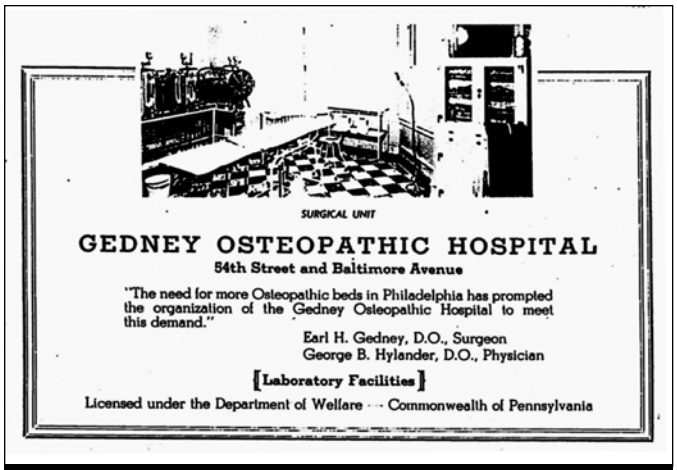
Figure 4. Board members listed on the letterhead of the American Society of Herniologists.

he started on a lifelong career of research and in June 1937, he published his first article *Special Technic: Hypermobile Joint: a preliminary report* (*Osteopathic Profession*. 1937; 9:30-31), followed by a presentation: *The hypermobile joint – further reports on injection method* at the February 13, 1938 meeting of the Osteopathic Clinical Society of Philadelphia. Gedney outlined the theory of using sclerosing solutions for joints which had become stretched and were causing pain. The 1937 article gave a preliminary protocol and two case reports, one of a patient with knee pain and another with low back pain, both successfully treated by addressing the hypermobile joint with irritating solutions. He had also recently fathered the Gedney Osteopathic Hospital in Philadelphia where he continued his research. (*See Figure 5.*)


SURGICAL UNIT

GEDNEY OSTEOPATHIC HOSPITAL

54th Street and Baltimore Avenue

"The need for more Osteopathic beds in Philadelphia has prompted the organization of the Gedney Osteopathic Hospital to meet this demand."

Earl H. Gedney, D.O., Surgeon
George B. Hylander, D.O., Physician

[Laboratory Facilities]

Licensed under the Department of Welfare · · · Commonwealth of Pennsylvania

Figure 5. January 1937 Osteopathic Digest Announcement for Gedney Osteopathic Hospital.

Gedney began experimenting with different irritating solutions and perfecting his technique for joint injections, along with his colleague, David Shuman, DO, a 1931 graduate of the Philadelphia College of Osteopathy and who was then an instructor there. (*See Figure 6.*) Both men began studying and using this technique on unstable joints, especially knees, lumbar spines and sacroiliac joints. In 1949, an article by Shuman appeared in the medical literature: *Sclerotherapy – Injections may be the best way to restrengthen ligaments in case of slipped knee cartilage* (*Osteopathic Profession*, 1949). Both Gedney and Shuman continued to do research and publish reports throughout the 1950s.

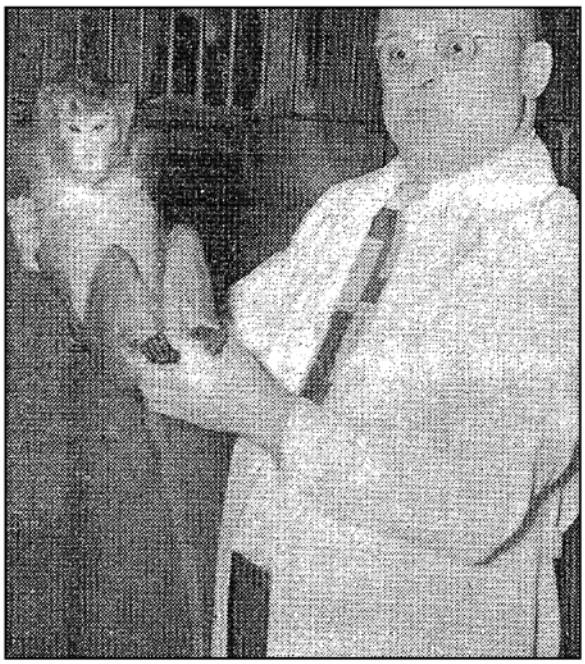

David Shuman
Lota Tau Sigma; Freshman Dance Committee; President Neurone Societu IV; Drew Obstetrical Society; Smith Neurological Society; Tennis; Inter-Class Bowling.
Frankfort High School; P. C. O. Pre-Osteopathic.

Figure 6. David Shuman, from 1931 yearbook, Philadelphia College of Osteopathy.

Skepticism, however, among orthopedic surgeons existed and more evidence and studies were needed. Now practicing in Maine, Dr. Gedney was determined to provide this evidence, using his own money to fund research if needed. In March, 1950, a Bangor, Maine paper headlined:

"*Bangor Doctor Seeks New Approach To Spinal Fusion Of Lower Back In His Experiments With Monkeys.*"

The article goes on to explain that Gedney had been contemplating this type of "needle surgery" study for 20 years, since his graduation from the Philadelphia College of Osteopathy, in order to address the alternative to surgical bone fusion "to the complete satisfaction of bone surgeons." (*See Figure 7.*) The paper reported that Dr. Gedney expected to pay out more than $3,000 from his own pocket to finish this study. The article also states, "The doctor says this experiment is a follow-up to another completed in 1940 which resulted in a new internationally recognized technique in treating hypermobile or loose joints. This method involves needle surgery." Unfortunately there does not appear to be any conclusion published to the monkey study, however there are three Gedney publications from 1951-1954 addressing disc, low back or sacroiliac issues and injection treatment, but all with regard to human subjects. (Disk syndrome: New approach in the treatment of symptomatic intervertebral disk, *Osteopathic Profession*, September 1951, 11-15; Technic for sclerotherapy in the management of hypermobile sacroiliac, *Osteopathic Profession*, August 1952, 16-19; 37-38; Progress report on use of sclerosing solutions in low back syndromes, *Osteopathic Profession*, August 1954, 18-21, 40-44.)



DR. GEDNEY AND "PRETTY"— Dr. Earl H. Gedney, Bangor, is currently engaged in a long-range experiment which may prove greatly benefical to persons needing surgery for spinal fusion. The doctor is hold ing "Pretty", one of his collaborators in the invovled research. (Staff photo by Cobb.)

Figure 7. Dr. Gedney with one of his monkeys "Pretty," *The Bangor Daily News*, Bangor, Maine, Friday March 10, 1950, p. 22.

By the 1950s, hernia surgical techniques had progressed so well that there was less demand for hernia sclerotherapy, and because of the interest generated by Gedney and Shuman, the herniologists began paying more attention to joint injections. Two groups formed out of the original group of herniologists: The Sclerotherapy College and, in Philadelphia, the Osteopathic College of Joint Sclerotherapy. In 1954 the two groups combined, forming the American Osteopathic College of Sclerotherapy, which became recognized and chartered by the AOA in 1956. David Shuman went on to be Secretary-Treasurer of the American Osteopathic College of Sclerotherapy from 1968-1977 and also served as President of the Organization, as well as holding distinguished positions as President of the Philadelphia County Osteopathic Society, head of Department of Osteopathic Therapeutics (Juanita Park Medical Center), and Member of the Board of Directors of Blue Cross. In 1960 Shuman published the first layperson's book on joint sclerotherapy, entitled *Your Aching Back and What You Can Do About It*. The book writes:

"…*application of sclerotherapy to weakened sacroiliacs was easy. No operation, no blood, no bone grafts. Just a little weekly hypodermic injection, repeated ten or perhaps a dozen times, and the sacroiliac stayed put. But when it came to problems like spondy [spondylolisthesis], beyond the reach of all operative techniques, and ruptured discs, where operations could promise only a little more than half a chance at complete recovery, sclerotherapy assumed its greatest significance. No myelograms, no nucleograms, no arthrodesis, no fusions, not even hospitalization. Just simple injections, easily made at an office visit the patient could make on his way to the movies.*" (Gedney and Staab, *Your Aching Back and What You Can Do About It*, Gramercy Publishing Co, NY, 1960, p. 104).

The book goes on to give numerous case reports, diagrams and examples. It also discusses the work of George Hackett, MD, another surgeon interested in joint sclerotherapy. About the time Gedney was starting to use joint sclerotherapy, George Hackett, MD, made an observation while doing hernia repair on patients previously treated for hernias with sclerosants. He is quoted as saying, "Injections made (usually in error) at

the junction of ligament and bone resulted in profuse proliferation of new tissue at this union." Although there is no evidence of direct collaboration between Hackett, and either Gedney or Shuman, the studies done independently support each other's conclusions, that sclerotherapy (Prolotherapy) for joint pain and disability worked.

Drs. Gedney and Shuman and others spent years in their research efforts. They looked at the microscopic effects on ligaments and tendons of various formulas to establish workable protocols for various treatment areas. They formed a lecture team and traveled to various osteopathic medical centers to lecture and demonstrate injections until 1963. In 1967, Shuman wrote a journal article stressing the importance of combining the osteopathic principles of mobilization and ambulation, along with joint sclerotherapy, for low back disorders, a novel concept because at the time most low back pain patients were being confined to bed rest for long periods of time. (Ambulation, osteopathic manipulative therapy, and joint sclerotherapy in the management of common low-back disorders, *Journal of the American Osteopathic Association*, 1967 67:52-59).

In 1986, the name of the American Osteopathic College of Sclerotherapy was changed to reflect its evolution into predominantly injections for joint pain. The new name was The American College of Osteopathic Pain Management and Sclerotherapy. In 1996 the group was granted full status as a college by the AOA and became the American College of Osteopathic Pain Management and Sclerotherapy. Because of a conflict over the use of the term "sclerotherapy" which was also being used by the osteopathic dermatology group to denote varicose veins injections, the AOA changed our name to The American College of Osteopathic Sclerotherapeutic Pain Management (ACOSPM), which is its current name. After twenty years this name has recently come under discussion as needing updating. Studies and biopsies over the last two decades have shown that Prolotherapy solutions in use today stimulate the proliferation of new normal ligament and tendon tissue, not scar tissue which was originally believed and which is reflected in the name "sclero" (scar) therapy. To further confuse the issue, the word "sclerotherapy" has become almost exclusively identified by the general public as meaning varicose vein injections. Thus "sclerotherapy" has become somewhat of a misnomer as it relates to regenerative joint injections such as Prolotherapy. At the most recent ACOSPM board meeting last spring, discussion began on the idea of changing the name to more accurately represent modern terminology while also preserving the unique historical background of the group. The new name proposed is: The American Osteopathic College of Prolotherapy and Sclerotherapeutic Pain Management. This preserves the historical background of sclerotherapy, and allows continued adjunct teaching of hernia, vein and hemorrhoid injections, but also puts forward the current main emphasis and purpose of our group: Prolotherapy joint injections to stimulate the repair and regeneration of injured joints, ligaments and tendons.

Meetings of the ACOSPM continue, with membership open to both DOs and MDs. Over the past forty years these meetings have taken place at least once or twice yearly, offering instruction to both novice and veteran physicians interested in learning about Prolotherapy and other pain injection techniques. At those conferences speakers demonstrate and share their knowledge. Topics include training in Prolotherapy technique as well as hands on workshops and introduction to current developments in the field such as platelet rich plasma (PRP) Prolotherapy injections. Also taught at the meetings are complementary pain injection techniques such as neural therapy and mesotherapy, providing additional tools for the pain practitioner to help his/her patient. Dr. Aline Fournier, a leader in the field of mesotherapy, and Dr. Gerald Harris, a leader in the field of neural therapy, are both regular speakers at the conferences. Other topics for upcoming meetings include the use of stem cells in Prolotherapy and current research. The ACOSPM's journal, "GET THE POINT" has recently been reinstated and is available on the group's website: www.acopms.com.

Also in the works at the ACOSPM is the creation of a residency program. This has already been presented at a meeting of the American Osteopathic Association (AOA) and is pending approval at the next AOA meeting. The residency program will be open to applications from members and will offer extensive training and practice in Prolotherapy and adjunct treatments. The development of an AOA sanctioned residency program is quite exciting as it allows for the creation of standards, protocols and board certification, and opens the door for the more consistent acceptance of medical insurance reimbursement for these procedures.

Video recordings of ACOSPM meetings from the 1980s onward document instruction and lectures. (*See Figures 8-12.*)

In conclusion, as an osteopathic physician I cannot help but appreciate the striking correlation between Prolotherapy and the osteopathic principles that must have appealed to the early pioneers in the field: that the body has the inherent capacity to repair itself, with the physician as an assistant in this process. Prolotherapy also encompasses the Hippocratic notion of "First, do no harm." While complications can occur, they are rare as compared to surgical risk, another appealing element for the early pioneers. The American College of Osteopathic Sclerotherapeutic Pain Management has come a long way in terms of medical and technical advances and the forwarding of the principles of Prolotherapy. I am sure if Drs. Earl Gedney, David Shuman, Harry Stahlman and the others were still with us they would be proud of how far we have come. ■

Figure 8. Dr. Rodney Chase demonstrating low back injections.

Figure 9. Dr. F. Curtis Hudgins demonstrating low back injections.

Figure 10. Dr. John Sessions demonstrating low back injections.

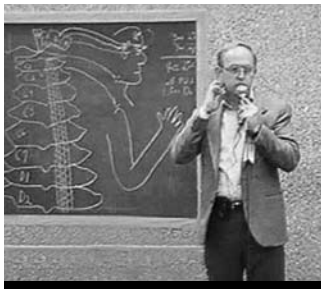


Figure 11. Dr. John Sessions discussing neck ligament referral patterns.

Figure 12. Dr. John Sessions, first graduating class, Texas College of Osteopathic Medicine, 1974 (back row).
Dr. Sessions is a current ACOSPM Board Member.

I would like to express special thanks to the following individuals who helped me in their historical knowledge, research assistance and/or sending photos and information:

Kent Pomeroy, MD, for his detailed historical chronology and support of our group. Mark Stahlman, NYC, grandson of Dr. Harry Stahlman, for taking the time to pull out his grandfather's photo albums and memorabilia, and also to Steve Stahlman, whose detailed family tree helped me to find one of the original herniologists. Linda Pavina, Executive Director of the American College of Osteopathic Sclerotherapeutic Pain Management, for her assistance in answering questions and transferring historical videos to DVD. Gerald Harris, DO, for locating the out of print book by David Shuman, and providing other useful information. Mitzi Killeen, Cataloger & Special Collections, Philadelphia College of Osteopathic Medicine medical library, for pulling, scanning, and emailing the archived information on Earl Gedney and David Shuman. Also thanks to Stephanie Ferretti and Randall Blackwell at the library for sending needed reference articles.

FANTASTIC FINDINGS

A Retrospective Study on Hackett-Hemwall Dextrose Prolotherapy for Chronic Shoulder Pain
at an Outpatient Charity Clinic in Rural Illinois

Ross A. Hauser, MD & Marion A. Hauser, MS, RD

ABSTRACT

The optimal long-term, symptomatic therapy for chronic shoulder pain has not been established. Accordingly, we investigated the outcomes of patients undergoing Hackett-Hemwall dextrose Prolotherapy treatment for unresolved shoulder pain at a charity clinic in rural Illinois. We studied a sample of 94 patients with an average of 53 months of unresolved shoulder pain that were treated quarterly with Prolotherapy. An average of 20 months following their last Prolotherapy session, patients were contacted and asked numerous questions in regard to their levels of pain and a variety of physical and psychological symptoms, as well as activities of daily living, before and after their last Prolotherapy treatment. The results of this study showed that patients had a statistically significant decline in their level of pain, stiffness, and crunching sensations (crepitation), to the p<.0000001 level with Prolotherapy, including the 39% of patients who were told by their medical doctors that there were no other treatment options for their pain and the twenty-one percent who were told that surgery was their only option. Over 82% of all patients experienced improvements in sleep, exercise ability, anxiety, depression, and overall disability with Prolotherapy. Ninety-seven percent of patients received pain relief with Prolotherapy. Conclusion: In this study, patients with chronic shoulder pain reported significant improvements in many clinically relevant parameters and overall quality of life after receiving Hackett-Hemwall dextrose Prolotherapy.

Journal of Prolotherapy. 2009;4:205-216.
KEYWORDS: alternative to shoulder surgery, shoulder pain, ligament injury, Prolotherapy, rotator cuff tear, rotator cuff tendinopathy, tendinosis.

Introduction

Shoulder pain is one of the most common reasons patients give for a physician pain visit, third only to headache and back pain.[1] It is a significant cause of morbidity worldwide with an incidence of 11-19 cases per 1,000 patients per year.[2] The prevalence increases with age, shoulder pain affecting 21% of persons 70 years and older.[3] The incidence of shoulder pain is escalating, especially among office workers with intensive computer use.[4,5] Because this occupational hazard is likely to increase in the future, it is all the more important to find effective therapies to treat chronic shoulder pain. Current conventional therapies for unresolved shoulder pain include: medical treatment with analgesics, non-steroidal anti-inflammatory drugs, anti-depressant medications, steroid shots, trigger point injections, muscle strengthening exercises, physiotherapy, acupuncture, chiropractic care, rest, massage therapy, manipulation, orthotics, surgical treatments including arthroscopy or total shoulder replacement, multidisciplinary group rehabilitation, education and counseling. The results of such therapies often leave the patients with residual pain.[6-11]

Prolotherapy is gaining in popularity as a pain management therapy in both complementary and allopathic medicine.[12-15] Its primary use is in the pain management associated with tendinopathies and ligament sprains in peripheral joints.[16,17] It also has a long history of being used in the treatment of spine and joint degenerative arthritis.[18-20] In double-blind human studies the evidence on the effectiveness of Prolotherapy has been considered promising but mixed.[21-23] Prolotherapy treatment is now done at some major medical centers and universities.[24,25]

George S. Hackett, MD, coined the term Prolotherapy.[26] As he described it, "The treatment consists of the injection of a solution within the relaxed ligament and tendon which will stimulate the production of new fibrous tissue and bone cells that will strengthen the 'weld' of fibrous tissue and bone to stabilize the articulation and permanently eliminate the disability."[27] Animal studies have shown that Prolotherapy induces the production of new collagen by stimulating the normal inflammatory reaction.[28,29] In addition, animal studies have shown improvements in ligament and tendon diameter and strength.[30,31] Human studies have shown improvements in pain symptoms including those with chronic low back pain.[32-35] Studies on the effectiveness of Prolotherapy on knee pain have been promising.[36,37] Though Prolotherapists routinely treat shoulder problems with Prolotherapy[38], no studies have been published to date. To evaluate the effectiveness of Hackett-Hemwall dextrose Prolotherapy, not just on shoulder pain but on quality of life measures, this observational retrospective study was undertaken.

Objective: To investigate the outcomes of patients undergoing Hackett-Hemwall dextrose Prolotherapy treatment for unresolved shoulder pain at a charity clinic in rural Illinois.

Patients and Methods: Patients with unresolved shoulder pain treated with dextrose Prolotherapy every three months were included into an observational study. The patients were called on the phone and asked to answer detailed questions on the level of their shoulder pain, stiffness, range of motion, medication usage, anxiety, depression, activities of daily living, and other quality of life measures before and after receiving dextrose Prolotherapy.

Results: Complete data was available on 94 shoulders who were treated during the years 2001-2005. The average starting shoulder pain level was 7.1 and ending shoulder pain level was 2.3. A matched sample paired t-test was used to calculate the difference in responses between the before and after measures for pain and stiffness for the 94 shoulder patients. The paired t-ratios for both pain and stiffness on the 94 shoulders were highly significant, using N pairs minus one as the degrees of freedom. For the entire 94 shoulder study participants the paired t-ratio was significant for pain relief at $t(93)=-13.3$ $p<.0000001$. In regard to stiffness, this also reached the highly statistically significant range with the paired t-ratio being $t(93) = 15.77$ $p<.0000001$. Range of motion improvement also reached statistical significance at $t(93) = -13.13$ $p<.0000001$.

In the subgroup who were told surgery was their only option the paired t-ratio was significant for pain relief at $t(19)=11.38$ $p<.0000001$. For stiffness in the subgroup of patients told surgery was their only option the paired t-ratio was significant for stiffness relief at $t(19)=5.85$ $p<.0000001$. Shoulder range of motion showed the paired t-ratio as significant at $t(19) = -8.82$ $p<.0000001$.

In patients told that no other treatment option existed, the results were also highly significant. In this subgroup of 37 patients, pain relief reached statistical significance with the paired t-ratio being $t(36)=17.92$ $p<.0000001$. For stiffness before and after Prolotherapy in this subgroup who were told there were no other treatment options, the paired t-ratio was also significant for stiffness at $t(36)=10.31$ $p<.0000001$ and for range of motion at $t(36) = -10.82$ $p<.0000001$.

The percentage of patients that had improvements in their pain after treatment with Prolotherapy was 97%. The percentage of patients that were able to decrease their medication usage by 75% or more was 87%. More than 76% of patients were able to decrease their additional pain treatments by 75% or more. Anxiety and depression symptoms were present in 47% and 55% respectively before Prolotherapy and only in 12% and 19% respectively after Prolotherapy. While 62% of patients could exercise less than 30 minutes prior to Prolotherapy, this dropped to 22% after Prolotherapy. Ninety-seven percent of patients felt Prolotherapy improved their life overall.

Conclusions: In this retrospective study, patients with an average of 53 months of chronic shoulder pain, even those whose medical doctors told them there was no other treatment for their pain or that surgery was their only option, reported clinically relevant improvements in their pain level and quality of life after receiving Hackett-Hemwall dextrose Prolotherapy.

Patients and Methods

FRAMEWORK AND SETTING

In October 1994 the primary authors (R.H., M.H.) started a Christian charity medical clinic called Beulah Land Natural Medicine Clinic in an impoverished area

in southern Illinois. The primary modality of treatment offered was Prolotherapy for pain control. Dextrose was selected as the main ingredient in the Prolotherapy solution because of it being readily available, inexpensive (compared to other proliferants), and having a high safety profile. The clinic met every three months until July 2005. All treatments were given free of charge.

PATIENTS

Patients who received Prolotherapy for their unresolved shoulder pain in the years 2001 to 2005 were interviewed via telephone by an independent data collector (D.P.) who had no prior knowledge of Prolotherapy. General inclusion criteria were an age of at least 18 years, having an unresolved shoulder condition more than six months that typically responds to Prolotherapy, and a willingness to undergo at least four Prolotherapy sessions, unless the pain remitted with fewer Prolotherapy sessions.

INTERVENTIONS

The Hackett-Hemwall technique of Prolotherapy was used. Each patient received 20 to 40 injections with a 15% dextrose, 0.2% lidocaine solution for a total of 20 to 30cc of solution used per shoulder. Each patient was given an intraarticular injection of 5 to 10cc of solution. Around the shoulder, tender areas were also injected, and 0.5 to 1cc of solution was used per extra-articular injection. (*See Figure 1.*) Tender areas injected on the anterior and superior portions of the shoulder could include the acromioclavicular joint and ligaments, rotator cuff tendon attachments, coracoacromial ligaments, as well as the biceps tendons and glenohumeral ligament attachments. No other therapies were used. As much as the pain would allow, the patients were asked to reduce or stop nonsteroidal anti-inflammatory and narcotic medications.

OUTCOMES

The independent data collector (D.P.) was the sole person obtaining the patient information during the telephone interviews. The patients were asked a series of questions about their pain and previous treatments before starting Prolotherapy. Their response to Prolotherapy was also detailed with an emphasis on the effect Prolotherapy had on their need for subsequent treatments and their quality of life. Specifically, patients were asked questions concerning years of pain, pain intensity, overall disability, number of physicians seen and medications taken, quality of life concerns, psychological factors, and whether the response to Prolotherapy continued after the Prolotherapy sessions were finished.

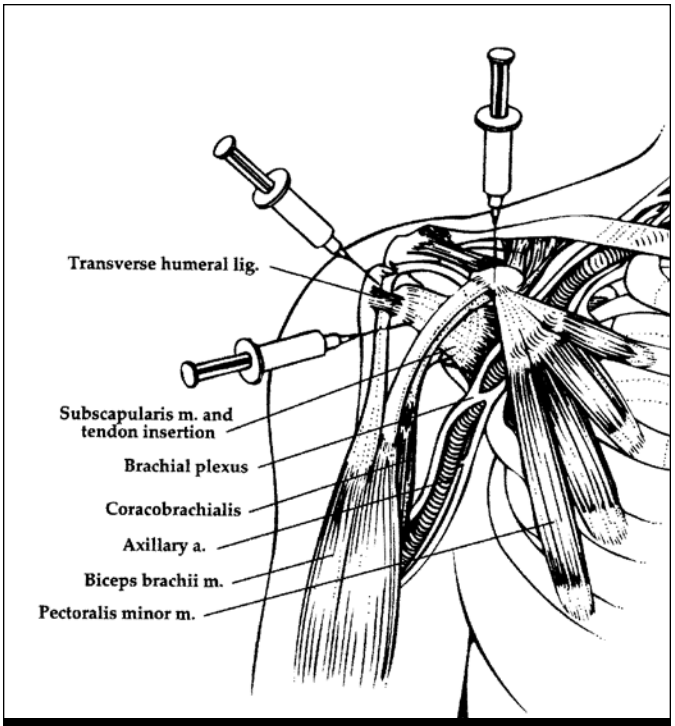


Figure 1. Prolotherapy to the shoulder. Injection sites to the shoulder are demonstrated, including the coracoid process, subscapularis tendon, and the greater tuberosity.

ANALYSIS

For the analysis, patient percentages of the various responses were calculated by another independent person (D.G.) who had no prior knowledge of Prolotherapy. These responses gathered from clients before Prolotherapy were then compared with the responses to the same questions after Prolotherapy. A matched sample t-test was used to determine if there were statistically significant improvements in the before and after Prolotherapy measurements for pain, stiffness, and crunching sensations. Further analyses were done with those patients who stated their medical doctors said that surgery was their only option or that there were no other treatment options for their pain.

Results

PATIENT CHARACTERISTICS

From a total of 122 patients with unresolved shoulder pain whose charts were analyzed and who were interviewed via telephone, 94 met the inclusion criteria. The main reasons for exclusion were inability to come for treatments primarily due to travel/distance (42%), stopped treatments because of their medical doctor's recommendation (i.e. needed treatments more frequently or other medical problems) or on their own (31%), inability or unwillingness to answer survey (16%), and other (11%).

A total of 94 shoulders from 90 people met the inclusion criteria. Of these, 60% were female and 40% were male. The average age of the patients was 54 years-old. Patients had an average of fifty-three months of pain, 33% had pain for greater than six years, and 19% had pain for between four and six years. Seventy-six percent received their first Prolotherapy treatment primarily because of the recommendation of a friend. The average patient saw 2.9 MD's before receiving Prolotherapy. Twenty-one percent were told by one of their physicians that surgery was the only answer to their pain problem, and 39% of patients were told by their physicians that there were no other treatment options for their chronic pain. Twenty-eight percent were taking one pharmaceutical drug for pain. Thirty percent were taking two or more drugs for pain. (*See Table 1.*)

Table 1. Demographics of the shoulder patient population.

Total number of shoulders treated	94
Percentage of female patients	60%
Percentage of male patients	40%
Average age of shoulder patients	54
Average number of MD's seen prior to Prolotherapy	2.9
Average years of pain	4.4
Average number of pain meds at start of Prolotherapy	1.2
Average number of pain meds after Prolotherapy	0.3
Percentage with pain improvement	97%
Percentage with stiffness improvement	93%
Percentage with crunching improvement	90%

TREATMENT OUTCOMES

Patients received an average of 3.8 Prolotherapy treatments per shoulder. The average time of follow-up after their last Prolotherapy session was 20 months.

Patients were asked to rate their pain, stiffness, and crunching sensation on a scale of 1 to 10. With 1 being no pain/stiffness/crunching and 10 being severe/crippling pain/stiffness/crunching. The 94 shoulders had an average starting pain level of 7.1, starting stiffness level of 5.4, and starting crunching level of 3.9. Patients were asked to rate their mobility on a scale of 1 to 7, with 1 being no motion, 2 through 5 were percentages of normal motion with 2 being 1-24%, 3 being 25-49%, 4 being 50-74% and 5 being 75-99% of normal motion. Normal motion was 6, and 7 was excessive motion or hypermobility. The average starting mobility level was 3.7.

The patients reported that their ending pain level after Prolotherapy was 2.3, ending mobility 5.2, ending stiffness 2.0, and ending crunching 1.9. Eighty-eight percent started with greater than serious pain (5 or more) but after Prolotherapy only 9.6% had that much pain. The percentage of patients who had a decrease in their pain level was 97%. (*See Figure 2.*) More than 86% of patients had minimal stiffness when finished with treatments, but only 28% started with it. (*See Figure 3.*) Ninety-seven percent of patients finished with 50% or greater of normal motion, whereas, prior to Prolotherapy only 58% had that amount of motion. Seventy percent of patients who were on prescription pain medications were able to stop taking them after Prolotherapy. Another 17% were

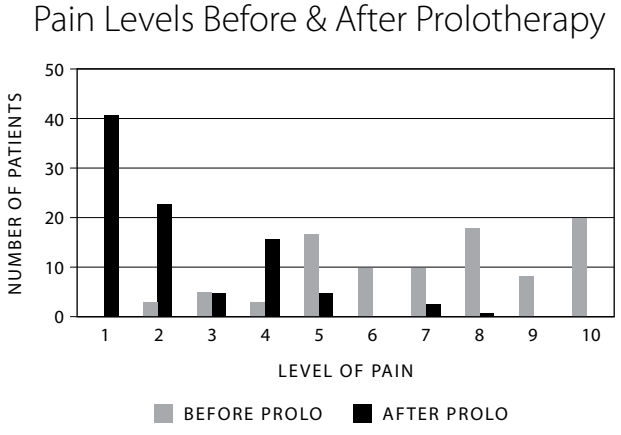


Figure 2. Pain levels before and after Hackett-Hemwall dextrose Prolotherapy in 94 shoulders.

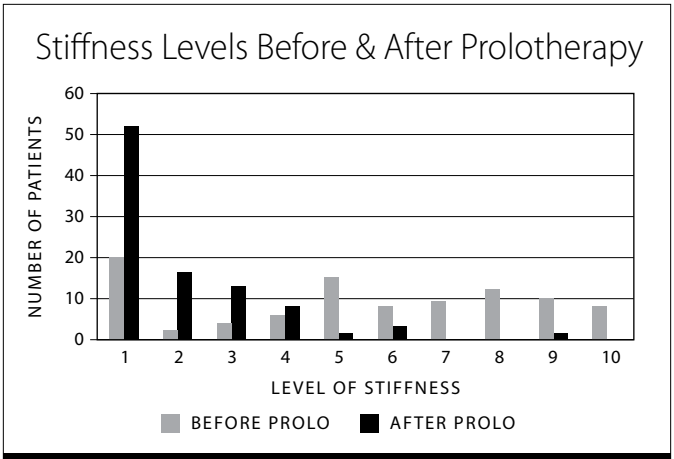


Figure 3. Stiffness levels before and after Hackett-Hemwall dextrose Prolotherapy in 94 shoulders.

able to decrease the amount needed by 75% or more. No patient had to increase their pain medication usage since receiving Prolotherapy. Sixty-six percent of the patients receiving other pain management care were able to stop after Prolotherapy. Another 10% were able to decrease it by 75% or more.

In regard to quality of life issues prior to receiving Prolotherapy, 81% of patients felt they had some type of overall disability before Prolotherapy, but only 20% felt so after it. (*See Figure 4.*) Before Prolotherapy, 12% noted some dependency on another person for activities of daily living which decreased to 4% after Prolotherapy. In regard to athletic ability prior to Prolotherapy, 28% said it was totally compromised (couldn't do any athletics), 15% ranked it as severely compromised (less than 10 minutes), 18% ranked it as very compromised (less than 30 minutes), in all 85% ranked it as at least somewhat compromised. After Prolotherapy, 34% were back to completely normal athletic ability with 77% able to do more than 30 minutes of exercise per day. (*See Figure 5.*)

Before Prolotherapy, 47% considered themselves having some depression and 55% had some anxiety but after Prolotherapy this decreased to 12% and 19%, respectively after Prolotherapy. (*See Figure 6.*) Three patients were on medications for depression and two other patients were on anxiety medications before Prolotherapy, but after treatment all five were able to stop taking their medications. Ninety-one percent of patients who started with depressed feelings and 75% of those with anxiety were improved at the time of follow-up. In regard to sleep, 80% said that their shoulder pain affected their ability to sleep before Prolotherapy. After Prolotherapy, 88% could sleep much better.

To a simple yes or no question: "*Has Prolotherapy changed your life for the better?*" 97% of patients treated answered "*yes.*" In quantifying the response, 49% felt their life was at least radically better with 67% noting that they were very much better with Prolotherapy, but 99% rated their condition as at least somewhat better. Eighty-seven percent rated Prolotherapy as at least very successful in treating their condition (50% or greater pain improvement) with 56% noting the Prolotherapy to be extremely successful (75% or greater pain improvement).

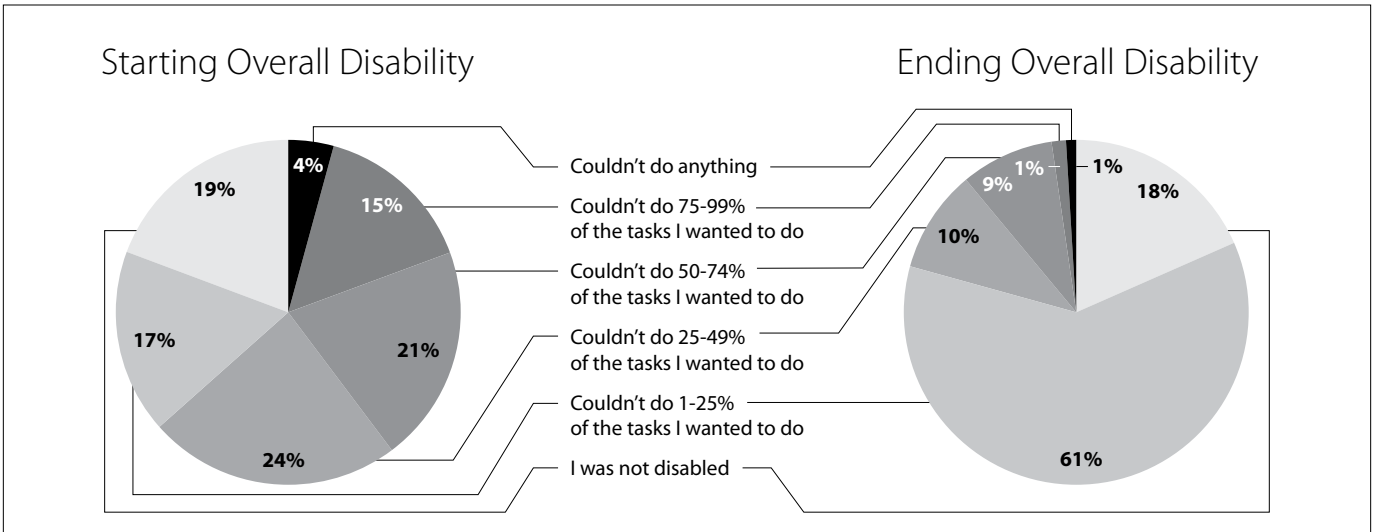


Figure 4. Improvement in overall disability before and after Hackett-Hemwall dextrose Prolotherapy.

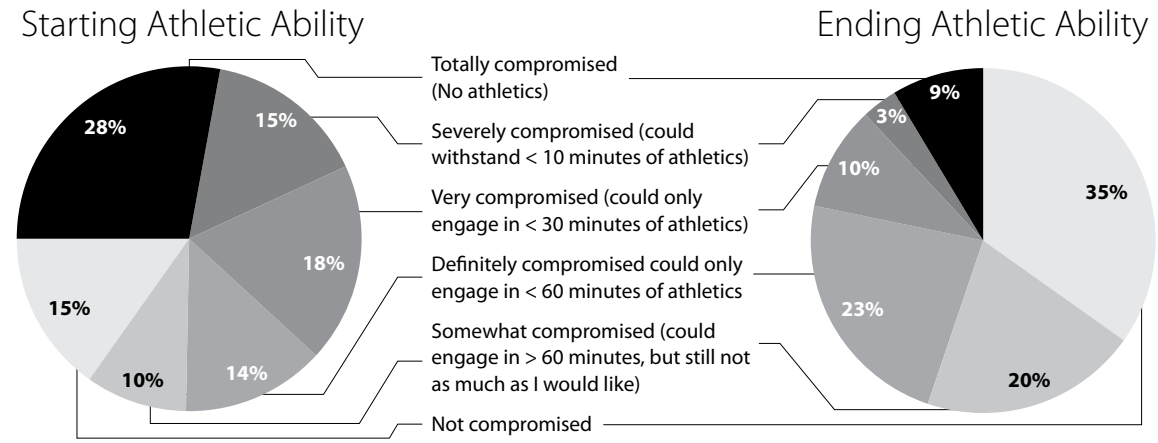


Figure 5. Improvement in athletic ability before and after Hackett-Hemwall dextrose Prolotherapy.

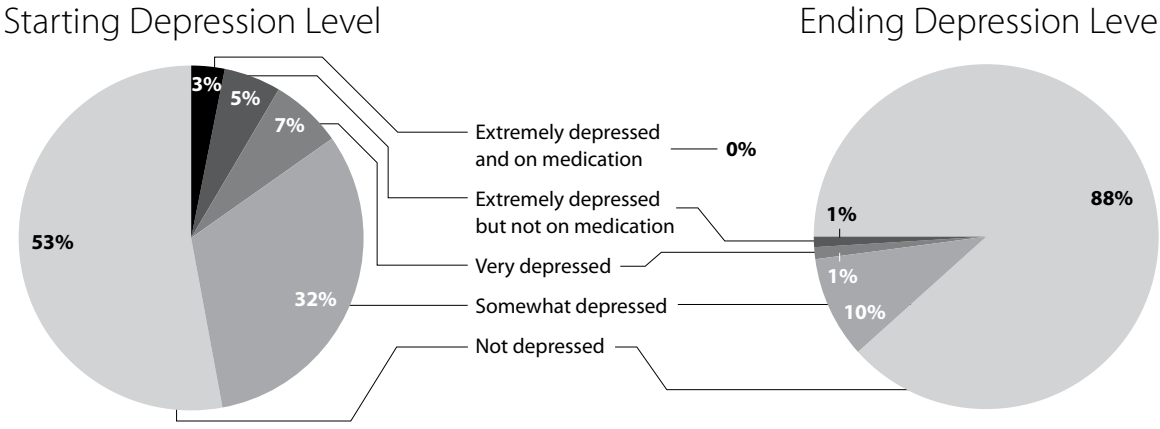


Figure 6. Depression levels before and after receiving Hackett-Hemwall dextrose Prolotherapy.

The average person in this study was 20 months out since their last Prolotherapy session. The patients were asked if the improvement with Prolotherapy lasted, and how much of the effect remained. In regard to pain, for instance, 68% noted that 100% of the improvement continued to this day, with 88% stating that at least 50% of the effect remained. Eighty-five percent of patients stated that the overall results of Prolotherapy has mostly continued (50% or greater). A summary of the lasting effects of Prolotherapy on the various quality of life measures is seen in *Table 2*.

Patients were asked the question, "*Are there reasons besides the Prolotherapy effect wearing off that are causing your pain/disability?*" Eighty-two percent with continued pain answered "*Yes.*" Forty-three percent believed they stopped Prolotherapy too soon (before pain was totally gone),

Table 2. Lasting improvements with Hackett-Hemwall dextrose Prolotherapy in shoulder pain patients. On average 20 months following their last Prolotherapy session, patients reported continued improvements in pain, stiffness, athletic ability, and overall disability.

Improvements	Pain	Stiffness	Athletic Ability	Overall Disability
Continued to this day (100%)	68	73	72	58
Very Much Continued (75-99%)	9	7	6	15
Has Mostly Continued (50-74%)	11	8	9	18
Total 50% or greater	88	88	87	91

21% had other medical reasons/conditions for their pain, 18% re-injured the area that had received Prolotherapy, 11% had a new area of pain, and 6% had increased life stressors. Of the clients whose pain increased for the above reasons after Prolotherapy was stopped, 80% are planning on receiving more Prolotherapy.

PATIENT SATISFACTION

Overall 97% of patients showed improvement in their pain with Prolotherapy. Eighty-six percent of patients treated considered the Prolotherapy treatment to be very successful (greater than 50% pain relief). In regard to the question "*Has Prolotherapy changed your life for the better?*" 97% answered "*Yes.*" Ninety-two percent knew someone who has benefited from Prolotherapy. Ninety-seven percent have recommended it to someone.

Statistical Analysis

A matched sample paired t-test was used to calculate the difference in responses between the before and after measures for pain, stiffness, and crunching. Using the matched sample t-test on all three variables, all p values reached statistical significance at the $p<.0000001$ level.

NO OTHER TREATMENT OPTIONS SUBGROUP

As previously noted, 39% of patients prior to Prolotherapy were told that there were no other treatment options for their pain. They had seen an average 3.3 medical doctors for their pain which they had experienced for an average of 5.1 years.

In analyzing just these patients, their before and after Prolotherapy values for pain, range of motion, stiffness and crunching can be seen in *Table 3*. All reached statistical significance to at least the $p<.0000001$ level.

Table 3. Before and after Prolotherapy statistics on shoulder patients told by their MD's that no other treatment options were available.

Symptom	Before Prolotherapy	After Prolotherapy	p Value
Pain	7.1	2.2	0.0000001
Range of Motion	3.6	5.4	0.0000001
Stiffness	5.8	2.0	0.0000001
Crunching	4.8	2.1	0.0000001

The starting and ending pain levels for these patients can be seen in *Figure 7*. Eighty-one percent of these patients had greater than 50% pain relief. Eighty-nine percent of them ended with greater than 75% of normal motion after Prolotherapy, whereas prior to it only 27% had that amount of motion. In regard to exercise ability, only 17% could exercise more than 30 minutes before Prolotherapy but after Prolotherapy this increased to 46%.

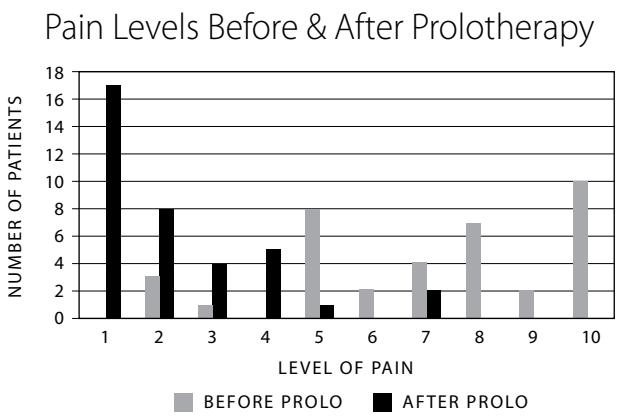


Figure 7. Pain levels before and after Hackett-Hemwall dextrose Prolotherapy in shoulder patients who were told that no other treatment options were available.

As a group, prior to Prolotherapy they were taking on average 1.3 pain medications, but after Prolotherapy only 0.4 pain medications. Twelve of these patients had completely stopped their pain medications after Prolotherapy. As of the follow-up, 25 of the patients were taking no medications and 12 were taking one pain medication, whereas prior to Prolotherapy 14 of the patients were taking two or more pain medications.

Before receiving Prolotherapy, 57% experienced some depressed feelings, but after Prolotherapy, this dropped to 14%. The three patients on medications for depression were able stop taking them after Prolotherapy. Fifty-nine percent of patients had some anxious thoughts prior to Prolotherapy, but after Prolotherapy only 27%. The two patients that were taking medications for anxiety were able discontinue them.

Ninety-five percent of these patients knew someone who benefited from Prolotherapy and an equal number recommended it to someone. Ninety-seven percent of this subgroup felt that the Prolotherapy changed their lives for the better.

SURGERY ONLY OPTION SUBGROUP

Twenty-one percent of patients, prior to Prolotherapy, were told by their physician that surgery was their only option. As a group, they had seen an average of 3.4 physicians for their pain which they had experienced on average for 53 months.

This group of patients' before and after values for pain, stiffness and crunching with Prolotherapy can be seen in *Table 4*. All reached statistical significance to the p<.0000001 level.

The starting and ending pain levels for all of these patients can be seen in *Table 4*. Ninety percent of these patients experienced greater than 50% pain relief. Fifty-five percent experienced greater than 75% pain relief. Ninety percent of them ended with greater than 75% of normal motion after Prolotherapy, whereas prior to Prolotherapy, only 15% possessed that amount of motion.

Table 4. Before and after Prolotherapy statistics on shoulder patients told by their MD's that surgery was their only option.

Symptom	Before Prolotherapy	After Prolotherapy	p Value
Pain	7.0	2.6	0.0000001
Range of Motion	4.2	5.4	0.0000001
Stiffness	5.1	2.3	0.0000001
Crunching	4.3	2.2	0.0000001

Prior to Prolotherapy the patients were taking on average 1.5 pain medications, but after Prolotherapy only 0.4 medications. Nine of these patients had totally stopped their pain medications that they were taking prior to Prolotherapy. Twenty months on average after their last Prolotherapy session, 13 were on no medications and seven were taking one pain medication, whereas prior to Prolotherapy nine of the patients were taking two or more pain medications.

Before receiving Prolotherapy, 50% felt they had some depressed feelings but after Prolotherapy it was down to only 15%. Fifty-nine percent of patients felt some anxiety prior to Prolotherapy but afterwards only 10%.

In regard to exercise, 85% said they could exercise less than 30 minutes per day using the affected shoulder before Prolotherapy, but after Prolotherapy only 20% were so limited. Ninety percent of the patients said Prolotherapy helped them sleep better. In regard to work situation, two of these patients who were completely disabled were able to get back to work because of Prolotherapy.

Ninety-five percent of these patients knew someone who has benefited from Prolotherapy and an equal number had recommended it to someone. Ninety-five percent also felt that the Prolotherapy changed their lives for the better.

Discussion

PRINCIPLE FINDINGS

The results of this retrospective, uncontrolled, observational study show that Prolotherapy helps decrease pain and improve the quality of life of patients with chronic shoulder pain. Decreases in pain, stiffness and crunching levels reached statistical significance to the p<.0000001 level with Prolotherapy, not only for the group as a whole but also for the 21% of the patients that were told that surgery was their only option and for the 39% that were told that their was no other treatment option for their pain. Ninety-nine percent of all patients had less shoulder pain, with 87% having 50% or greater of their pain relieved. In regard to pain medication, 87% decreased their need for it by 75% or more. Eighty-seven percent showed an improvement in sleep. For those with depressed and anxious feelings, 91% were less depressed and 75% were less anxious long term. In regard to overall disability, this decreased from 81% of the patients prior to Prolotherapy to 20% after it. In regard to athletic ability, only 39% of the patients could do more than 30 minutes of exercise prior to Prolotherapy but this increased to 78% after Prolotherapy. In 97% of patients with unresolved shoulder pain for an average of 20 months, the Hackett-Hemwall technique of dextrose Prolotherapy changed their life for the better. (*See Table 5.*)

STRENGTHS AND WEAKNESSES

Our study cannot be compared to a clinical trial in which an intervention is investigated under controlled conditions. Instead, it's aimed to document the response of patients with unresolved shoulder pain to the Hackett-Hemwall technique of dextrose Prolotherapy at a charity medical clinic. Clear strengths of the study are the numerous quality of life parameters that were studied.

Table 5. Summary of results of Hackett-Hemwall dextrose Prolotherapy shoulder study.

Demographics	All Shoulder Patients	No Other Treatment Option	Surgery Only Option
Total number of shoulders	94	37	20
Avg. years of pain	4.6	5.2	3.9
# of pain meds used before Prolotherapy	1.2	1.3	1.5
# of pain meds used after Prolotherapy	0.3	0.4	0.4
Pain level before Prolotherapy	7.1	7.1	7.0
Pain level after Prolotherapy	2.3	2.2	2.6
Stiffness level before Prolotherapy	5.4	5.8	5.1
Stiffness level after Prolotherapy	2.0	2.0	2.3
Greater than 50% pain relief	87%	81%	90%
Athletic Ability > 30 Minutes of Exercise before Prolotherapy	29%	17%	15%
Athletic Ability > 30 Minutes of Exercise after Prolotherapy	78%	46%	80%
Prolotherapy changed life for the better	97%	97%	95%

Quality of life issues such as overall disability, stiffness, range of motion, activities of daily living, athletic (exercise) ability, anxiety and depression, in addition to pain level, are important factors affecting the person with unresolved shoulder pain. Decreases in medication usage and additional pain management care were also documented. The improvement in such a large number of shoulders, treated solely by Prolotherapy, is likely to have resulted from Prolotherapy, especially when 61% of the patients were either told by their medical doctors that there was no other treatment for their pain or that surgery was their only option. Another strength is that many of the above parameters are objective. So while there is no one hundred percent definitive medical test to document pain improvement or the progress with Prolotherapy, an increased ability to exercise, have more range of motion and use less medications and other pain therapies are objective changes.

The quality of the cases treated in this study is also a strength. The average person in this study had unresolved shoulder pain for four years, eleven months and had seen over three physicians already. As noted earlier, fifty-seven (61%) of the patients were either told by their MD(s) that there was no other treatment option for their pain or that surgery was their only option. So clearly this patient population represented *chronic* unresponsive shoulder pain. Having a follow-up time on average of twenty months since their last Prolotherapy session also was a strength, because chronic joint pain typically doesn't just spontaneously remit. The normal course is actually the opposite, progressively worse pain. So for this group of patients to have such a drastic improvement in their pain and for that improvement to last, gives credence to the notion that the improvement is from the Prolotherapy itself.

Because this was a charity medical clinic with limited resources and personnel, the only therapy that was used was Prolotherapy. The Prolotherapy treatments could only be given every three months. In private practice, the Hackett-Hemwall technique of dextrose Prolotherapy is typically given every four to six weeks. If a patient is not improving or has poor healing ability, the Prolotherapy solutions may be changed and strengthened or the patient is advised on additional measures to improve their overall health. This can include advice on diet, supplements, exercise, weight loss, changes in medications, additional blood tests, and/or other medical care. Often patients are weaned immediately off of anti-inflammatory and narcotic medications that inhibit the inflammatory response that is needed to get a healing effect from Prolotherapy. Since this was not done in this study, the results at this charity clinic are an indication of the *lowest level of success* with Hackett-Hemwall dextrose Prolotherapy. This makes the results even that much more impressive.

A shortcoming of our study is the subjective nature of some of the evaluated parameters. Subjective parameters of this sort included pain, stiffness, anxiety, and depression levels. The results relied on the answers to questions by the patients. Another shortcoming is the additional pain management care that they were receiving was not controlled. What was documented was the change that occurred in it with Prolotherapy. There was also a lack of X-ray and MRI correlation for diagnosis and response to treatment. A lack of physical examination documentation in the patients' chart made categorization of the patients into various diagnostic parameters impossible.

INTERPRETATION OF FINDINGS

Musculoskeletal disorders of the shoulder are extremely common, with reports of prevalence ranging from one in three people experiencing shoulder pain at some stage of their lives to approximately half the population experiencing at least one episode of shoulder pain annually.[39] Hackett-Hemwall dextrose Prolotherapy was shown to be very effective in eliminating pain and improving the quality of life in this group of patients with chronic shoulder pain. This included the subgroup of patients that were told by their physicians that there were no other treatment options for their pain or that surgery was their only option.

While the differential diagnosis for chronic shoulder pain can include rotator cuff impingement, glenohumeral joint osteoarthritis, rotator cuff tear, bursitis, calcific or bicipital tendinitis, labral tear, myofascial pain syndrome, adhesive capsulitis (frozen shoulder), in the vast majority of cases, the pain relates to degeneration of the rotator cuff.[40,41] The incidence of rotator cuff degeneration increases as people age, although even rotator cuff tears may not always be symptomatic. The overall prevalence of tears of the rotator cuff on MRI is 34% among symptom-free patients of all age groups, being 15% for full-thickness tears and 20% for partial-thickness tears.[42] In one study, only 28% of all rotator cuff tears were painful and in another study 54% of asymptomatic individuals older than 60 years had either a partial-thickness or full-thickness rotator cuff tear.[43,44]

The pathophysiological mechanism of this rotator cuff degeneration appears to multifactorial. Several authors have stressed the role of intrinsic tendon physiology as the main cause of degeneration.[45,46] A zone of relative hypovascularity in the supraspinatus tendon approximately 1cm from the insertion site on the greater tuberosity, which corresponds to the critical zone where most rotator cuff degeneration and tears occur. This poor blood supply, coupled with chronic tendon overload leads to degeneration in the hypovascular region of the rotator cuff because of poor healing and these areas can eventually progress to rotator cuff tears. Another reason for rotator cuff degeneration is from impingement of the supraspinatus tendon. The supraspinatus tendon is clinically the most important rotator cuff tendon because it is involved, either alone or in combination with one or more additional tendons, in 95% of cuff tears.[47]

Because of this many patients with chronic shoulder pain are searching for conservative and alternative treatments for their pain.[48-50] Searching for alternatives, simply put, are patients who meet the criteria for shoulder surgery but want a more conservative option. Even surgeons themselves often recommend a trial of conservative care for conditions such as rotator cuff tears and subacromial impringement syndrome before surgery is recommended.[51,52] In many shoulder conditions, conservative care gives similar results as shoulder surgery with significantly less risk.[53,54] Patients realize that total shoulder replacement surgeries, arthroscopic procedures and even cortisone shots carry with them significant risk including prosthesis failure, nerve injury, infection, tissue damage, post-op blood clot and potential for continued pain.[55-59]

One of the treatments that chronic pain sufferers are using instead of surgery and conventional pain medications including narcotics is Prolotherapy.[60,61] Prolotherapy works by stimulating the body to repair these soft tissue structures. It starts and accelerates the inflammatory healing cascade by which fibroblasts proliferate. Fibroblasts are the cells through which collagen is made and by which ligaments and tendons repair.

For those patients suffering from chronic shoulder pain, histologic and MRI studies have shown that the pathophysiology is one of rotator cuff degeneration, not inflammation.[62-64] In other words, chronic shoulder pain comes from tendon degeneration, in which collagen content within the tendon substance is either missing or changed.[65,66] Since Prolotherapy is the injection of a solution for the purpose of tightening and strengthening weak tendons, ligaments or other structures involved in the stability and movement of a joint, it would be expected to be successful for those suffering from chronic shoulder pain.

Conclusions

The Hackett-Hemwall technique of dextrose Prolotherapy used on patients who had an average duration of four years, eleven months of unresolved shoulder pain who were twenty months out from their last Prolotherapy session was shown in this observational study to improve their quality of life. They reported less pain, stiffness, crunching sensation, disability, depressed and anxious

thoughts, medication and other pain therapy usage, as well as improved range of motion, sleep, exercise ability, and activities of daily living. This included patients who were told there were no other treatment options for their pain or that surgery was their only option. Therefore, Hackett-Hemwall dextrose Prolotherapy is a treatment that should be highly considered for people suffering with unresolved shoulder pain. ■

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REMARKABLE RECOVERIES

Non-Operative Treatment of Cervical Radiculopathy

A Three Part Article from the Approach of a Physiatrist, Chiropractor, and Physical Therapist

Ross A. Hauser, MD, Glen M. Batson, DC, & Chris Ferrigno, MS, PT

ABSTRACT

The painful condition resulting from soft tissue damage and degenerative disc changes causing pressure on a cervical nerve root is called cervical radiculopathy. It often produces agonizing neck pain, a burning sensation, along with numbness radiating down the arms, shoulder blades, and back, or up into the head. Authors discuss cervical radiculopathy from the position of a Physiatrist (R.H.), chiropractor (G.B.), and physical therapist (C.F.). Each author reviews case studies and techniques utilized in order to successfully treat patients presenting with cervical radiculopathy.

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KEYWORDS: Barré-Lieou syndrome, cervical lordosis, cervical radiculopathy, McKenzie exercises, physical therapy, Prolotherapy, RESULTS system.

Cervical radiculopathy refers to a pinching or inflammation of a cervical nerve at its exit point in the spine, called the neuroforamen. It is caused by lesions that narrow the space in the neuroforamen, including cervical disk herniations, but more commonly occurs with cervical spondylosis.[1,2] This latter condition refers to a gradual wear and tear or age-related degenerative changes.[3] Many of these changes can be diagnosed or identified on conventional X-rays and MRI's and may include narrowing of the disc space, bulging of the contour of the disc, herniation of the disc, calcification of the disc, and vertebral margins that result in spurs. (*See Figure 1.*) When the spurring significantly narrows around the nerve root exit passage or foramen it is referred to as neuroforaminal stenosis. These degenerative changes can lead to constant or episodic waves of pain. The symptoms of cervical radiculopathy typically include severe neck pain with radiation of the pain to the back of shoulder blade, shoulders, arm, or hand. Numbness or weakness in the arm can also be present.

Cervical radiculopathy is a neurologic condition characterized by dysfunction of a certain spinal nerve, the roots of the nerve, or both. Cervical radiculopathy usually presents with pain in the neck or one arm, with a combination of sensory loss, loss of motor function, or reflex changes in the affected nerve-root distribution.[4] Cervical radiculopathy can also cause headaches,[5] head pain,[6] and facial pain or dysfunction. Population-based data from Rochester, Minnesota, indicates that cervical radiculopathy has an annual incidence rate of 107.3 per 100,000 for men and 63.5 per 100,000 for women, with a peak at 50 to 54 years of age.[7] The most common cause of cervical radiculopathy (70 to 75 percent of cases) is from foraminal encroachment of the spinal nerves due to a combination of factors, including decreased disc height and degenerative changes of the uncovertebral joints anteriorly and zygapophyseal joints posteriorly. Disc herniation of the nucleus pulposus is responsible for 20 to 25 percent of cases.[8] Cervical radiculopathy can be multifactorial in etiology, with onset also initiated from zygapophyseal (facet) joint syndrome, ligament laxity or injury, tumors, infections, inflammatory mediators, and/or trauma.

ANATOMY AND PHYSIOLOGY

The anatomy of the cervical spine consists of seven cervical vertebra, six cervical discs, eight pairs of cervical nerve roots, ligaments, muscles, and the spinal cord. Eight pairs of cervical nerve roots are formed directly from multiple tiny rootlets that originate directly from

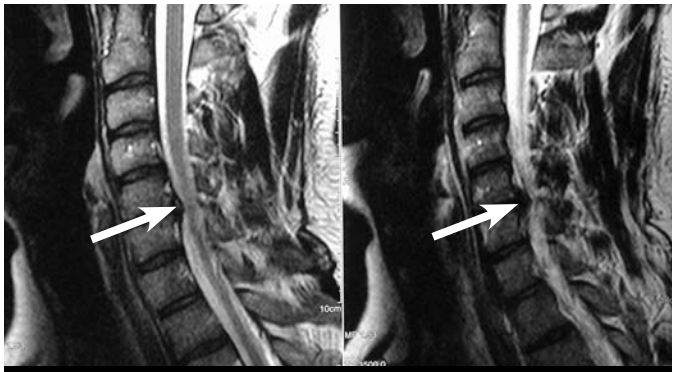

Figure 1. MRI of patient with cervical radiculopathy showing degeneration in cervical spine.

the spinal cord. These tiny rootlets coalesce immediately within the intraspinal canal and form the dorsal (sensory) and the ventral (motor) roots. These join together just before passing through the intervertebral foramen and form the spinal nerve root. On exiting the foramen, the nerve root splits into the small posterior ramus and the larger anterior ramus. In contrast to the roots, there are only seven cervical vertebra whereas the eight root exits below the seventh cervical vertebra and above the first thoracic vertebra.[9] It is as the cervical nerve roots enter the neuroforamina that they are most susceptible to injury. The neuroforamen are bordered anteromedially by the uncovertebral joint, posterolaterally by the facet joint, superiorly by the pedicle of the vertebral body immediately above, and inferiorly by the pedicle of the vertebral body immediately below. The medial section of the foramen is derived from the intervertebral discs and the vertebral endplates. The roots originate in close proximity to the level at which they exit the intraspinal canal. Consequently, the cervical roots generally pass through the canal and in a somewhat more horizontal fashion. This arrangement causes the neuroforamen to originate more medially and the cervical root and the cervical spinal cord to be in close proximity, thereby susceptible to abnormalities of these medial structures such as osteophytes or disc herniations, leading to the symptoms of cervical radiculopathy.[10,11]

A majority of patients who have cervical radiculopathy improve within 1-2 months with appropriate medical treatment, which can consist of rest, cervical immobilization, analgesics, anti-inflammatory agents, muscle relaxants, physical therapy, as well as chiropractic or osteopathic manipulation.[12-14] There are several case series reports suggesting that even patients with severe neurological deficits and severe pain can be managed quite successfully using a nonoperative approach.[15-17] Generally the patient is to refrain from repetitive movements of the neck and forceful or heavy lifting. Sometimes a soft cervical collar is prescribed to limit neck motion and provide splinting and rest in a position of comfort. Physicians will often prescribe anti-inflammatory medications or short courses of oral corticosteroid medications to provide pain relief and hopefully decrease nerve inflammation. Physical therapy is used to provide techniques such as intermittent traction and McKenzie exercises to try and decrease nerve tension by opening up the neural foraminal spaces. Chiropractors may utilize mobilization techniques such as manipulation when vertebral rotations are involved in the disease process. For those who do not respond to these conservative measures or for those whose pain is excruciating, cervical epidural steroid, periradicular steroid, or Prolotherapy injections may be given. For some, surgery will be recommended. This article will look at a variety of conservative nonoperative approaches including Prolotherapy, chiropractic, and physical therapy available to patients who are suffering from cervical radiculopathy. Some patients will need just one of these techniques, but others require some or all of the therapies to resolve their cervical radiculopathy. ■

A Chiropractic Therapeutic Approach to Cervical Radiculopathy

Glen M. Batson, DC

CHIROPRACTIC CERVICAL SPINE EVALUATION

The chiropractic approach to the evaluation and treatment of cervical radiculopathy is similar to the allopathic approach and diagnosis, however, the chiropractic evaluation centers on the spinal segments, their contiguous biomechanical function, and alteration of segmental biomechanical function which may cause associated neurological and soft tissue symptomatology. The chiropractic analysis reviews the symptomatology, however, further investigates to determine the primary mechanism of action causing the associated symptomatology. The doctor of chiropractic is trained to evaluate the patient as a whole. The point of pain is reviewed as is all integrated biomechanics and system functions. The point of pain is a symptom, and not always the direct point of pathology. The premise of the chiropractic philosophy is that the vertebral subluxation, whether caused through direct trauma or micro trauma, causes altered vertebral segmental function, causing joint instability, and thus a myriad of sequential events. The vertebral segmental dysfunction, subluxation, causes irritation to the facet joints and disc material via abnormal function, stretching of the supporting ligament structure, altered biomechanical function, irritation to neuro receptors, abnormal loading of facets and disc material with subsequent disc bulge or herniation, and thus neurological compromise. The subluxation complex not only causes

altered joint function, but also biochemical changes at the joint level also facilitating in the degenerative process due to the direct insult or origin of this subluxation. The chiropractic examination encompasses a review of posture, gait, scoliosis, shoulder heights, and foot/ankle function. The chiropractic treatment for this condition is to correct and stabilize the subluxation process through spinal manipulation, soft tissue stabilization and re-education through strengthening and conditioning, education of ergonomics and posture, and nutrition.

In the chiropractic field of medicine, spinal manipulation is utilized for the therapeutic correction of a subluxation. Spinal manipulation is delivered in many forms, however in this office, a spinal manipulation is defined as a predetermined specific degree of force delivered to a specific spinal segment by a trained chiropractic physician, in a specific direction, for a specific end result: the correction and restoration of the joint structure, and relief of associated soft tissue and neurological compromise. A chiropractic adjustment should be a therapeutic thrust or percussion to an osseous structure for correction of the joint instability, correction of biomechanical function, restoration of osseous and ligament function and integrity, for relief of the associated soft tissue and neurological compromise. The chiropractic adjustment should be delivered manually by the physician's hand or a percussive machine, however, segmental specificity, degree of thrust or percussion, and direction of thrust is integral in the proper restoration of spinal function.

I utilize the "RESULTS" system of chiropractic analysis and procedures formulated by Dr. Walter V. Pierce.[1] The RESULTS system of chiropractic is exactly as it is read; results are the ultimate goal. The RESULTS technique for chiropractic analysis utilizes multiple diagnostic modalities for interpretation of the subluxation and neurological compromise, and a therapeutic treatment regiment for the restoration and correction of these structural and neurological conditions. The RESULTS system utilizes static X-ray examination of the spinal regions in question for evaluation of pathological process, subluxation complex, degenerative joint and disc disease, disc space thinning, osteophytic formation, and determination of postural integrity.

Static X-rays are performed for determination of the subluxation and for determination of the cervical lordosis. The cervical lordosis should be a curve apexed anterior with a 17cm anterior convexity. The normal lordosis is integral to the cervical biomechanical functioning. Loss of the normal lordosis, to any degree less than normal lordosis, indicates altered facet function, increased axial load to the intervertebral disc, and increased stress to the surrounding ligament structures. The loss of lordosis also indicates some degree of anterior head translation and ultimately compensatory loading throughout the lower lumbar spine and pelvis. (*See Figures 1a & 1b.*)

Fluoroscopic spinal X-ray imaging is also utilized and consists of dynamic imaging of the spinal regions in question for real-time imaging of the osseous structures in full ranges of motion for proper and specific diagnosis of facet function, ligament laxity, disc integrity, and pathological process.[2-14] Fluoroscopic analysis is the only diagnostic procedure to visibly evaluate the spinal segments in normal motion for determination of biomechanical function or pathology. All other imaging such as X-ray, MRI, CT are in a static mode, non-motion, possibly not demonstrating a segmental instability or pathology. All imaging is recorded on a DVD recorder for analysis and storage for comparison studies if needed. All radiographs and fluoroscopy scans are performed in the standing, weight bearing position. DTG instrumentation is utilized consisting of infrared diagnostic heat sensing of the dermatomal levels of the spinal regions for determination of vascular and neurological compromise. The readings are graphed and retained for comparison analysis.

I utilize a Variable Frequency Adjuster instrument for applying induced harmonic forces to spinal segments and other articular complexes. Resonant oscillations, when induced within a vertebral complex by a driven harmonic frequency have shown to improve range of motion, and muscle relaxation resulting from the reprogramming or re-education of mechanoreceptors within the articular complexes of the vertebral segments.[15] Mechanoreceptors respond to continual changes in the loading and unloading of spinal articular complexes.[16] This procedure is utilized by performing percussive activity to the posterior segments of a selected vertebra for restoration of joint and ligament function, restoration of cervical lordosis, and an increase in normal posture. This procedure can be performed in the prone or seated position. (*See Figure 2.*)

Deep tissue neuro-musculoskeletal re-education therapy is rendered to patients, as indicated, for the restoration of cervical function, reduction of spasm, increase in cervical range of motion, retraction of the cranial, cervical,

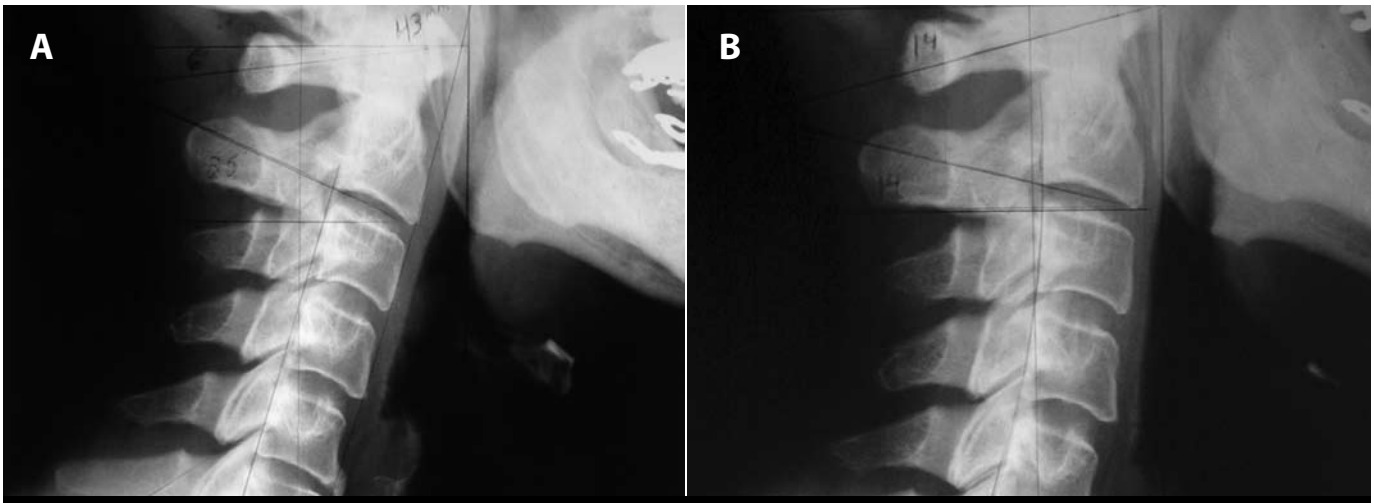

Figure 1. Comparison of before and after X-rays show improvement in cervical lordosis, as indicated by Georges Line which runs along posterior vertebral bodies.

and scapula region to increase the cervical lordosis and posture. A portable cervical Starr Traction appliance is utilized in conjunction to the manipulation for traction of the disc and osseous structures of the cervical spine to rehydrate the disc, educate ligaments and muscles, and to relieve the neurological irritation. Home ice therapy regiments are utilized for the reduction of edema, spasm, and pain.

RESULTS System normal X-ray line analysis findings: Cervical lordosis of 17cm, superior C1 angle of 18 to 24 degrees, zygapophysis angle at C5 or C6 of 35 to 55 degrees, C2 angle of 0.0 degrees, A-P vector intersection of 0.0. Fluid and contiguous function of facet, ligaments, and endplates via fluoroscopic analysis. (*See Figure 3*.)

CLINICAL CASE STUDY

Case # 4842: The patient is a 54 year-old female who experienced severe cervical spine pain and severe right upper extremity pain, numbness, and tingling resulting from lifting objects in her home. Patient has been diagnosed by primary physician and emergency room physicians as cervical radiculopathy. Medication was rendered consisting of Vicodin with mild relief. Patient presented to Batson Chiropractic with complaints of cervical spine pain, pain into the upper bilateral shoulder and scapular region with pain radiating to the right shoulder, right upper extremity region 8/10 in severity. Patient described numbness, tingling, and pain throughout the entire right upper extremity region extending into the hand and fingers consisting of the first, second, and third digits. Patient describes cervical crepitus, pain in all ranges of motion, muscle spasm and tension into the shoulders bilaterally, loss of strength of the right upper extremity region as well as pain into the right shoulder and scapula region.

Physical Examination: reveals a 54 year-old female, presenting with pain to the cervical spine and right upper extremity. Patient presents with positive orthopedic and neurological findings consistent with the diagnosis of cervical radiculopathy.

Figure 2. Patient being treated with Variable Frequency adjuster.

X-ray Examination: consisted of static A-P, Lateral, Flexion, Extension views of the cervical spine revealing loss of cervical lordosis with mild kyphosis of the lower cervical region measuring 34 cm, gross anterior head translation measuring 45 mm as measured from the anterior superior endplate of C7 to a perpendicular plum line from the anterior aspect of the C1 tubercle, C5 zygapophysis angle of 37 degrees, C2 angle of -30 degrees, and C1 angle of 22 degrees, degenerative joint and disc disease with disc space thinning C5-C6 with large osteophytic formation

Figure 3. X-ray of cervical spine demonstrating normal lordosis.

and vacuum phenomenon, milder vertebral and disc degeneration at the C4-C5, and C6-C7 segmental levels with mild osteophytic formation. Facet sclerosis noted at multiple levels. Flexion-extension views of the cervical region revealed subluxation: C0 in flexion, C1 flexion, C2 flexion, C6 flexion, C3 extension, C4 extension, C5 extension, C6 extension.

MRI examination: revealed mild atlantodental joint degeneration, minimal posterior disc bulge at C3-C4 right of midline, mild circumferential disc annual bulge C4-C5 with mild impression upon the thecal sac without evidence of spinal cord impingement or neuroforaminal or canal stenosis. C5-C6 revealed degeneration of the intervertebral disc with circumferential annular bulging approximately 3.5 mm posteriorly. There was effacement of the CSF space and slight flattening of the surface of the cord by the bulging disc annulus without evidence of cord compression. Moderate bilateral neuroforaminal narrowing due to the bulging of the intervertebral disc and adjacent posterolateral uncovertebral joint osteophytes. There was impingement of the C6 nerve root bilaterally. C6-C7 disc degeneration with eccentric right posterolateral annual bulging of approximately 2 mm. Moderate to marked right neuroforaminal narrowing due to the posterolateral soft disc protrusion with possible impingement of the right C7 nerve root and foramen.

Patient received twenty therapeutic chiropractic treatment sessions as outlined above and twelve cervical traction sessions over a nine week period of time. Patient responded to chiropractic procedures with positive outcome, experiencing complete resolution of all subjective symptomatology, normal findings of all objective findings, marked improvements in post radiographic findings. Patient returned to normal daily living status with mild restrictions.

Post static lateral radiographic findings after nine weeks of care demonstrated improvements in line analysis as: C1 angle 16 degrees (prior 22 degrees), C2 angle -17 degrees (prior -30 degrees), C5 zygapophysis angle 34 degrees (prior 37 degrees), lordosis angle -58 degrees (prior -34 degrees), measurement of anterior head translation of 16 mm (prior 45 mm).

Conclusion: Patient responded to chiropractic spinal care with complete resolution of cervical radiculopathy, and all subjective symptomatology. Resolution and restoration of proper objective findings are demonstrated by examination and post radiographic findings. Continued care was recommended for further structural spinal restoration.

CONCLUSION

Neck pain is encountered frequently and is considered one of the most common chronic pain conditions and a major problem in modern society.[17] Pain associated with the cervical spine can be multi-factorial in etiology. Cervical radiculopathy is one set of conditions that is associated with the complications as related to the underlying mechanism of neck pain. Poterfield and DeRosa[18] refers to the cycle wherein **pain** causes **spasm** which causes **decreased blood flow** and **edema** which causes **hypoxia** and **biochemical change** causing **chemical irritation** resulting in **pain.** There is substantial evidence that the chiropractic adjustments are beneficial in relieving a wide variety of pain syndromes. As discussed, the philosophy of chiropractic is that the primary mechanism of the condition is the vertebral subluxation causing the altered segmental function, instability, and the cascade of neurological and biomechanical ramifications as outlined above. The combination of the restoration of the segmental dysfunction/subluxation, ligament function and integrity, disc height and function, and postural changes all benefit the patient and their specific presenting symptomatology. A large number of case reports and documentation have appeared in peer-reviewed and literature supporting chiropractic treatment and chiropractic manual therapy.[19-23] As evidenced throughout, the multi-factorial condition

of cervical radiculopathy may indicate a multidiscipline approach for therapeutic correction and recovery. The combination of chiropractic manipulation, Prolotherapy, physical therapy, traction, postural and ergonomic education all may play an integral role in the alleviation of the neurological compromise associated with cervical radiculopathy.

As a doctor of chiropractic, I am a proponent of preventative medicine. Understanding the sequella of complications which can cause ailments or serious health ramifications, Chiropractic analysis and treatment in conjunction to Prolotherapy, strengthening, and postural correction are essential for the well being of the population, young or old. The prevention, or even the correction, of a vertebral subluxation can have far reaching positive ramifications in our daily lives. Trauma or injury to the spinal regions causes splinting. Splinting causes prolonged fixations between segments which further decreases the overall range of motion in the neck and imposes unnecessary additional stress on damaged intersegmental units that are trying to heal. By reducing the adjacent fixations through manipulation, we restore more normal biomechanics to the spine, and in turn relieve the stress at the injured segments, thereby providing an environment more conductive to repair.[24] Correction of the subluxation reduces and eliminates the cycle of pain as outlined by Poterfield and DeRosa. Education of the population, both the public and health care providers, on spinal biomechanics and essentials of maintaining or correcting spinal biomechanics is imperative in the quest for preventative and optimal health. ■

Therapeutic Injections for Cervical Radiculopathy

Ross A. Hauser, MD, Physiatrist

Even when faced with severe disabling pain, many patients desire a non-surgical approach to their problem. While anti-inflammatory medications and oral corticosteroids can decrease nerve inflammation, some cases of cervical radiculopathy necessitate injecting steroids directly into or around the inflamed nerve. Studies have shown that even patients who have not responded to physical therapy, oral medications, and other conservative treatments, or those whose cervical radiculopathy symptoms and radiographic findings make them surgical candidates, can still experience significant benefits with cervical epidural and periradicular steroid injections and not need surgical intervention.[1,2] An Orthopedic Surgery Task Force on Neck Pain that appraised the scientific literature from 1980 to 2006 on surgical interventions for neck pain alone or with radicular pain concluded, "it is not clear from the evidence that long-term outcomes improved with the surgical treatment of cervical radiculopathy compared to nonoperative measures."[3] The Cervical Spine Research Society did a prospective, multicenter investigation of patients who presented with symptomatic cervical radiculopathy from cervical spondylosis and/or disc disease. They found that 26% of patients who underwent surgery reported persistent excruciating or horrible pain on follow-up.[4] For these reasons, a nonoperative conservative approach, which may include cervical injections, is prudent for most patients with cervical radiculopathy.

Cervical radiculopathy is, by definition, a disease of the cervical spinal root in which the nerve root is either impinged upon, inflamed or both.[5] Steroid and/or Prolotherapy injection therapy is utilized to help the patient (1) maintain an ambulatory or outpatient treatment status; (2) maintain participation in a physical therapy or rehabilitation program; (3) continue to work (4) decrease the need for analgesics; and (5) in some cases, avoid or delay surgical intervention.[6,7]

Steroid injection therapy for cervical radiculopathy is utilized to directly decrease the inflammation in a specific nerve root. Each cervical nerve can be injected (or blocked) paravertebrally by approaching the nerve in a lateral or posterior direction. Cervical nerve roots (C1-C8) pass laterally through their respective foramina with the sulcus of each transverse process and exit at the level above the vertebral segment for which they are numbered (*See Figure 1.*) Since these transforaminal or periradicular corticosteroid injections are given onto a specific nerve root, they are typically done under fluoroscopic guidance. Studies have shown statistically significant neck and radicular pain relief with these types of injections.[8,9]

When it is not clear which cervical nerve root is involved or if several nerve roots are irritated, a cervical epidural injection can be utilized. The procedure can be performed in an outpatient setting using fluoroscopy (X-ray guidance) where a needle can be directed, in most cases under local anesthesia alone, to the target site.

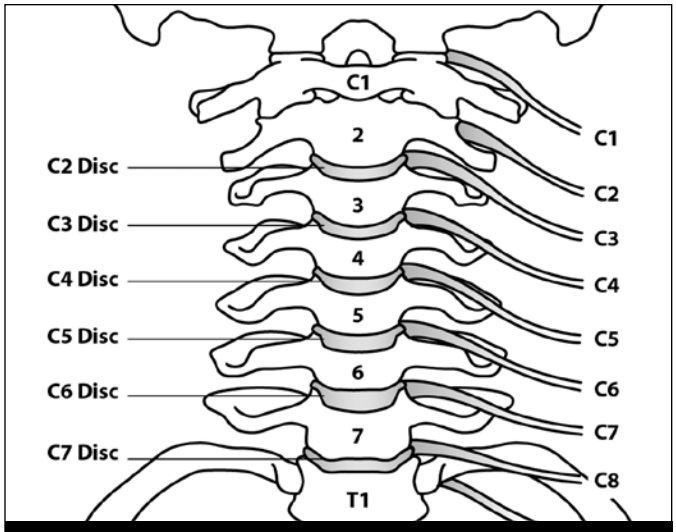

Figure 1. Anterior view of neck showing cervical nerve roots. Cervical radiculopathy occurs when one of these nerve roots is irritated or pinched.

(*See Figures 2a & 2b.*) The membrane covering the spine and nerve roots is called the dura. The space surrounding the dura is the epidural space. An epidural injection places anti-inflammatory medicine into the epidural space to decrease inflammation of the nerve roots, reducing pain and hopefully aiding the healing process. It may provide permanent relief or pain relief for several months while the injury/cause is healing. Improvement may occur immediately or within two weeks. Some patients will respond with one injection, but some may require up to three, interspersed over the course of a recovery period of one to three months. It is still unclear which factors or conditions, including herniated discs or spinal canal stenosis, optimize pain relief with cervical epidural steroid injections.[10,11]

One of the most useful techniques in experienced hands for the treatment of cervical radiculopathy is Prolotherapy. Prolotherapy has a long history of being used in neck pain with and without arm and hand pain.[12-17] The mechanisms by which Prolotherapy can decrease pain and expedite healing time can be seen in *Figure 3*. Since many people with neck pain with concomitant shoulder, arm or hand pain come with the diagnosis of cervical radiculopathy, the first order of business for the treating physician is to investigate whether or not the diagnoses are correct. What most doctors and patients don't realize is that ligament injuries in the neck can refer pain down the arm. (*See Figure 4.*) In my experience the most common reason for referral pain or pins-and-needles sensation

Figure 2a. C7 nerve root block under fluoroscopy. While the patient is in a supine position with the neck turned to contra-lateral side, a 25 gauge 2 inch needle is advanced under fluoroscopy into the right C6/7 neural foramen.

Figure 2b. C7 nerve root block under fluoroscopy. After confirmation of accurate needle placement with flow of contrast along the right C7 nerve root in both the AP and oblique views, injection of a local anesthetic and steroid is performed.

Prolotherapy can decrease pain and expedite healing time by producing:

- Decrease in Muscle Spasms
- Stabilization of Vertebral Segments
- Stimulation of Ligament Growth
- Elimination of Referral Pain Patterns
- Resolution of Multiple Pain Generators
- Improvement of Spinal Alignment

Figure 3. Mechanisms by which Prolotherapy can decrease pain and expedite healing time.

down the arm is not a pinched nerve, but ligament laxity in the neck or upper thoracic region. Clearly if someone does not have a somatic (voluntary) nerve getting pinched (one of the cervical nerves discussed above) then having the person get a transforaminal or cervical epidural steroid injection(s) would be futile. If such a person had cervical ligament injury as the cause of their neck pain

Hackett Referral Patterns

HEAD AND NECK REFERRAL PAIN PATTERNS
LIGAMENT AND TENDON RELAXATION

AREA OF WEAKNESS	REFERRAL PATTERN
OCCIPUT AREA A	FOREHEAD AND EYE
OCCIPUT AREA B	TEMPLE, EYEBROW, AND NOSE
OCCIPUT AREA C	ABOVE THE EAR
CERVICAL VERTEBRAE 1-3 (UPPER)	BACK OF NECK AND POSTERIOR SCAPULAR REGION (NOT SHOWN)
CERVICAL VERTEBRAE 4-5 (MIDDLE)	LATERAL ARM AND FOREARM INTO THE THUMB, INDEX AND MIDDLE FINGER
CERVICAL VERTEBRAE 6-7 (LOWER)	MEDIAL ARM AND FOREARM INTO THE LATERAL HAND, RING AND LITTLE FINGER

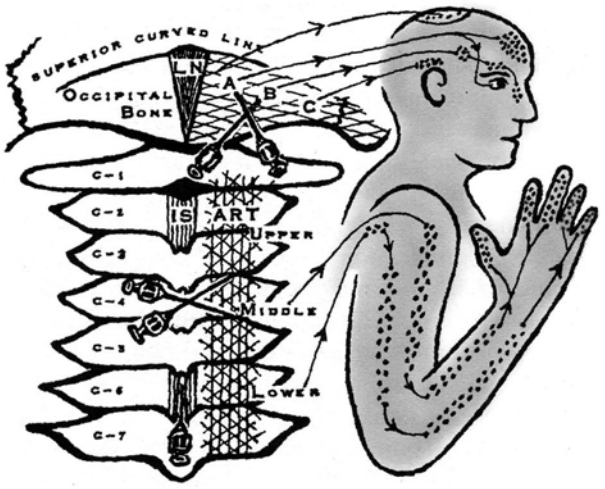

Figure 4. Ligament injuries to the neck can refer pain to the arm and hand as depicted in this referral diagram outlined by Dr. Hackett.

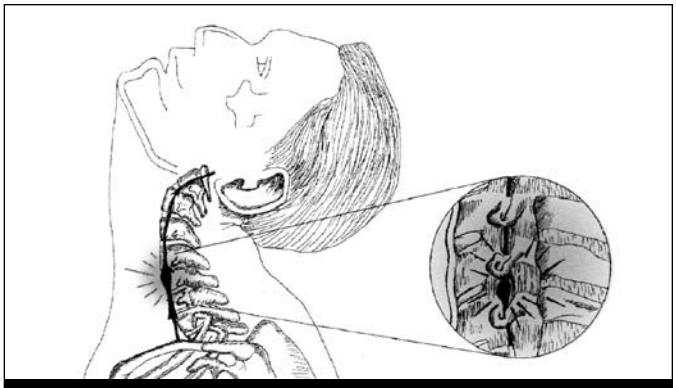

Figure 5. Whiplash injury in sports can lead to Barré-Lieou syndrome. Injury to the ligaments in the neck can cause the vertebrae to move (subluxation) pinching on the autonomic sympathetic nerves.

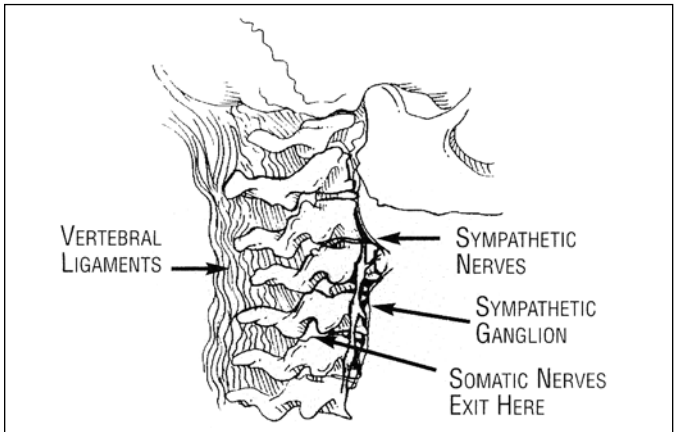

Figure 6. Relationship of the sympathetic nerves to the neck vertebrae. The sympathetic nerves and ganglion sit just in front of the cervical vertabrae, and their proper functioning depends on proper vertebral alignment.

Symptoms that Characterize Barré-Lieou syndrome

- Headache
- Facial pain
- Ear pain
- Vertigo
- Tinnitus
- Loss of voice
- Hoarseness
- Neck Pain
- Severe fatigue
- Sinus congestion
- Chest pain
- Sense of eyeball being pulled out
- Brain fog

Figure 7. Symptoms that characterize Barré-Lieou syndrome.

with referral symptoms down the arm then Prolotherapy or other conservative treatments would be warranted.

Ligaments are taut structures that prevent excessive movement of bones. The cervical ligaments prevent excessive movement of the neck vertebrae. When these cervical vertebrae rotate excessively to one side the condition is called cervical subluxation. This excessive movement of cervical vertebrae can lead to the irritation of autonomic nerves (nerves not under our voluntary control) which can lead to a host of symptoms including Barré-Lieou syndrome. (*See Figures 5, 6, & 7.*) Whether a person has had a forceful whiplash injury or side flexion injury, or they simply just sit at a computer terminal with forward head posture, ligament laxity or injury can result. (*See Figure 8.*)

If the ligament weakness condition persists, not only can cervical subluxation occur, but the body will induce muscle spasm and eventually bone overgrowth or spur formation to stabilize the unstable segments. Dr. Liyand Dai from Changzheng Hospital in Shanghai, China found a direct correlation between cervical instability and the development of disc degeneration (arthritis of the neck).[18] Prolotherapy has been found to be effective for the

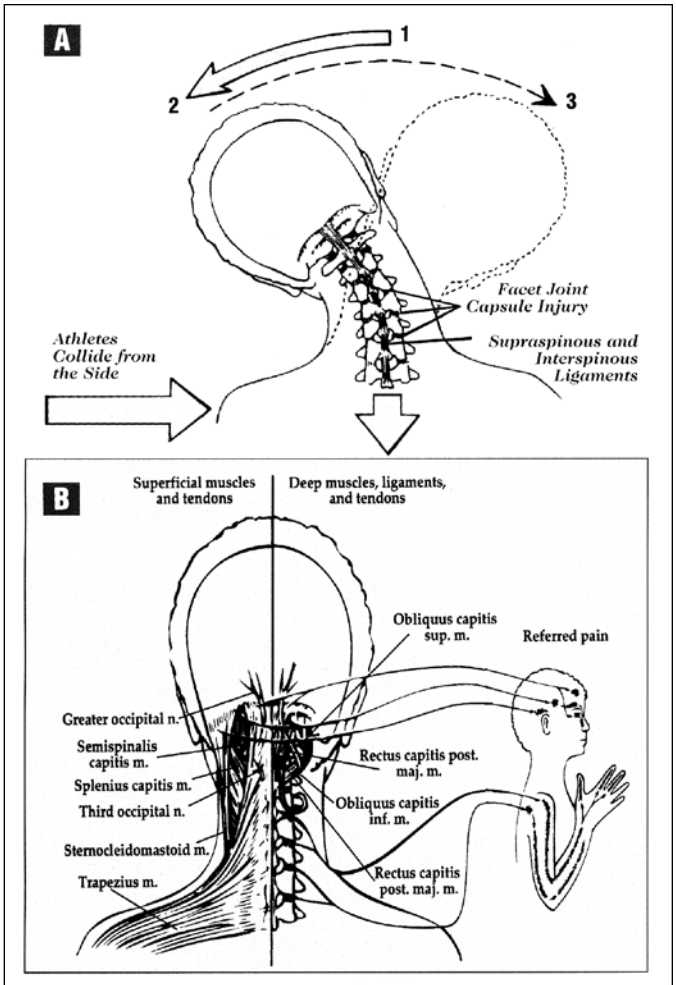

Figure 8. A forceful side flexion injury results in asymmetric injury to the facet joints, vertebrae, and associated ligaments. Pain can then develop in the head and arm because of the referral patterns of the neck ligaments.

treatment of cervical instability.[19] Prolotherapy will treat the underlying cause of the person's cervical instability or cervical degeneration by stimulating ligament repair. It can be used alone or in combination with the treatments discussed in this article. The following is a case history to show how Prolotherapy was used in the treatment of cervical radiculopathy.

CASE STUDY #1. CERVICAL RADICULOPATHY IMPROVES WITH PROLOTHERAPY

A 38 year-old male, came to see Dr. Ross Hauser at Caring Medical in April 2008 with complaints of severe pain in his neck that radiated down his right arm with numbness of his right index finger and posterior wrist (C6 distribution). His pain began earlier that month after lifting a TV. Prior to this injury he was an active person who did not have pain. He stated that his pain was at its worst when lying down (a 10 out of 10 pain), but is helped by wearing a neck brace while sleeping. He was taking Norco two to three times per day for pain, a Medrol dose pack, and Daypro at the time of his first visit. An MRI ordered by his primary doctor revealed a right sided disc herniation at C5-C6 and C6-C7.

Upon initial exam, his right arm muscle strength was normal but had slightly diminished sensation in C6 dermatome. Upon extension of his neck and right lateral rotation he had shooting pains down his right arm. The patient received Prolotherapy at his first visit to his entire neck and right scapular region. He was taken off Norco and Daypro and given Ultram for pain and Ambien to help him sleep.

He returned every 2 weeks for the same treatment and at his 3rd visit he reported 50% improvement in pain. His pain was down to 5 out of 10. He still had numbness of his right index finger with lying down. He moved his appointments to every 3 to 4 weeks over the next few treatments and at his 5th visit he reported 70% improvement in pain and that he no longer had pain unless he was lying down. His finger was unchanged at this time.

The patient continued his Prolotherapy every 6 weeks or so over the next few treatments and, at what would have been treatment #9, he reported that his neck was doing "really good." He did not receive treatment at this visit to his neck but wanted to get his knees and feet treated for unrelated injuries because Prolotherapy had worked so well on his neck. He was on no pain medication for his cervical radiculopathy after his 8th visit and the sensation to his right index finger and posterior wrist was back to normal. He was also back to full activities including exercise. Six months after his last Prolotherapy treatment he continues to do well.

CASE STUDY #2. THE DOCTOR'S CASE

While the last case study was treated with only Prolotherapy and medications, there are times where a variety of therapies are needed to resolve cervical radiculopathy. The following case I know very well because it is my own (R.H.). In January 2008, I had the best race of my life when I ran a 1:29:53 and placed 82nd out of over 12,000 people in the Disney Half Marathon. I made the podium for my age group (45 to 49). The next day I paced my

wife, Marion, to a 5:11 marathon. Within a few weeks after this I noticed a severe pain by my right scapula after a swim workout. I was unable to do my planned workouts over the next few days as the pain grew worse. Eventually it was completely disabling, causing me to keep my neck flexed and often my right arm raised with my palm on the back of my head to provide relief. The pain was severe on the right side of my neck, right scapula and felt like a hot poker digging into the right back of my hand between my thumb and index finger. The pain was making work very difficult, and despite pain medication, the pain continued.

I eventually had an MRI and X-rays of my neck. The MRI showed no surgical lesions, but did show extension degeneration bilaterally especially at the C5-C6 region. (*See Figure 9.*) The neck radiograph showed a straight cervical spine with loss of cervical lordosis and a posterior, right, superior C6 vertebra. (*See Figure 10.*) Trying to choose the most conservative treatment, chiropractic, physiotherapy, including high velocity manipulation, and some physical therapy (including analysis by C.F.) was done. After several weeks and a 50% reduction of the pain, a video fluoroscopic analysis was done (by G.B.). This still showed a posterior right C6, but the alignment and motion of the upper cervical spine was improved. G.B. then started treating me with the Pierce Technique of chiropractic. This had me to 85% improvement, but after a bike accident (yes, I was still training), I regressed back to severe neck, scapular, and arm pain. At this point a series of Prolotherapy treatments were started using stronger solutions in the left lower cervical region to help with spinal alignment. The first Prolotherapy alone produced definite improvement. Within a couple of weeks after the first Prolotherapy treatment I was back on my bike and exercising almost daily. By early April, I was back to Ironman training.

In total, I needed four Prolotherapy visits but I am happy to say that in July 2008, I completed the Ironman in Lake Placid, despite it pouring rain the whole time. After swimming 2.4 miles and cycling 112 miles in the pouring rain I was still able to run a 4 hour 20 minute marathon. (*See Figure 11.*) It is now over 18 months after my cervical radiculopathy incident and I am completely pain free though on occasion I will get a very, very slight tingling in the back of right hand. My friends know that I am back to running, cycling and swimming with a vengeance. As there are many others out there who need to know that cervical radiculopathy can be treated conservatively, we decided to write this article for *JOP*! ■

Figure 9. MRI of Ross Hauser showing extensive degeneration at C5-C6. This overgrowth of bone was one of the causes of my cervical radiculopathy.

Figure 10. Lateral C-spine X-ray. The curved line shows the normal curve of the cervical spine. This X-ray demonstrates a straight cervical spine, indicative of a lot of muscle spasms which commonly occur with cervical radiculopathy.

Figure 11. Ross Hauser, MD during the 2008 Ironman Lake Placid. A 4:20 marathon in the pouring rain after swimming 2.4 miles and cycling 112 miles in a downpour is pretty good for a 45 year-old who just a few months prior to this had full blown cervical radiculopathy.

Physical Therapy Approach to Cervical Radiculopathy

Chris Ferrigno, MS, PT

Cervical radiculopathy can be a severely debilitating condition which can be difficult to manage for both the patient and the health care provider. While a far less common malady than lumbar radiculopathy, cervical radiculopathy is widespread and a very common diagnosis treated within a physical therapy practice. Physical therapists have many treatment options focusing on treating both the symptoms and the underlying origin of the condition.

Historically, physical therapists have been trained to use physical modalities to provide a short term decrease of patient's symptoms. These modalities often include thermal agents such as hot packs, cold packs, or other physical agents like ultrasound, electrical stimulation, interferential current and iontophoresis, for pain control. I certainly see the benefit of using physical agents for pain control, especially with a patient who is experiencing acute, severe discomfort. However, there has recently been a shift in the approach many therapists take, including myself, to treat cervical radiculopathy. The focus for cervical radiculopathy is now centered more on the cause of symptoms rather than simply addressing symptoms themselves.

In 1932, Joel Goldthwait et al. wrote a marvelous description of posture and body mechanics relating to health and disease.[1] His writings were specific to the health of children, but his lessons were revolutionary, profound and very applicable to the approach that many physical therapists now take in treating cervical radiculopathy.[1] Goldthwait wrote, "Body mechanics may be defined as the mechanical correlation of various systems of the body with special reference to the skeletal, muscular and visceral systems and their neurological associations. Normal body mechanics may be said to obtain when this mechanical correlation is most favorable to the function of these systems."[1] In other words, deviate from the norm and problems will occur. Many cases of cervical radiculopathy are discogenic,[2] and occur because of an accumulation of mictotrauma to the cervical spine. To understand the physical therapist's approach to treating the cause of cervical radiculopathy, I would like to review discogenic pathology and discuss its relationship with posture and biomechanical deviations.

Discogenic pain results from either a bulge of a lower cervical disc in the posterior or posterolateral direction, migration of a disc or fragment, or from a herniation of the nucleus pulposis protruding through the annulus. The disc, while a highly stable structure, also has its breaking point, which is a crucial concept in understanding the progression of neck pain and cervical radiculopathy. In the case of the cervical spine, proper alignment is required for the optimal cervical disc environment. When improper forces are applied over a period of time, the disc degrades. In the case of poor posture, the most common postural deviation is the forward head posture.[3] (*See Figure 1.*) This posture, which has been directly correlated to neck disability[4] and pain,[5] applies increased forces to the anterior aspects of each lower cervical disc and decreased forces to the posterior aspect of the disc, thereby creating a pressure differential. This differential in pressure, when repeatedly applied over decades of life, can cause the nucleus of the disc to migrate posteriorly,[6] leading to the aforementioned bulge or herniation posteriorly.

Cervical radiculopathy and neck pain cases have been on the rise in my practice over the last few years. A quick anecdote might explain the reason for this increase:

As I was on an airplane a few months back, I was sitting slumped, staring at the mini screen of my MP3 player,

Figure 1. Forward head posture and slouching can be directly responsible for a person's neck pain.

and realized I was having a slight numbness in my thumb. I lifted my head, looked around the plane, and counted 34 passengers who were looking down at cell phones, MP3 players, and the countless other techie devices existing today, reading newspapers, and playing Soduku. (*See Figure 2.*) I envisioned the 34 poorly-postured passengers going to work the next day for 8-10 hours, logging on to the computer while placing a phone between an ear and shoulder, until they could return from work maybe via a train, like I do, where they would continue their barrage of texting, emailing, and song selection with their hand held devices, only to arrive home where they would spend the remainder of the evening on the sofa in front of the TV, laptop in hand, staring at the screen with forward head and shoulders, wondering who be the next person voted off the island or which couple lost the most weight, while updating their social network site and cleaning all the viruses off of their hard drive. Basically, many of these people would be spending 16+ hours of their day with a slumped, forward head posture, compressing both their lower cervical disc and opening up their neural foramen allowing spurs to form.

Yes, I know this was a bit of an exaggerated response, but I thought about my thumb numbness, and the pains and parasthesias of my patients, and realized that my approach to neck pain, which focuses on posture and mechanical treatment, was validated even more during the quick glance around the plane. I can give patients hot packs, home e-stim units, neck stretch exercises, mobilizations, and soft tissue massages, but unless the stimulus of their disorder was addressed, their condition was not going to be corrected in the long term.

Figure 2. Poor posture throughout the day can cause many issues including cervical radiculopathy.

Clinicians can address patient's posture and biomechanical deviations in a variety of ways. In order to promote improved alignment in all spinal segments, I start with instructing patients on proper pelvic positioning moving up through the lumbar and thoracic spine. I teach patients which surfaces are good for sitting, including firmer surfaces and chairs which fit their body geometry. I discuss how to properly position themselves in the appropriate chair as well as how to position themselves within their workstations, whether at home or at the job. (*See Figure 3.*) I then look at various ways to enhance scapular stabilization, which will provide a solid base for the cervical spine. This is achieved by having patients work the stabilizing muscles such as serratus anterior, middle and lower trapezius, rhomboids, and latissimus dorsi. After the patient has a comprehensive understanding of how to effectively contract these muscles, then additional exercises are issued to combine scapular stabilization with cervical retraction with everyday arm movements, such as reaching overhead, carrying their briefcase, or simulating typing at their desk.

After the lumbar, thoracic, and scapular positions have been addressed, the cervical spine is managed through the use of a mechanical approach involving cervical retraction. This movement, if performed properly, will decrease lower cervical spine flexion and upper cervical extension, both of which occur in forward head positioning. As lower cervical flexion decreases, the pressure on the anterior aspect of the lower cervical disc decreases. This results in even disc pressure—the best environment for the disc.

While cervical retraction is an exercise to progress and promote proper posture, it also can be used as both a palliative and therapeutic exercise to directly and immediately address the patient's pain. An important concept of cervical retraction is taking the movement to the end range of that movement. (*See Figure 4.*) The exercise may be done in sitting, supine or even prone, depending on the patient's response during a thorough evaluation. End range movement is crucial to initiate pain centralization. By retracting the cervical spine, pressure is place on the posterior aspect of the cervical disc. With repeated movements at end range, the disc has the potential to creep anteriorly and take pressure off the irritated nerve.[7,8] Cervical retraction exercises can also be coupled with cervical extension at some point during the treatment so as to provide increased force from

Figure 3. Patients are taught appropriate posture and positioning while sitting.

Figure 4. Cervical retraction taken to the end-range of the movement.

posterior to anterior on the cervical spine. (*See Figure 5.*) The upper thoracic and upper cervical spine would also be addressed, to reduce the stresses in the affected lower cervical spine. With significant repetition and progression of force on the disc (using all of the mentioned methods), centralization of symptoms can occur,[9] resting cervical posture can improve,[9] and the chance of reoccurrence of symptoms can be reduced.[8,10,11]

CASE STUDY #1

A 52 year-old, female attorney came in with complaints of right arm pain, which was medically diagnosed from the referring physician as cervical radiculopathy. This patient reported a 50% reduction of symptoms from cervical ESI (epidural steroid injection). She presented with C6 dermatomal pain, with intermittently severe symptoms. Following a mechanical evaluation, which initially exacerbated her symptoms, the patient was instructed on cervical retraction exercises to perform every two hours during waking hours. The patient returned one week later for follow up with slight pain in the upper arm and neck only. The patient was reinstructed on the retraction exercise, and in the clinic the patient was able to abolish her radicular symptoms and had moderate axial pain. During that visit, the retraction movement was changed slightly in order to emphasize a higher degree of end-range movement. On second follow-up, another week later, the patient reported no significant pain with an occasional axial aching pain.

CASE STUDY #2

A 48 year-old, male restaurateur presented to physical therapy with significant, nearly constant right upper trap and right lower humeral pain, and intermittent pain into his right thumb. The patient could easily turn on and off his thumb pain when sitting at work by simply changing the chair at his desk, and found significant relief sleeping in a foldable beach lounger. During mechanical evaluation, the patient's symptoms were exacerbated with end-range cervical retraction. By the end of evaluation, the patient could tolerate a movement approximately 25% of his end-range movement. The patient required a total of six visits, required various posture changes, including changing the position in which the patient performed his exercises, from supine, to prone, to sitting.

In summary, the treatment of cervical radiculopathy requires considerable attention to the patient's posture and body mechanics. Clinicians need to make the patient aware that they can manage their condition with a few basic movement principles which include a well-performed cervical retraction coupled with cervical extension motion. (*See Figure 6.*) While not all patients respond to mechanical treatment, which usually includes cervical retraction, cervical and thoracic extension, and posture education, most patients are successful in significantly reducing their peripheral and central symptoms. ■

Figure 5. Cervical retraction coupled with cervical extension.

Figure 6. A well-performed cervical self-retraction.

CONCLUSION

Cervical radiculopathy, though a serious and disabling painful condition, can often be treated conservatively. At times, Prolotherapy, nerve blocks, chiropractic, osteopathy or physical therapy alone can resolve the condition, sometimes a combination of approaches will be needed. While the person is getting treated, close monitoring by the clinicians is necessary to ensure the condition is resolving. With proper care non-operative treatment of cervical radiculopathy is not only effective but recommended, in these authors' clinical experience. ■

* In a future JOP article we will also present the osteopathic approach to cervical radiculopathy.

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TEACHING TECHNIQUES

Prolotherapy Under C-Arm Fluoroscopy

Christopher J. Centeno, MD

Interventional pain management traditionally has focused on the use of C-arm fluoroscopy to inject the spine. Fluoroscopy is a real time X-ray designed to allow the physician to guide a needle into a specific location. (*See Figure 1.*) While Prolotherapy has been performed without the use of imaging guidance, our training in pain management lent itself to using this technology for certain Prolotherapy techniques.

Like many physicians practicing regenerative medicine, our interest in Prolotherapy began because of our general dissatisfaction with the results of injecting steroids. In addition, we were also concerned about the body of literature that demonstrated that injecting high dose steroids (milligram range) could lead to problems in the joint.[1-5] This phenomenon, known as apoptosis, means that these medications can shut down all normal repair and maintenance functions in the joint for months, ultimately leading to a less swollen, but more degenerated joint.[3] In addition, high dose corticosteroids have also been shown to cause other issues such as systemic side effects and even catastrophic illnesses such as osteonecrosis.[6]

> ***Osteonecrosis*** – *Loss of blood supply to bone leading to the death of bone tissue.*

One solution to this problem is simple, inject much less steroid. In lower concentrations (nanogram range), corticosteroids can have a net positive joint impact (by up regulating TGF-beta production and moving mesenchymal stem cells toward chondrogenic differentiation).[7] Despite this modification of the steroid injection, our practice began looking for better options. While Prolotherapy has been considered by some to be controversial, the data supporting the use of hyper-osmolar agents in injection therapy (the medication used in most Prolotherapy solutions) is as good as many of the techniques and procedures used every day in interventional pain management. This led our group to consider combining the use of proliferant injections with our core competency of interventional pain management (driving needles under X-ray).

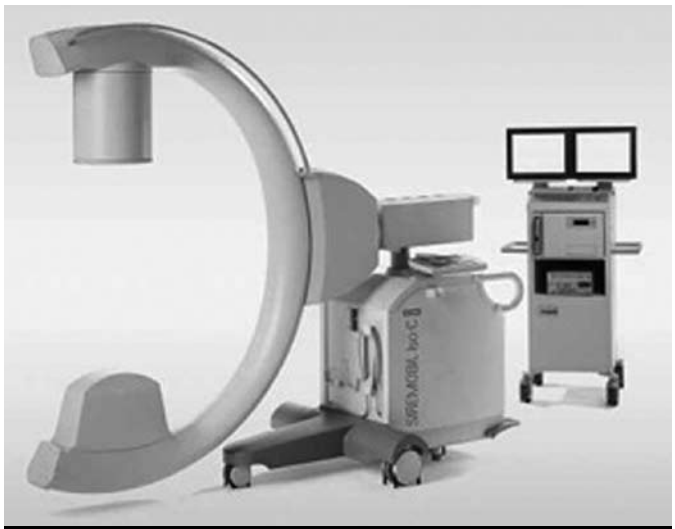

Figure 1. C-arm fluoroscope that allows accurate guidance of a needle to a specific location.

C-arm fluoroscopy has been used for many years for needle guidance. Its advantage over fixed radiography (usual X-ray techniques performed in a hospital) is 360 degree coverage of any area to be injected and its ability to show live imaging. Its disadvantage is radiation exposure. However, the average radiation exposure during fluoroscopy is on the order of 5-10 cross country plane flights (where the high altitude exposes us to X-ray radiation from the sun).

The C-arm is commonly used with the image intensifier (I.I.) superior and the X-ray generator inferior or under the table. The standard lexicon of C-arm positioning uses many familiar terms from standard radiography with additional language to cover dynamic positioning of the beam. This includes AP, lateral, and oblique, but adds in C-arm motion terms which include orbital rotation (moving the C-arm around a fixed target, also called oblique), cephalad tilt (tilting the I.I. toward the

head), caudal tilt (tilting the I.I. toward the feet), and the concept of "wig-wag" or moving the C-arm from a fixed point at the connection of the "C" to the machine in an angle cephalad to caudal (for a prone lying patient) or vice versa. (*See Figure 2.*)

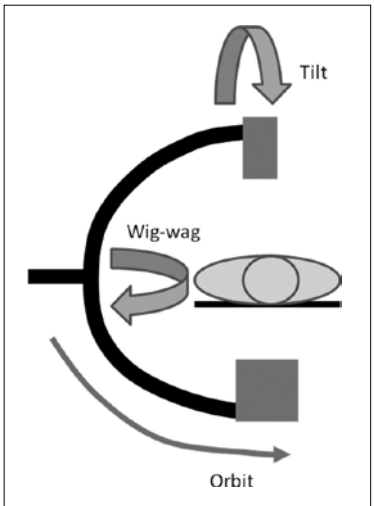

Figure 2. C-arm movements.

The needle is usually imaged "down the beam" (looking down the hub of the needle). The needle can also be imaged "off axis" (looking at the length of the needle at an angle). Two images are often used to confirm final needle placement, such as AP and lateral. This is known as "bi-planar" imaging. In addition, radiographic contrast agents are always used to confirm dye flow (these are substances that show up on X-ray as dark, so that the physician knows where the medication will flow). I have heard experienced radiographic technicians refer to this as "the dye doesn't lie", meaning that correct placement of the medication is always determined by dye flow in the target space, such as intraarticular. Thus, it's imperative to not only learn how to place the needle safely and accurately, but also to learn the correct dye flow pattern for each area injected.

ACCESSING INTRAARTICULAR LIGAMENTS WITH FLUOROSCOPY

Ligaments are the duct tape of the body. They help hold bones and joints together. Several joints in the body have important ligaments inside the joint. These include the C0-C1 facet joint (top neck joint just below the skull), the knee, and the sacro-iliac joint (joint between the back of the hip and tailbone). Many of these ligaments serve important stability functions like the cruciates in the knee or serve as "last resort" attachments to prevent catastrophic failure, like the interosseous ligaments inside the SI joint. The upper cervical ligaments are unique in that they seem to serve both functions.[8-11]

The C0-C1 facet is a joint about the size of a large finger joint. (*See Figure 3.*) There are actually 7 neck facet joints on each side. These can be commonly injured in a rear

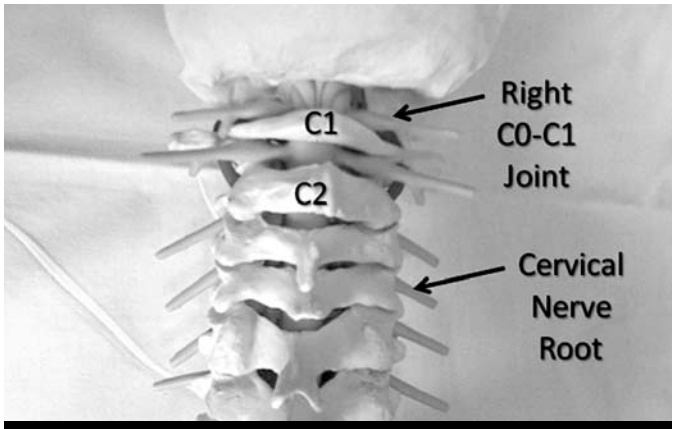

Figure 3. Diagram of C0-C1 joint location.

end or other type of car crash.[12] The upper neck joints tend to be injured along with the ligaments that hold the head on.[13] These important ligaments include the alar, transverse, and accessory. Like other ligaments, when they are injured, they often fail to heal. The alar ligament courses through a part of the C0-C1 facet joint, so they are commonly injured together. Symptoms from this type of injury can include headaches, dizziness, disorientation, and pain at the base of the skull into the neck. Numbness and tingling in the extremities can also be present.

INJECTING THE C0-C1 JOINT

The C0-C1 joint is a good example of a joint that very difficult to access reliably without imaging guidance. (*See Figure 4.*) The vertebral artery runs close to the joint and its location anterior to the spinal cord makes injecting the joint blind a challenge. However, the medial joint also houses a portion of the alar ligament, which is an important ligament as discussed above.[13]

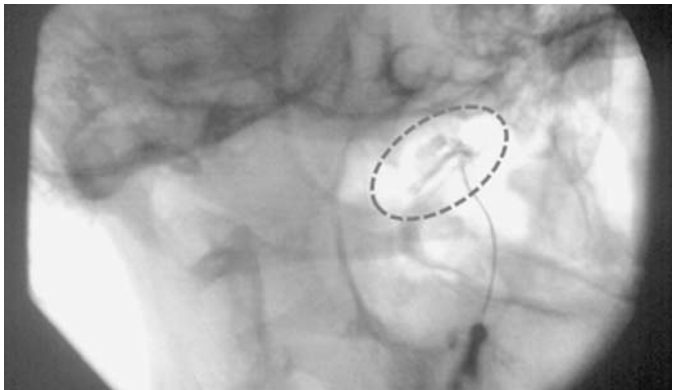

Figure 4. Contrast flow inside the C0-C1 joint. Note the needle entering the joint from below. Contrast flow is oblique along the joint line (dashed circle).

Why inject this joint to get to the alar ligament at all? Despite some minor risks, in the hands of an experienced interventionalist, complications are very rare. Our own practice has injected hundreds of C0-C1 joints without incident. In addition, my own clinical experience shows that patients with alar ligament stretch and sub failure injuries are miserable. Because the ligamentous checks to upper cervical stability are lost, the upper cervical muscles and trapezii go into overdrive, trying to act as stabilizers. This leads to significant neck, shoulder, and upper back pain. While surgical fusion is an option, the surgery has a high complication and mortality rate.[14] As a result, stiffening and initiating even a small repair response in the ligament can lead to dramatic benefits for the patient.

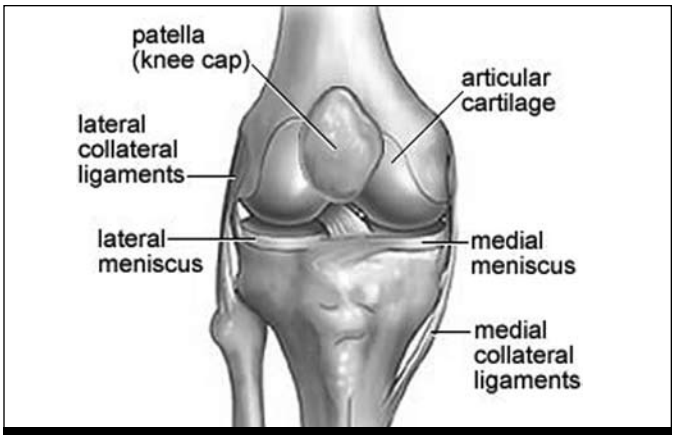

Figure 5. Right knee joint anatomy.

KNEE JOINT INJECTIONS

Traditional Prolotherapy injections for the knee usually involve injecting many tender sites around the knee including the collateral ligaments, pes anserine bursa area, or the knee cap. These parts of the knee anatomy can be injected without injecting inside the joint. However, if injection inside the joint is needed to treat a lax ACL as in the techniques described by Reeves, then being "in the joint" becomes important.[15,16] The knee would seem to be a simple joint to inject. However, when this assertion has been tested to see determine the accuracy of blind injections, different studies obtain different results. Lopes determined that blind injection of various peripheral joints of rheumatoid arthritis patients has an accuracy of 77-100%.[17] Toda further characterized accuracy as between 55-100% depending on the severity of the osteoarthritis.[18] Esenyel reported even lower accuracy, with only 56-85% of the injections getting the medicine in the joint, depending on the side of the anterior injection portal (medial or lateral).

Even if the practitioner can approach 100% accuracy, newer regenerative medicine techniques (more on this later) will require more accurate placement of cells or agents in specific parts of the joint (such as into the meniscal tissue, LCL, ACL, or medial chondral surface). In addition, even sclerosants have been determined to have much greater action at their initial injection site with declining effects as the distance from the site increases. We have developed many techniques depending on the structures being treated.

The knee has many parts. (*See Figure 5.*) The long bone of the thigh (femur) has its ends (the top part of the knee joint), covered with cartilage (called articular or chondral cartilage). This surface can commonly be injured and develop a "pot hole" in the cartilage which is also called an OCD (osteochondral defect). The meniscus acts as the shock absorber tissues between the femur and tibia bone. Finally, there are cruciate ligaments in the middle of the knee that hold the two bones together in a front back direction and collateral ligaments on the inside/outside of the knee that hold it together in the side to side direction.

The knee articular surfaces are easily injected with the knee flexed about 90 degrees. This position brings the weight bearing surface anterior. A lateral knee view is then developed on the C-arm, with both chrondral surfaces aligned by adjusting wig-wag. (*See Figure 6.*) The injection

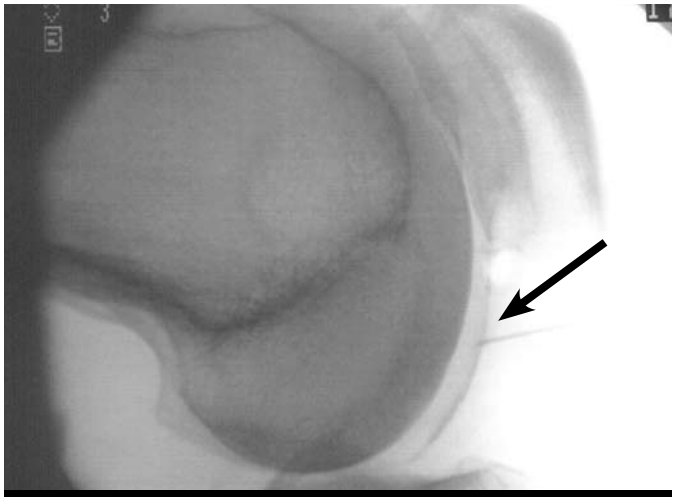

Figure 6. Anterior needle placement just lateral to the patella and directed perpendicular to the chondral surfaces. Note the contrast flow along the weight bearing chondral surface of the femur.

is begun just lateral or medial to the patella and directed toward the palpable chondral surface. Once the cartilage is lightly struck, the needle is pulled back slightly and a loss of resistance technique is used to ensure maximum chondral flow of contrast and injectate. This injection can be done in most patients with just a 27 gauge 1.5 inch or a 25 gauge 2 inch needle.

Injecting the knee through the usual anterior medial and lateral ports just inferior to the patella will usually result in more medial flow of contrast in the joint. (*See Figure 7.*) This approach is therefore preferred for access to the ACL and PCL. Fluoro also allows the ability to determine dye flow into the ACL or PCL once the sheath is penetrated.

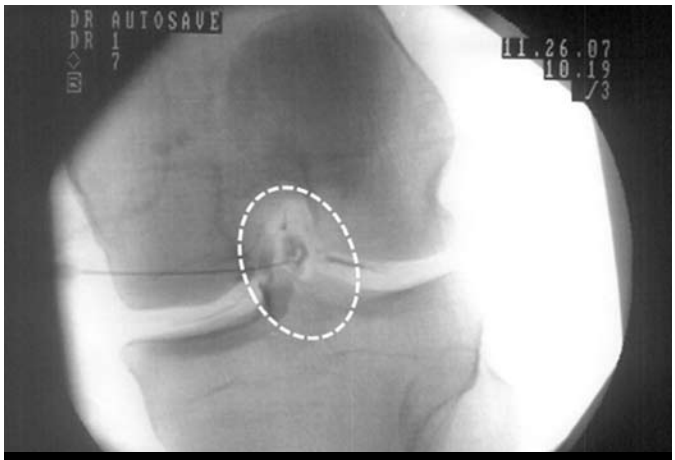

Figure 7. Typical anterior medial or lateral injection ports more likely to produce mid-line flow of contrast and medication to treat ACL/PCL.

In summary, depending on where the effect is desired, using C-arm guidance allows the physician to place the medication in the right spot. (*See Figure 8.*) As discussed, treating the "potholes" (OCD's) in the articular cartilage requires a different approach than treating the ligaments (ACL or PCL) in the middle of the knee.

Figure 8. Sunrise view fluoroscopy for patella-femoral injection.

INTRAARTICULAR SI JOINT INJECTION

SI joint pain is present in between 18.5-30% of patients presenting with chronic low back pain.[19-24] Laxity in this joint has been also associated with back pain.[25-27] SI joint symptoms include pain in the back of the hip (PSIS area) often with pain in the groin and down the front of the thigh. Various SI joint ligaments can also mimic referred pain down the leg and into the foot. The "Fortin finger test" is usually present where the patient points to the PSIS area as the point of maximum pain.

The SI joint is another example of a joint with a strong ligament inside (interosseous). The joint is not perilous to access blindly, but very difficult to do so with any reliability. As an example, as an experienced interventionalist, the number of physicians able to access the joint and obtain good intraarticular flow even with fluoroscopic guidance is small.[28] While many believe they can access the joint without imaging, in cadaver courses where we have tested this ability, a large number of attempts fail to establish convincing flow of contrast within the confines of the joint.

The starting point on the skin for injecting the SI joint is usually the bottom of the sacrum. The needle is inserted under fluoroscopy guidance. From this point, our technique for SI joint injection under fluoroscopy differs from those usually described. We enter the lower part of the SI joint similar to other techniques, but recognize that the SI joint is a potential space. As a result, a 22 gauge needle 3.5 inch quinke is used (over a 25 gauge needle) to dilate the lower portion of the joint. The fluoroscope beam is tilted cephald so that the lower portion of the joint can be imaged with the beam "looking down" the lower joint. As with any other technique, more time is spent with image prep than injection. The C-arm is orbited back and forth such that both sides of the lower joint are crisp. This injection technique relies on the idea that small changes in the depth of the injection can lead to dramatic improvement in contrast flow. (*See Figure 9.*) As a result, the needle is inserted into the joint lucency until "articular slide" is appreciated. This is a tactile feel whereby the needle starts to slide or glide as

Figure 9. Contrast flow within the left SI joint. Note the medial and lateral visible joint lines.

if between two lubricated joint surfaces. Once the needle has been inserted approximated 1-2 cm into the joint, the injectionist attempts to inject contrast under only light to moderate pressure. Usually no immediate contrast flow will be detected in the joint (in my experience less than 10-20% of the time) and the plunger of the needle will fail to budge. To reduce fluoroscope exposure, the needle is then very slowly extracted while the injectionist turns his or her attention from the fluoroscope screen to the syringe. Without any imaging, while the needle is very slowly extracted, the physician continues to apply light to moderate pressure to the plunger. Once a significant loss of resistance is seen in the syringe, the physician injects ¼ cc of contrast and checks the fluoroscope image. If an arthrogram is not detected, the needle continues to be slowly withdrawn until one is detected or the needle needs to be reinserted for a second pass. Please realize that the needle extraction occurs millimeter by millimeter as often flow will be obtained at a very specific point (for instance at 6 mm of extraction but not until this exact point has been reached). As a result, think of this technique as similar to other loss of resistance techniques.

Why does this technique work? The SI joint is a very tortuous joint that is different in most patients.[4] As a result, the needle often ends up against cartilage or bone and is unable to transmit contrast into the joint. In addition, as the needle is extracted, it can be freed of local impediments to flow yet remains in the joint capsule. Our group has also had great success with the same technique applied to cervical facet injections. Again, here as with the SI technique, the needle often remains in the capsule but actually leaves the space between joint surfaces.

We have found that many patients, who fail to respond to injecting the SI joint ligaments using the traditional Prolotherapy techniques described by Hackett, often get relief with this X-ray guided technique. These are usually patients with more severe instability that involves damage to the interosseous ligaments.

CONFIRMING TENDON ORIGINS/INSERTIONS BY IMAGING THEIR BONY LANDMARKS

Muscles move our joints. To do that, they need a place on the bone to anchor (origin) and a place to attach (insertion). Many of the original Hackett points for Prolotherapy involved injecting tendon origins or insertions (enthesis). While many of these are easily accessible, I have found fluoroscopy very helpful for imaging deeper landmarks where incorrect needle position could cause unintended injury. While many of these areas can be easily accessed in thin patients, obese or heavily muscled subjects can be difficult to accurately inject. I have outlined three areas where I have seen fluoroscopy improve clinical outcomes:

1. Adductor origin at the ischial tuberosity
2. Rib origin/insertions of paraspinal muscles
3. Superior labral attachment of the biceps tendon

ADDUCTOR ORIGIN AT THE ISCHIAL TUBEROSITY

Enthesopathy of the adductor origin is a common problem in athletes. Enthesopathy means that the area where a muscle or tendon attaches to bone is being overloaded (which leads to chronic swelling at that attachment site). Our own clinical experience shows it's also common in patients with chronic SI instability and those with upper lumbar radiculitis. Early clinical data has shown Prolotherapy to be effective for this condition.[29] Patients with this problem often have significant groin pain that may extend to the inside of the knee.

The adductor muscle is illustrated in *Figure 10*. Note how the muscle originates from the groin area and travels down toward the inside of the upper thigh and knee. In *Figure 11*, the areas of attachment of the various muscles of the adductor complex are illustrated. The adductor group origin including the magnus, longus, and brevis as well as the garcilis can be injected at the tuberosity of the ishium. However, a stray needle in a heavy patient could also end up injuring many structures in the perineum or bladder. As a result, we utilize a contralateral oblique

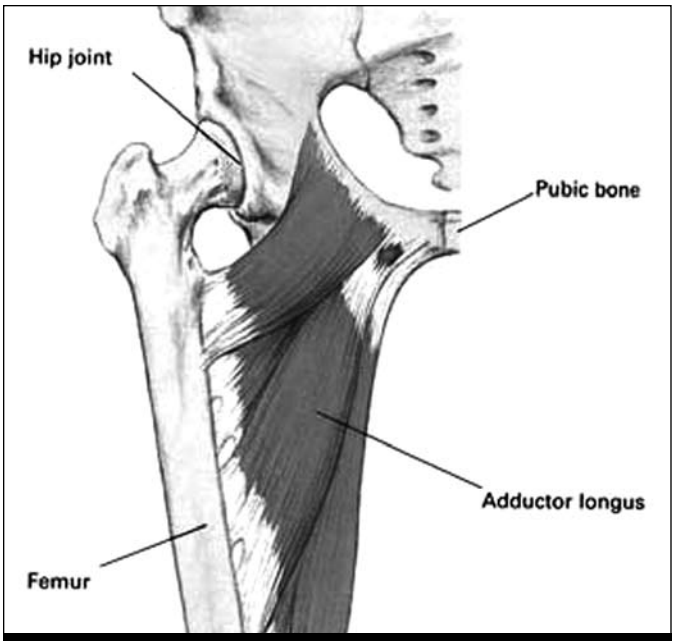

Figure 10. Adductor muscle complex.

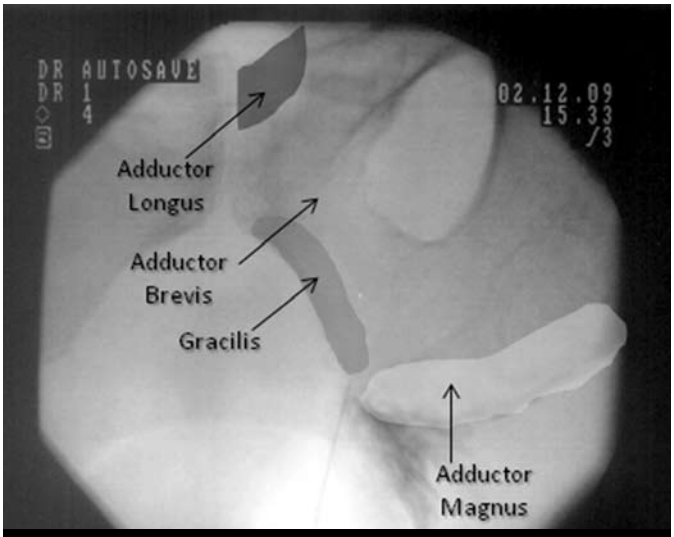

Figure 11. The attachments of the adductor group of muscles on the left ischial tuberosity with a needle shown injecting contrast and medication into the adductor magnus attachment.

angle on the C-arm and use manual pressure to find the bony prominence of the tuberosity in the A-P plane. The patient is positioned supine on a fluoroscopy table with the hip to be injected slightly abducted. By flipping between a contralateral oblique and an AP view, we obtain easy bi-planar imaging to guide the needle to its bony target without posterior overshoot. *Figure 11* also shows an AP demonstrating dye flow in the origin of the adductor magnus and gracilis. Note that the pubic symphysis is easy visible on an AP view and can be injected as well. *Figure 12* shows a contralateral oblique of the same injection site, where the C-arm is approximately at 35 degrees of rotation opposite to the side injected. Note the fact that the ischial tuberosity is seen "on end" in this projection.

RIB TENDON ORIGIN/INSERTION INJECTION

We see many patients with rib related pain after car crashes, as a result of surgeries where the ribs have been manipulated, or due to scoliosis. The pain is usually along the rib and can travel along its course. While many of these pain syndromes are due to enthesopathy, many are misdiagnosed as costochondritis. *Figure 13* shows just a few of the attachment points of the muscles to the rib cage.

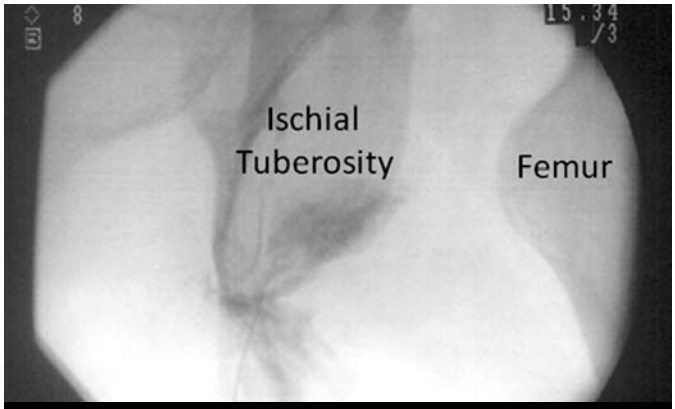

Figure 12. A left contralateral oblique of the right ischial tuberosity showing it "on end" with a needle touching bone at the inferior end of the tuberosity.

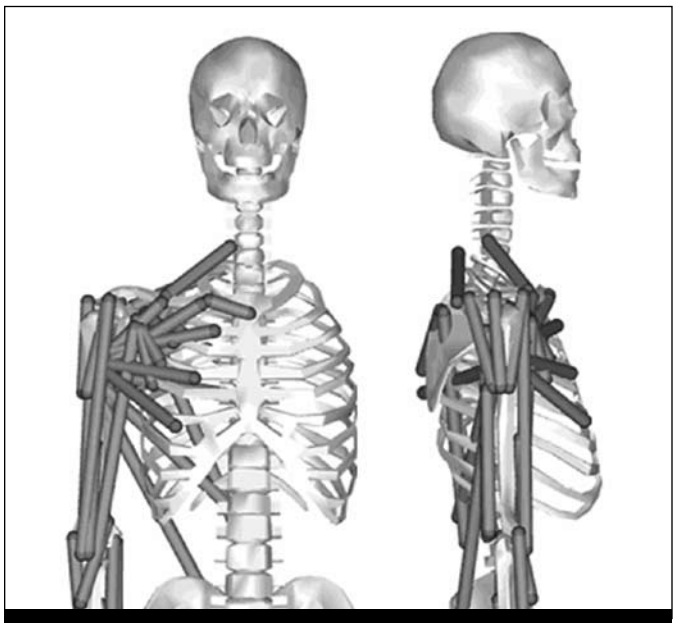

Figure 13. Attachment sites of muscles to the rib cage.

Injecting painful areas of enthesopathy from paraspinal muscles that insert on the ribs can be a very successful treatment for many patients with chronic upper back and rib pain. However, in patients who are obese, the fear of lung puncture with resultant pneumothorax has driven me to utilize AP fluoroscopy. *Figure 14* shows that in AP view, the ribs are easily visible. As the injection site moves more lateral along the rib, I usually add ipsilateral oblique to ensure that the target rib is easily visible so that the needle direction is horizontal to the direction of the beam. Points along the anterior chest can be similarly imaged if needed. In addition, points along the mid-axillary line require the patient to be side lying and the beam to be positioned AP. Finally, with AP fluoroscopy, the ligaments attaching the rib to the transverse process can be easily and safely injected.

Figure 14. An AP of the thorax showing easily visible ribs and a needle "touching down" on the medial aspect of the right 4th rib.

SUPERIOR ATTACHMENT OF THE BICEPS TENDON TO THE LABRUM-SLAP TEARS

The biceps muscle attaches itself to the top of the shoulder joint (superior labrum), where it can become torn. Most patients have pain with lifting the shoulder forward, made worse by a palm up maneuver where the biceps tendon is stressed. *Figure 15* shows the glenoid fossa (the socket part of the ball and socket joint of the shoulder) looking into the joint. The SLAP tear is shown at the superior (top) part of the labrum. The best way to visualize the labrum is that it's the lip around the socket where the ball of the shoulder joints fits. A sudden shift of the ball in this socket joint can injure this fibro-cartilage lip (labrum).

Many different types of tears to this attachment have been described.[30] Type 1 is by far the most prevalent,

Figure 15. Tear of the superior labrum.

which involves a non-displaced fraying or injury to the biceps attachment and is often associated with rotator cuff tears. While our surgical colleagues commonly debride these under arthroscopy, we have had good success with Prolotherapy injections at the attachment using fluoroscopy to identify the target area. While types 2-4 which involve more detachment may be more difficult to treat, we have also seen some success with these cases as well.

Setting up this injection involves knowledge that the glenoid fossa faces anterior. As such, an ipsilateral oblique will show the labrum as a clock face. (*See Figure 16.*) The needle is then directed toward the outer rim of the

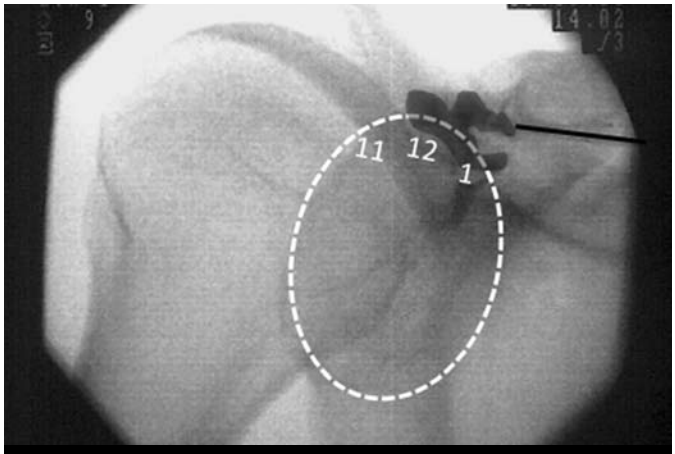

Figure 16. An ipsilateral oblique of the left shoulder showing the glenoid fossa as a clock face (outlined in the dashed circle). The injection targets for most SLAP tears are the 11am-1pm positions. This is an off-axis view.

glenoid labrum from the 11-1 o'clock positions. This area can be injected with contrast to confirm flow along the more proximal biceps tendon origin. Flow can also be demonstrated along the more distal biceps tendon as seen in *Figure 17*.

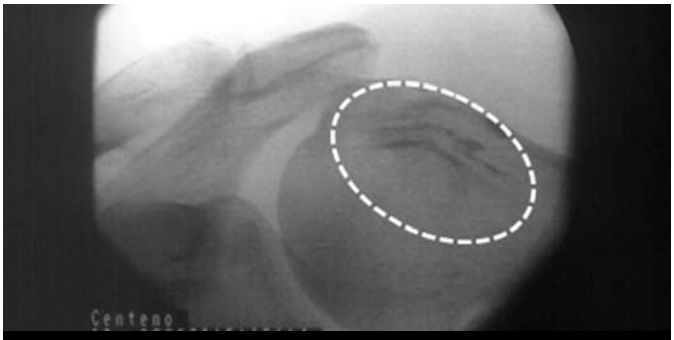

Figure 17. A right shoulder AP showing the dye flow along the right biceps tendon as it traverses just lateral to the greater tuberosity in the biceps groove of the humerus.

THE CERVICAL SPINE-MAKING YOUR LIFE EASIER

Cervical ligament injuries are common in car crash victims who have been diagnosed with "whiplash."[10,13, 31-37] While this catch all, pejorative term doesn't allow for this more specific diagnosis, we have seen dramatic results from patients who have been treated with cervical Prolotherapy. These patients commonly have instability symptoms like popping and cracking in the neck. Often times these sounds cause pain.

I remember the first time an experienced Prolotherapist showed me her injection technique for the cervical spine. She flexed the neck over a chest pillow and had the patient bring the chin to the chest to bring the spinous processes (SP's) more superficial. She then proceeded to use what I called the "hunt and peck" technique, trying to find the cervical SP's. This worked for this experienced practitioner, but the first time I attempted this in the office, I was likely injecting far too superficial to make a difference (out of fear of placing the needle into the epidural space or worse). After attending a scientific conference where an experienced interventional pain physician described a cervical cord injury and resultant quadriplegia from a blind trigger point injection with a 1.5 inch needle, I became even more concerned. While I have safely injected the supraspinous and interspinous ligaments in this area without fluoro, I have recently adopted a technique for use in larger patients that has improved the coverage of these ligaments.

The patient is positioned prone on a fluoroscopy table. The C-arm beam is lateral so that the SP's are easily visible. Manual palpation is then used (as in the original Hackett technique) and the needle position remains midline, but the lateral X-ray image is used to guide the needle to the posterior aspect of spinous process. (*See Figure 18*.) I find that while my blind technique might have me injecting 3-4 of the 7 SP's available to treat, with this fluoroscopy procedure I can now safely inject all of his SP's. I can also specifically target the SP's associated with laxity in flexion on flexion-extension views or Digital Motion X-ray (DMX). In addition, note that in *Figure 19*, the dashed line represents the ligamentum flavum which should not be penetrated. This also allows the Prolotherapist to get deeper coverage of the interspinous ligament, without fear of an epidural or intra-dural injection.

Figure 18. The injection technique for injecting cervical interspinous and supraspinous ligaments under fluoroscopy. The patient is shown prone and the needle is inserted posterior in the midline with the fluoroscopy unit in lateral view.

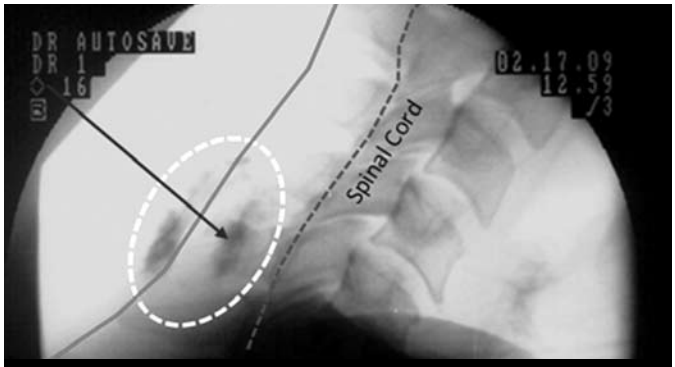

Figure 19. A lateral view c-spine showing the needle position enhanced by the black arrow and the level of the supraspinous ligament denoted by the gray line. The dashed line represents the level of the ligamentum flavum, which should not be penetrated by the advancing needle.

Does the traditional Hackett technique of injecting the supraspinous and interspinous ligaments help cervical instability? Several years ago we tested this theory by measuring cervical translational instability as in *Figure 20*. We used cervical flexion-extension views where the film reader was blinded to which films were pre or post Prolotherapy. Our study showed significant decreases in cervical flexion translation after treatment, but not for translation in extension.[38] This made sense, as only the checks to flexion were treated (supraspinous and interspinous ligaments) and not the checks to extension (anterior longitudinal ligament).

The patient is set up identically as above, and palpation is still used to confirm mid-line and start needle placement. An AP with a cephalic tilt can also be used to confirm that the needle is midline. Contrast can also be used to identify the location of the posterior atlanto-occipital membrane (PAOM) without injecting intra-dural or epidural. If contrast is detected anterior to the line of the PAOM in the epidural space, no injection of proliferant is undertaken (anterior to the dashed line in *Figure 20*). Since the rectus capitus posterior minor may be an important muscle in headache generation due to its attachment to the dura, injecting these sub occipital muscle attachments is clinically important.[39-42] This same injection technique can also be used to inject deeper sub occipital and cervical muscles (rectus capitus posterior major and minor) that attach at the skull base while confirming that the needle placement is not near the foramen magnum.

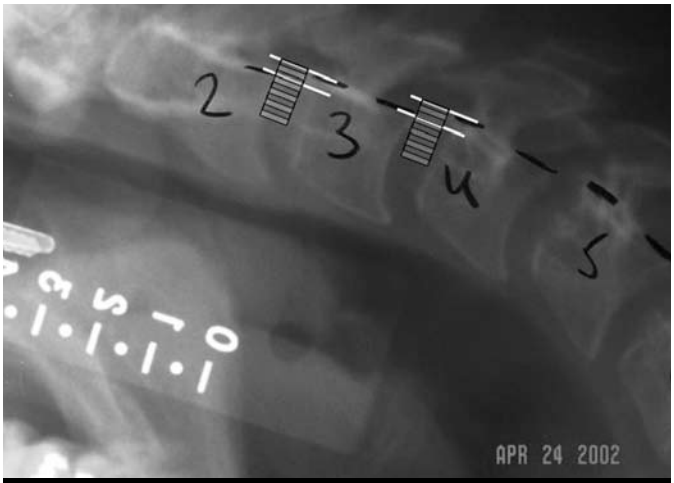

Figure 20. Cervical translation measured in mm (shown as vertical marks). Note the radiographic ruler in the field (lower left) which is used to benchmark the 1 cm distance at this magnification. There is 2-3 mm of anterolisthesis of C2 on C3 and 3-4 mm at C3 on C4.

This lateral fluoroscopy technique has also opened up a new area of injection. The posterior aspect of C2 is easily injected blind in thin patients, but heavier patients rarely have this area injected. This site is not only the attachment of the nuchal ligament, but also of many smaller sub occipital muscles prone to enthesopathy. The posterior aspect of C1 is another example of a bony landmark tied into this rich area of ligamentous stability for the upper neck, being attached to the posterior atlanto-occipital membrane (an extension of the ligamentum flavum that reaches into the posterior aspect of the foramen magnum) as well as the ligamentum nuchae. (*See Figure 21.*) Again, because of the risk of injury to the patient, rarely is the posterior aspect of C1 injected. However, a lateral fluoroscopy view makes these areas safely accessible.

NEEDLE DRIVING SKILLS

Driving long needles under fluoroscopy is harder than it looks. The first several dozen times it will prove more difficult than blind injections and anatomical orientation as well as recognition of bony landmarks will prove difficult. However, once learned, the skills developed are

Figure 21. Cervical lateral view showing contrast in the area of the nuchal ligament (posterior to C1). Note the contrast also in the supraspinous ligament of the C2-C3 vertebra (dashed black circle). The dashed line represents the level of the ligamentum flavum and then the posterior atlanto-occipital membrane from C1-C0.

invaluable. Our group believes that medicine is on the verge of a great renaissance in regenerative injection therapy that will require the accurate placement of growth factors, stem cells, and other agents. In our practice, we have demonstrated MRI evidence of repair of various musculoskeletal tissues with accurate placement of mesenchymal stem cells (MSC) into peripheral joints.[43,44] We have also observed regeneration of the posterior disc annulus with reduction in disc bulge size as well as the healing of chronic fracture non-union using highly accurate placement of MSC's under C-arm guidance. (*See Figures 22 & 23*.) These new autologous cell based procedures have allowed us to add a state of the art cell biology facility to our practice. This is important to note as it represents what I call "Prolotherapy 2.0 and 3.0". Regardless of the injectate, whether it be autologous cells, off the shelf cells, autologous or recombinant growth factors, or biologic scaffolding, the need for accurate placement of these substances will be more important. While fluoroscopy will eventually be replaced by newer high-frequency, low-intensity computer enhanced radiography, "needle driving" skills to make these regenerative medicine techniques successful will be in high demand. As a result, I would encourage all Prolotherapists who are early in their careers and amenable to learning a new skill set to consider interventional pain training. While ultrasonography has some advantages over C-arm including the ability to better visualize soft tissues and avoiding ionizing radiation exposure, as discussed above, the next generation of high frequency X-ray technology will solve these issues, making this high frequency fluoroscopy the future needle guidance tool of choice for most deep injection applications. Groups such as The International Spinal Injection Society (www.spinalinjection.com) and the American Society of Interventional Pain Physicians (www.asipp.org) offer excellent course work and certification programs. We are also happy to help in educating Prolotherapists who have taken this formal training, further hone their needle driving skills. ■

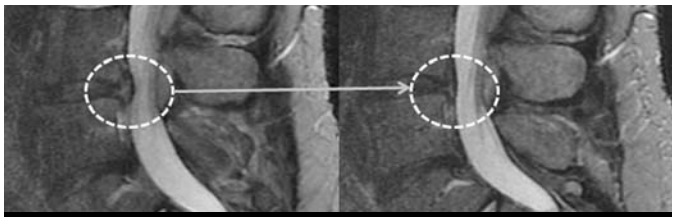

Figure 22. L4-L5 sub-ligamentous disc extrusion before and 3 months after placement of autologous MSC's in the disc via fluoroscopy.

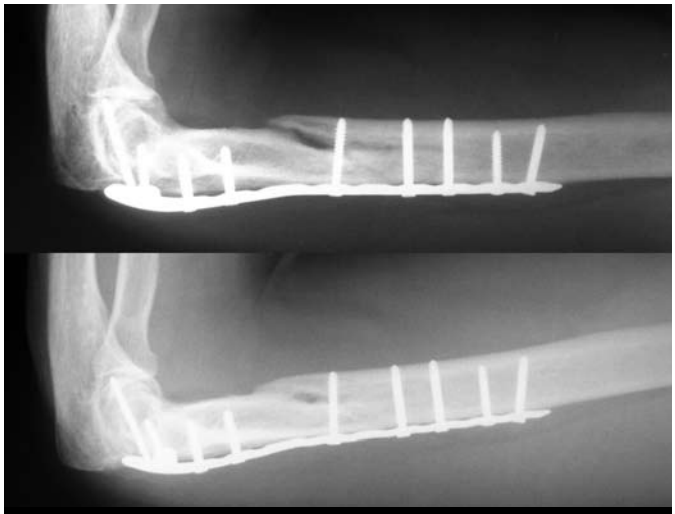

Figure 23. 38 yo white female smoker s/p ORIF for distal humerus fracture who failed a bone stimulator and was treated with percutaneously implanted MSC's into the fracture line. Five week post-op film on bottom showing healed fracture.

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TEACHING TECHNIQUES

Shoulder Prolotherapy Injection Technique

Rodney S. Van Pelt, MD

As with other joints in the body, Prolotherapy is routinely the preferred treatment option for chronic shoulder pain/injury. Prolotherapy can be used successfully for treating most chronic injuries of the shoulder including rotator cuff injuries and tears, arthritis, sprains, and AC separation. Prolotherapy is 85-90% successful in stimulating healing of the injured shoulder.

The initial step, of course, is to establish the diagnosis. Knowing what is injured is essential to treating it properly. We use a combination of history, physical exam (active and passive movements and palpation), and when necessary, imaging studies. A thorough knowledge of the anatomy of the shoulder is crucial to proper diagnosis and treatment with Prolotherapy. (*See Figure 1.*)

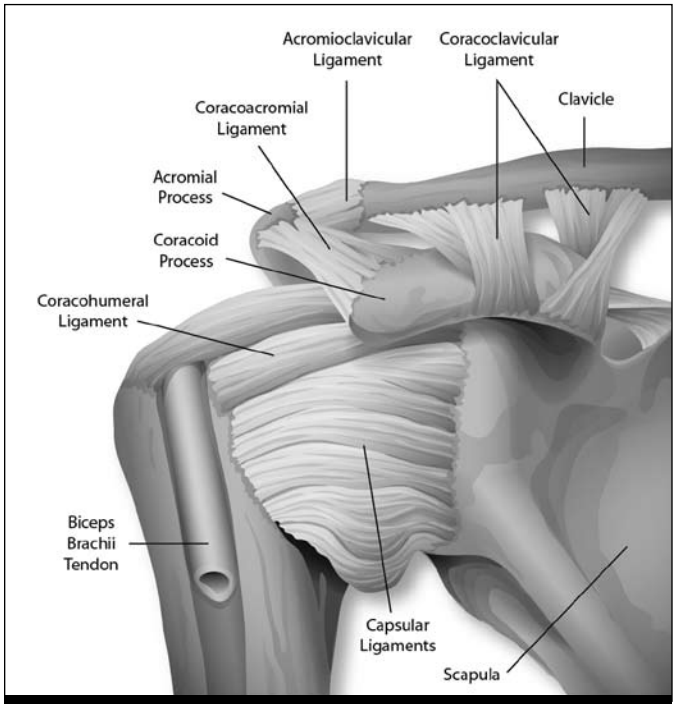

Figure 1. Anatomy illustration of the shoulder.

I have the patient expose the shoulder and cleanse the skin in preparation for injections. Next, I administer local anesthetic prior to the Prolotherapy shots. I use a small syringe with about 2cc of 1% lidocaine buffered with 0.2cc of sodium bicarbonate. With a 30G ½ inch needle, I inject about 0.1cc to make a small raised bleb over each site I plan to inject with Prolotherapy.

As you know, which structure lies under a given location on the surface of the skin depends on the position of the bone beneath the skin. Accordingly, in the treatment of the shoulder, the position of the arm is important to approach the desired underlying structure.

Begin by giving the intraarticular (I.A.) injection. This treats arthritis of the shoulder. So, with the patient sitting on the edge of the exam table, I position the arm at the patient's side with the elbow flexed to 90 degrees and the forearm across the abdomen (this internally rotates the humerus and expands the posterior capsule).

The syringe for I.A. injection should include 3cc 50% dextrose, 2cc 1% lidocaine and then filled to 6cc total volume with saline. (Strong proliferants such as sodium morrhuate should be used with caution I.A. as they may cause a very strong, and or prolonged capsulitis).

Figure 2. Intraarticular injection of the shoulder.

The skin entry point for the intraarticular injection is just below the posterior lateral aspect of the acromion. The needle is then directed and advanced toward the coracoid process (antero-medially). (*See Figure 2.*) Typically, the patient will experience pain as the needle passes through the capsule as this is a well innervated structure. The needle should be withdrawn about 1 mm after touching the humeral head. The contents of the syringe are injected here. It should flow freely. If it takes a strong pressure on the plunger then you have not positioned the needle intraarticularly. Reposition the needle and proceed.

Following the I.A. injection the shoulder should be repeatedly flexed and extended to distribute the solution throughout the joint.

The injections to the supporting tendons and ligaments consist of one or two 12cc syringes depending on how broad the injuries are to the shoulder. These contain standard Prolotherapy solution and may be supplemented with stronger proliferants such as sodium morrhuate when needed.

In order to treat the anterior shoulder structures I will use two positions of the arm. First, for the supraspinatus tendon, I will position the patient's arm at their side with the elbow to 90 degrees flexion, and internally rotate the humerus until the hand is across the belt line behind the back. The location of the tendon will be found by palpation for the tenderness over the greater tubercle antero-superiorly on the humerus. The needle is partially withdrawn and redirected about the insertion site thus "peppering" the insertion of the tendon with 0.5cc of solution in each spot. Two to 4cc will be peppered about the insertion of the supraspinatus on the humerus. (*See Figure 3.*)

The second position is with the patient's arm at their side with the hand resting on the thigh near the knee. Then palpation confirms the injuries of the subscapularis, and pectoralis major, inserting anteriorly on the proximal humerus several centimeters below the humeral head. Six to eight separate insertion sites are made into the injured teno-osseous junction. (*See Figure 4.*)

The coracoid process is injected next. There are several ligaments and tendons that attach to this point of bone including the coraco-acromial, coraco-clavicular ligaments and the long head of the biceps, coraco-brachialis and the pectoralis minor tendons. One to 2cc of solution are peppered here. (*See Figure 5.*)

Figure 3. Prolotherapy injection of the supraspinatus tendon.

Figure 4. Prolotherapy injection into the subscapularis and pectoralis major tendons.

Figure 5. Injection of the coracoid process. Many important structures attach here including: coraco-acromial, coraco-clavicular ligaments, and the long head of the biceps, coraco-brachialis and pectoralis minor tendons.

Next, we inject along the anterior lateral portion of the lateral clavicle for additional deltoid origin. We continue with injections along the anterior, lateral, and posterior aspects of the acromion when injuries are found here. It is largely the deltiod that originates here. Two to 4cc of Prolotherapy solution would be peppered here if indicated. Occasionally, the lateral humerus is tender and indicating further deltoid tendonitis. Two to four additional cc's of Prolotherapy solution would be peppered here if indicated.

Injection of the infraspinatus tendon and teres minor is done along the posterior humerus. The upper arm is flexed with the elbow again bent to 90 degrees. Then let the arm rotate externally (allowing the hand to move laterally). Tenderness over the posterior humerus along the proximal 3 cm reveals the injured tendons. Two to four injections are administered here when injured. (*See Figure 6.*)

Figure 6. Injection technique for the posterior shoulder. Injections of the posterior shoulder treat injuries to the infraspinatus and teres minor tendons.

Figure 7. Injection into and around the acromioclavicular joint.

The AC (acromio-clavicular) joint sprain is common. This is also called "shoulder separation." It responds very well to Prolotherapy. Three to 5cc's of standard solution are peppered into the supporting ligaments posterior, superior, and anterior. I will inject along both sides of the joint (insertion and origin) (*See Figure 7.*).

In cases of severe shoulder arthritis the delivery of injections is very painful. The pain associated with injection tends to decline with subsequent treatments as the underlying inflammation begins to settle down, i.e. as the injuries to the shoulder begin to heal.

Prolotherapy to the shoulder is very gratifying. The success rate is high and the results are generally wonderful. With care and knowledge of the anatomy you will "prolo your patient's pain away!" ■

IT'S A WIDE WIDE WORLD

It Happens Every March in Honduras

Celebrating the 40th Anniversary of the Hemwall Honduran Program

Gary B. Clark, MD, MPA

ABSTRACT

The Hackett-Hemwall Foundation organizes a medical mission training course every March. JOP columnist and Prolotherapist, Gary B. Clark, MD, MPA, reviews the fortieth anniversary of the Hemwall Honduran program, which occurred in March 2009. The HHF course is the largest Prolotherapy training program of its kind. This physician group provides medical care to over 4,000 Honduran patients annually. Dr. Clark's article reflects on the history of the program, along with how far it has come and continues to reach.

Journal of Prolotherapy. 2009;4:246-248.
KEYWORDS: Prolotherapy, Hackett-Hemwall Foundation, Honduras, training.

In rural Honduras, women often bear many children and work very hard for their entire lives, providing the necessary help to their families that only a mother can give. These women have no 401k retirement funds or paid vacations. If such a woman becomes disabled, she cannot hire a nanny to take her place—if she works at all, she already works as the nanny. So, if such a woman ails, her entire family suffers.

Such was the case last March for a 60-year-old woman who stoically limped into the Honduran Red Cross (Crus Rojas Hondurena) clinic in La Ceiba, Honduras. Yes, she limped—but she had the fire in her eye of pride and independence. She had walked all the way to the intra-city clinic from her rural village outside of La Ceiba. Her painful gait was caused by a sore and swollen knee.

The limp-provoking knee had weighed down this woman for twenty aching years while she unfailingly continued her daily chores and supported her family's needs. It had been plaguing her daily existence for all that time, slowly but surely becoming progressively worse as each year went by—an all too common story in rural Honduras. But, in the matter of just the next hour, the cause of her knee disability would be specifically diagnosed by careful history and physical examination and set upon the course of healing by a simple, almost painless injection technique wielded by an American physician.

Every March a select team of over 100 dedicated doctors and health-care workers from the United States, Canada, and several other countries of the world visits La Ceiba and two other small towns near the northern Honduran Caribbean coast. Over three weeks, this team of doctors, nurses, technicians, interpreters, and other dedicated volunteers provides careful treatment to over 3,000 patients with multi-joint injury, complicated varicose vein disease, dental disease, and otolaryngologic disease. At the same time that qualified physicians are performing the treatments, they are being guided by mentors, one-on-one. You can figure out the workload performed in a hot, tropical climate and, at the same time, having to work through a volunteer interpreter. As one well-seasoned but first-year doc put it: "Wow! I haven't worked so hard since internship! This is fabulous!"

It happens every March in Honduras.

Left to right: With their indispensable Honduran interpreter, Gary B. Clark, MD, and Joseph P. Mullane, MD, treat a patient's knee for multiple ligament sprain injuries.

So, why Honduras? In 1968, Gus Hemwall, an MD Prolotherapist from the Chicago area, met a Honduran pediatrician at a medical meeting in the United States. The Honduran physician was not only from the coastal town of La Ceiba but just happened to be the Vice President of Honduras. The Honduran doctor invited Gus to bring Prolotherapy to La Ceiba. On that invitation, Dr. Hemwall first visited La Ceiba in 1968 and met Lester and Margaret Beckman. Lester "Beck" Beckman was Assistant General Manager for Dole Fruit Company at the time.

That first visit spurred Gus to organizing a yearly trip with like-motivated physicians to La Ceiba. Aided by the Beckmans, the Dole Fruit Company, and the Honduran Red Cross, this small band of philanthropic doctors began making a difference in the lives of the rural and urban Honduran people. From the very beginning, the Beckman's were staunch supporters of the Honduran medical project, offering their time, their home, and their fortune. Since then, many a physician has learned and, in turn, has taught the basics of Prolotherapy aided initially by American and Canadian teachers, armed with Netter's Anatomy and a rickety old skeleton—all nestled under the welcome shade of the huge mango tree in Lester's and Margaret's backyard.

Left to right: Chet Hermansen, Margaret Beckman, Mary Doherty, and Jeffery Patterson, DO, as Jeff acknowledges Margaret's forty years of gracious service to HHF and the Honduran people.

Gus planned the first medical project for later in September 1968. However, as Margaret relates the story, it was very rainy at that time, so the first project was rescheduled for March 1969. There were only 7 people on the first medical mission trip. But, it was not too long before the project eventually became much larger and very diverse in its organization. In its largest year, there were 150 MDs, DDSs, RNs, engineers, medical assistants, drivers, and cooks and the medical care provided was of a broad medical-surgical spectrum.

Jeff Patterson's first year in Honduras was in 1987, when he served in the small coastal town of Tela on invitation by Dr. Hemwall. In 1994, Dr. Hemwall refocused the project on providing just Prolotherapy and Vein Therapy. Dr. Hemwall's last year in La Ceiba was 1997. In 1998, Gus Hemwall died while attending a Prolotherapy conference.

Dr. Hemwall always conducted the Honduran gathering in a medical mission style. This style has been carried on by Jeff Patterson as much as possible. Through 2005, it was common for the entire group to assemble at Margaret's home for supper after a very long day's work—before the 1-2 hour long evening didactic Prolotherapy lecture. The entire group would always pause around Margaret's dining room table—heavily laden with that evening's scrumptious meal—to give united thanks for their good fortune to be in the succor of Margaret's home and to be able to help the Honduran people. That evening dinner grace has been led by healthcare providers of many spiritual persuasions.

Honduran patient receiving Prolotherapy to the neck and thoracic spine. "Kids, don't try this at home."

The Hackett-Hemwall Honduran Program now includes three treatment locations:

- La Ceiba is a city of approximately 100,000 people, lying at the foot of 5000 feet Pico Bonito, and still a major banana port. The work there is sponsored by the local Honduran Red Cross.
- Tela, of approximately 50,000 people, is a seaside town and former home of the Tela Railroad Company, producers of Chiquita Bananas. The work there is sponsored by the Tela Evangelical Church.
- Olanchito, of approximately 30,000 people, is located further inland within the mountains. The work there is sponsored by the Sociedad de Agriculturores y Gandares de Olanchito.

Dr. Hemwall's pioneering efforts have since continued through the Hackett-Hemwall Foundation (HHF), which continues Gus' dream for the Hondurans and other nationalities. The Foundation is led by a handful of dedicated osteopathic and medical doctors centered in Madison, Wisconsin, under the direction of Dr. Jeffrey Patterson, administrated by Mary Doherty, and supported academically by the University of Wisconsin. HHF has grown to include healthcare work in Honduras, Mexico, and the Philippines.

The Foundation has 3 basic goals: *education*, *research*, and *medical care*. In keeping with its goal of *education*, their Prolotherapy Program is the largest training program of its kind in the world. HHF considers Prolotherapy as a surgical subspecialty that requires significant education and practical hands-on training to perform really well. Consequently, HHF strives to provide the best Prolotherapy training available to physicians anywhere in the world. Over the years, the Foundation has trained hundreds of physicians in Prolotherapy from eighteen different countries.

The HHF Vein Program, under the direction of Rick Owens, MD, is expanding and providing similar education and clinical care. Dr. Owens has brought his and other phlebologists' expertise to provide ultrasound-guided vein sclerosis to the Honduran people using the most up-to-date vein sclerosing techniques. Physicians from across the United States and Canada travel with their ultrasound machines to share their knowledge and skills and to treat hundreds of extremely needy patients with horribly severe varicose vein disease—you have to see one of these weeping, crusted ulcers to realize what "horrible" really means. The HHF ENT program (which occurs in February) is under the direction of Michael McDonald, MD. The Dental Program is under the direction of Dana Lubet, DDS.

Left to right: Irene Briceno, MD, and Stephen Cavillino, MD, perform cervical spine Prolotherapy.

HHF has fostered a working relationship with the medical school in Tegucigalpa, Honduras, to train anesthesiology residents—much through the continuous effort of Dan Wert, DO. HHF is actively establishing relationships with medical schools in Honduras, Nicaragua and Guadalajara, Mexico. Likewise, HHF has fostered excellent working relationships with local Honduran physicians who receive HHF training in joint and vein therapies.

In supporting *research*, HHF continues to fund ongoing basic and clinical research in Prolotherapy.

In providing *medical care*, HHF is currently providing medical care to approximately 4,000 Honduran patients yearly, providing Prolotherapy, Vein Sclerosing, ENT Surgery and Dental Care. In addition, HHF works with local Honduran schools and hospitals, providing them with supply and logistical needs. HHF is following suit in Mexico and the Philippines, treating hundreds more there, as well.

As for the 60-year-spry Honduran lady in La Ceiba last March? She—along with the hundreds of others who made their way to the Honduran Red Cross that week—happily returned to her home and family. An American doctor had treated her knee by using Prolotherapy. She had been definitively treated and was bolstered with reaffirmed hope—for the first time in years—of finally being free of disabling pain.

It happens every March in Honduras. ■

ACKNOWLEDGMENT

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The entire group of HHF doctors and supportive staff at Tela.

This group picture was taken during the 1993 Honduras trip. Dr. Hemwall is in the backseat of the truck. His legacy lives on, every March in Honduras.

IT'S A WIDE WIDE WORLD

Why I Switched from Orthopedic Surgery to Prolotherapy

Joern Funck, MD

THE JOURNEY

In 1975, after I finished my clinical education as an orthopedic surgeon, I opened my private office as an orthopedist in Luebeck, Germany. In those days the possibilities to operate were not so good for young orthopedic surgeons. Big operations, like hip replacements, were done only in the large public hospitals.

At that time I decided to treat soft tissues with injections, medication, and physiotherapy and not to operate any more. In the beginning, numerous shoulder patients had a problem when medication was not successful. I started studying manual therapy, but to manipulate a cervical spine was not the solution of shoulder problems, as my teachers at that time insisted. At last, I remembered a little booklet from Dr. James Cyriax from London who gave me diagnostic and treatment advice for shoulders which turned out to be very successful. So I took extended training in orthopedic medicine by Cyriax, which was not common in Germany at the time.

CORTISONE VERSUS PROLOTHERAPY

The only treatment after a secured shoulder diagnosis in those days was a cortisone injection. Cortisone typically helped very quickly, but the problem had a tendency to come back. After several injections with cortisone, the risk of a rupture of the treated tendon was present or the success of the injection diminished. While practicing traditional cortisone injections, I was introduced to Prolotherapy by one of my teachers in manipulation, Professor Tilscher, from Vienna.

In 1998, after 20 years of treating only low back pain patients with Prolotherapy, I introduced my colleague, orthopedist Dr. Baehnisch, from Leipzig, Germany to Prolotherapy. He traveled to the United States several times where he received in depth training from Dr.'s Ravin and Cantieri. These doctors used the Cyriax diagnostic and treatment techniques as well, so it was not difficult to follow their advances. Consequently, we were able to set up new standards for our own work back in Germany. I started treating shoulder tendon problems with Prolotherapy and could leave the cortisone path behind with all its associated problems.

SUCCESSFUL RESULTS WITH PROLOTHERAPY

From the year 2000 until 2006, I have compiled 1500 cases in which I used Prolotherapy as the primary mode of treatment. The treatments were successful in 88.3% of them.

In Germany, we once believed that Prolotherapy would only work on ligaments and not on tendons. My own success in treating tendinosis of shoulder tendons since 2002 defeated that whole theory in my mind. A tendinosis means a weakness of a tendon accompanied with some signs of inflammation.

My experience with hip pain brings further proof to the efficacy of Prolotherapy, as there is a similar problem with hip pain. Cyriax teaches that a hip has to show a so-called capsular pattern when the doctor moves the joint for diagnostic reasons. The pain is expected in the groin if this joint is really the problem. But many patients show more pain on the outer side of the hip going down to the knee. The large bone called the greater trochanter, where the gluteal muscles and a bursa (fluid filled sac) attach is often the origin of the pain and typically such a person is diagnosed with trochanteric bursitis (inflammation of the bursa).

Until the year 2000, I typically injected this bursa, like all my teachers before me, with 40 mg Triamcinalone (cortisone) with mostly good, but only temporary relief. So people came back for more injections. At the end, I recall five patients who did not respond any more to this therapy. So I sent them to an orthopedic clinic, where the bursa was surgically removed.

One side note that I would like to mention: My security in those difficult diagnostic cases is always the test injection with a local anaesthetic. Although the Cyriax techniques are very accurate, they sometimes fail, especially in the important shoulder diagnostic. MRI's are not useful, so I rarely order them. For patients with chronic pain on their long road from expert to expert, test injections provide a hopeful sign to convince them that their diagnosis has really been secured. ■

Read the extended story online at www.journalofprolotherapy.com

IT'S A WIDE WIDE WORLD

Literature Reviews

Gary B. Clark, MD, MPA

CERVICAL SPINE WHIPLASH INJURIES AND PROLOTHERAPY

Case Study: *On 9 December 1945, General George S. Patton and his chief of staff were being driven in a sedan near Mannheim, Germany, with Patton sitting on the right side of the back seat. A US Army 2½-ton truck, traveling in the opposite direction, veered across the median and hit Patton's car at the right front fender. Each vehicle was traveling at 20-30 miles-per-hour. Of the four involved, Patton was the only person injured. Immediately complaining of neck pain, struggling for breath, and paralyzed from the neck down, he was rushed to the US Army hospital in Heidelberg.*

INTRODUCTION

Cervical spine injury following abrupt acceleration-deceleration accidents were first labeled by Crowe in 1928 as "whiplash injury."[1] Such neck injuries can be experienced from very early life, as witnessed in the "shaken baby syndrome,"[2] on into adulthood. Whiplash has been most often described subsequent to motor vehicle accidents in which the victim is rear-ended. However, similar neck injury symptoms and signs have been attributed to a variety of other causes, including head-banging, head-first falls, diving, snowboarding and skiing, bicycling, roller coaster riding, pugilistic or criminal assault-and-battery, minor railway accidents, aircraft launching and ejection accidents, commercial airplane runway accidents, high-velocity therapeutic manipulation—and even low speed, carnival-style, bumper-car accidents. The exact circumstances of the accident can be complex, involving very complicated force vectors.

HISTORY AND RELATED SYMPTOMS

From the very beginning of life, the cervical spine (C-spine) is fraught with significant risks of injury. This includes varying degrees of ligament and musculotendon strain or sprain, along with vertebral dislocation or fracture and even spinal cord trauma (e.g., contusion, hemorrhage) with associated neurological effects. C-spine whiplash injuries can be compounded by brain stem injury due to direct trauma or edema and stroke due to arterial damage and intracranial injuries of varying severity, including coup-countercoup contusion, translational parenchymal tearing, and hemorrhage. These central nervous system injuries can lead to a wide spectrum of neurological and psychological symptoms commensurate with a closed head injury. Cervical sprain injury can also be associated with signs and symptoms of Barré-Lieou Syndrome due to injury of the cervical sympathetic chain.

Table 1. The 1995 Quebec Task Force guidelines provide a convenient scheme for grading the severity of a whiplash disorder.

Grade	Symptoms	Signs
Grade 0	No neck pain, stiffness, or any other physical symptoms	No physical signs on examination
Grade 1	Only complaints of neck pain, tenderness, or pain	No physical signs on examination
Grade 2	Complaints of neck pain, tenderness, or pain	Physical examination evidence of musculoskeletal point tenderness and/or decreased range of motion
Grade 3	Complaints of neck pain, tenderness, or pain plus history of insomnia	All the above plus physical examination evidence of decreased range of motion or neurological signs, e.g., decreased deep tendon reflexes, weakness, or sensory deficit.
Grade 4	All the above	All the above plus radiological evidence of vertebral subluxation, fracture, or spinal cord injury.

CLINICAL DIAGNOSIS

The complete understanding of the patient's whiplash accident often has to be reconstructed forwards and backwards from a carefully gleaned clinical history and an expert, thorough, functional musculoskeletal and neurological physical examination. A good understanding of the biomechanics of whiplash injury is a "must-have."

The 1995 Quebec Task Force guidelines provide a convenient scheme for grading the severity of a whiplash disorder.[3] (*See Table 1.*)

BIOMECHANICAL PATHOPHYSIOLOGY

Since the John Stapp sled experiments in the 1940s-50s, it has been conventional wisdom that a rear impact causes the victim's head and neck to abruptly move out of their normally lordotic neutral posture in two phases.

- First, in the *Retraction Phase*, the head is forced to move into hyperextension as the victim's seat pushes the person's torso forward, causing the unrestrained head and neck to move backwards into extreme hyperextension.
- Secondly, after a very brief inertial delay, there is a *Rebound Phase* during which the head and neck recover and recoil into an extremely hyperflexed position.

Our main intention is to familiarize the reader—both Physician and Patient—with the basic concepts and language of cervical spine whiplash injury. We would also like to stimulate reading and increase the general level of understanding of Prolotherapy of this anatomic area. Please access the website of the National Library of Medicine (www.pubmed.gov) to review the following, and other articles.

S-SHAPED CERVICAL SPINE DEFORMATION DURING WHIPLASH

Biomechanics of Whiplash injury.
Panjabi MM, et al. Orthopade, 1998 Dec;27(12): 813-9.

ABSTRACT SUMMARY

Panjabi, Cholewicki, et al., (1998) employed human cadaveric specimens subjected to 2.5 to 10.5 g-force accelerations. These tests were monitored by functional radiography, high-speed cinephotography, transducer stretch monitoring, flexibility tests, post-trauma and CT and MRI scans, and the specimens were ultimately sectioned for histological microscopic study.

In this study, the investigators observed that, in their Phase I, the normally lordotic C-spine was deformed into an S-shaped curve resulting in:

a. Upper cervical hyperflexion at C0-C2 with elongation of the vertebral artery
b. Lower cervical hyperextension with the most severe capsular ligament stretching occurring at C6-C7.

This first, S-shaped phase was associated with soft tissue injuries.

In their Phase II, all segments of the C-spine became fully extended, with the head reaching its maximum posterior excursion. No soft tissue injuries were noted in this phase.

JOP COMMENTARY

The cited paper represents a series of Yale University studies that strongly suggest that, after direct rear-to-front (posterior-to-anterior) impact to the cervical spine, the cervical vertebrae at C6-7 are initially forced into a nonphysiological hyperextension while, in the same initial phase, the upper cervical vertebrae (C0-C1-C2) essentially are forced into hyperflexion, resulting in the formation of an abnormal S-shape curvature of the cervical spine. Their Phases I and II represented the classical Retraction Phase. They did not report on a classic Rebound Phase.

The extent of traumatic damage depended on the degree of the accelerative g-force acting on the C-spine. At lower g-force acceleration, the inferior C-spine, particularly at C6-C7, was most vulnerable—causing stress on inter-vertebral zygapophyseal facet joint ligament structures. At higher g-forces, the upper C-spine (C0-C1) was more vulnerable—stressing those vertebral musculoskeletal structures as well as the vertebral artery. However, during either extreme of acceleration, the lower C-spine still remained structurally more at risk—with the risk of lower C-spine (C6-7) injury being four times as great at higher acceleration.

Based on these observations, the classic Rebound Phase did not appear associated with significant ligament injury. However, more will be said, later, in regard to specific musculotendinous injuries occurring in the classic Rebound Phase.

CERVICAL VERTEBRAL ZYGAPOPHYSEAL FACET JOINT INJURY AFTER REAR-END WHIPLASH

The prevalence of chronic cervical zygapophyseal joint pain after whiplash. Barnsley, et al. *Spine*. 1995 Jan 1;20(1):20-25.

Neck ligament strength is decreased following whiplash trauma. Yashura T, et al. *BMC Musculoskelet Disor*. 2006;7:103.

ABSTRACT SUMMARIES

Barnsley, et al., (1995) employed diagnostic local anesthetic blocks of cervical zygapophyseal facet joints of whiplash patients to determine the nature of refractory cervical joint pain after whiplash. This double-blind, controlled study revealed that the cervical facet joints were the most common source of chronic neck pain amongst 54% of 50 whiplash patients.

Yashura, et al., (2006) conducted a controlled study of anterior and posterior longitudinal, capsular, and interspinous and supraspinous cervical ligaments from cadaver donors who had sustained various severities of documented rear impacts. Intervertebral zygapophyseal facet capsular ligaments demonstrated significantly lower failure force and less energy absorption capacity, overall. The injuries were most predominant at the C5-C6 level. The ligamentum flavum and the interspinous and supraspinous ligaments played only secondary roles in post-whiplash intervertebral instability.

JOP COMMENTARY

The controlled Australian studies of Barnsley, et al., demonstrate evidence that corroborates the biomechanics of whiplash observed by Panjabi, et al.. These studies suggest not only direct correlation of the chronic clinical symptoms suffered by whiplash victims with the observed biomechanical S-shaped distortion—but also direct correlation of zygapophyseal facet joint injury. (*See Figure 1.*)

The controlled studies of Yashura T, et al., represent a collaboration of investigative efforts amongst Marianna University (Japan), Yale, Dartmouth, and Rush University (Chicago). They surmised that direct, rear-to-front acceleration accidents produce cervical spine whiplash injuries that are characterized by intervertebral zygapophyseal facet joint instability and facet capsular ligament sprain laxity. (*See Figure 2.*) These injuries are

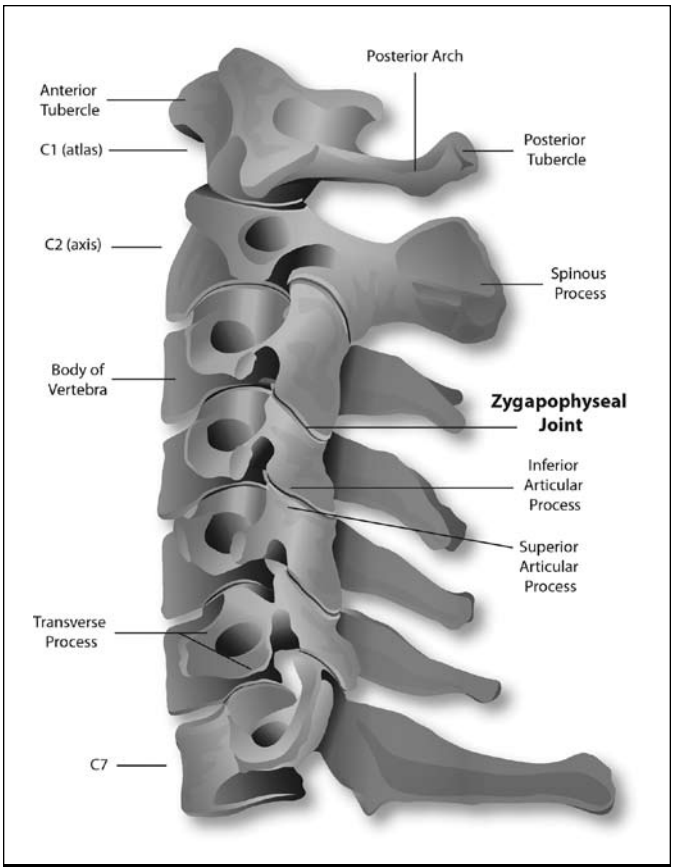

Figure 1. Lateral view of the cervical spine anatomy highlighting a zygapophaseal facet joint.

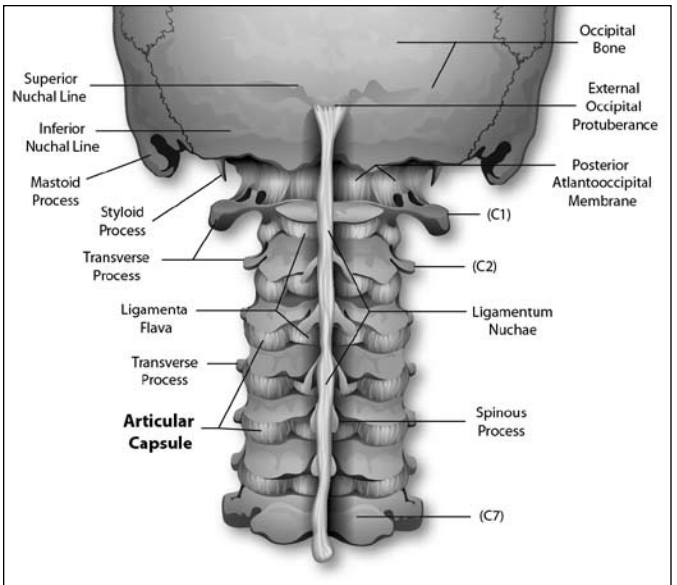

Figure 2. Posterior view of cervical spine and occipital highlighting articular capsules.

amenable to Prolotherapy treatment as long as they are in the Grade 0 to low-Grade 3 of severity using the Quebec Scale. This study supports what Prolotherapists have demonstrated empirically in the course of their clinical assessments and treatments over the past 70-80 years.

CERVICAL SPINE MUSCLE INJURY AFTER REAR-END WHIPLASH

Musculotendon and fascicle strains in anterior and posterior neck muscles during whiplash injury.
Vasavada An, et al. *Spine*. 2007 Apr1;32(7):756-65.

ABSTRACT SUMMARY

Vasavada, et al., (2007) integrated experimental human rear-end automobile impact data with a biomechanical neck musculoskeletal model based on clinical electromyographic studies. They calculated anterior and posterior neck musculotendon and fascicular strains that would be experienced subsequent to the forces of direct rear-end whiplash injuries. They observed that the anterior Sternocleidomastoid muscle was selectively strained during the classic Retraction Phase. On the other hand, in the classic Rebound Phase, the posterior muscles (Splenius capitis, Semispinalis capitis, and upper Trapezius) were selectively strained. These extensor muscles demonstrated more extensive strain injuries consistent with clinical reports of preponderant extensor muscle pain after whiplash.

JOP COMMENTARY

Vasavada, et al., from Washington State University, helped to better correlate the dynamics of the classic whiplash Retraction-Rebound phasing. Whereas Panjabi and Bogduk, et al., reported no particular importance of the classical Rebound Phase to zygapophyseal facet capsular ligament injury. Vasavada, et al., demonstrated that the classic Retraction Phase is related to anterior muscle injury—whereas the Rebound Phase is associated with more extensive posterior muscle injury.

When excessive intervertebral ligament strain is associated with excessive paravertebral musculotendon strain, one should consider Prolotherapy of both ligament and musculotendon sprain injuries.

CERVICAL SPINE INJURY AFTER REAR-END WHIPLASH IMPACTS WITH NECK-HEAD ROTATION

Effect of neck rotation in whiplash-type rear impacts.
Kumar, et al. *Spine*. 2005;30(15)1742-9.

ABSTRACT SUMMARY

Kumar, et al., (2005) from Edmonton, Canada, performed bilateral electromyographic monitoring of human volunteers subjected to incremental acceleration forces. With the volunteer's head rotated out of neutral at the time of simulated rear impact, there was a 88 to 94% greater risk of sprain injury to the contralateral Sternocleidomastoid muscle.

JOP COMMENTARY

The Kumar, et al., report represents three separate papers published in 2005 by this Canadian team. The effect of head rotation on the contralateral anterior Sternocleidomastoid muscles was quite prominent—at least triple compared to any effect on the posterior Trapezius and Splenius capitis muscles.

UPPER CERVICAL INTERVERTEBRAL INJURY AFTER FRONTAL WHIPLASH WITH NECK-HEAD ROTATION

Head position and impact direction in whiplash injuries: associations with MRI-verified lesions of ligaments and membranes in the upper cervical spine.
Kaale BR, et al. *J Neurotrauma*. 2005 Nov;22(11):1194-302.

ABSTRACT SUMMARY

Kaale, et al., (2005) performed a controlled MRI study of upper cervical spine injuries in whiplash patients. They focused on the alar and transverse ligaments and tectorial and posterior atlanto-occipital membrane at the C1-C2 levels. Whiplash victims who had been sitting with their head and neck rotated to one side demonstrated a predominance of high-grade injuries of the alar and transverse ligaments. Those who were involved in front-to-rear collisions were more likely to have transverse ligament and posterior atlanto-occipital membrane injuries. In any case, alar ligament injury was found to be the most common upper C-spine injury. In all whiplash victims affected by upper C-spine injury, their injuries were predominantly high-grade.

JOP COMMENTARY

These Norwegian studies again corroborate the biomechanical model presaged by the 1998 work of Panjabi, et al., which suggested that the upper cervical spine segments are more likely to be involved in higher g-force rear-end whiplash accidents. Kaale, et al., even go further to suggest that upper cervical spine injuries are further unique in that they are more likely to be seen in accelerative trauma in which the patient's head was either rotated or when the force was coming from the front instead of the rear.

PROLOTHERAPY TREATMENT OF CERVICAL WHIPLASH INJURIES

Retrospective case series on patients with chronic spinal pain with dextrose prolotherapy.
Hopper RA, et al. *J Altern Complement Med*. 2004 Aug;10(4):670-4.

Fluoroscopically guided cervical prolotherapy for instability with blinded pre and post radiographic reading.
Centeno CJ, et al. *Pain Physician*. 2005 Jan;8910:67-72.

Intraligamentous injection of sclerosing solutions (Prolotherapy) for spinal pain: a critical review of the literature.
Dagenais S, et al. *Spine J*. 2005 May-Jun;5(3):310-28.

Side effects and adverse events related to intraligamentous injection of sclerosing agents (Prolotherapy) for the back and neck: a survey of practitioners.
Dagenais S, et al. *Arch Phy Med and Rehab*. 2006 Jul;87(7):909-913.

Case series on chronic whiplash related neck pain treated with intraarticular zygapophyseal joint regeneration injection therapy. Hooper, et al. *Pain Physician*. 2007 Mar;10(2):313-318.

ABSTRACT SUMMARIES

Hooper and Ding (2004) reported on a non-controlled, retrospective case series study of 77 patients receiving Prolotherapy to various spinal sections including the C-spine. They reported their C-spine treatments as having lower pain reduction outcomes than thoracic and lumbar treatments.

Centeno, et al., (2005) conducted a blinded, prospective case series study—the first report of fluoroscopy-guided cervical Prolotherapy. They treated 6 patients exhibiting varying degrees of C-spine instability between C3 and C7. Flexion instability was most marked at the C4-C5 level, whereas extension instability was most marked at C2-C3 level. There were no details regarding collision variables. Their treatment, using 12.5% dextrose Prolotherapy decreased instability in flexion more often than in extension, which correlated with their treating only posterior ligaments.

Dagenais, et al., (2005) conducted a Cochrane computerized review of the literature reporting on Prolotherapy of all segments of the spine. It pointed to a great variation of injection and supportive treatments protocols, there being a lack of standardization in the overall practice of Prolotherapy as reported in the literature. It recommended better focus of future research and improved standardization of the practice. Still, the authors reported that the literature, overall, indicates that Prolotherapy "may be effective at reducing spinal pain."

Dagenais, et al., (2006) conducted a survey of 171 Prolotherapy practitioners and reported on the benign and adverse events related to Prolotherapy for the back and neck. They found that the collateral events cited were not unlike those associated with any other spinal injection procedures.

Hooper, et al., (2007) reported an uncontrolled study of Prolotherapy of 18 whiplash patients receiving intraarticular cervical zygapophyseal facet joint injection with 20% dextrose. Their mean neck disability index was reduced by 55% in 12 months from 24.71 to 10.94. Their best clinical outcomes were those combining Prolotherapy with rehabilitative physical therapy.

JOP COMMENTARY

The above-cited articles on Prolotherapy of the C-spine are representative of most investigative reports on Prolotherapy. Generally, such reports consist of case studies, either retrospective or prospective. However, the reports that do exist provide substantial "strength of evidence" that Prolotherapy is effective. Better delineation of the efficacy of C-spine Prolotherapy by more rigorous controlled experimental study is needed.

One major "pearl" gleaned from Hooper, et al. (2007) is the value of ancillary rehabilitative care, such as Rolfing, Pilates, or Physical Therapy following Prolotherapy. Also, one major correction of a common misconception is that Prolotherapy is not a "sclerosing" (i.e., scarring) therapy—as is inappropriately proposed by Dagenais, et al.. Prolotherapy is a "regenerative" technique that is substantiated by the current literature.

The topic of cervical spine injury was exhaustively addressed by Ruth Jackson, MD, in the 1940s and 50s based largely upon her clinical radiological and surgical observations.[4] Much of what has been revealed by experimental research has corroborated her work. We hope that the above review widens the reader's understanding of whiplash injury and Prolotherapy of associated ligament and tendon injuries.

Case Study (continued): *Why was General Patten the only person out of four injured? To piece that mystery together one might ask, "What was Patten doing at the time of impact that the other two individuals in the sedan were not doing?" Was Patton looking away from the oncoming truck while the other three individuals were looking straight at the suddenly looming problem and bracing appropriately? Was he gazing out the window to his right—perhaps lost in reverie over some ancient battle—if so, he would have not seen the oncoming truck. He would not have had time to effectively brace. And his neck and head would have been rotated to the right.*

All speculation aside, Patton experienced an abrupt frontal acceleration due to a 2½-ton truck hitting his 1-ton sedan at the front right quarter. It was a violent frontal impact with a clockwise centrifugal element. With those forces alone, he could have easily have sustained a severe Quebec Grade 3 to 4 whiplash injury of the mid to upper C-spine with potential vertebral skeletal fracture, along with vertebral artery, cervical cord, and medullary brainstem collateral damage.

Another way to ask the question is, "What forces impacting on Patton were different compared to what the other two individuals in the sedan experienced?" Hit by a 2½-ton truck at the sedan's right front quarter, delivering a robust, clockwise centrifugal force, the other two in the sedan were thrust outward against the right interior insides of the vehicle. Seat belts were not standard equipment in the 1940s. After an initial hyperflexion phase, Patton was forcibly launched tangentially across a spacious rear seating compartment, his forehead impacting against the driver's front seat framework. In so doing, he experienced a crushing, frontal blow with severe cervical hyperextension.

Confirmed by X-ray, his cervical injuries included a fractured C3 vertebra and posterior dislocation of C4 on C5, all associated with quadriplegia and one unfunctional hemidiaphragm. Whatever neck ligament and muscle soft tissue damage existed suddenly became moot.

Despite the determined and expert efforts of Colonel R. Glen Spurling, USA, MC, and a sterling neurosurgical team, Patton died, likely of pulmonary embolism, on 21 December. He was placed to rest outside of Luxembourg aside many of his fellow soldiers. All the rest is clinical history. But, biomechanically, we can still wonder and learn.[5] ■

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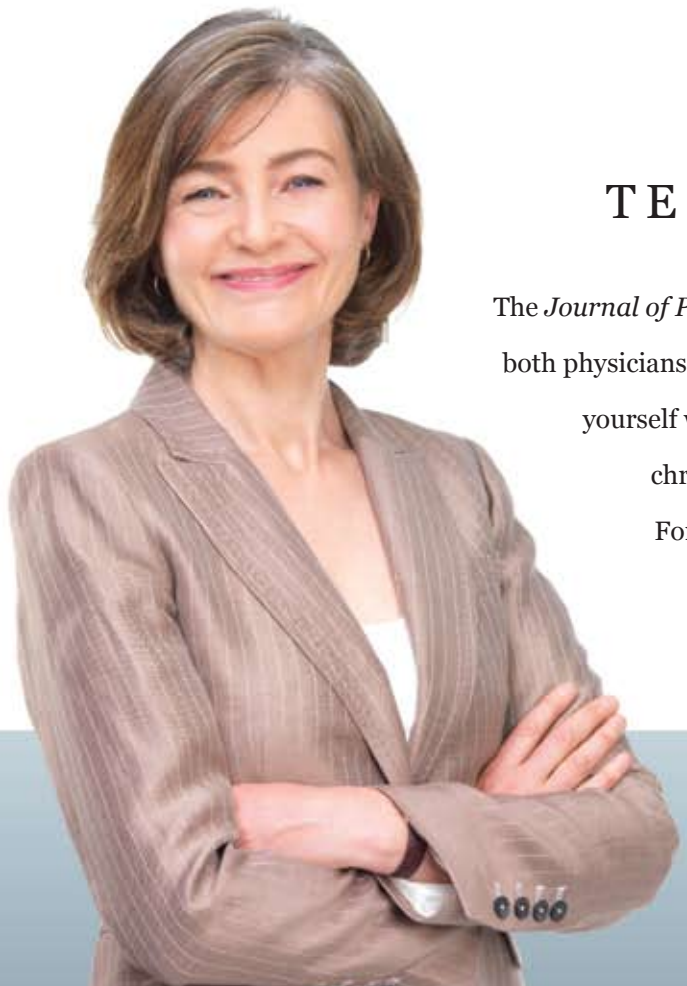

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