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MENISCAL INJURIES & TEMPOROMANDIBULAR JOINT DYSFUNCTION

IN THIS ISSUE

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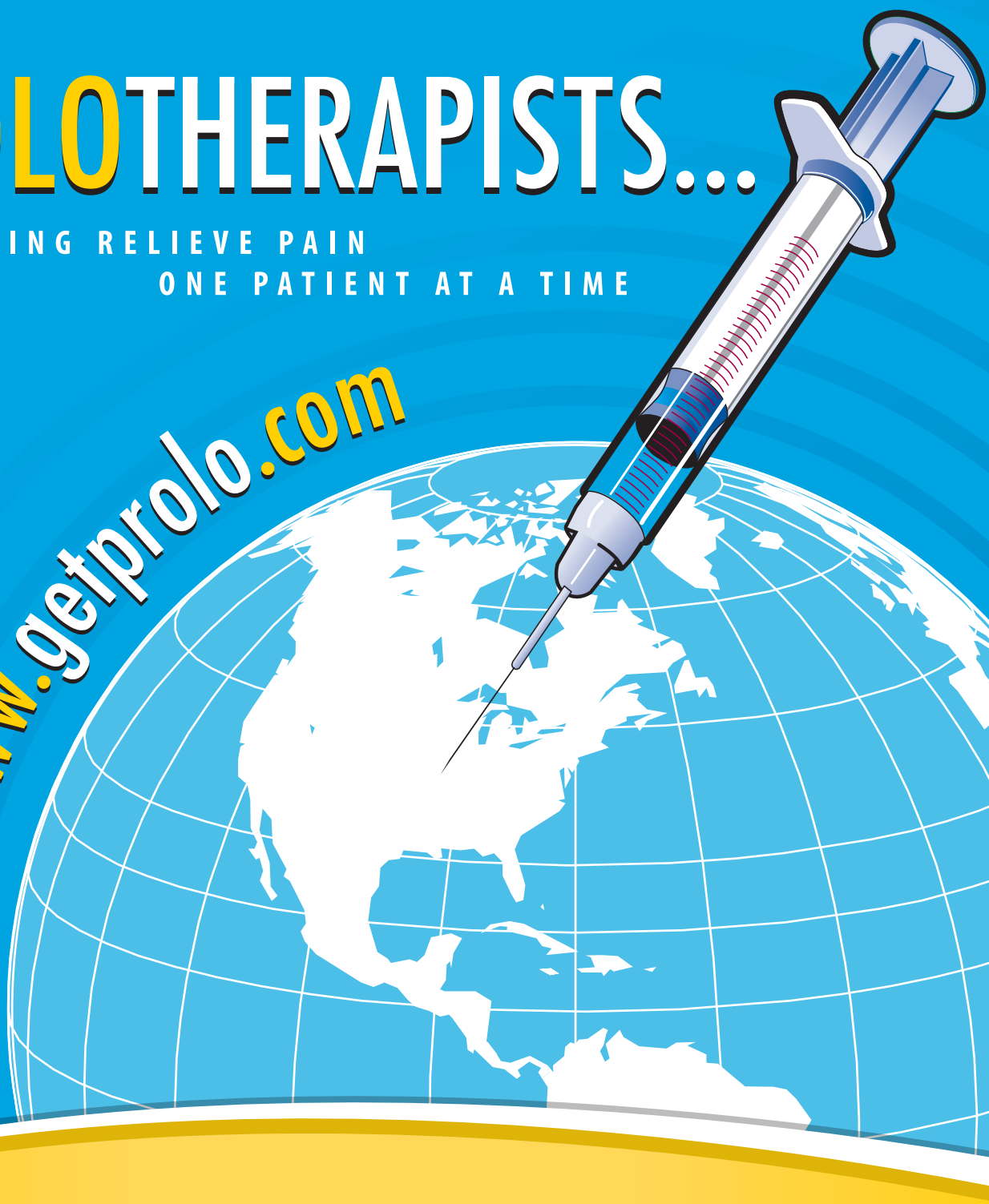

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Table of Contents

JOP Team

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GREAT NEWS CORNER

Prolotherapy is the Best Treatment for Knee Pain and Instability

Ross A. Hauser, MD

For many years, data has been mounting that arthroscopy just doesn't work any better than conservative care for most knee conditions, including degenerative arthritis. This is based on thorough research published in some of the most prestigious medical journals in the world.[1-4] This has lead insurance companies to not cover arthroscopic debridement of the knee for knee pain, but they will cover it for mechanical symptoms. This may sound reasonable until one really looks at the definition of mechanical symptoms of the knee: any type of locking, popping or giving way of the knee! Basically, almost every person with a knee has some type of "popping" or crunching (also called crepitation) noise in their knees. This means that a patient who sees an orthopedist who documents mechanical symptoms in the patient's knee and/or if the patient's MRI shows any type of loose body or meniscal tear, then arthroscopic surgery can be done and will be covered by insurance.

One problem with the above scenario is that MRIs cannot reveal the cause of the patient's pain. Among persons with radiographic evidence of osteoarthritis, the prevalence of a meniscal tear was 63% among those with knee pain, catching, or stiffness on most days, and 60% among those without symptoms.[5] Let's think about this some more. A full 60% of people who have no pain will show a meniscal tear on MRI! The net result is that the number of knee arthroscopies continues to rise because everyone with a knee problem qualifies for it! But there is a better way… and that is Prolotherapy.

If there is one joint in the body that responds tremendously well to Prolotherapy, it is the knee! Whether the condition is degenerative arthritis, pes anserine or patellar tendinopathy, collateral or cruciate ligament sprains—they all respond well to Prolotherapy. For decades, Prolotherapy physicians have treated painful knees, with and without mechanical symptoms, successfully with Prolotherapy. It's really just a matter of how many treatments are needed.

Arthroscopic surgery for mensical issues typically results in meniscectomy (removal). The thinking is simply that the meniscal tear didn't heal on its own, so we need to remove this tissue and the knee will feel better. This type of thinking is a bad idea. I urge you to take a look at the following subheadings excerpted from *Prolo Your Sports Injuries Away!* which may further convince you:

"Study Shows Increased Contact Stress Pressure After Meniscectomy."

"Study Shows Meniscal Surgery Actually Increases Injury."

"Incomplete Healing And Further Deterioration Result After Meniscal Repair Surgery."

"Meniscectomy Causes Arthritis."

"Partial Meniscectomy: More Arthritic Changes Result."[6]

Prolo Your Sports Injuries Away! was written in 2001 and is loaded with references to back up its claims regarding treating mensical injuries. After nearly 10 years, we felt it was time to revisit the mensicus, therefore Caring Medical (my private practice) hired a pre-med college student to co-author a meniscus paper. During her research, she related her findings to me during a meeting, "Meniscectomy surgery results (partial or complete) are terrible! Why would anyone get that surgery?" Well said, Hilary! The data clearly reveals that arthroscopic partial meniscectomy will age a patient's knee by 20 years! In almost every knee arthroscopy report I have seen (hundreds and hundreds), over 90% describe in detail the removal of meniscal tissue (meniscectomy). (*See Figure 1.*) Once the meniscal tissue is gone, there is a tremendous increase in pressure on the articular cartilage and this quickly starts to break down. This is what we call the progression from arthroscopy to arthritis.

Two pre-med college students, Hilary Phillips and Havil Maddela, collaborated with us on Prolotherapy for MRI-documented cases of meniscal degeneration and meniscal tears on patients from Caring Medical. The results of this study reveal that Prolotherapy is the best option for knee pain and instability.

DESCRIPTION OF THE PROCEDURE: *The patient was placed in a supine position and general anesthesia was administered. The knee was prepped and draped in usual manner. The tourniquet was raised to 350 mmHg. The arthroscope was inserted into the suprapatellar pouch. The underside of the patella was noted to be free of any pathology. No Loose bodies were noted. The scope was swept from the medial compartment of the knee. A complex tear of the posterior two-thirds of the medial meniscus was evident. Chondromalacia of the medial femoral condyle was quite severe and some areas with bone were exposed. This was over the entire weightbearing surface grade 3 to grade 4. The intercondylar notch exhibited an intact cruciate ligament complex and the lateral meniscus was noted at its free edge of the middle third and slightly posterior third to have an attritional tear. The lateral meniscus was trimmed with a basket forceps taking approximately 10% of the middle third and posterior third. The basket forceps was utilized to trim away the torn meniscus in the medial compartment of the knee and this was further smoothed with a 5.5 mm end cutter and a chondroplasty was performed with similar instrument over the femoral condyle to remove the unstable cartilage. The patient had approximately 20% of the posterior middle thirds balancing it into the anterior third. After this was done to the satisfaction of the surgeon, the knee was irrigated with a Toomey syringe, and closed with 4-0 Vicryl. Depo-Medrol and Marcaine was instilled. A bulky dressing applied. The patient tolerated the procedure well.*

Figure 1. Operative report describing meniscectomy during a knee arthroscopy. This patient, like most I've treated, had no idea that their meniscus was removed. They would not have gone through with the arthroscopy, especially if the future arthritis risks were known ahead of time.

Also in this issue, we welcome new columnist, Jack Henry, DC who presents a meniscal tear case. We are looking forward to Dr. Henry's contributions in educating our readership on radiologic findings. *Skill Enhancement* columnist, Rodney Van Pelt, MD demonstrates Prolotherapy for pubis pain. Veterinary columnist, Babette Gladstein, VMD discusses Prolotherapy used in spinal injury cases she has treated.

In the Spotlight first features Peter Blakemore, DO who has written a piece highlighting the Neuromusculoskeletal Medicine residency at Michigan State University. Students can elect to rotate in private Prolotherapy offices, which continues to gain headway into medical residencies and hopefully will soon be offered in the school. Also *In the Spotlight* is an interview I conducted with Joanne Borg-Stein, MD, who is practicing PRP Prolotherapy at Harvard.

From Germany, Joern Funck, MD reports a *Remarkable Recovery* case and explanation of how to treat the coronary ligament of the knee. In this issue, we also have two articles relating to temporomandibular joint dysfunction and dentistry. First Roy Hakala, DDS and Kim Ledermann, DDS wrote a great article on Prolotherapy for TMJ dysfunction. Second, our *JOP* team interviewed Jeri Coffey, DDS in her Riverside, Illinois office and consulted her on when to consider a dental cause for a patient presenting with chronic headaches.

Last but not least, in *It's a Wide, Wide World*, Wanona Wellspring, DN has authored an article on using aromatherapy as an adjunctive pain therapy. In addition, Jose Eleazar Calderon de la Fuente, MD from Mexico has written to share the outcome of the first Prolotherapy conference in Mexico City. He did a tremendous amount of work, and the results were nothing short of remarkable in regard to the patients who were treated and the fellow physicians to whom he taught the Hackett-Hemwall technique of Prolotherapy.

As always, thanks to all of our readers for your continued support of Prolotherapy. As the issue shows, Prolotherapy and its practitioners are continuing to improve patients' lives around the world! ■

Until the next injection,
Ross A. Hauser, MD

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Ozone Prolotherapy course in Mexico: A letter from José Eleazar Calderón de la Fuente, MD following the FIOOT Prolotherapy course in Mexico City

Ross A. Hauser, MD

LETTER FROM READER

Dear Dr. Ross Hauser,

I want to inform you that the first course of Prolotherapy in Mexico City, has been a success. The course took place on November 27th and 28th 2009. It was organized by the International Federation of Ozone Oxygen Therapy (FIOOT). Its President, Dr. Fabio Antúnez Guzmán, made the opening presentation, and the course was taught by myself.

The first day of the course involved a long slide show, which explained the technical aspects of the procedure, and was received with much greater success than I expected. It also reviewed historical Prolotherapy topics from its founder, Dr. George S. Hackett, along with those of Dr. Gustav A. Hemwall. The slides also featured theoretical, clinical topics, physical examination and especially the histiopathologic studies carried out by different physicians in the United States, which was an overwhelming proof of the Prolotherapy science.

Dr. Calderon with students, marking the low back at the injection sites.

The second day was practical application with patients of different pathologies and different regions (neck, lumbar, knees, ankles and elbows, even a temporomandibular). They were first injected by me, then other doctors were allowed to inject, among which were mostly orthopedists and chiropractors, anesthesiologists (who specialize in pain conditions, ie: phantom pain), and one specialist in physical medicine and rehabilitation.

We distributed the complimentary "*Prolo Your Pain Away!*" books you sent, which were very well received, as well as the *Journal of Prolotherapy* issues. It reaffirmed the credibility and confidence in this technique, due to the great seriousness and global acceptance of the journal.

The end of the course was closed by our President, Dr. Antúnez, and was proceeded by the distribution of diplomas (distributed by myself). Of course, **the most important and wonderful part of this course was that it was recognized by our Secretary of Public Education (SEP), which is the body of educational oversight in our country, and allows us to perform Prolotherapy freely in our clinics.** Two days after the event, the president of FIOOT and I spoke. He told me that the treated patients were extremely happy, because for the first time they noted a positive change in their chronic

pain. Dr. Antúnez was so pleased that he wants to hold the course twice a year by FIOOT. He also invited me to come to Monclava, Coah. to reaffirm his training, and to take a personalized course in my clinic.

With great esteem and affection for having been taught to see the world of chronic pain from a different perspective, your student,

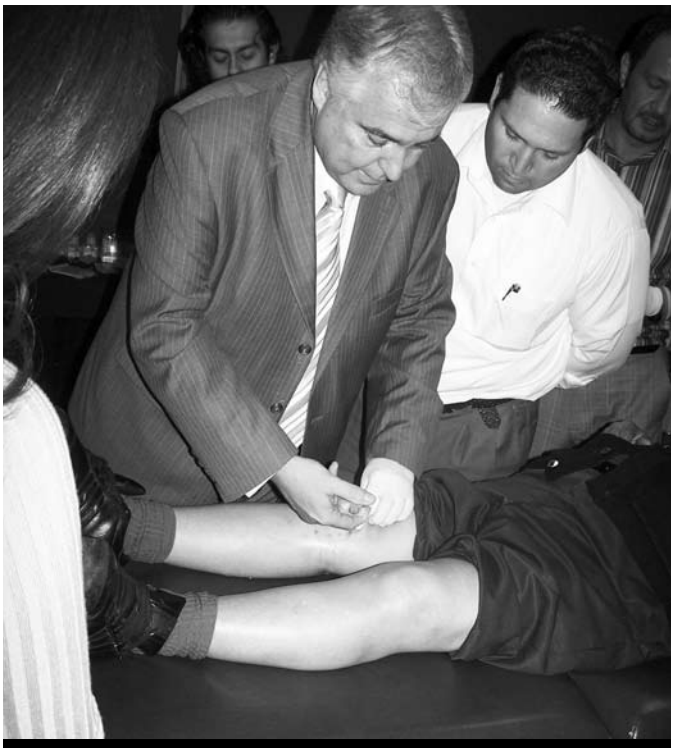
Dr. José Eleazar Calderón de la Fuente

EDITOR'S COMMENTS

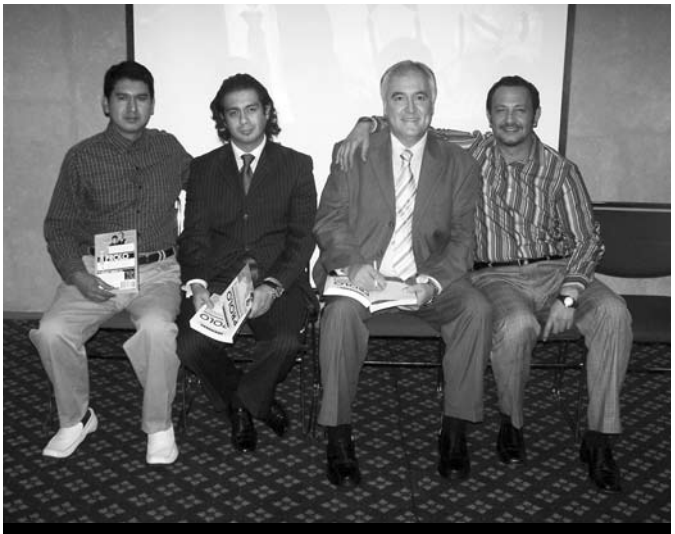
Dear Dr. Calderon:

That is great news that Prolotherapy has been recognized by the Secretary of Public Education in Mexico. It is in large measure because of your tremendous effort to be one of the first Prolotherapists in all of Mexico. As a representative of Prolotherapists around the world, I congratulate you on your work in Mexico! As Prolotherapy gets accepted not only by patients and the physicians who perform Prolotherapy, but by the governing bodies overseeing public health and medical care in the various countries, its availability to eliminate pain across the globe will surely continue to grow. Let's hope one day we see Prolotherapy as one of the main therapies available for people suffering from disabling pain!

Ross A. Hauser, M.D. ■



Dr. Calderon demonstrating Prolotherapy to a knee.



Two students with Dr. Calderon and Dr. Fabio Antunes (FIOOT President).

IN THE SPOTLIGHT

Prolotherapy and Platelet Rich Plasma Research at Harvard: Interview with Joanne Borg-Stein, MD

Ross A. Hauser, MD & Joanne Borg-Stein, MD

RH: Dr. Borg-Stein, please give our readership an overview of who you are, and your role at Harvard.

JBS: I am on faculty at the Harvard Department of Physical Medicine and Rehab, and also at the Spaulding Rehabilitation Hospital. I have roles as the director of the spine center at Newton Wellesley Hospital and medical director of the Spaulding Rehab center in Wellesley, Massachusetts. Also, I am the team physician for Wellesley College, a division three women's college, with 12 varsity teams. I am also the director of our sports medicine fellowship here at Spaulding and Harvard. I see people that are older, younger, and adolescent, with acute, sub-acute, and chronic musculoskeletal injuries.

RH: In looking at your qualifications and some of the items on the Spaulding Rehab website, it says your research interests include Platelet Rich Plasma, women's sports injuries and prevention, sports medicine, among others. Can you go into detail on how that inspired some of your research interests?

JBS: I'd say about 10-12 years ago, I started getting interested in regenerative medicine and Prolotherapy. I did some training in New England, and at other courses, and started using Prolotherapy as a first regenerative treatment. We are now in the final stages of publishing our research comparing Prolotherapy to corticosteroid injections for chronic lateral elbow pain. We hope to have that in print within the next few months. Our recruitment was not as strong as we wished because a lot of the patients did not want steroids. They did not want to be randomized. We seemed to have a trend toward better outcomes with the Prolotherapy group than the steroid group. That was a few years ago. More recently, over the past two to three years, as I studied musculoskeletal ultrasound and became more familiar and comfortable with that, I started using more Platelet Rich Plasma for treatment of chronic musculoskeletal injuries. Our sports medicine fellow is analyzing our first two years of data. We looked at patients prospectively, and we have outcome measures pre- and post-treatment. We're going to be analyzing them to see how our patients have done with Platelet Rich Plasma. Our next step is to set up some randomized, controlled trials, applying Platelet Rich Plasma to different musculoskeletal diagnoses.

RH: Having done some Platelet Rich Plasma for the last several years, are there certain conditions that you have a sense that this particular type of Prolotherapy works best with?

JBS: We are in a learning curve to try to sort that out. Research thus far is strongest for the use of Platelet Rich Plasma for tendinopathy. This includes the non-insertional tendinopathy, mid-substance tendinopathy, and small partial tears. The applications are expanding as we try to figure out what the physiological effect of PRP may be on ligaments, muscles, joints, arthritis. Currently, the strongest indication is tendinopathies.

RH: Please elaborate for readers who may not be familiar with the term tendinopathy, versus tendonitis, and tendinosis.

JBS: Sure. Our old thinking was that tendonitis, or inflammation of the tendon, was the pathologic process. We've learned over the last 10 or 12 years that in chronic conditions, overuse, or degenerative change in the substance of the tendon, is not necessarily inflammation around the tendon. So that is why we've had to consider other treatment options that help to restore, regenerate, or help heal these areas. Tendinopathy is just the general term that refers to any disorder of the tendons. There's a spectrum from just some mild thickening, to disruptions of the tendon fibers, to small defects and partial tears in the tendon fibers. We all have to be careful because this is part of wear and tear and aging. We have to make

sure we correlate what we see on ultrasound, MRI, with our physical examination, and the actual pathology. So, tendinopathy is just the term that's describing this generic type of change in the tendon. Tendonitis would be the term that applies to the inflammatory response in the tendon or the surrounding sheath around the tendon.

RH: In your discussion on a lot of the chronic conditions being more degenerative and those situations needing PRP Prolotherapy or traditional Prolotherapy to try to regenerate the structures, are there other modalities that you would prescribe or recommend in those situations?

JBS: Certainly. Those of us who do injections of Prolotherapy or Platelet Rich Plasma injections have treated, or are treating, our patients with a precise physical examination, bio-mechanical assessment and adjustments, and strengthening. We also consider medical, metabolic or nutritional factors. You've got to look at their structure. Patients may have some deformity, leg length discrepancy, weakness, or muscle imbalance. So, injection is just one minor part of the rehabilitation process to try to heal the tissue. The most important being exercise, and all the other factors that we do in rehabilitation.

Dr. Borg-Stein performing a Platelet Rich Plasma (PRP) treatment.

RH: As you discussed, you are a chief of Physical Medicine & Rehabilitation at a teaching hospital and are affiliated with Harvard Medical School. Are you sensing that in the field of Physical Medicine & Rehabilitation, there is more of an openness toward alternative therapies such as Prolotherapy?

JBS: I think that there's a very healthy and appropriate degree of academic skepticism, but willingness to take a look and consider that there may be a valid science behind it. So people are open to hearing about it, but are compelling those of us in the field who are interested in this, to be diligent, to do the controlled trials and understand the basic science and put an evidenced foundation behind the clinical practice.

RH: Okay. You have done a lot of work related to pain and musculoskeletal pain as it relates to pelvic disorders. I was hoping you could elaborate a little on that. What type of disorders do you see, and what type of treatment modalities are helpful for those disorders?

JBS: I do not treat gynecological and pelvic floor pain and incontinence. I really deal more with sports and musculoskeletal injuries around the pelvis. It can be often ligamentous or tendinopathy, sacroiliac, hip girdle, labrum, adductors or groin muscles, lower abdominal muscles and their attachments, and are often associated with kicking sport athletes and are very frequently managed conservatively. Rarely do patients need surgical intervention. So it's something that we can approach like everything else with good analysis of their sport and their bio-mechanics, their muscles and their strength. I personally think it is an area that can respond quite well to regenerative injection treatments, if other treatments fail. I've been most impressed with the research that Topol and Reeves published both in the *Archives of PM&R* and the *American Journal of PM&R* in terms of their outcome, using Prolotherapy for treating kicking sport athletes, rugby soccer players, in South America. They have excellent outcomes with very chronic conditions.

RH: One condition you mention there was hip or labral issues. Do you find that is a condition that responds to regenerative injection therapy?

JBS: I don't know yet. The hip girdle is complicated. Often times labral tears are incidental radiographic finding and not the proximate cause of pain. I think we

need to be diligent and careful in our physical examination and assessment of the hip girdle: anteriorly, laterally and posteriorly. I don't think there is any data yet, and certainly no radiographic data and pre- and post- studies, looking at what happens to the torn labrum if one gets regenerative injections.

RH: Another condition you seem to have a research interest in revolves around cervicogenic disorders. You had co-authored some papers and discussions. I was hoping you could elaborate on that subject.

JBS: Something I was doing more active research 10-15 years ago. Although I continue that in clinical care, I have not really committed any research time to that in a decade or so. I think local trigger point and regenerative-type injections can be helpful in some of the soft tissue musculoskeletal conditions in and around the neck scapula, and shoulder girdle. But we haven't really done any research pertaining to Prolotherapy and vertigo, per se.

RH: Do you teach residents?

JBS: We have a full time PM&R resident and a PM&R sports medicine fellow that I teach.

RH: If you were talking to them about how to document results with regenerative injection therapy, what type of advice would you give them?

JBS: You want to get important information about a patient's functional status. Look at what they were able to do beforehand and what they were able to do after. Certainly would like to know their pain rating and pain score as well. So both functional outcome measures and pain rating measures would be important.

RH: Is there anything else you want to tell me that you think would be important about your particular interests or things that you've seen?

JBS: I think that with rehabilitation medicine and the management of soft tissue injuries that we do, this could present an opportunity to get people better in ways that we haven't before. That said, there is a temptation when there is a new treatment to make generalizations and conclusions without supporting it with appropriate research. I think that's our call for the future. To think about and be leaders in the science and clinical outcomes, to give people studies that can give this a strong academic basis, so that people will continue to do it, support it, and add it to their treatment regimen. I had the opportunity to set up a task force in the American Academy of PM&R for research in Platelet Rich Plasma in which we're trying to get a collaborative effort between different centers across the country and different practitioners that have an interest in it. Hopefully we can really do a good job. I hope soon you will see a review article that we put together going over all the literature, both in animal and in human models, summarizing what we know in regenerative biology as it applies to sports injuries and musculoskeletal injuries. I'm hoping that will give us all the background that we need to go forward and do good science. ■

IN THE SPOTLIGHT

Osteopathic Neuromusculoskeletal Medicine Residency Program: From a Resident's Perspective

Peter J. Blakemore, DO

I have been around Prolotherapy for over half my life. Through high school and before my undergraduate education, I worked as a lab tech and medical assistant at Caring Medical in Oak Park, Illinois, and assisted in many medical missions that incorporated Prolotherapy into the basic patient care. I also had the opportunity to work with some excellent osteopathic doctors who integrated their knowledge of the human body, palpation and manipulation skills, and their osteopathic medicine philosophy, with Prolotherapy to treat many musculoskeletal problems. When I applied to medical schools, I decided I wanted to have the philosophy of medicine and training that the osteopathic schools provided. Through medical school, I continued to enjoy working with musculoskeletal problems and directed my focus toward that type of patient, particularly enjoying the use of manipulation to care for these problems. During these years of training, I determined that there were at least a few specific modalities I wanted to become very proficient in using for the future. Two of those treatment types were osteopathic manipulation and Prolotherapy. I also wanted to receive more extensive training in the anatomy and physiology of the human body and focus on learning how to improve the function of a person from a neurological and musculoskeletal perspective. As I looked into residencies, I wanted something that would help me get that training, and allow me to continue developing my skills in manipulation, and also study Prolotherapy. I was led to, what I feel is the best fit for my specific requirements: a Neuromusculoskeletal Medicine residency.

Neuromusculoskeletal Medicine (NMM) residency programs are relatively new and they are uniquely osteopathic. They are sometimes referred to as Neuromusculoskeletal Medicine/Osteopathic Manipulative Medicine (NMM/OMM) programs because of the extensive training and specialization in manipulation. There are only a handful of programs, mostly small, with only a few residents per year at most.

There are several other ways to obtain similar training, including plus-one fellowships that may be performed after other residencies or a combined Family Practice/Neuromusculoskeletal Medicine residency (FP/NMM). NMM/OMM is one of 18 medical specialties recognized by the American Osteopathic Association (AOA) Bureau of Osteopathic Specialties (www.osteopathic.org). NMM/OMM specialists are board certified through the American Osteopathic Board of Neuromusculoskeletal Medicine (www.aobnmm.org).

The Neuromusculoskeletal Medicine residency (NMM) at Michigan State University (MSU) is part of the Michigan State College of Osteopathic Medicine, and is under the direction Lisa DeStefano, DO. (*See Figure 1.*) It is a two year residency, following a general medicine rotating internship. The residency prepares well rounded physicians to practice and teach musculoskeletal medicine, with emphasis on Osteopathic Manipulative Medicine (OMM). A normal week is divided into three main parts,

Figure 1. Peter Blakemore, DO with his primary attending physician and residency director, Lisa DeStefano, DO.

with three to four half-days of direct patient care in the clinic: two half-days of teaching in the medical school, and two whole days devoted to the resident's educational rotations. As a resident, I treat and follow my own patient load, usually starting as new patients. I manage the patient's care personally. The clinic is an osteopathic manipulation specialty clinic and most of our patients come with musculoskeletal or pain complaints. (*See Figure 2.*) The clinic has two to four residents, and approximately 10 physicians, most of whom also teach in the college of osteopathic medicine. All the attending physicians are specialists in manipulation, and some have additional specialty training. Whenever residents are seeing patients in the clinic, there is an assigned attending physician on site to supervise, and give instruction and advice as needed. All patients are presented to the attending physician, and as a new resident, there is involvement with each patient by the attending. This personal involvement from the attending physician gradually changes through the residency as the resident becomes more competent, so that by the end of the program the resident will be comfortable and competent to see all their patients without supervision. There are some injection treatments performed at the clinic, including trigger point injections, but at present, patients who require Prolotherapy are usually referred out to another Prolotherapist. Through the residency program, though, we are planning to begin treating our own patients with Prolotherapy in the very near future.

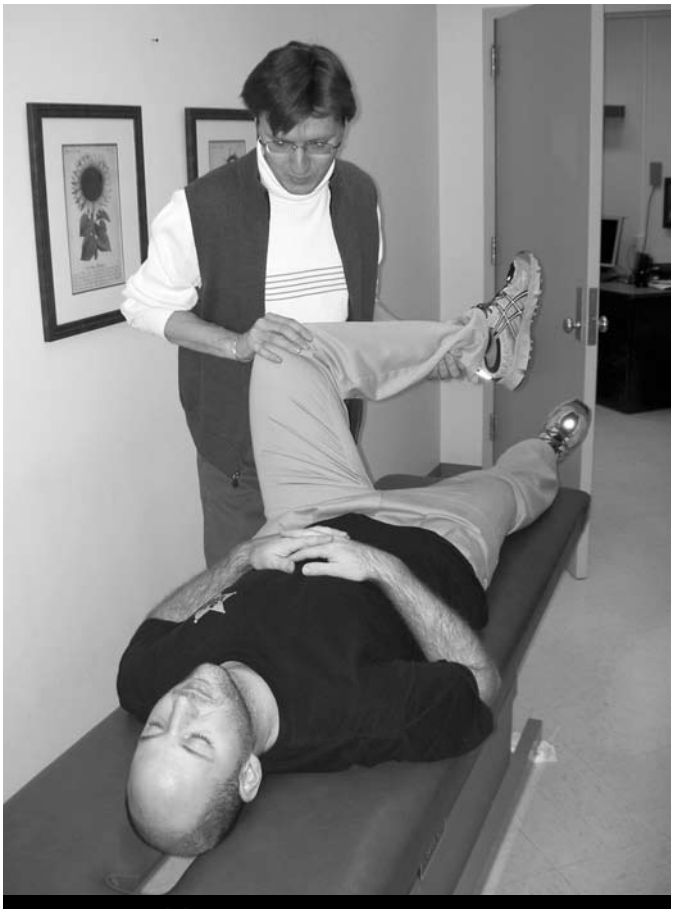


Figure 2. Dr. Blakemore examining a patient.

The environment is very conducive to learning by requiring the resident to personally take the responsibility for the patient while incorporating a teaching atmosphere for instruction as needed. The situation is also extremely beneficial to the patient because the resident usually has more time to devote to each patient than the attending physician would be able to give, and the patient's care is directed through a combination of the resident's fresh perspective and the attending physician's advanced experience and counsel.

The second main division of time in a normal week is devoted to teaching in the college of osteopathic medicine. (*See Figure 3.*) The medical students spend their first two years of school on site at the campus during their preclerkship portion before doing their clinical years. In addition to the complete medical school curriculum of basic sciences and applied medical sciences, osteopathic physicians are trained to use their hands for diagnosis and treatment with osteopathic manipulation. Through the NMM residency at MSU, the resident's are involved in teaching Osteopathic manipulation to the students. This teaching ranges from being a small group instructor for 10-15 students to personally teach the students the practical portion of the manipulation curriculum to giving complete lectures to the entire 250 student class.

During two full days of a normal week, the NMM resident is also involved in a rotation schedule to continue his/her own training in allied fields to better understand disease processes and produce a competent, well-rounded doctor. These rotations include specialties like rheumatology, physical medicine and rehabilitation, radiology, sports medicine and neurology. The research portion of the residency is also performed using the rotation schedule. There are also elective rotation blocks that can be used to personalize the resident's education in specific areas of interest. The electives may be performed in the normal rotation schedule of two days per week or there are allowances to do devoted rotations where an entire month

Figure 3. Dr. Blakemore teaching a group of medical students.

is spent on a rotation. In that case, the patient and teaching responsibilities may be waived so the resident can spend a significant amount of time in that area of study and, if necessary, travel to a distant site for the rotation.

In my case, I have used one of my electives to do a devoted Prolotherapy rotation. I spent a month working with Mark Cantieri, DO in Mishawaka, Indiana. Dr Cantieri is a specialist in Osteopathic manipulation and Prolotherapy and treats primarily musculoskeletal problems. During that month I was able to apply myself in depth to the study of muscle firing patterns, biomechanics and ligament and tendon injuries and their relationships to the overall function of the patient. It was very helpful to study a practice type that uses an integration of manipulation, therapy and injections, including Prolotherapy, to treat musculoskeletal pain and dysfunction. Dr Cantieri is an excellent physician and teacher. His training was invaluable.

The residency at MSU also hosts other NMM and FP/NMM residencies, approximately once per month, to take part in a journal club and didactics that have a musculoskeletal and osteopathic manipulation focus. Other responsibilities include assisting in a student run free clinic where medical students see patients from the community and treat them using osteopathic manipulation at no charge and oversight of a research study using osteopathic manipulation to prevent the occurrence of stress fractures in athletes. In the stress fracture study, we have been following the MSU women's cross country team for a number of years, under the direction of Lynn Brumm, DO, and have been developing a program of interventional manipulation to evaluate for and treat incorrect biomechanics to decrease the stress that is applied through the athletics. Thereby decreasing the incidence of stress fractures.

Overall, the Neuromusculoskeletal Medicine residency gives a good preparatory base to practice musculoskeletal medicine with a focus on improved function and decreased pain and gives the opportunity for an osteopathic physician to improve his diagnostic and manipulation skills and integrate the use of valuable procedures like Prolotherapy. ■

For more information about NMM/OMM residencies, visit the American Academy of Osteopathy (www.academyofosteopathy.org).

FANTASTIC FINDINGS

The Case for Utilizing Prolotherapy as First-Line Treatment for Meniscal Pathology:

A Retrospective Study Shows Prolotherapy is Effective in the Treatment of MRI-Documented Meniscal Tears and Degeneration

Ross A. Hauser, MD, Hilary J. Phillips, and Havil S. Maddela

ABSTRACT

Meniscus injuries are a common cause of knee pain, accounting for one sixth of knee surgeries. Tears are the most common form of meniscal injuries, and have poor healing ability primarily because less than 25% of the menisci receive a direct blood supply. While surgical treatments have ranged from total to partial meniscectomy, meniscal repair and even meniscus transplantation, all have a high long-term failure rate with the recurrence of symptoms including pain, instability, locking, and re-injury. The most serious of the long-term consequences is an acceleration of joint degeneration. This poor healing potential of meniscus tears and degeneration has led to the investigation of methods to stimulate biological meniscal repair. Research has shown that damaged menisci lack the growth factors to heal. In vitro studies have found that growth factors, including platelet derived growth factor (PDGF), transforming growth factor (TGF), and others, augment menisci cell proliferation and collagen growth manifold. Animal studies with these same growth factors have confirmed that meniscal tears and degeneration can be stimulated to repair with various growth factors or solutions that stimulate growth factor production. The injection technique whereby the proliferation of cells is stimulated via growth factor production is called Prolotherapy. Prolotherapy solutions can include dextrose, human growth hormone, platelet rich plasma, and others, all of which stimulate connective tissue cells to proliferate.

A retrospective study was done involving 24 patients, representing 28 knees, whose primary knee complaints were due to meniscal pathology documented by MRI. The average number of Prolotherapy visits was six and the patients were followed on average 18 months after their last Prolotherapy visit. Prolotherapy caused a statistically significant decline in the patients' knee pain and stiffness. Starting and ending knee pain declined from 7.2 to 1.6, while stiffness went from 6.0 to 1.8. Prolotherapy caused large improvements in other clinically relevant areas such as range of motion, crepitation, exercise, and walking ability. Patients stated that the response to Prolotherapy met their expectations in 27 out of the 28 knees (96%). Only one out of the 28 patients ended up getting surgery after Prolotherapy. Based on the results of this study, Prolotherapy appears to be an effective treatment for meniscal pathology. While this is only a pilot study, the results are so overwhelmingly positive that it warrants using Prolotherapy as first-line therapy for meniscal pathology including meniscal tears and degeneration.

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KEYWORDS: human growth hormone, meniscal degeneration, meniscal tear, meniscus, platelet rich plasma, Prolotherapy.

EPIDEMIOLOGY OF MENISCAL INJURIES

Knee injuries are a common concern resulting in over 1 million surgeries performed to the knee in the United States every year.[1-3] According to the National Athletic Trainers' Association, knee injuries account for 10% to 19% of high school sports injuries and 60.3% of all high school athletic-related surgeries.[4] Similar studies of collegiate sports have shown that knee injuries make up 7% to 54% of athletic injuries, varying by the nature of the sport.[5-9] The leading injuries to the knee, in both adults and children alike, are primarily patellofemoral derangements or ligament strains and tears.[10-12] Secondary to these injuries are meniscal tears, which have generated particular interest in both the young and elderly population as studies over the past several decades have revealed a rise in both degenerative and traumatic meniscal injuries. Meniscal tears occur as early as childhood, where they serve as the leading cause of pediatric arthroscopy, and increase with age and activity.[13, 14] An estimated one sixth of knee surgeries are

performed for lesions of the meniscus, and it is likely that many more remain untreated every year.[15, 16] In one study of cadaver knees, untreated meniscal lesions were found in 34% of the autopsied subjects.[17]

A significant percentage of meniscal injuries result from athletic injury. On a professional level, meniscal tears accounted for 0.7% of all injuries sustained in the National Basketball Association, totaling 3,819 days missed by NBA athletes over a 10 year span.[18] In college sports, studies conducted over a 16 year span by the National Collegiate Athletic Association Injury Surveillance System found internal knee derangement was second only to ankle sprains in both men's and women's college basketball and men's and women's soccer.[5-8] An independent study of college football had equally devastating statistics, reporting injuries to the meniscus in roughly one in five elite college football athletes.[9] With participation in college sports on the rise, the number of meniscal injuries and subsequent surgeries are consequently rising at an alarming rate.[19] Although athletes appear to have the highest instance of injury, meniscus injuries can happen anywhere, regardless of a person's level of activity. A research study conducted in Greece showed that meniscal tears developed equally from traumatic and non-traumatic causes with 72% of all meniscal tears occurring during normal activities of daily living.[20]

ANATOMY & FUNCTION

The menisci (plural of meniscus) are a pair of C-shaped fibrocartilages which lie between the femur and tibia in each knee, extending peripherally along each medial and lateral aspect of the knee. (*See Figure 1.*) The anatomy of both menisci is essentially the same, with the only exception being that the medial meniscus is slightly more circular than its hemispherical lateral counterpart. Each meniscus has a flat underside to match the smooth top of the tibial surface, and a concave superior shape to provide congruency with the convex femoral condyle. Anterior and posterior horns from each meniscus then attach to the tibia to hold them in place. The meniscus is comprised of approximately 70% water and 30% organic matter. This organic matter is primarily a fibrous collagen matrix consisting of type I collagen, fibrochondrocytes, proteoglycans, and a small amount of dry noncollagenous matter.[21, 27] There has been a great deal of speculation and research dedicated to what exact function the meniscus serves, but today there is general consensus that the menisci provide stability in the joint, nutrition and lubrication to articular cartilage, and shock absorption during movement.[21-25]

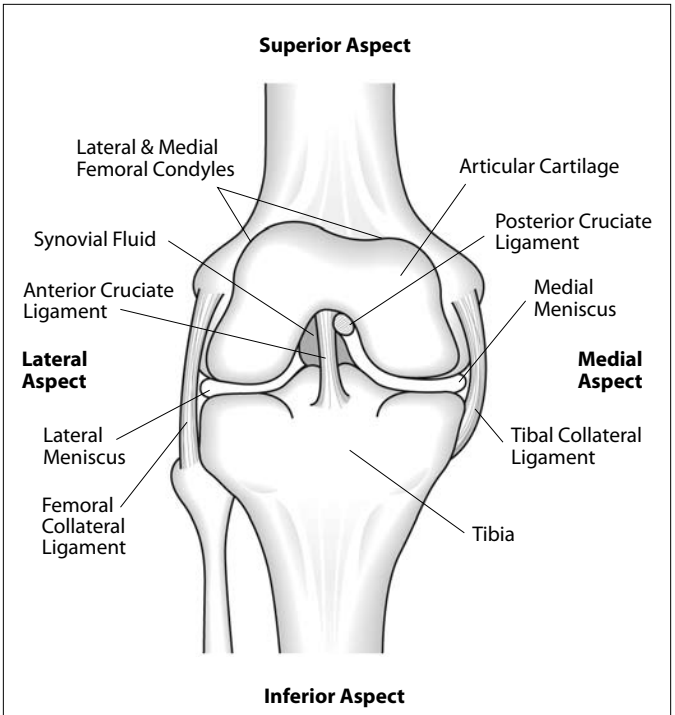


Figure 1. Anterior aspect of the right knee.

The menisci provide stability to the knee joint by both restricting motion and providing a contour surface for tibiofemoral bone tracking. The function of stability is shared with several ligaments which work together to prevent overextension of any motion. The transverse ligament connects the two menisci in the front of each knee and prevents them from being pushed outside of the joint at any point. Hypermobility is avoided through the connection of the medial collateral ligament (MCL) to the medial tibial condyle, femoral condyle, and medial meniscus, and the connection of the lateral collateral ligament (LCL) to the lateral femoral epicondyle and the head of the fibula; these ligaments provide tension and limit motion during full flexion and extension, respectively. The anterior and posterior meniscofemoral ligaments form an attachment between the lateral meniscus and the femur and remain taut during complete flexion. Lastly, the anterior cruciate ligament (ACL) and posterior cruciate ligament (PCL) are responsible for preventing too much backward or forward motion of the tibia.[23, 24]

The menisci also provide shock absorption and stability by equally distributing weight across the joint. It is

estimated that 45% to 70% of the weight-bearing load is transmitted through the menisci in a completely intact joint.[21] By channeling the majority of this weight evenly, the meniscus is able to avoid placing too much direct stress at any one point of the knee. In turn, proper weight transmission in the knee reduces stress on any other joints in the body affected by load bearing.[25]

One of the most vital roles of the meniscus is to provide lubrication to the knee, which it accomplishes through diffusing synovial fluid across the joint. Synovial fluid provides nutrition and acts as a protective measure for articular cartilages in the knee.[26] The femoral condyle in the knee is covered in a thin layer of articular cartilage, which serves to reduce motional friction and to withstand weight bearing. This cartilage is very susceptible to injury both because of its lack of proximity to blood supply and the high level of stress placed on it by excessive motion.[27,28] The meniscus, therefore, is able to provide a much-needed source of nutrition to the femoral and tibial articular cartilage by spreading fluid to that avascular area.

By acting as a spacer between the femur and tibia, the meniscus eliminates any direct contact between the bones, preventing any contact wear.[29] To see what effect the presence of the meniscus has on degeneration within the knee, researchers from the UK at the Institute of Medical and Biological Engineering conducted an in vitro study by mounting dissected bovine knee joints in a pendulum friction simulator and monitoring wear on knee cartilage both with and without a meniscus. Their results showed no change in surface integrity or loss of cartilage with an intact meniscus, *but removal of the meniscus resulted in immediate surface wear and cartilage deterioration.*[30]

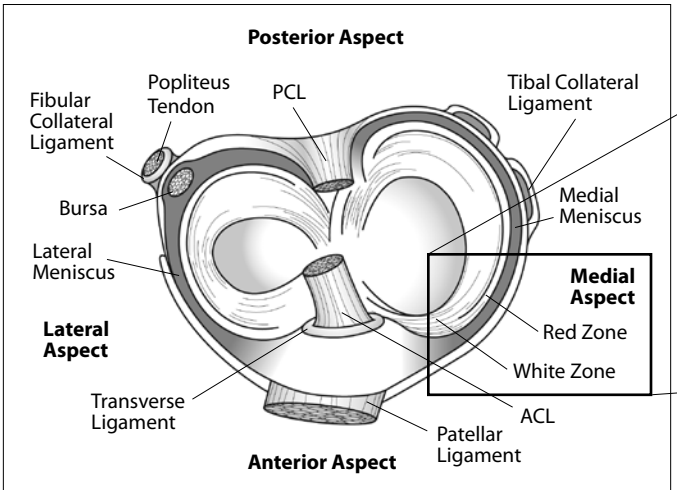


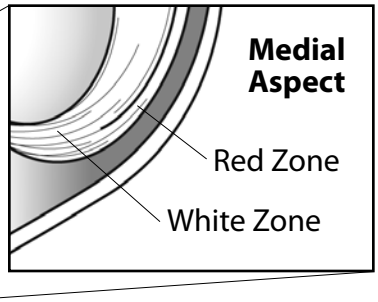
Figure 2. Superior aspect of right knee showing red and white zones.

The ability to preserve the meniscus, unfortunately, is somewhat hampered by the fact that only a very small percentage (10% to 25% peripherally) of the meniscus receives direct blood supply.[31] This area is often referred to as the red zone, and the inner portion of the meniscus which does not receive blood supply is referred to as the white zone. (*See Figure 2.*) While the red zone has a moderate chance of healing from injury, the white zone is almost completely incapable of healing itself in the event of injury.[32]

INJURY

Tears are the most common form of meniscal injury, and are generally classified by appearance into four categories: longitudal tears (also referred to as bucket handle tears), radial tears, horizontal tears, and oblique tears.[33] (*See Figure 3.*) Research indicates that radial or horizontal tears are more likely to occur in the elderly population while younger patients have a higher incidence of longitudal tears.[34-36] Each can be further described as partial thickness tears or complete thickness tears, depending on the vertical depth of the tear. (*See Figure 4.*)

Meniscal damage can be caused by either trauma or gradual degeneration. Traumatic injury is most often a result of a twisting motion in the knee or the motion of rising from a squatting position, both of which place particular strain and pressure on the meniscus. More often than not, traumatic injuries occur during athletic activity. The ratio of degenerative to traumatic tears increases from equal incidence in those under 20 years of age to a ratio of 7:8 in the 30 to 39 age group, to nearly 4:1 in individuals over the age of 40.[20] This pattern of increased degenerative breakdown is to be expected with age, as joint wear will result from years of mechanical stress. Unlike the anatomy of younger and more active patients, however, the fibers in older patients are less capable of healing themselves, due to decreased diffusion of synovial fluid with lessened motion.[37]



Longitudinal (bucket handle) Tears – vertical tear around the long axis of the meniscus often with displacement of the inner margin (bucket handle).

Radial Tears – extend from the medial rim toward the lateral rim of the meniscus.

Horizontal Tears – tears that are in the same horizontal axis as the meniscus tissue.

Oblique Tears – full thickness tears running obliquely from the inner edge of the meniscus out into the body of the meniscus.

Complex Tears – more than one of the above patterns.

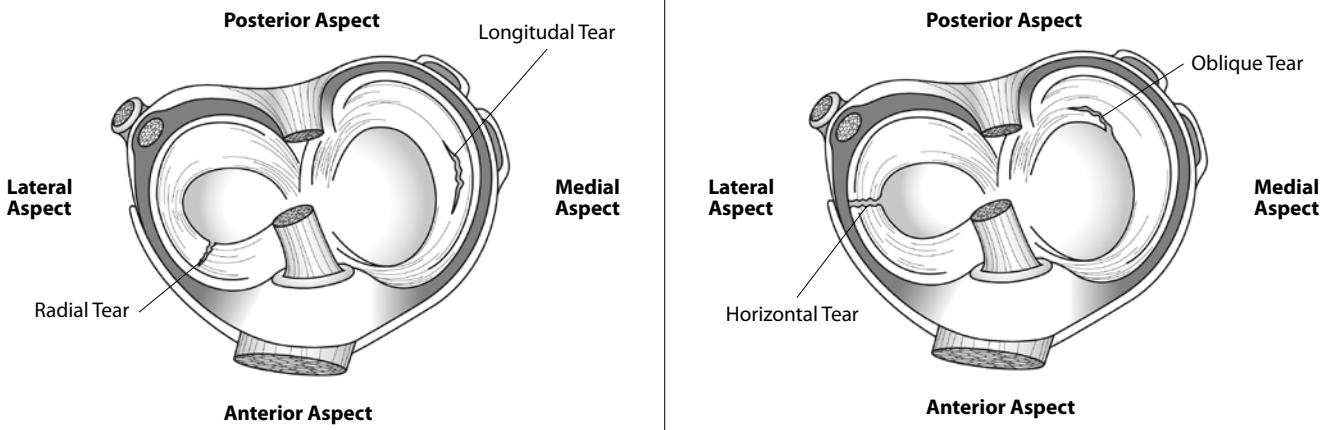
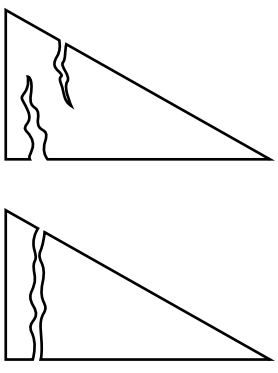


Figure 3. Common types of meniscal tears.



Partial Thickness Tear:
Any tear which extends through only a portion of the vertical depth of the meniscus.

Full Thickness Tear:
Any tear which extends through the entire vertical depth of the meniscus.

Figure 4. Depths of tears in the meniscus.

A basic ability to identify meniscal tear symptoms is essential for diagnosis and treatment of injury. (*See Figure 5.*) The first symptom typically indicative of a meniscal tear is pain. In the case of a traumatic tear, pain may present immediately at the time of injury and is often accompanied by an audible pop. In a degenerative tear, the onset of pain may be more gradual, with no definite moment of injury. In both cases, pain may be accompanied by swelling and subsequent limitation in range of motion. Another hallmark of meniscal tears is clicking, popping, or locking in the knee joint. These symptoms are most likely a result of a torn flap of meniscal tissue which catches in the joint during movement. Instability and weakness are also both common symptoms because a damaged meniscus, as well as damaged ligaments and tendons, inhibits normal mechanical function.

The severity of initiating trauma, as well as the nature and characteristics of the tear, plays an important role in the meniscus' ability to heal. (*See Figure 6.*) Tears that are shorter, partial thickness, and located in the vascular red zone have a much better chance of healing than extensive, complete thickness tears located in the white zone.[38, 39] When other cartilages and ligaments are injured in the knee, this can also have a detrimental effect on the meniscus' ability to heal on its own. Because of the interdependence of each of the knee's mechanisms,

Symptoms of Meniscus Tears

- Clicking or popping
- Decreased knee range of motion
- Instability
- Joint line tenderness
- Locking
- Pain
- Swelling
- Weakness

Figure 5. Symptoms of meniscus tears.

More Likely to Heal	Less Likely to Heal
• Males	• Females
• Patients <50 years old	• Patients 50+ years old
• Patients with BMI < 40	• Patients with BMI > 40
• Traumatic tears	• Degenerative tears
• Red zone tears	• White zone tears
• Radial or oblique tears	• Horizontal or longitudal tears
• Partial thickness tears	• Complete thickness tears
• Shorter tears	• Longer tears
• Lateral meniscus	• Medial meniscus
• Isolated tears	• Tears with associated injuries

Figure 6. Factors affecting the healing of a torn meniscus.

meniscal injuries often occur in conjunction with other internal ligament damage; the most common example of this is O'Donoghue's "unhappy triad," the correlated injury of the meniscus (debatably either medial or lateral), tibial collateral ligament, and ACL.[40-42] The severity of meniscal lesions has been found to increase in direct proportion to ACL injury and/or laxity, and create less favorable conditions for repair.[43] Furthermore, previous injury to either the meniscus or any other ligament inside the knee can increase the risk of future injury to the meniscus, even if the injury has healed or been surgically repaired.

Another condition which can be both a cause and complication of meniscal tears is a discoid meniscus. (*See Figure 7.*) A discoid meniscus occurs when the lateral meniscus takes on the shape of a disc, rather than a crescent, and is most often manifested in adolescence.[44] Although the cause has never been officially determined, the repercussions of a discoid meniscus have been widely documented. Often referred to as "snapping knee syndrome," this condition is identified with its only symptom, snapping on extension. The "snap" is caused when the femur and the meniscus are not able to move in sync with each other and the femur either slips over a ridge in the meniscus or off of the meniscus altogether.[45] Unlike the normal meniscus, which is shaped to fit the condyle of the femur, a discoid meniscus lacks the configuration to serve as a stable surface for motion. This abnormal tracking adds stress on the meniscus, increasing the probability of lateral meniscus tears.[46] Unfortunately, discoid menisci often remain undetected when no symptoms present prior to injury, and the only other way to identify a discoid meniscus is by magnetic resonance imaging (MRI).

IMAGING

For decades, MR imaging has been used as a primary determinant for meniscal injuries. MR imaging uses magnetic frequency to read radio waves given off by protons in the body; through these waves, the MRI is able to identify different tissues in the body and produce a semi-accurate picture of these tissues. The fact that MR imaging is more sensitive to some tissues than others, however, can prevent it from producing a completely accurate picture of an injured area. This can cause injured tissues to remain undetected, or other "abnormalities" on the MRI to be misread as actual injuries. These errors include shadows, truncation artifacts, and even foreign tissues, such as scar tissue, that can have the appearance of an injury on an MRI film. As a result, relying on MR imaging alone, especially as it relates to meniscal tears, will very often lead to an improper diagnosis and, subsequently, improper treatment.

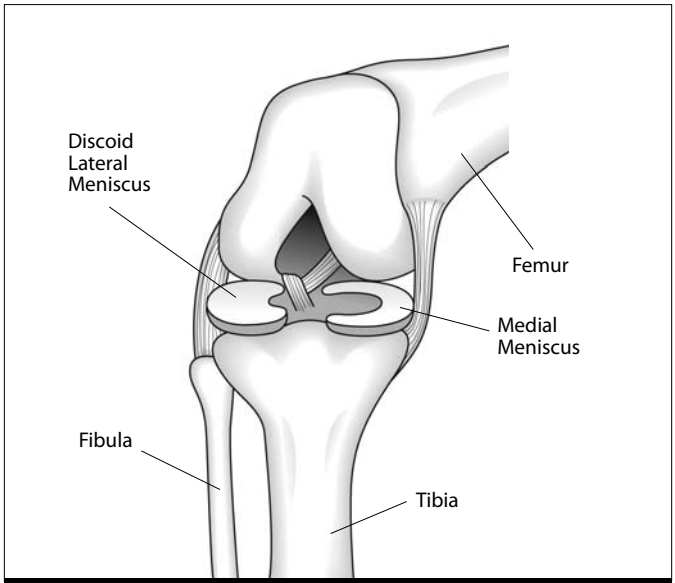


Figure 7. Discoid meniscus of right knee.

One study that brought these issues into the spotlight was performed on college basketball players at Duke University who displayed no clinical symptoms of knee abnormality. Internal irregularities of the knee including cartilage defects, joint effusions, bone marrow edema, and even discoid menisci were found on the MRIs of 75% of subjects, who never displayed any symptoms of meniscal abnormality.[47] When an MRI shows a tear or meniscal degeneration when the person has no symptoms, this is called a false positive. The MRI is falsely positive. Kornick and associates investigated 64 volunteers, between the ages of 10 and 74, and found that over 25% had abnormal signals in their menisci, despite being totally asymptomatic.[48] More distressing is the fact that in another study on children, mean age 12.2 years, 66% showed a high signal intensity within the menisci.[49] A high signal intensity is one of the criterion to diagnose degenerative menisci. (*See Figure 8.*) Perhaps the best study to date to document abnormal meniscal MRI findings in asymptomatic individuals was published in the *New England Journal of Medicin*e in 2008.[50] In this study, MRI scans on 991 knees were taken and compared to clients responses about pain and disability in those knees. The prevalence of meniscal tear or of meniscal destruction in the knee as detected on MRI ranged from 19% among women 50 to 59 years of age to 56% among men 70 to 90 years of age. The MRIs in these patients ages 50 to 90 showed that over 60% had meniscal tears documented on MRI and that *61% of subjects who had meniscal tears did not have any pain, aching, or stiffness in their knees*.

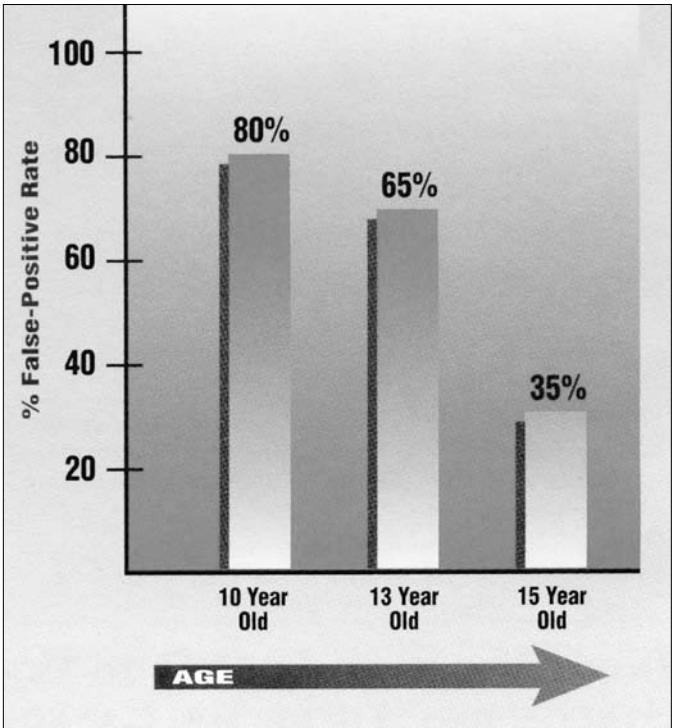
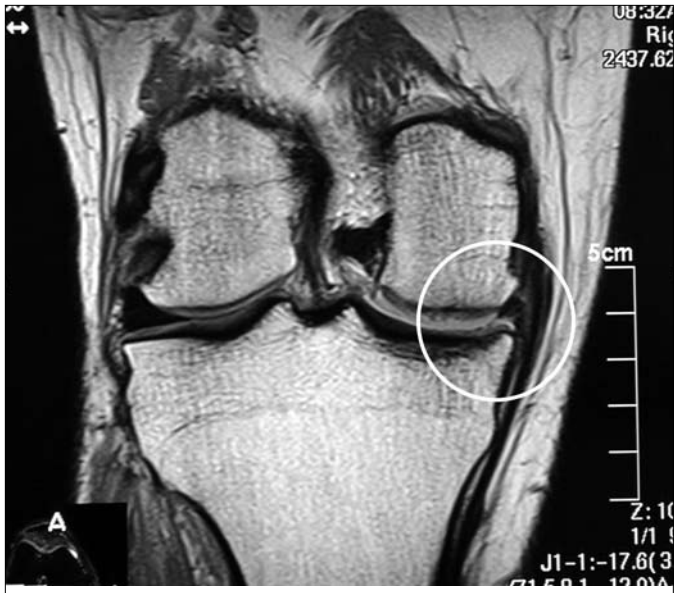


Figure 8. False-positive MRIs of the knee in teenagers. Because significant abnormalities show up in the menisci on MRI in teenagers, when no true injury exists, relying on this modality to make a diagnosis is a scary proposition, especially if surgery is contemplated.

Used with permission of Beulah Land Press © 2001 Oak Park, IL. *Prolo Your Sports Injuries Away!*, fig. 16-10.

Not only do MRI findings often fail to correlate with the associated symptoms of meniscal injury, they are also frequently found to be inaccurate in correctly predicting meniscal pathology found on arthroscopy.[51-54] This was the case in a study in which clinical examination correctly identified 97% of medial meniscal tears and 85% of lateral meniscal tears found on arthroscopy, as opposed to MRI predictions, which were 10% less accurate in each category.[55] Gelb et al. found that, when compared to arthroscopic findings, clinical examination was 100% accurate in the diagnosis of ACL injuries, 91% accurate for meniscal tears, and 100% accurate for articular cartilage damage. MR imaging, on the other hand, was 95% sensitive for ACL injuries, 82% sensitive for meniscal tears, and only 33% accurate in predicting articular cartilage injuries.[56] Other published studies by Liodakis and his colleagues found similar results when studying the preoperative MRI scans of 2,000 arthroscopic meniscectomy patients. Their patients' MRI findings only correlated with the intraoperative arthroscopic findings a mean of 52% of the time.[57] One study published in the *Journal of Arthroscopic Surgery* reported that 35% of their patients would have undergone unnecessary surgery if the examiner had relied on just MRI findings of meniscal tear alone, leading the researchers to conclude that MRIs are "an expensive, unnecessary procedure."[58] (*See Figure 9.*)

Just as MRIs can lead to false-positive readings, they may also produce false-negative findings by failing to detect an actual meniscal injury. This was the case in one study of 254 human knees, where the researchers found that 13% of their patients presented with normal MRIs, despite exhibiting symptoms of meniscal injury confirmable on arthroscopy.[59] In studying the correlation between arthroscopy, clinical examination, and MR imaging, Stanitski found that 71% of his patients were given inaccurate MRI readings, with 24% showing false-positive evidence of meniscal tears, while actual ACL, meniscal, and cartilage injuries went undetected in half of the patients.[60]



Excerpt from radiologist's MRI report.

FINDINGS:
Post surgical changes are demonstrated in medial meniscus with smaller than expected size of body of medial meniscus. Altered signal intensity in body and posterior horn of medial meniscus extending to inferior articular surface demonstrates similar appearance to previous outside MR. This either represents residual changes from prior surgery and meniscal tear or recurrent tear persistent from prior exam.

Figure 9. MRI of the right knee without contrast. Noted are changes in the medial meniscus. See how even the radiologist cannot determine whether this represents a recurrent meniscal tear or is just post surgical changes.

Part of the reason there are so many "abnormalities" in the menisci in asymptomatic individuals is because structures that attach to the menisci can cause an increased signal, which produces the false appearance of a meniscal tear. This was demonstrated in a study in which 109 patients had both arthroscopy and MR imaging of the knee, and the two were correlated.[61] It was found that 42 people (39%) had a normal meniscofemoral ligament attaching onto the lateral meniscus that was appearing on the MR scan as a lateral meniscal tear (high-signal intensity). As seen by these and numerous other studies, MR imaging often disagrees with patients' clinical symptoms or arthroscopic findings, making it a poor tool for diagnosis. At an average cost of $2,500 per scan, MR imaging is an unnecessary expense, especially when incorrect results initiate unnecessary surgeries. It is clear from the knowledge that we have that MRIs are not helping solve the problem of knee pain but can be *part* of the problem.

TREATMENTS

The traditional management of a torn meniscus most often involves some measure of surgical treatment, such as partial or total meniscectomy, meniscal repair, or meniscal transplant. There are an estimated 650,000 arthroscopic meniscal procedures and a total number of 850,000 meniscal surgeries performed in the United States every year.[1-3]

The most aggressive surgical treatment is meniscectomy, which involves either complete or partial removal of the meniscus depending on the horizontal extent of the tear. Guided by arthroscopy, the damaged portion of the meniscus is surgically debrided and removed. In either operation, a peripheral rim of the meniscus must be kept to preserve any form of normal function within the knee. The decision of whether to remove all or part of the meniscus is based on the severity of the tear, the restriction of activity caused by the tear, and the age of the tear. Total meniscectomy is generally performed on the most severe and avascular tears which cannot be otherwise repaired.[62, 63]

Short-term follow-up of meniscectomy has generated some positive results. For example, a meniscectomy can provide temporary pain relief in early stages following the operation, especially when an acute tear had caused excessive pain or popping preoperatively. Another immediate result may be a greater feeling of stability, if the tear had previously been a source of instability. On long-term follow-up, however, these initial improvements have rarely been shown to last.[63-65] Complete pain relief from meniscectomy is nearly unheard of after more than 10 years and, at that point, more complex issues including limited range of motion, radiographic degeneration, crepitation, and severe functional impairment have usually begun to surface. In many cases, a simple meniscus tear, if operated on, can become a career-ending injury.[63-66] In long-term follow-up studies, four to 14 years after a meniscectomy, nearly 50% of patients had to decrease or stop their typical sporting activities.[63, 64] This included the adolescents who underwent total meniscectomy. The X-ray progression of the degenerative change paralleled the reduction in activity. Some 17 years after follow-up after total meniscectomy, the incidence of degenerative arthritis as documented by X-ray was 300% more likely in the knee that had the meniscectomy versus the non-operated knee.[64]

Joint instability is a common result of meniscectomy, which is not surprising considering that the meniscus is a primary stabilizing component of the knee. One of the principle reasons for meniscal operation is to improve joint stability, yet meniscectomy often appears to have the opposite effect, eliciting even more instability, crepitation, and degeneration than the injury produced prior to operation. This is why reoperation rates after meniscectomy can be as high as 29% to improve the joint instability that the meniscectomy caused.[65-67] A knee joint becomes unstable when ligaments, cartilages, or bone structures are weakened and unable to carry out the level of function of a healthy knee. Such is the case when the meniscus is removed from the knee and unable to perform the usual weight-bearing and tracking functions, placing additional stress on the rest of the knee.[68, 69] Common physical symptoms of instability after meniscectomy are crepitation, such as cracking or popping, and locking in the joint. On radiographic examination, this postoperative deterioration of the joint is evidenced by narrowing of joint space and flattening of the tibiofemoral surfaces. Because the knee is a joint designed for rotational motion, the shape of the bone structures is a vital part of mobility, and when those rotational mechanisms are altered, proper motion is not possible, causing the crepitation in the joint. For example, one study following over 1,000 meniscectomy patients found that 10 to 20 years after the surgery, 27% had more crepitus in the knees which underwent meniscectomy than they had in the untreated knees.[66] In this same group of patients, degenerative changes ranging from flattened tibial and femoral bone surfaces to significant joint space narrowing were found in 62.5% of the patients with X-ray evaluation of their knees. These researchers concluded that there was a direct correlation between the degeneration of these tibiofemoral surfaces and complaints on clinical examination.[65] A similar study found that 10 years after undergoing meniscectomy, 65% of patients had radiographic evidence of joint space narrowing greater that 50%.[69]

The greatest risk of partial and total meniscectomy is in the development of long term degenerative osteoarthritis. Numerous studies have confirmed that a large percentage of the meniscectomy population experience joint osteoarthritis later in life.[70-76] One study found that 15 to 22 years after having a meniscectomy, the odds ratio of knee degenerative arthritis was 2.6 after medial meniscectomy and 5.3 after lateral meniscectomy, using the non-operated knee as the control.[71] In one study, 20 to 29 years after meniscectomy, X-rays showed 53% had significant progression of degenerative arthritis compared to 13% of the non-operated knees.[72] Another group of researchers found that 21 years after meniscectomy, 71% of operated knees showed signs of at least mild degeneration and 48% showed signs of moderate or severe joint degeneration.[74] Another study found that 40% of meniscectomies resulted in degenerative osteoarthritis, and many were accompanied by other injuries, including a large number of ligament tears.[75] One study noted, that "although risk factors for post-traumatic osteoarthritis are multifactorial, the primary risk factor that stood out in this study was if a meniscectomy had been performed." In this study the risk of developing osteoarthritis in the knee after meniscectomy was 100%.[76]

Joint instability *is a common result of meniscectomy.*

Biomechanically, the development of osteoarthritis can be explained, in part, by the increased stress placed on the tibia and femur post meniscectomy. It is a known fact that reducing the size of contact area on a surface increases pressure in the remaining area. Therefore, by removing all or part of the meniscus from the knee, the area through which weight is transmitted in the joint is reduced, thus increasing the pressure on both the tibia and the femur, and their articular cartilage. The amount of contact stress on the tibiofemoral joint can increase by 65% with only a 10% reduction in contact area, and this percentage increases in proportion to the amount of meniscus removed. Complete removal of the meniscus can increase contact stress by as much as 700%.[74-77] (*See Figure 10.*) What this means for any knee without a meniscus is that it now bears the pressure proportional to carrying seven extra people on one knee.

An additional aspect contributing to the acceleration of the osteoarthritic process is through structural wear of the articular cartilage. (*See Figure 11.*) By depriving the joint of the ability to lubricate the articular cartilage, the motion of the femur against the tibia will begin to break down the cartilage. When these articular cartilage cells, which are metabolically active, degenerate faster than they can regenerate, the result is the accelerated breakdown (degeneration) within the joint.[76] One study which followed rabbits in three-month intervals after varying levels of injury, found that the amount of cartilage damage sustained was greatest in the meniscectomy subjects, proving this treatment to be even more damaging than

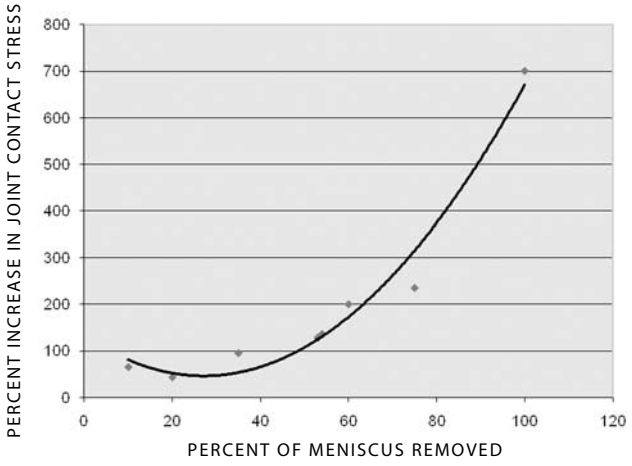


Figure 10. Increase in joint contact stress versus percent of meniscus removed. As the percentage of meniscus removed during surgery increases, joint contract stress increases exponentially. Thus arthroscopic meniscectomy dramatically increases the incidence of future degenerative knee arthritis.

Source: 1. Baratz ME, et al. Meniscal tears: the effect of meniscectomy and of repair on intraarticular contact areas and stress in the human knee. A preliminary report. *Am J Sports Med*. 1986;14:270-275.

2. Lee SJ, et al. Tibiofemoral contact mechanics after serial medial meniscectomies in the human cadaveric knee. *Am J Sports Med*. 2006;34(8):1334-1344.

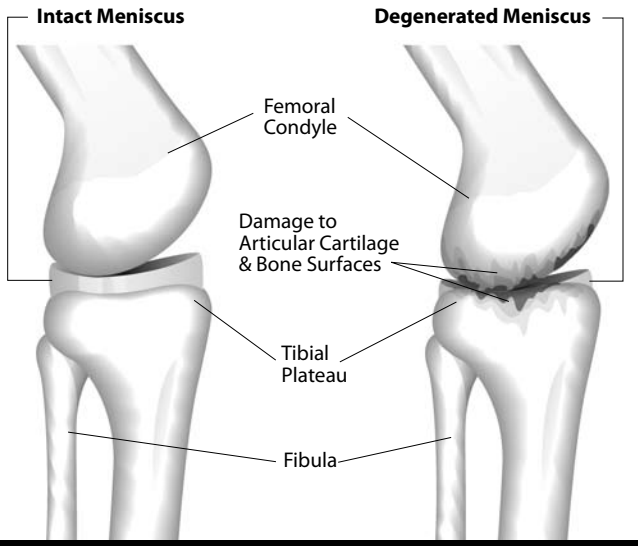


Figure 11. Healthy knee joint with intact meniscus and degenerated knee joint without meniscus. The removal of part or all of the meniscus during arthroscopic surgery accelerates the degeneration of the articular cartilage.

non-treatment.[77] Although osteoarthritis (OA) may have a reputation as a slowly developing disease only prevalent in the elderly, this is clearly not the case. Cartilage loss can develop from adolescent injuries and appear as early as a few years after a meniscectomy.[78-81] Precursors to OA, such as evidence of biological cartilage alterations, can appear in as little as three months post meniscectomy.[82, 83] Because OA develops steadily with time, this can have devastating effects by just five to 10 years after the procedure. The articular cartilage in a knee deteriorates at an average rate of 4.1% per year after meniscectomy.[84] This rate is about twice the rate of normal cartilage loss with aging.[85] After OA forms, the articular cartilage continues to deteriorate in the knee joint at a rate of about four to five percent per year.[86, 87]

The results of total meniscectomy have led to a more cautious approach to meniscal excision, particularly with surgical techniques removing only the damaged portion of the meniscus.[85-88] The thought is that if a portion of the meniscus is preserved, then meniscal function will be more normal as well. Studies have confirmed that removing only the torn portion of a meniscus lowers the severity of postoperative complications, shortens the length of hospital recovery and therapy, and reduces overall pain levels, but the nature of postoperative complications remains the same. These risks include degenerative osteoarthritis, joint instability, femoral and tibial surface damage, and risk of re-injury requiring re-operation.[87, 88] Partial meniscectomy, like total meniscectomy, was found via MRI volume measurement to cause cartilage loss at a rate of 4.1% per year; a rate that is 78% faster than controls.[89] Other researchers noted when meniscal integrity is compromised, such as with partial meniscectomy, the likelihood of developing degenerative arthritis is large.[90, 91] One of the main reasons for this, is that partial meniscectomy by definition puts additional strain on the ligamentous support of the knee to provide stability. Follow-up studies, show that ligament laxity in the medial and lateral collateral ligaments and anterior cruciate ligaments is increased with meniscectomies.[92-94] In regard to degenerative symptoms, one study reported that one year after undergoing an operation, 9% of partial meniscectomy patients experienced functional impairment, versus 28% of total meniscectomy patients. Almost seven years later, these numbers had increased to 62% in partial meniscectomy patients and 52% in total meniscectomy patients.[95] McGinity et al. documented in his study of post surgical function that "athletes who have undergone partial meniscectomy and total meniscectomy were equally likely to give up sports altogether as a direct result of the operation."[96]

As the importance of maintaining complete intact menisci has become more widely recognized, the desire for a less invasive and more curative treatment has been sought out for meniscal injuries. For this reason, many have turned to meniscal repair as their treatment of choice. Meniscal repair utilizes one of several suturing techniques to reattach a torn flap of the meniscus, rather than removing it. In preparation for meniscal repair, the meniscus is generally debrided to remove any tissue that is rendered too loose or "contaminated" to heal, and then the procedure is performed either open or through incision under arthroscopy.[97] Meniscal repair is generally reserved for peripheral tears that extend into the red zone, because the likelihood of healing is greater in that region.[97, 98]

The short-term results of meniscal repair have varied significantly, with a range of both promising and disappointing outcomes.[99, 100] As the ability to track long-term results has become possible, repair failures and associated symptoms have been observed in large numbers, proving the effectiveness of this treatment to be questionable at best. Preoperative symptoms have been shown to resurface as early as six months following meniscal repair, and can lead to long-term joint damage prevalent decades later.[101, 102] Specifically, as documented by CT arthrogram, completely healing from meniscal repair was found in only 58% of the menisci.[101] After a 13 year follow-up the failure rate in one Swedish study was 29%.[102] In this same study, knee function showed a statistically significant decline in the meniscal-repaired knee compared to the non-operated knee. The authors noted, "We conclude that 13 years after repair, knee function is good but not better than after meniscectomy and not as good as in an uninjured knee."

A failed meniscal repair is generally defined as lack of improvement after operation or, more specifically, any re-injury and subsequent re-operation. Re-injury after meniscal repair is not uncommon, affecting the original site of injury as well as new areas of the meniscus. Six independently performed studies, conducted an average of eight years after a repair, found that 10% to 38% of all meniscal repairs were considered failures.[103-108] The 38% failure rate was in patients under the age of 18. It is also worth noting that these injuries were not isolated, but in many cases occurred in addition to the return of multiple preoperative symptoms, such as joint pain, instability, weakness, and swelling. In summary, it can be concluded that about 25% of all meniscal repairs are failures. In more practical terms, for 25% of all patients undergoing meniscal repair, the surgery will either not relieve their symptoms or the repair will fail and their symptoms will again return and need another operation or some other form of therapy. For instance, in one study, meniscectomy was needed in 10% of the patients after meniscal repair.[109] Considering the average follow-up for these groups of studies was eight years, imagine what the failure rate of meniscal repairs would be at 16 or 24 years!

Another concern associated with meniscal repair is, not surprisingly, long-term degenerative osteoarthritis.[109-112] This makes sense since a great percentage of meniscal repairs do not heal completely. One study found that only 30% of patients after meniscal repair showed no signs of osteoarthritis, whereas 83% of patients exhibited no signs of osteoarthritis before the treatment.[109] Although meniscal repair is most frequently performed in regions of greater vascularity, the treatment does not actually stimulate meniscal healing through vascular supply.[110] There was a 12% re-injury rate after meniscal repair in this study.

The most recent contribution to surgical treatment of meniscus injuries has been the advent of the meniscal transplant. Transplantation can be performed either with human allograft or artificial collagen implants, with the majority utilizing deep-frozen cryopreserved allografts extracted from human cadaver knees. Before a transplant can be conducted, the patient must undergo arthroscopic removal of any remaining meniscal tissue to prepare for the new implant. Using one of two techniques, a bone plug or a bridge, the implant is then placed inside the knee in alignment with the femur and tibia, and then sutured into place. This procedure requires careful measurement of the meniscus and precision in matching the size and placement of a new meniscus, as even the slightest error in measurement could cause improper tracking and damage to the knee.[113]

This method has been monitored closely for short-term results, but because it is a relatively new treatment and methods between studies have varied, long-term results are difficult to assess. Based on what information we do have, however, hope for long-term relief remains questionable. In a number of studies spanning from two to seven years after allograft transplantation, failure rates ranged from 28% to 58%, where symptoms such as allograft deterioration, new tears, and unresolved pain

symptoms resulted in premature removal of allografts or additional arthroscopic surgeries.[113-115] As one study states, "[patients] should be advised that the procedure is not curative in the long term, and additional surgery will most likely be required."[113] (*See Figure 12.*) Recovery time is another important issue in assessing any treatment, and transplants have a longer rehabilitation time than other meniscal operations. In documented transplantation cases, patients did not begin physical rehabilitation until eight weeks post operation, at which time they were started on non-strenuous activities such as cycling, followed by swimming and walking, between nine and 12 weeks post operation. Even in the most successful knees, patients were informed that they should never return to arduous physical activity, including athletics.[114] Meniscal transplantation with such a high failure rate, diminishes the hope that anyone, especially athletes, would have for maintaining an active lifestyle.

Although there is some short term improvement in aspects such as pain control, the long term effects of meniscectomy, meniscal repair, and meniscal allograft transplantation reveal that symptoms, such as pain and instability, will persist for years afterward. The main reason that these and other treatments are ineffective in healing the meniscus can simply be attributed to the fact that, regardless of what is done to structurally repair the meniscus, it is still primarily an avascular cartilaginous structure which cannot heal without a sufficient supply of nutrition. The poor healing potential of meniscal tears has led to the investigation of methods to provide blood supply to the injured area. The methods include vascular access channels and synovial pedicale flaps. Unfortunately, no surgical treatment to date has been shown to stimulate healing of the meniscus. On the contrary, surgeries often have the opposite effect. They initiate additional damage to the joint, further decreasing the probability of healing. Current surgical techniques for meniscal injuries accelerate menisci and joint degeneration. Perhaps Lohmander et al. in their comprehensive review of surgical procedures for meniscal pathology said it best, "there is a lack of evidence to support a protective role of repair or reconstructive surgery of the anterior cruciate ligament or meniscus against osteoarthritis development…Osteoarthritis developed in the injured joints is caused by intraarticular pathogenic processes initiated at the time of injury, combined with long-term changes in dynamic joint loading."[116] The bottom line is surgical procedures do not initiate the regenerative process needed in these traumatized knee joints. Left alone or treated by the surgery, the degenerative process initiated by the initial trauma continues, unless something is done to initiate regeneration. The reverse of degeneration is simply regeneration. In other words, a degenerative process can only be reversed when stimulated to repair itself. Degeneration of the meniscus is initiated by a damaged meniscus' inability to repair itself, and the surgical procedures themselves accelerate the degenerative process. The ideal treatment for the damaged meniscus is one that can stimulate regeneration of the degenerated or torn meniscus. The injection technique whereby the proliferation of cells is stimulated via growth factor production is called Prolotherapy. (*See Figure 13.*)

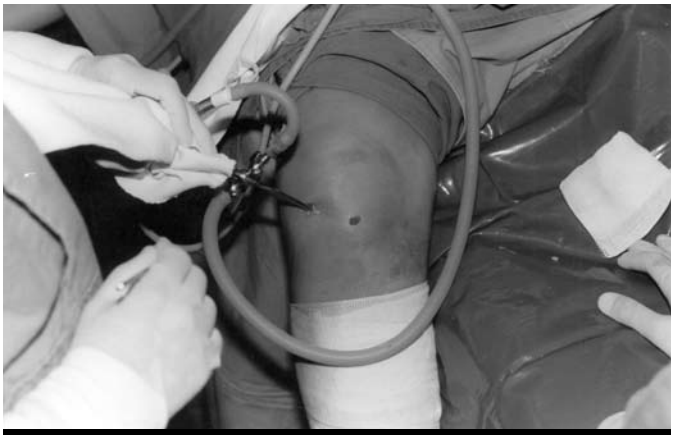


Figure 12. Arthroscopy of the knee. Arthroscopy of the knee for meniscal injury is often non-curative and can lead to long term problems, including degenerative arthritis.

PROLOTHERAPY FOR MENISCAL PATHOLOGY

In order to understand how growth factors affect the treatment of meniscus injuries, it is first important to understand the role that they play in the natural process of healing. The preliminary steps of healing begin with the attraction of blood cells to the site of an injured tissue. When a tissue is injured, bleeding will naturally occur in that area. A specialized type of blood cell called platelets, rush to the area to cause coagulation, or the clotting of blood cells, to prevent excessive bleeding from an injury. In addition, platelets also release growth factors which are an integral part of the healing process. Each platelet is made up of an alpha granule and a dense granule which contain a number of proteins and growth factors; the growth factors contained in the alpha-granule are an especially important component to healing. When activated by an injury, the platelets will change shape and develop branches to spread over injured tissue to

Figure 13. Effects of treatments for meniscal tears. Only Prolotherapy stimulates the repair of injured meniscal tissue.

Effects of treatment	Meniscal removal	Meniscal repair	Meniscal transplant	Untreated injury	Prolotherapy
Articular cartilage deterioration	YES	YES	YES	YES	NO
Bone deformity	YES	YES	YES	YES	NO
Chronic pain	YES	YES	YES	YES	NO
Continuing instability	YES	YES	YES	YES	NO
Joint space narrowing on MRI	YES	YES	YES	YES	NO
Likely to be re-injured	YES	YES	YES	YES	NO
Long term osteoarthritis	YES	YES	YES	YES	NO
Restricted motion	YES	YES	YES	YES	NO
Weakened ligaments	YES	YES	YES	YES	NO
Stimulates meniscus repair	NO	NO	NO	NO	YES

help stop the bleeding in a process called aggregation, and then release growth factors, primarily from the alpha granules.

At this point, the healing process then proceeds in three simple stages: inflammatory, fibroblastic, and maturation. After growth factors are released from the platelets, they stimulate the inflammatory stage, each growth factor playing a key role. (*See Figure 14.*) This stage is marked by the appearance of monocytes which are white blood cells that respond quickly to inflammatory signals and elicit an immune response. Growth factor production is at its highest level immediately following the inflammatory stage. Fibroblasts begin to enter the site within the first 48 hours after an injury and become the most abundant cells in that area by the seventh day. The fibroblasts deposit collagen, the main material of tissues such as the meniscus, for up to many weeks afterward. The maturation of collagen may then continue for up to one to two years after the initial inflammatory event.

It is important to understand that each of these stages stimulates the next. If the inflammatory stage does not occur, neither will the fibroblastic stage, and so on. *If there is not a significant enough immune response to completely regenerate the damaged tissue in any of these stages, the injury will be unable to heal completely, leaving the person with a chronic degenerated knee.*

In the case of the injured meniscus, it is clear that the damaged tissue can not repair itself. Healing in the meniscus depends on the having enough of a blood supply and/or growth factors at the site of the injury. Since less than 20% of the meniscus is vascularized by the time a person reaches the age of 40 years, meniscal healing is generally incomplete.[117] Once torn, the menisci, because of its low cellularity and incomplete healing response, is unable to fully repair itself.[118, 119] In one study, upon a five-year follow up after meniscal allograft transplantation, transplanted menisci were found to have decreased growth factor production indicating decreased biological function. Furthermore, the transplanted menisci were repopulated with fewer cells than even an untreated torn meniscus.[120, 121] It has also been shown that the number of cells in the meniscus decreases with age.[122]

IN VIVO AND IN VITRO STUDIES ON GROWTH FACTORS IN STIMULATING MENISCAL REPAIR

Because growth factors are known to be a basic component of healing, the adjunct use of growth factors to stimulate connective tissue repair has been studied as a potential for the treatment of injured soft tissues, including the meniscus. Direct exposure of connective tissues to fibroblastic growth factors can indeed cause new cell growth and formation of collagen. Therefore, injecting growth factors at the site of a soft tissue injury allows the damaged tissue to heal itself.

Before any treatment is tested on humans, it is common practice to investigate the effect of that treatment, in this case growth factors, on cells (*see side bar*), as well as on animal models with similar pathology to humans. The

Figure 14. Various growth factors found in platelets and their actions.

Platelet-Derived Growth Factor (PDGF)	Attracts immune system cells to the area and stimulates them to proliferate. Has been shown to enhance ligament and tendon healing.
Transforming Growth Factor- β (TGF- β)	Secreted by and affects all major cell types involved in healing. Similar affects as PDGF.
Vascular Endothelial Growth Factor (VEGF)	Helps new blood vessel formation, thereby increasing vascularity in injured areas.
Fibroblast Growth Factor (FGF)	Promotes the growth of the cells involved in collagen and cartilage formation.

primary objective of these studies is to determine if and how a poorly vascularized tissue, such as the meniscus, can be stimulated for reliable cellular and tissue repair. In such studies, growth factors, such as the ones extracted and secreted from the platelets are incubated with meniscal cells and then injected into injured meniscal tissue to see if cellular repair and regeneration occurs. Many studies demonstrate that injection of various growth factors can increase meniscal cell activity and stimulate repair, in this tissue and other connective tissues.[123-140] As with other tissues that have a poor blood supply, like cartilage, meniscal cells are sparse. They are best categorized as fibrochondrocytes, as they have cellular characteristics of chondrocytes, cartilage cells, and fibroblasts that synthesize connective tissues such as ligaments.[141] The meniscal cells are responsible for maintaining the extracellular matrix. The ideal mode of treatment for meniscal tears and degeneration would stimulate the production of meniscal fibrochondrocytes and its synthesis of extracellular matrix (ECM). Increased ECM synthesis would render the generated meniscal tissue more able to withstand the forces placed on the knee. For it is the collagen, proteoglycans and glycoproteins in the ECM which give the meniscus its compressive properties to withstand tensile loads.[142]

in vivo *- experimentation done on live isolated cells.*

in vitro *- experimentation done in an artificial environment outside the living organism.*

Platelet-derived growth factor (PDGF) is one growth factor commonly used in animal meniscus studies. One recent study measured both cell proliferation and extracellular collagen matrix formation in each of the inner, middle, and outer regions of sheep menisci, in the presence of PDGF-AB. After one week, meniscal cell proliferation was apparent in all three meniscal zones, reaching an 800% increase in the inner vascular zone compared to control. The formation of the collagen matrix had increased by 450% in the middle zone and by 300% in the outer zone. (*See Figure 15.*) An increase in the production of glycosaminoglycans, a main component of synovial fluid, in each of the three zones was observed.[132] Meniscal cell migration was also stimulated. A similar in vitro study found that cell production of sheep menisci increased with proportion to the increased concentration of PDGF-AB used. This study observed a 2.5-fold increase in cell production.[133] Another in vitro study placed bovine meniscal cells in different solutions containing cytokines and measured the effect of each on the synthesis of new

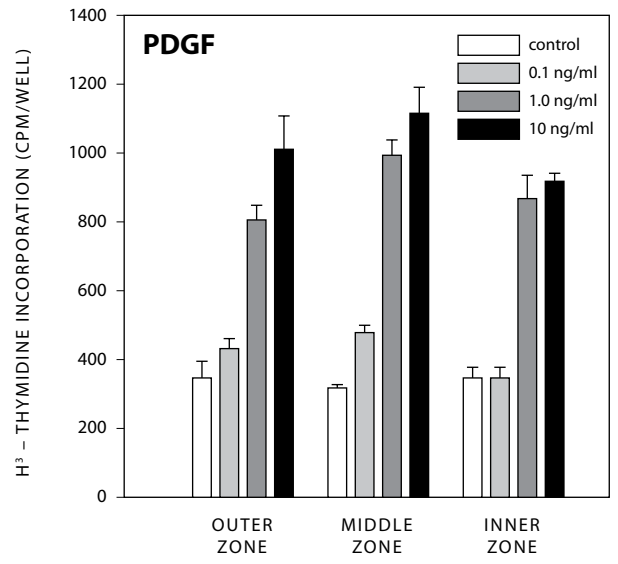


Figure 15. Effect of platelet-derived growth factor-AB on DNA synthesis in cells from the three zones of the meniscus. Results are mean + SEM (N = 12). Platelet-derived growth factor at 1 and 10 ng/ml increased DNA synthesis (in both the middle and inner zones) by over 400% compared with control.

Source: Bhargava MM, et al. The effect of cytokines on the proliferation and migration of bovine meniscal cells. *Am J Sports Med*. 1999;27:636-643.

cells in each of the three meniscal zones. The authors reported that significant DNA synthesis occurred in meniscal cells treated with PDGF-AB, hepatocye growth factor, and bone morphogenic protein-2, in all three regions.[134] Similar results were found when analyzing the effect of basic fibroblastic growth factor (bFGF) on meniscal cells from sheep. When cultured in the bFGF, the formation of DNA increased by as much as seven-fold, and protein synthesis increased by as much as 15-fold in the inner (avascular) zone of the meniscus. The results of the outer and middle zones likewise yielded statistically significant cell growth.[135, 138] The synthesis of proteoglycans, the principle component of the extracellular collagen matrix, was specifically measured in another study on sheep menisci. In all meniscal zones, transforming growth factor beta (TGF-β) stimulated proteoglycan production by up to 100% and the proteoglycans were larger than controls. TGF-β also stimulated cell division in the fibrochondrocyte cultures.[137] Other authors have also confirmed that meniscal fibrochondrocytes from all three zones, including the avascular zone, can proliferate and generate new extracellular matrix given the proper stimuli.[128, 129, 139, 140] Such findings have been the basis of the integration of growth factors in the treatment of meniscal pathology.

One study involved the use of growth factors TGF-β1 and insulin-like growth factor (IGF-1) as an aid in the insertion of meniscal plugs into the avascular portion of the meniscus. This study found that TGF-β1 was effective in forming an attachment between the actual meniscus and the plugs, and IGF-1 was effective in cell proliferation. Both growth factors also significantly increased the cell density of the plugs.[127] Canine menisci with a defect in the avascular portion documented a 10-fold increase in healing by the addition of a fibrin sealant and endothelial cell growth factor.[137] In this study, the ingrowth of new blood vessels (neovascularization) and granulation tissue (connective tissue) to the avascular portion of the meniscus was noted. Growth factors have even been introduced into surgical treatments, particularly meniscal transplantation, to preserve and enhance joint tissue.[143, 144]

The evidence that avascular cells are capable of regeneration, when properly stimulated to do so, serves as the basis and rationale for Prolotherapy in the treatment of meniscal pathology.

PROLOTHERAPY STIMULATES GROWTH FACTOR FORMATION

The primary objective of Prolotherapy injections is to initiate or recreate the inflammatory stage of the healing process. It does so by raising the levels of growth factors to resume or initiate a repair sequence that has prematurely aborted or never started.[145] Cells in the area of exposure, such as fibroblasts, chondrocytes and fibrochondrocytes, can also be expected to respond if the growth factors are those that proliferate such cells.[146] By triggering this cascade of anabolic events, Prolotherapy stimulates the new growth of cells and is indirectly responsible for rebuilding depleted tissues.

Typical Prolotherapy solutions use a hypertonic solution of dextrose (glucose) as its base. Studies have shown that even a brief exposure to small amounts of glucose molecules causes an elevation in growth factors such as IGF-1, TGF-β, TFG-β, bFGF, and PDGF-B.[145-150] Another substance used in Prolotherapy, especially for degenerative knee conditions, is human growth hormone (HGH).[151] HGH stimulates the production of IGF-1 in the liver, but it can also have an important role in the localized treatment of degenerate cartilage cells. Circulating and locally produced IGF-1 can stimulate DNA synthesis, cell replication, and proteoglycan and glycosaminoglycan synthesis in articular chondocytes.[152] Additional studies show that HGH and IGF-1 have both been shown to cause growth and repair of articular cartilage cells.[153-155] One reason for this cartilage growth can be that cartilage cells have HGH receptors.[156] Anecdotal radiographic evidence of the regeneration of articular cartilage has been seen with and without the use of HGH with Prolotherapy to the knee.[157, 158] Other published studies have documented symptomatic improvement in patients with degenerative knee arthritis with Prolotherapy.[159-161]

Another emerging technique in the field of Prolotherapy is Platelet Rich Plasma Prolotherapy (PRPP), which utilizes the injection of human autologous blood components to facilitate healing of degenerative tissue injuries. In this technique a small amount of whole blood is drawn and is separated into platelet poor plasma and platelet rich plasma. The latter is used in PRPP and consists of plasma, which is the liquid component of blood, containing a high concentration of platelets. Because platelets are the storehouses of growth factors, platelet rich plasma is abundant in growth factors. PRPP though not only provides a higher concentration of growth factors to the tissue than is provided by normal blood supply, it stimulates the injured tissues to increase their own innate growth factor production.[162-164] PRPP has shown in one controlled study to give statistically significantly better results for knee osteoarthritis then hyaluronan injection.[165]

In actual clinical practice, there are a host of solutions available to the doctor performing Prolotherapy. Although there have been no studies to date directly addressing the use of Prolotherapy for meniscal injuries, Prolotherapy has a long history of treating degenerative knee conditions including meniscal pathology.[166-169] For seventeen years the primary author (R.H.) has treated meniscal pathology successfully with Prolotherapy. This retrospective study was done to document the degree of improvement in meniscal tears and degeneration with Prolotherapy.

PATIENTS AND METHODS

All patients were treated at the primary author's private practice, Caring Medical and Rehabilitation Services in Oak Park, Illinois. A premedical student (H.M.) reviewed in-house medical charts of patients who had completed their last Prolotherapy treatment at least one year ago and had MRI documented meniscal pathology. This criterion was chosen to give adequate time to determine if the positive effects of the Prolotherapy treatments

continued once they were finished. H.M. completed phone interviews asking the patients a series of questions with an emphasis on the effect Prolotherapy had on their knee pain, stiffness, and quality of life.

All patients received the Hackett-Hemwall technique of dextrose Prolotherapy to the knee. This included a 15% dextrose, 10% Sarapin and 0.2% lidocaine solution as the base solution. Each patient was given an intraarticular injection of 5-10cc of solution. Twenty-four of 28 knees received 2IU of human growth hormone added to this base solution. Two patients received 3.5cc of Platelet Rich Plasma Prolotherapy (PRPP) injected inside the joint. One patient received only base solution and one patient received manganese as an additive. Injections were also given along the tender points about the knee, including the medial collateral ligament. Patients typically received a total of 30-40cc of solution per treatment visit. Patients were seen every four to six weeks. (*See Figure 16.*)

All data was analyzed by an independent computer consultant (D.G.), who had no previous knowledge of Prolotherapy. A matched sample paired t-test was used to determine statistically significant improvements in the before and after Prolotherapy measurements for pain and stiffness.

PATIENT CHARACTERISTICS

Data was tabulated on 28 knees in 24 patients. Of the 24 patients, 71% (17) were male and 29% (7) were female with an average age of 45 years. Eighteen knees had MRI documented meniscal tears of which eight were acute and ten were chronic (over six months since the tear). The medial meniscus was torn in sixteen of the knees and the lateral meniscus in two. According to the radiographic reports, four of the tears were complex, three were vertical, three were horizontal, two were bucket handle, and one was complete. The other five were nondescript meniscal tears. Arthroscopy had been previously performed on ten of the knees. Ten of the knees had MRI documented meniscal degeneration without tears. (*See Table 1.*)

Table 1. Patient characteristics prior to Prolotherapy.

Injured knees	n=28
Percentage of male patients	71%
Percentage of female patients	29%
Average age of patients	45
Left knees treated	14
Right knees treated	14
Knees with MRI documented meniscal tears	18
Number of complex tears	4
Number of vertical tears	3
Number of horizontal tears	3
Number of bucket handle tears	2
Number of complete tears	1
Number of non-descript tears	5
Arthroscopy previously performed	10
MRI documented meniscal degeneration	10

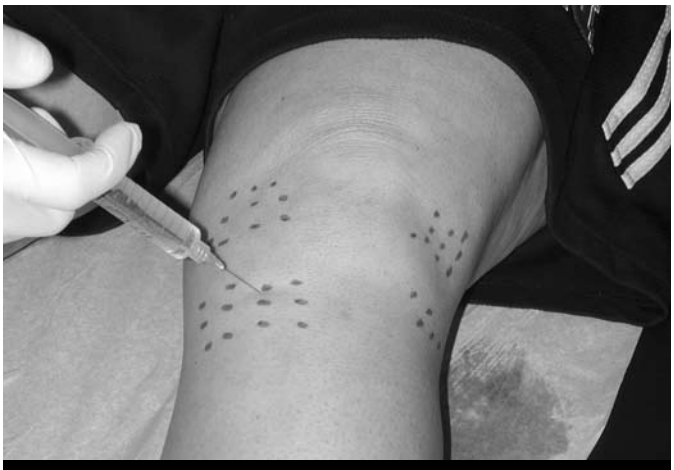


Figure 16. Typical injection sites for Hackett-Hemwall dextrose Prolotherapy of the knee.

Source: Hauser R, et al. A retrospective study on dextrose Prolotherapy for unresolved knee pain. *Journal of Prolotherapy*. 2009;1:11-21.

TREATMENT OUTCOMES

Patients received an average of 6.2 Prolotherapy treatments per knee. The average time since their last Prolotherapy treatment was 18.6 months.

Patients were asked to rate their knee pain, stiffness, and crepitation (crunching sensation) levels on a scale of 0 (none) to 10 (severe crippling). For the 28 knees the average starting pain level was 7.2, stiffness 5.8, and crepitation 4.9 which improved to levels of 1.6, 2.0, and 2.5 respectively, after Prolotherapy. (*See Figure 17.*) Before Prolotherapy, 17 patients were taking one or more pain medications, but after Prolotherapy only three were taking one pain medication.

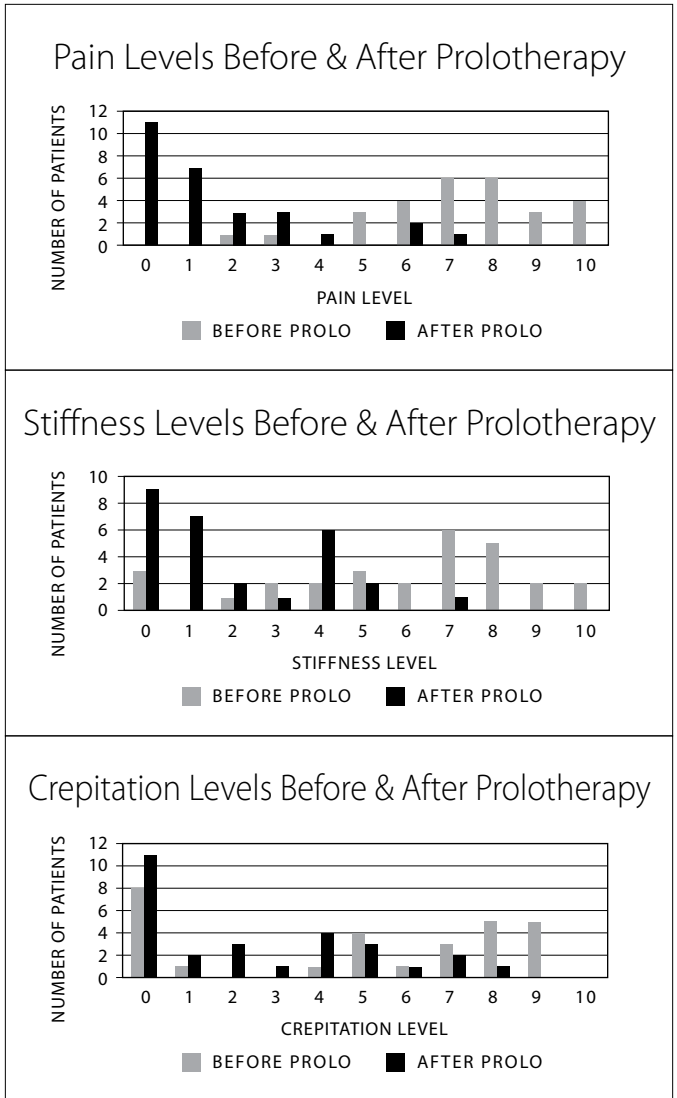


Figure 17. Pain, stiffness, and crepitation levels before and after Hackett-Hemwall Prolotherapy in 28 patients with unresolved knee pain due to meniscal injuries.

Patients were also asked to rank their knee range of motion with 0 being normal motion and 10 representing no motion. The average range of motion improved from a level of 4.1 to 1.1 after Prolotherapy. Only 25.9% of the patients had normal motion (0 or 1) before Prolotherapy, but after Prolotherapy this increased to 75%. Before Prolotherapy only four (14.3%) patients had normal walking ability (0% compromised), but this increased to 20 (71.4%) after Prolotherapy. (*See Figure 18.*) In regard to exercise ability, before Prolotherapy 14.2% of patients could exercise greater than 60 minutes, but after Prolotherapy this increased to 85.7%. (*See Figure 19.*)

In regard to the question "*Did the improvements with Prolotherapy last?*" 96.4% of the patients stated they still have lasting pain relief in their knees as a result of the Prolotherapy. Eighty-six percent reported lasting improvement in stiffness, while 100% of the patients noted their improvement in walking ability continues to this day.

To the question "*Did Prolotherapy meet your expectations?*" 96.4% (27 out of 28) of the patients treated answered "*yes.*" In regard to the question "*Did you end up getting surgery on your knee?*" only one patient answered "*yes.*"

STATISTICAL ANALYSIS

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 24 patients (representing 28 knees). Using the paired t-test, the p values for pain and stiffness for the two groups reached statistical significance to the $p<.000001$ level.

DISCUSSION: PRINCIPLE FINDINGS

The results of this pilot, retrospective, uncontrolled study show that Prolotherapy helps decrease pain and stiffness and improve the quality of life in patients with meniscal tears and degeneration. This includes tears in all three meniscal zones, as well complete and complex meniscal tears. The Hackett-Hemwall dextrose Prolotherapy, including those with human growth hormone or platelet rich plasma added to the intraarticular injection, improved pain and stiffness to a statistically significant level. From the patient's point of view there were noticeable improvements in crepitation and range of motion of their knees. Ninety-six percent (27 out of 28 knees) improved to the point that the patients felt that Prolotherapy met their expectations and no surgery for meniscal pathology was needed. Major improvements in other quality of life issues, including walking ability, exercise ability, and decreased medication usage was also reported with Prolotherapy.

One patient underwent a total knee replacement in February 2010. In reviewing this patient's chart, his initial MRI revealed "a degenerative tear involving the anterior horn and body of the lateral meniscus which extends in a longitudinal fashion to the apex and superior surface." The patient's dates of Prolotherapy treatment were 10/18/06, 2/5/07, 3/19/07 and 7/26/07. At the

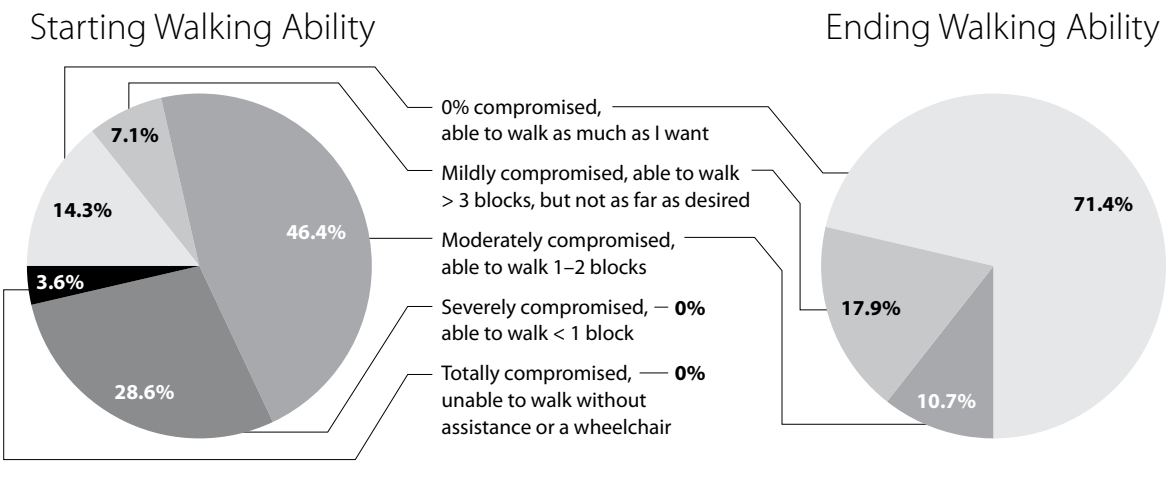


Figure 18. Walking ability before and after Hackett-Hemwall Prolotherapy in 28 patients with unresolved knee pain due to meniscal injuries.

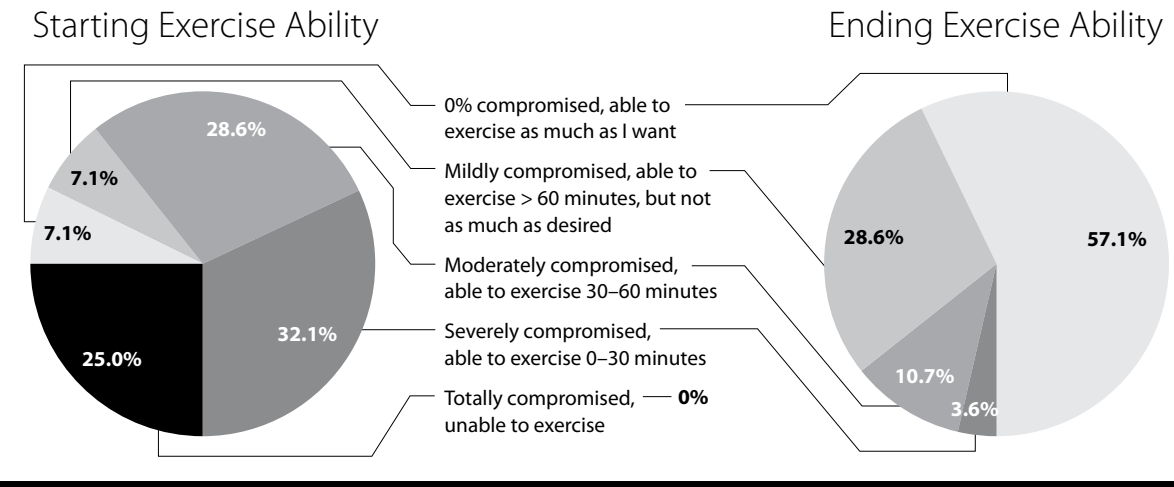


Figure 19. Exercise ability before and after Hackett-Hemwall Prolotherapy in 28 patients with unresolved knee pain due to meniscal injuries.

third visit he said his overall improvement was 70% and at his last visit his overall improvement was 80%. He was not seen after 7/26/07. While this patient ended up needing a total knee replacement in February 2010, our review found that the patient did not comply with the recommended Prolotherapy treatment course, to be received every four to six weeks until his pain resolved or he was satisfied with the improvements. It is not known why this patient did not continue to follow-up and receive more Prolotherapy after the July 2007 visit, if his pain returned, as reported.

While this study cannot be compared to a clinical trial in which an intervention is investigated under controlled conditions, clearly the findings are extremely positive. The level of improvement with pain and stiffness met a highly statistically significant level and more importantly the Prolotherapy met the expectations of the patient in 27 of 28 knees to the point that surgery was not required. The marked decrease in pain and stiffness was accompanied by similar improvements in walking and exercise ability, suggestive that the Prolotherapy was indeed repairing the meniscus tear. Another plausible explanation for the extremely high success rate of this study is that the treatment given was Hackett-Hemwall Prolotherapy. In this type of Prolotherapy, not only are the meniscal injuries treated, but also any joint instability, ligament weakness or tear, as well as any tendinopathy.

In regard to the patients with degeneration of the menisci, Prolotherapy strengthened the menisci to the point that they could function properly under load. As previously mentioned, various types of tears were treated and showed improvement with Prolotherapy, including the tears of the white zone (with little or no blood supply). One reason to do this study was to determine if a certain type of meniscal tear did not respond to Prolotherapy. But in this pilot study, all type of tears (including vertical, horizontal, complex and oblique) and locations (lateral, medial, posterior, and anterior) responded. In the future, MRI documentation of meniscal repair with Prolotherapy would confirm these conclusions.

CONCLUSIONS

The Hackett-Hemwall technique of dextrose Prolotherapy used on patients with MRI documented meniscal pathology including tears and degeneration, interviewed an average of 18 months after their last Prolotherapy treatment, was shown in this retrospective pilot study to improve patients' quality of life. Most patients reported statistically significantly less pain and stiffness and major improvements in range of motion, crepitation of the knee, medication usage, walking ability, and exercise ability. The improvements with Prolotherapy met the expectations of the patients in over 96% of the knees to the point where surgery was not needed. Prolotherapy improved knee pain and function regardless of the type or location of the meniscal tear or degeneration. The improvements were so overwhelmingly positive that Hackett-Hemwall Prolotherapy should be considered as a first-line treatment for pain and disability caused by meniscal tears and degeneration. If these results are confirmed by further studies under more controlled circumstances, with larger patient populations, and with MRI confirmation, surely Hackett-Hemwall Prolotherapy *will* become a first-line treatment for meniscal tears and degeneration. ■

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REMARKABLE RECOVERIES

Knee Coronary Ligament Injury and How it Can be Cured Successfully with Prolotherapy!

Joern Funck, MD

A very common knee problem, especially with sports men and women, is a lesion of the coronary ligament. Nevertheless, many doctors and even knee experts have never heard of this specific ligament and its problems. The coronary ligament runs from the meniscus to the tibial plateau edge (medial and lateral), on the inside and outside of the knee, and the symptoms can be very similar to a meniscus lesion or meniscus tear. (*See Figure 1.*) In this case, the doctor has to find the tender point right beneath the meniscus and secure his/her diagnosis with a test injection of anaesthetic. If the pain disappears the diagnosis is correct and Prolotherapy can be administered very successfully.

A TYPICAL CASE

Patient RB, a woman friend of mine, was suffering from severe knee problems since the year 2000. At this time, a first X-ray was taken. The pain steadily got worse. In 2005, at the age of 71, she was not able to go on hiking trips in the hill country anymore. Her family doctor prescribed NSAIDs. Due to her ongoing pain, she decided to seek help at the University of Luebeck medical school in that year. She thought that maybe she was suffering from a rheumatic disease. However, the doctors at the clinic found only small signs of arthrosis, no arthritis, and were unable to offer any real solutions.

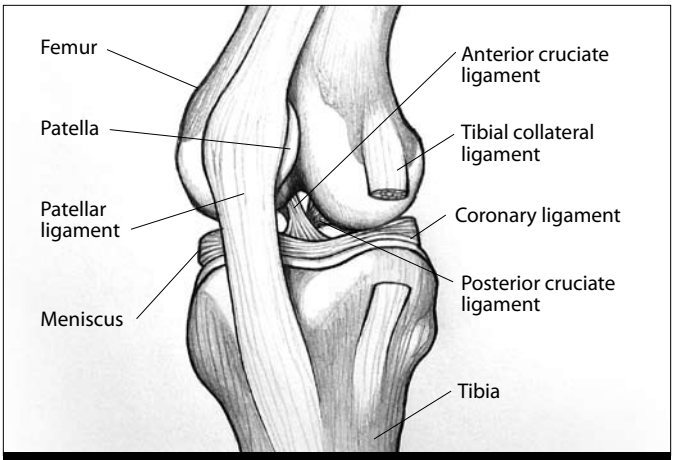

Figure 1. Illustration of knee showing the coronary ligament.

When RB came into my office, I found a very small tender point on the inside of both knees where the medial (inside) coronary ligament is situated. The coronary ligament produces pain at the junction of the meniscus and the tibial plateau and a painful lateral rotatory movement can mislead you, because this test could also be a sign of a torn meniscus. Pain distal to the joint line indicates ligament injury, while pain more cephalad can be of meniscus origin. The test injection with a local anaesthetic secured the true diagnosis on both knees in this single case, because after 20 minutes the patient was able to climb stairs without pain. Right after this test, she got the first Prolotherapy injection on both knees.

The Prolotherapy needle was directly aimed at the tender point, just under the skin, and done in the typical peppering style of Dr. Cyriax, the father of Orthopedic Medicine. I used 2mL of proliferant at each side. (*See Figure 2.*) As the proliferant, I always use 40% glucose, mixed down to a 15% solution with lidocaine. Three months after five sessions of Prolotherapy, received at two week intervals, she told me that she could walk again without pain. Now in 2010, five years after this event, I called her by phone and she informed me that she continues to walk without pain.

From the year 2000 until 2006, I counted 120 knee treatments in my private office in Luebeck. Three months after the treatment with Prolotherapy, 102 patients told me that it had been successful, 12 patients failed, and eight patients were not able to be reached. ■

Figure 2. Injection sites for Prolotherapy to the coronary ligament.

WONDER WHY?

The Use of Prolotherapy for Temporomandibular Joint Dysfunction

Roy V. Hakala, DDS & Kim M. Ledermann, DDS

ABSTRACT

Prolotherapy was first described in the scientific literature in 1937 for the treatment of TMJ disorders. This article describes basic TMJ anatomy and the common components of TMJ dysfunction (TMD). Diagnostic methods used to identify TMD are listed and the technique for injecting the TMJ is detailed. Three case studies are included. A clinical survey of 30 patients treated with Prolotherapy is presented and documents the effectiveness of TMJ Prolotherapy, even in cases refractive to conventional treatment with an intraoral orthosis, physical therapy, home exercises, and dietary restrictions.

Journal of Prolotherapy. 2010;2(3):439-446.
KEYWORDS: Prolotherapy, temporomandiublar joint dysfunction, TMD, TMJ.

Temporomandibular joint disorders, commonly known as TMJD or TMD, are endemic in the American population. The National Institute of Health estimates that 10 million Americans are afflicted with some form of TMD that is capable of developing into significant, long-term problems.[1] TMD is frequently a causative agent or a significant aggravating factor in such common symptoms as tension headache, migraine, facial pain, ear pain, and tinnitus; but effective treatment may be difficult to obtain. Even the largest academy dedicated to the diagnosis and treatment of TMD, the American Academy of Craniofacial Pain, has only about 900 members out of the 150,000 currently licensed dentists in the U.S., and only about 15 percent of these members limit their practices to TMD.[2] Prolotherapy is an effective treatment choice for TMD sufferers who do not have access to other forms of treatment, to those patients who cannot or will not tolerate other treatment plans, and to patients whose conditions do not respond to other treatment modalities.

SYMPTOMS OF TMD

Headache is the most common TMD symptom.[3] The temporalis muscle is thickest immediately behind the orbit and contracts each time the teeth are brought together. Tension or spasm in the temporalis muscle frequently is the cause of temple-area headaches and headaches that feel like a piercing pain in the back of the eye.

Migraine, with or without aura, is frequently associated with TMD. Postural compensations for jaw misalignment often produce head and neck protraction. Such faulty posture combined with the unbalanced weight of the head, often ten to fifteen pounds, places a heavy load on the posterior cervical muscles, where many migraines begin.

Facial pain is a common result of tension or trigger point development in the masseter muscles that extend from the zygomatic arch ("cheekbone") to the lower and posterior border of the jaw. The masseter muscles are the primary elevators of the jaw when eating and bring the teeth into contact before the temporalis muscles contract. TMD-related jaw misalignment often results in parafunction of the masseters, with pain extending over the lower half of the face.

Temporomandibular joint (TMJ) pain is an obvious sign of TMD but is usually found on palpation, rather than a chief complaint. TMD sufferers quickly learn that chewing certain types of food is painful, and modify their diets so as to minimize frank joint pain. Conversely, some TMD sufferers often discover that it feels better to keep something such as chewing gum between their teeth, minimizing compression of painful structures within the TMJs. Without a physical examination that includes TMJ palpation, TMD diagnosis is easily missed.

Restricted jaw movement, irregular jaw movement, and TMJ sounds such as clicking, popping, or crepitation are obvious symptoms of TMD, but patients may mask these symptoms. Eating only soft foods and limiting mouth opening by taking only small bites can prevent noticeable joint noise. Also, patients with minor joint sounds may not perceive these noises to be abnormal unless the noise is accompanied by pain.

Otalgia and tinnitus are reported by as many as 65 percent of TMJ sufferers[4], due to the close proximity of the external auditory meatus to the TMJ and to tension on structures such as the discomallear and malleomandibular ligaments.[5] However, patients with ear symptoms rarely perceive a connection between their ear symptoms and symptoms of TMD. Such patients often go through repeated courses of antibiotics for suspected ear infections and may have had extensive ear imaging before being referred for a TMJ evaluation.

TMJ EXAMINATION

A few basic diagnostic procedures can identify most cases of TMD. These include:

- Firm bilateral palpation of temporalis muscles in the anterior, middle, and posterior segments.
- Firm bilateral palpation of the masseter muscles at their zygomatic origins, at their mid-bellies, and at their insertions on the mandible.
- Light palpation over both TMJs during maximal opening and closing to detect joint noises and irregularity in movement.
- Firm palpation with the small fingers in the patient's ears as the patient opens and closes the mouth.
- Measurement of maximum interincisal opening, which is normally in the range of 48-52 millimeters, sometimes approximated as "three finger widths."
- Observation to determine if jaw movements are smooth, linear, and free of pain.

When checking for joint sounds, avoid using a stethoscope. Stethoscopes are of a specific length to optimize detection of heart sounds, rarely pick up significant TMJ sounds, and can lead to false negative conclusions. If palpation does not provide definitive results such as clicking or crepitation, closer examination with either an obstetric or vascular Doppler may be helpful.

TMD TREATMENT

Parafunctional jaw habits, such as chewing pencils or fingernails or excessive gum chewing, can aggravate TMD. Stress often is blamed as a causative agent. Encouraging the patient to discontinue non-functional jaw activities and work on stress reduction may provide some benefit, especially in cases with smooth joint function and only minor facial muscle pain;[6] however, jaw parafunction and stress have never been proven to cause internal TMJ derangement. Orthodontic treatment often is recommended for TMD sufferers, but the literature shows no relationship between malocclusion and TMD.[7]

Effective treatment of all but the most minor cases of TMD requires some understanding of the joint anatomy and function.

TMJ ANATOMY

The TMJ fossa ("glenoid fossa") is located in the temporal bone, immediately anterior to the ear. The tympanic plate of bone between the ear and the TMJ fossa is very thin, almost to the point of being transparent when observed surgically. This thin plate of bone is not suited to bearing any significant load and, in a healthy joint, the mandibular condyle remains a few millimeters anterior to it, even during forceful chewing. The retrodiscal tissues are uncompressed and the retrodiscal ligaments stabilize the posterior aspect of the disc.

The anterior slope of the glenoid fossa is thick and capable of supporting masticatory pressure on the condyle. The mandibular condyle normally is separated from this part of the fossa by the fibrous (not cartilaginous) disc, which moves with the condyle during all jaw movements. This disc is loosely attached and remains properly positioned between the condyle and fossa due to its biconcave shape that closely adapts to the convexity of the condyle and the eminence, and by peripheral ligaments that normally limit its movement. (*See Figure 1.*)

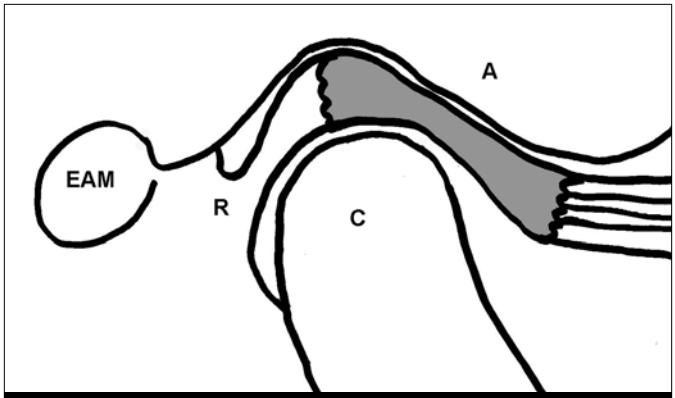

Figure 1. Schematic representation of normal TMJ. The disc (gray) maintains alignment between the articular slope and eminence (A) and the condyle (C). The condyle remains well-separated from the external auditory meatus (EAM) with no significant pressure on the retrodiscal tissues (R).

TMJ INTERNAL DERANGEMENT

Since the disc is not adherent to either the condyle or fossa, it can be displaced by various factors including trauma. Low-grade, long-term trauma such as a significant malocclusion can thin the margins of the disc and cause it to lose stability. Direct trauma such as a blow to the jaw can cause joint misalignment and disc displacement. So-called "indirect trauma" involving violent acceleration and deceleration of the head and jaw has been shown to damage the restraining ligaments and allow disc displacement and misalignment of the joint. (*See Figures 2 & 3.*) One magnetic resonance imaging (MRI) study suggested that as many as two-thirds of patients who receive a significant cervical acceleration/deceleration neck injury ("whiplash") suffer concurrent TMJ injuries.[8]

Disc displacement is often in the anterior or anteromedial direction with reciprocal posterior displacement of the mandibular condyle into the retrodiscal tissues, adjacent to the external auditory meatus. (*See Figure 4.*) During mouth opening, the condyle first rotates and then translates forward, often with a perceptible click as the condyle passes over the posterior border of the disc.

After an unpredictable period of jaw clicking on opening, the ligaments may become so injured and lax that the disc remains out of place, obstructing the condyle and limiting jaw movement. This joint condition is commonly referred to as "closed lock." The joint becomes quieter at this point but the posteriorly displaced condyle may eventually perforate the retrodiscal tissues, resulting in bone-on-bone contact and degenerative condylar changes. (*See Figure 5.*) Pain levels vacillate with the progression of this internal joint derangement.

Figure 2. This MRI reveals normal "bow tie" disc anatomy and placement from the twelve o'clock to three o'clock position (between arrows), anterosuperior to the condyle.

Magnetic resonance images courtesy of Imaging Systems, Inc., of Peachtree City, GA.

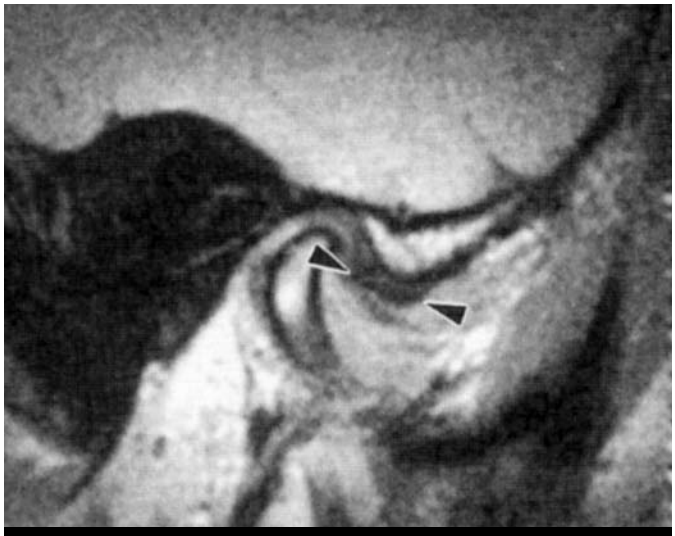

Figure 3. This MRI shows a distorted disc (between arrows) that is displaced anteriorly and inferiorly to the condyle. Reciprocally, the condyle is displaced posteriorly into the retrodiscal tissues adjacent to the external auditory meatus.

Magnetic resonance images courtesy of Imaging Systems, Inc., of Peachtree City, GA.

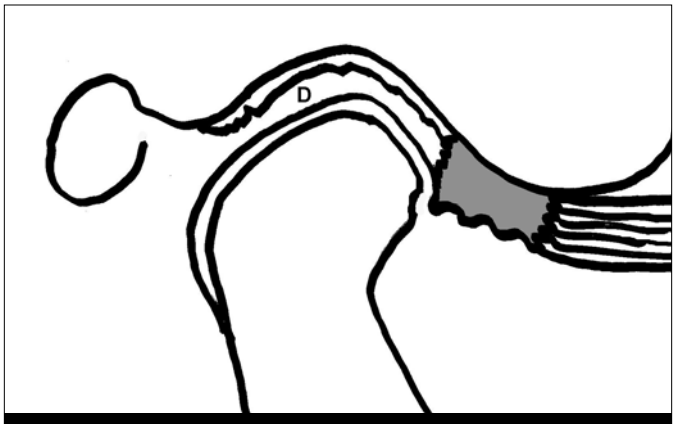

Figure 4. The disc has displaced anteriorly and become distorted. The condyle is beginning to remodel and develop a "beak" on its anterior surface. The extended and disrupted retrodiscal ligaments (D) can no longer stabilize the disc.

TREATMENT STRATEGIES

The most common treatment approach to TMD is construction of an intraoral nightguard. Such appliances protect the teeth but do not necessarily realign the displaced structures within the TMJ. Even if alignment is

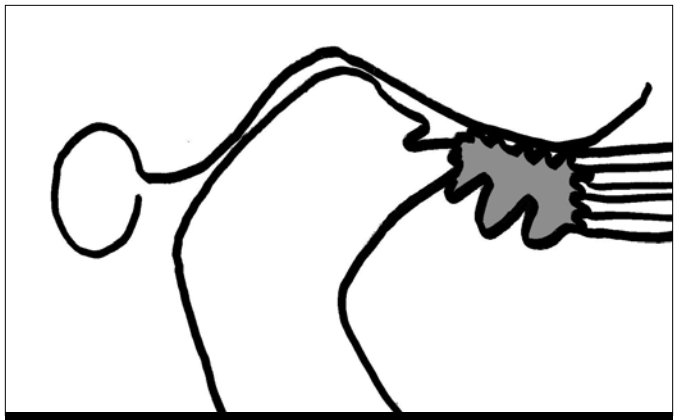

Figure 5. The condyle has perforated the retrodiscal tissues and begun to place pathologic pressure on the tissues between the condyle and the ear, often producing various types of otalgia and/or tinnitus. The disc and anterior surface of the condyle have undergone severe degenerative change.

achieved overnight, leaving the appliance out during the day allows joint misalignment during waking hours and the degenerative process within the joint may continue. Furthermore, bulky appliances may intrude on tongue space and compromise both comfort and breathing, and rubbery appliances often encourage bruxism, which can aggravate the myogenous pain of the disorder.[9]

TMJ surgery is indicated only in cases with no other practical alternative and is generally considered as a last resort. No fully functional total TMJ replacement joint is available and synthetic TMJ discs were removed from the market in 1991. Discectomy may relieve pressure on the painful structures within the joints but, without discs, the joints and occlusion are unstable and these patients often have recurrent pain and dysfunction.[10]

Orthodontic treatment or prosthodontic (crown and bridge dentistry) treatment is sometimes used to establish functional dental occlusion, but this treatment is not normally done until the TMJs have been stabilized in a comfortable and functional position by other means.[11, 12]

Physical therapy by a practitioner knowledgeable about TMJ anatomy and function can be very helpful, but such improvement tends to be limited and short-term if the intracapsular TMJ structures cannot be aligned and stabilized.

Occlusal orthotics that are worn over the teeth 24 hours a day and have an occlusal surface that realigns the condyles and discs within their fossae can be very effective, but not all patients are willing or able to wear such appliances on a full-time basis. Also, some discs remain unstable even after many months of use of such an appliance.[13]

PROLOTHERAPY AS TMJ THERAPY

The first published article on Prolotherapy, short for "proliferation injection therapy" and now also known as regenerative injection therapy (RIT), focused on treating the TMJ.[14] As readers of this journal undoubtedly know, the basic principle of Prolotherapy is to inject a substance that will cause a low-grade inflammatory process within the joint, drawing in fibroblasts that strengthen the attachments of tendons and ligaments. The process stabilizes the joint, improves the range of motion in a hypomobile joint, helps prevent dislocation in a hypermobile joint, and relieves pain.

Prolotherapy has been an important adjunct to TMD treatment in our office. While we work extensively with intraoral orthoses, physical therapy, home exercises, and dietary restrictions, not all patients respond optimally. Some patients are reluctant or unable to wear an intraoral appliance full-time because such appliances can interfere with speech. This means that many teachers, salespeople, receptionists, and others who speak for a living are reluctant to wear an orthosis during the day, or simply refuse to do so. Physical or mental handicaps can prevent some patients from being able to care for, or function with, an intraoral appliance. Some disc displacements are so severe that an intraoral appliance cannot reasonably be made to the dimensions necessary to recapture the discs. Some patients with particularly lax or damaged ligaments experience pain relief while wearing the orthosis, but pain and joint noise returns as soon as the appliance is removed. Prolotherapy can be effective in all such cases.

TECHNIQUES FOR TMJ PROLOTHERAPY

The face and TMJ are highly innervated and sensitive areas. Injections in this area must be as atraumatic as possible. To this end, we routinely use a 30-gauge, one-inch needle. We also use a dextrose solution whenever possible, as it causes less post-injection soreness than fish oil or pumice, and pumice is difficult to express through a 30-gauge needle. Compounding pharmacies can provide pre-mixed solutions, but we mix our solutions directly in the syringe. This consists of drawing up 0.75mL of 50% dextrose, 0.75mL of bacteriostatic water, and 1.5mL of 2% lidocaine into a 3-mL syringe for each TMJ.

Using a 25-gauge needle to draw up the solutions speeds the process, then the needle is changed to 30-gauge and the syringe is shaken and the air expressed. The result is a dextrose concentration of approximately 12.5%. The precise concentration of dextrose is not critical so long as it is strongly hypertonic and causes adequate cell wall lysis to attract fibroblasts and begin the regenerative process.

Since TMJ disc displacement usually is anterior, our priority is to accomplish repair of the extended or torn posterior disc attachment. We locate the posterior joint space by cleansing the skin immediately anterior to the ear with alcohol and palpating the lateral pole of the condyle as the patient opens and closes. (*See Figure 6.*) The target is the depth of the depression that forms immediately anterior to the tragus of the ear as the condyle translates forward and down. This can be marked with a washable felt-tip pen, if desired. (*See Figure 7.*) Then, a disposable bite block is placed between the patient's anterior teeth to keep the patient from closing the condyle back into the fossa and onto the needle. The injection needle penetrates the skin at the marked point and is directed medially and slightly anteriorly to avoid penetration into the ear. Surface skin and connective tissue is deceptively thick in this location and the needle usually penetrates to, or nearly to, its full one-inch length before encountering the medial wall of the fossa. Slight negative pressure is exerted on the plunger to confirm that the needle tip is not in a vessel, even though no vessels of any size are expected to be encountered within the fossa. One mL of Prolotherapy solution is deposited here. (*See Figure 8.*)

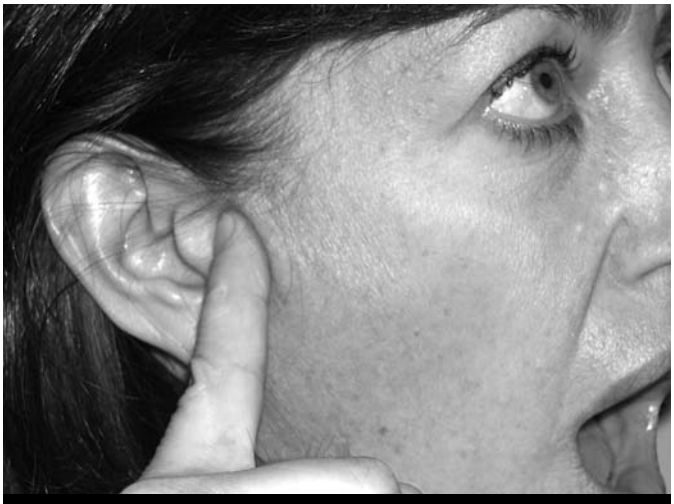

Figure 6. Palpation of the TMJ fossa posterior to the translated condyle with mouth wide open.

Figure 7. Marked injection sites.

Figure 8. Angle and depth for injection of posterior joint space with a one-inch needle, behind the translated condyle and into the depth of the fossa.

The second target is the anterior disc attachment, where the disc connects to the superior portion of the lateral pterygoid muscle. This muscle often is foreshortened or in spasm in cases of chronic disc displacement. Injecting the Prolotherapy solution here can strengthen the tendinous attachment of this muscle to the disc at the same time the anesthetic component anesthetizes and elongates the muscle, which can allow the disc to reposition itself over the condyle and often produces an immediate reduction in TMJ clicking. We locate this target area at the same time we palpate the location of the posterior joint space, note the location of the slight depression just anterior to the condyle when the mouth is closed, and mark this point with washable ink. Marking this point before injecting the posterior aspect of the joint is advisable, as it becomes much more difficult to palpate this depression after the posterior joint recess has been injected. For this injection, the bite block is removed and the patient is instructed to

close gently, moving the condyle back into the fossa. We insert the needle at the marked point, again directing the tip medially and angulated slightly anteriorly to, or nearly to, its full one-inch length. Aspiration is performed and another 1mL of Prolotherapy solution is injected here.

Most TMD patients have some chronic masseter tension and pain with resultant strain on its attachment to the zygomatic arch. The third mL of Prolotherapy solution is used to address this problem. We palpate the masseter attachment along the inferior border of the zygomatic arch at the same time that we palpate and mark the posterior and anterior aspects of the condyle, and mark the area of the masseter that is most tender to palpation. Asking the patient to clench the teeth makes the masseter stand out, and the area that is most rigid to palpation is usually the most tender as well. The patient is told to relax the jaw, and the final mL is injected directly into this area, again at or near the full one-inch length of the needle.

The injection sites are wiped with alcohol, which removes the washable ink as well, and a pulse is taken for the medical record and to confirm that the patient has relaxed and is ready for discharge.

Our standard program is to repeat the injections three times, at two-week, four-week, and six-week intervals. This totals four injection appointments over twelve weeks. We palpate the joints for pain and noise, and palpate the affected muscles for pain, at each appointment. We also measure the range of jaw motion interincisally and record all these findings. Patients typically report some improvement after the first injection appointment but often have some increased discomfort shortly before the second appointment. The following appointments generally produce more benefit, quieter joints, and symptom relief without rebound. We expect the healing process to continue for at least twelve more weeks and schedule a final recall three months out.

COMPLICATIONS

Dextrose is a corn product and must not be used in patients with a corn allergy. Also, an alternative local anesthetic must be used in patients who are allergic to lidocaine.

At the one-inch depth of needle penetration, the areas described above have no major blood vessels and intravascular injections are not a significant risk with this technique, especially if aspiration is performed before each injection. Some authorities have stated that the lumen of a 30-gauge needle is too small to admit red blood cells, but clinical experience in injecting other, more vascular areas has shown that blood can easily be drawn up through this small needle. On rare occasion, the local anesthetic will diffuse forward and partially paralyze the lower eyelid. When this happens, it is immediately apparent and the patient is told to make a conscious effort to blink that eye frequently for the next hour or so, until the anesthetic effect diminishes, to lubricate the eye and prevent a corneal abrasion. Fair-skinned patients may display some minor bruising for a day or two but this is more common if the operator has difficulty locating landmarks and moves the needle laterally after insertion. The most common side effect is a temporary change in the dental occlusion. Until the 2mL of injection solutions dissipates from the joint, which may take one to four days, the condyle will rest lower in the fossa and the posterior teeth may not fully occlude. It is important to warn the patient that this is likely, and to be careful to chew food carefully and thoroughly before swallowing.

CASES

Case #1 is a 49-year-old female. Her original chief complaints included temporalis-area headaches one to two times per week, bilateral facial pain that was worse on the left side, and bilateral TMJ clicking. Symptoms were not known to be related to any particular incident or injury and had been present for about four years prior to her initial examination in our office. She had a good range of mandibular motion at baseline. She was treated with a home care program, therapy, and wore an intraoral orthosis for four months with some success. The most significant improvement was reduction of her headaches, but TMJ clicking indicative of persistent disc displacement, and intermittent facial pain remained.

A series of four Prolotherapy appointments was carried out over twelve weeks, as previously described above. On follow-up 11 weeks later, her mandibular range of motion remained good and her maximum mandibular protrusion had increased from five millimeters to 10 millimeters. The patient reported that she was feeling much better as her facial pain and TMJ clicking had dissipated. Very minimal masseter discomfort was elicited on firm palpation. Mild intermittent clicking was palpable in the left TMJ but the patient reported that this was steadily diminishing.

Case #2 is a 56-year-old female who presented to our clinic in chronic closed lock. She had TMJ clicking for several years and her jaw became locked four months prior to her initial examination at our clinic. Chief complaints include limited ROM and throbbing pain in the left TMJ, which had begun spreading over her lower face and into both temples. Her maximum opening at the initial exam was about half of normal at only 29 millimeters with deflection of her jaw to the left on opening. Use of an intraoral orthosis along with home care and physical therapy over three months produced only minor improvement with myalgia and slight improvement in range of movement.

A series of Prolotherapy appointments was carried out as described above but only to the left TMJ and masseter muscle. By the fourth visit, maximum opening had improved to 38 millimeters and lateral and protrusive range of movement had improved as well. Headache and facial pain had resolved and no significant tenderness was reported on palpation of the left TMJ or temporalis or masseter muscles.

Case #3 is a 23-year-old male who presented with audible and palpable clicking in the left TMJ, accompanied by pain that he rated at 3-4 on a scale of 5. Treatment alternatives were presented and treatment with an intraoral orthosis to be worn full-time for four to six months was recommended. The patient declined this treatment plan as he worked as a professional model and was concerned that wearing a dental appliance would adversely affect his facial appearance. He opted for Prolotherapy, which was done at four separate appointments over a 12-week interval. At three-month recall, both the TMJ clicking and the joint pain were completely gone.

STATISTICS

Chart review of the most recent 30 patients treated with Prolotherapy demonstrates significant therapeutic benefit. All 30 of these patients had unilateral or bilateral TMJ clicking in a total of 55 joints. All clicking was easily palpable and reported pain on firm preauricular palpation of these joints averaged a level of 2.8 on a scale of 5, and these signs and symptoms had persisted despite at least 5 months of treatment with an intraoral orthosis, home exercises, and dietary restrictions. It should be noted that these patients were essentially refractory to such typical nonsurgical care.

All of these patients in this audit received Prolotherapy injections in the affected joints and ipsilateral masseter muscle origins at four separate appointments over an average of 14.2 weeks. At 12-week recall, 43 joints (78%) had substantial improvement in clicking (no longer detectable by clinical palpation and perceptible only as reported by the patient) and 32 had completely quit clicking (no clicking perceptible by palpation or by patient report). The palpation pain report had improved to a level of 1 or less on a scale of 5, in 39 joints (71%), and had reached a level of zero in 23 joints (42%). None of these patients had any significant bruising, and only one had an event of paresis of the lower eyelid, which lasted approximately 90 minutes.

DISCUSSION

In our office, Prolotherapy is used most often for patients who have been refractory to treatment with an intraoral orthosis, physical therapy, dietary restrictions, and home care. Our clinical results in our office indicate that Prolotherapy can be very effective, even in these difficult patients. We speculate that Prolotherapy success would be even greater when used in milder cases of TMD but we do not yet have the statistics to support this hypothesis. Continued research into Prolotherapy effectiveness in patient populations with varying histories, symptom sets, and levels of TMD severity is needed.

SUMMARY

TMJ Prolotherapy has been performed in various clinical settings for more than 70 years. This technique continues to demonstrate its safety and effectiveness, even in patients who do not respond adequately to other forms of nonsurgical therapy. ■

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WONDER WHY?

How to Tell when Chronic Headaches have a Dental Cause:

Functional occlusion in patients with chronic headaches: Interview with Jeri Coffey, DDS

Jeri Coffey, DDS, Ross A. Hauser, MD, Nicole M. Baird, CHFP, & Doug R. Skinkis

ABSTRACT

The Journal of Prolotherapy team of Ross Hauser, MD, Nicole Baird, and Doug Skinkis, met with Jeri Coffey, DDS in her office in Riverside, Illinois. Dr. Coffey is often referred patients whose headache and neck pain may be due, in part, to dental occlusion problems. She is trained in the Dawson Technique of dentistry, which stresses the importance of functional occlusion. In this interview, Dr. Coffey discusses how headaches, migraines, and neck pain are often related to a bite problem, and how correcting this can result in lessened intensity and frequency of headaches. She explains the specific questions she asks patients to determine if there is the likelihood of malocclusion being one cause of their headaches. In addition, she explains the key differences in how a patient without headaches will generally present compared to a patient with chronic headache and neck pain complaints.

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KEYWORDS: Dawson technique, equilibration, functional occlusion, headache, malocclusion, mandibular condyle, migraine, neck pain, temporomandibular joint, TMJ.

The *Journal of Prolotherapy* team of Ross Hauser, MD, Nicole Baird, and Doug Skinkis, met with Jeri Coffey, DDS in her office in Riverside, Illinois. Dr. Coffey is often referred patients whose headache and neck pain may be due, in part, to dental occlusion problems. She is trained in the Dawson Technique of dentistry, which stresses the importance of functional occlusion. As Dr. Coffey demonstrated during our interview, headache, neck pain, and migraine patients have key differences in their bite that are indicative of a dental component to their condition.

JOP: When do you believe a migraine is related to a person's bite?

Dr. Coffey: I think most migraines have some element of a bite issue. If you have headache patients that you have ruled out organic causes for, and your only effective treatment is pain medication, you need to consider a dental bite problem as a possible cause. When I see patients, the first thing I ask them is where exactly do they feel the migraine. If the patient has a one-sided headache/migraine, I feel there is a high probability their bite is involved. Or if someone has one-sided neck pain or shoulder pain, I'll check their bite. The typical bite-related headaches are felt in the suboccipitals, temporalis, and/or migraine.

I explain to a patient why I feel that is important. You see, your teeth can bite together and chew and chew and chew. When you open and close just a little bit, you have a rotational movement between the upper and lower jaw. When you start to open your mouth wide, the joint unseats and then comes back together when you close. Ideally, when the teeth are fully closed together, the mandibular condyles are fully seated. In headache sufferers, those two things cannot occur together. Either the joint can fully seat, or the teeth can bite together. When they do not occur together, the four major muscle groups that control the jaw can NEVER relax. It would be as if I asked you to pick up a bag of groceries and never let you put it down. Eventually, your arm would get fatigued and begin to recruit the muscles in the shoulder, then the neck and the upper back. Same goes for a patient whose condyle is never properly seated. Nearby muscle groups need to be continuously recruited for jaw function. That recruitment causes stiff necks and headaches. (*See Figure 1.*)

JOP: How do you explain the ligament and other structural involvement to a patient?

Dr. Coffey: In dentistry we used to just put the blue paper in a patient's mouth and have them close it. Well, that proves that the teeth come together, but how does that relate to the joint? We want the teeth and the joint to be able to close at the same time. Some places we want the teeth to come together and touch, and other places we do not want them to touch. When you look at the teeth and where they are "marking" or touching, we want nothing to touch on an incline because then it moves your jaw. We

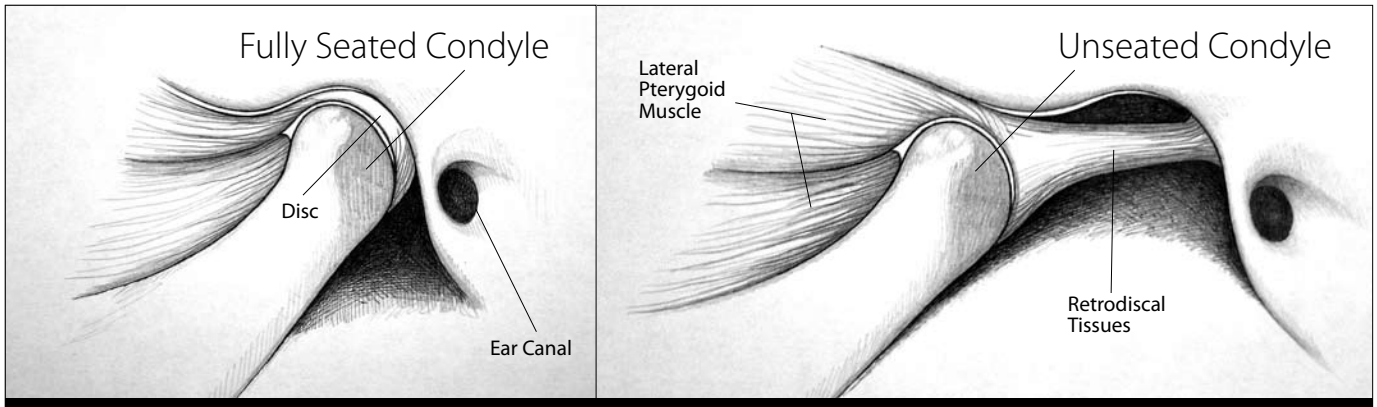


Figure 1. In headache patients, very often the condyle is never fully seated which, in turn, never allows the surrounding musculature to relax.

also want nothing to touch in the back of a tooth, because it will shove your jaw forward or backward. **In the perfect bite, every tooth is hitting, at the same time and the same intensity all around the entire mouth.** Now, in some bites it is impossible, and you cannot get that 100%, but it's what you're shooting for.

When I'm talking with a patient and I see there is a spot hitting on an incline, I explain that we need to erase that because the incline is interfering with that joint seating. It's more important that the joint seat, than the teeth seat. There are ligaments connecting the lower jaw to the back of the skull and those are the ones we don't want to stretch out. If you dislocate over and over again, you are really going to over stretch the TMJ ligaments. These will totally fatigue and then you do not have a guard from that joint unseating. You also begin wearing down the disc in the condyle.

Teeth are designed to take pressure along their axis on a vertical plane. When teeth hit opposing teeth on a diagonal plane, versus vertical, it unseats the TMJ. When teeth are together, there are certain parts of the teeth that should touch, and other parts that absolutely should not touch. Headache patients have a lot of "not touch" areas touching. The dental procedure of equilibration relieves the "not touch" areas. Hence, it redirects the forces into a vertical plane, thereby allowing the joints to fully seat and the musculature to finally relax.

JOP: So, to a patient sitting in front of you, what do you ask them during the exam?

Dr. Coffey: First thing I ask them to do is "Bite your teeth together a few times fast." Then I ask this exact question, and the phrasing is important: "Which side hits first: the left, right, or front?" The *right* answer is *nothing* should hit first. All the teeth should all hit at the same time. When biting teeth together fast, *nothing* should touch first. If one or several teeth hit first, this is an immediate sign that there is a bite problem. When you make a patient choose a side (right, left, or front), the right answer is actually "neither, everything hits at the same time." But I do not ask them "Does anything hit first?" because the answer will be "No." So phrasing the question the first way makes the patient concentrate on what is really happening when they open and close.

For headache patients, I will manually seat their condyle and I will then tap their teeth together a few times fast. I want them to answer the same question to see if they notice a difference when the condyle is properly seated. I'm looking for their point of interference. Headache patients will tend to hit on one side first when I've seated the joint versus when they tap their teeth together on their own. Patients may also begin to open up and tell me things that happen when they bite, often confirming the recruitment of additional musculature to eat or when using their jaw. For instance, some people who tell me they hit everywhere at the same time are actually dislocating and recruiting muscle groups in order to do that. It still means the joint is not seated properly and those jaw muscles can never relax.

Upon examination, some patients will also present more classic problems that indicate a bite problem. Often this can include a large difference between the upper teeth and lower teeth, which is called an overjet. It can be the presence of tori, which are bony bumps on the roof or floor of the mouth. Or it may be a noticeable abfraction

Dr. Coffey manually seating a patient's condyle to see which teeth hit first, compared to when the patient taps their own teeth together.

lesion, which is a ditched out area of the tooth, near the gum line, which you can feel with your finger or fingernail. (*See Figure 2.*) For example, with tori, the patient may be really working like a maniac on their teeth, much more than the average person. So, the body is going to try and build up the area around the teeth to support it.

JOP: You also use a questionnaire for your patients to rule out a bite problem. Can we go through that?

Dr. Coffey: Sure. Generally three or more "Yes" answers to these questions indicate an occlusion problem. (*See Figure 3.*)

JOP: On this questionnaire, one question is if the patient can chew gum?

Dr. Coffey: Yes, and not "do you" but "can you." Generally there are two extremes. The first is the person who cannot chew gum because it almost immediately causes aching and stress in the jaw. The other extreme is the person who chews gum all day long because their jaw is so fatigued that is the only thing that brings some relief in the jaw muscles. Otherwise, they will clench their jaw all day.

JOP: Ringing in the ears is an interesting one.

Dr. Coffey: Since I began asking that question, I've had three people who had complained about tinnitus and it cleared up after we fixed their bite. The thought is if your jaw is unseating, or pounding up and back down, all day long, you can get ringing in your ears.

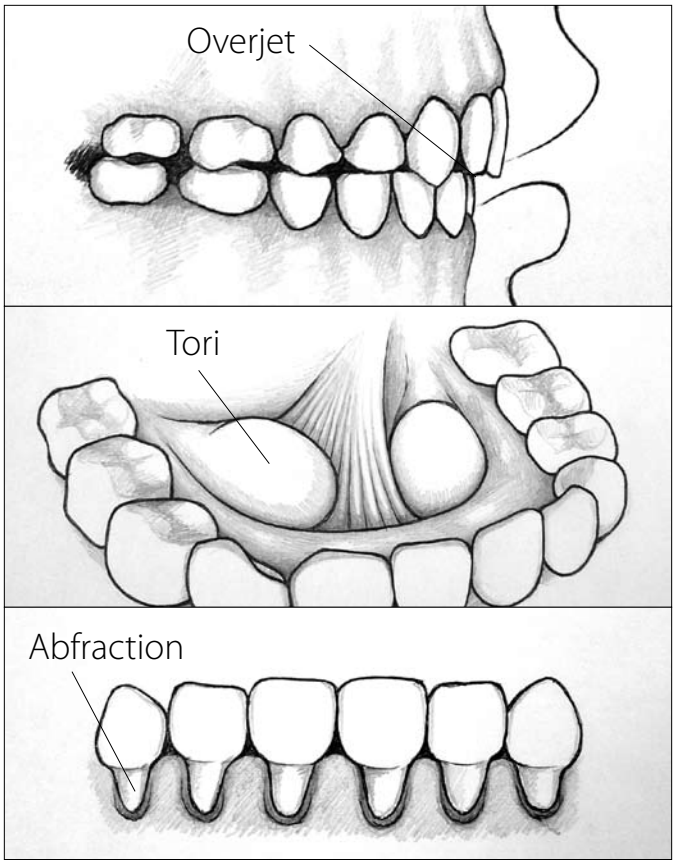


Figure 2. Examples of some additional classic dental problems that indicate a bite problem.

Another one "Do you hear your jaw pop?" sometimes they won't hear it, but others can. Or you may be able to feel it. If you feel it pop out, there is a 100% chance the patient has a problem with subluxating.

But one of the most interesting questions for most people is the location of their tongue through the day. Realize that 95% of the day is considered "at rest" for most people, meaning they are not chewing, speaking, or swallowing. Your teeth should be slightly apart and your tongue should be in the valley of your lower teeth. Again, you should only bring your teeth together when you chew, speak, or swallow. But when your tongue is glued to the roof of your mouth it creates suction. It's a splinting technique.

When people answer "no" to this question about their tongue, but I can tell they have a problem with subluxating, I ask them to check and get back with me. I tell them "For the next two days check in with yourself once per hour." Ask yourself two questions. First, "Are my teeth slightly apart, or clenched together?" Second question is

Signs and symptoms that the condyle and teeth do not seat at the same time

1. Do you have teeth that are sensitive to cold?
2. Do you have any teeth that have fractured, chipped, or cracked?
3. Do you have any crowns that have fractured, chipped, or cracked?
4. Do any of your teeth show wear?
5. Are any of your teeth shorter than they used to be?
6. Have your gums receded around any teeth?
7. Do you have abfraction lesions? (Ditched out spots near gum)
8. Have you had fillings break?
9. Do you have any loose teeth?
10. Are any of your teeth tender to biting or chewing?
11. Do your jaws get tired when chewing?
12. Do your jaws get sore?
13. Can you chew gum?
14. Do you chew gum for more than an hour per day?
15. Do you have extra bony bumps on the roof or floor of your mouth? (tori)
16. Do you get more than two headaches per year?
17. Do you suffer from stiff necks?
18. Do you suffer from sore/tight shoulders?
19. Do you get frequent ear pain?
20. Do you have tinnitus?
21. Do you hear your jaw pop when you open or chew?
22. Do you hear joint noises when you open or chew? (scratching or squish)
23. Do you clench your teeth?
24. Do you grind your teeth?
25. Is your tongue frequently pushed against the roof of your mouth?
26. Do you have jaw joint pain?
27. Are any of the four muscles of chewing tender to touch?

Figure 3. Patient questionnaire to recognize when headaches and facial pain have a dental cause. Three or more "Yes" answers are indicative of a bite problem.

"Where is my tongue? On the roof of my mouth, or in the valley of my lower teeth?" Most people are surprised to learn that they spend most of the day with their tongue plastered to the roof of their mouth! Creating this suction takes off about 50% of the stress on the muscles.

JOP: What are some symptoms a physician can look for?

Dr. Coffey: There are some key factors in their medical history that may point to a bite problem. (*See Table 1.*) The last question of the questionnaire is an easy thing a physician can do. Palpate the mastication, or chewing, muscles to check for tenderness. So, you can palpate the masseter, the temporalis, and the medial and lateral pterygoids, and ask the patient if there is soreness when you press on these areas. (*See Figure 4.*) This can indicate areas that would need to be addressed due to a bite problem. Also, one of the most obvious physical signs to look and feel for is the patient's jaw dislocating upon opening their mouth wide.

One last trick is, with a gloved hand, put your finger in their mouth and see where the tongue goes. Most often in cases where people unknowingly keep their tongue suctioned against the roof of their mouth, you will see them move their tongue back as you enter their mouth. If you hold your finger toward the roof of their mouth, and ask them to just leave their tongue in the valley of their lower teeth, see if they are even able to do it or if they are still pressing against your finger. Many people just don't know how to keep their tongue down, because it is always at the roof of their mouth and that they do not even notice it being there anymore.

Table 1. Normal patient versus headache patient.

Normal	Abnormal
Experiences less than two headaches per year.	Experiences two or more headaches per year.
Extremely infrequently experiences a stiff neck.	Frequently experiences a stiff neck.
When biting teeth together fast, *nothing* should touch first. When you make a patient choose a side (right, left, or front), the right answer is actually "Neither, everything hits at the same time."	When biting teeth together fast, one side is hitting first (right, left, or front).
At rest (while not chewing, speaking, or swallowing), the teeth should not touch at all. They should only come together to chew, swallow, or speak.	Top and bottom teeth are touching all the time, only coming *apart* when they chew, swallow, or speak.
At rest, the tongue should be in the valley of the mouth.	The tongue is plastered against the roof of their mouth constantly. This is the body's effort to create a splint for the musculature through suction.
There is not subluxation of the mandible upon opening the mouth wide. This can be felt by placing both hands on cheeks with fingertips right at the ear, upon opening and closing the mouth.	There is a lateral pop out of the heads of the mandibular condyle upon opening the mouth wide. This proves the joints and the teeth do not match, often causing headaches.
No cracked or fractured teeth, unless the reason is related to trauma.	Multiple cracks or fractures indicate a probable bite discrepancy.
No history of cracked, chipped, or fractured crowns.	History of cracked, chipped, or fractured crowns is almost 100% due to dental occlusion problems.
No tinnitus.	Often patients suffering from tinnitus have a bite discrepancy.

JOP: Very interesting, you know this is not something that most physicians would be looking for or were trained in.

Dr. Coffey: You know, this is relatively new over the last seven to ten years that the way we adjust teeth has changed. We used to seat the jaw by going up and back and adjust the teeth that way, and it was horrible. But the more cadaver research that was done really showed that the mandible seats forward and up. Once we realized that it has a definite stop and it's reproducible, there is something called an articulator where I can make models and take records on a patient and it is 100% reproducible, provided we go up and forward. So, we used to think the jaw seated back and up, but it's really forward and up. Pete Dawson, DDS who did a lot of the research on this is considered the father of modern dentistry.

JOP: What is the equilibration procedure like when someone wants to correct their occlusion problem?

Dr. Coffey: Equilibration is just a light sanding so teeth can seat evenly. Basically, I will mark their teeth to see what is not lined up correctly and I will "erase" those, which means I very selectively and minimally grind down the areas that should not be touching. Then people will often say "Oh my goodness, you're grinding my teeth?! " I explain that actually you are grinding down your own teeth, and you are doing it indiscriminately. So, I'm going to do it less than you are, and then you're going to be able to stop. So, instead of your teeth becoming flattened because you're grinding down everything, I'm going to find a tiny little spot and only take off about a tenth of a millimeter.

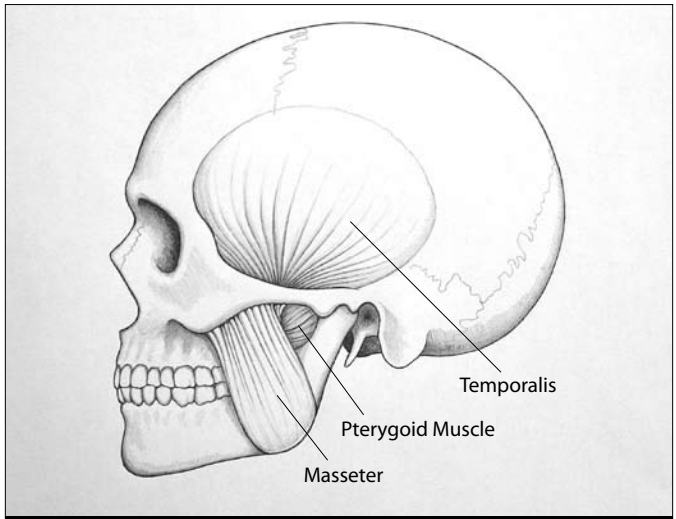
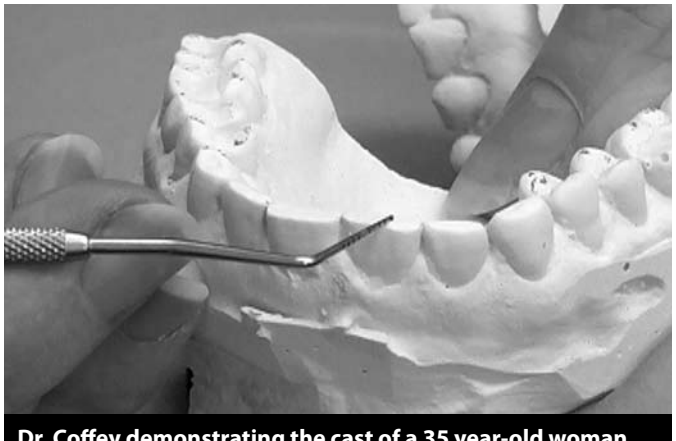


Figure 4. Palpating the mastication, or chewing, muscles for tenderness may help indicate a bite problem.

One case I have here is a girl who is 35 years-old. At mid-thirties, the normal length of these front teeth should be 10mm. She has ground hers down to 6.5mm. It's an excessive amount of wear. So, on the questionnaire, where it says "Do your teeth look shorter?" She would say "yes." She's worn away over a third of her natural teeth. For years, I thought she was biting her fingernails or would just assume that she was nervous and grinding her teeth down in the front. But it was actually because she had so many interference issues in the back teeth that it was making her do that. She wasn't doing it because she was nervous, there were so many things happening in the back teeth that it was driving her jaw forward to give her relief.

JOP: What do you tell someone who says that they've already had their teeth shaved, or they wear a splint and have had a lot of dental work done already?

Dr. Coffey: I tell the patient that you're obviously still symptomatic even though you've worn all these different splints. So, why don't we do some of these tests and check if this is a possibility for you. I often share my own story with patients. I had a headache every day for 90 days, and I've worn every splint known to man. I had a lot of occipital headaches that turned into migraines. I knew it was my bite, I just could not prove it. Because everything we've read and studied, and everything that we're taught in dental school does not go into this. I took the course a couple years ago and I was able to get substantial relief from my headaches. I went from having a headache a minimum of 20 days out of the month to only a couple very minor, manageable headaches a month. So, for me, this was a huge improvement. The splint that I wear now is different than any splint I wore in the past.



Dr. Coffey demonstrating the cast of a 35 year-old woman whose teeth are over a third shorter than normal, due to abnormal grinding.

What we realize now with splinting is we have to cover all of the teeth and keep your back teeth from touching with the splint. It reduces the compressive force and I can generally alleviate a patients symptoms this way.

JOP: Do you find that people still need to wear a splint afterward?

Dr. Coffey: About 20% of people, no matter if their equilibration is perfect, still need a splint at night. The majority of people do not. But 20% of people will sleep with a splint at night, but will wear nothing during the day.

JOP: What types of results are typical after an equilibration procedure?

Dr. Coffey: Most headaches have multiple triggers, and the aspect I am involved in is correcting the bite. When the joint is seated properly and the muscles all start doing the jobs they were intended for, and for the lengths of time they were intended to do them, the headaches lessen considerably. If the bite is one of the primary causes of the headaches, you can expect a minimum of 40% reduction in headache numbers and intensity from this aspect.

First I will do a spot adjustment, which acts as a test. When we know the bite is off and the patient has headaches, I will do a spot adjustment to see if the whole procedure is likely to be beneficial. Often patients will have relief right afterward for four to five days. Then after those days, the headache will come back. I tell them this is normal and not to be disappointed. It is only to see if the test works, we then move ahead with the remaining adjustments. I'd say 80% are good after the full procedure, and 20% may need additional work as the musculature relaxes.

CASE STUDIES

For a number of years, Jeri Coffey, DDS has assisted Ross Hauser, MD, in the care of some of his Prolotherapy patients. Temporal and occipital headaches, neck pain, and TMJ pain are the conditions most often helped by equilibration. Following are three of these cases…

BJ WITH TMJ

BJ came to Caring Medical at the age of 38 for care of his temporomandibular joint syndrome. He stated that he had suffered with it for most of his life. Despite going to several dentists, getting his "teeth shaved," and wearing many different appliances, he continued to suffer facial pain with loss of motion in his jaw. He woke up with facial pain (bilateral, though worse on the right). He received numerous Prolotherapy injections to his TMJ's, over the course of several years. BJ would get almost complete pain relief with Prolotherapy, but the pain would eventually come back. A referral was made for BJ to see Dr. Coffey.

Dr. Coffey's assessment: This patient presented with nearly flat posterior teeth and completely flat, straight edges to his anterior teeth, demonstrating excessive wear. At first, we made appliances to keep his teeth apart at night and during sports. He also reported TMJ pain that had persisted after other treatment attempts. The appliances had some positive benefits initially. The patient's upper right first molar became increasingly painful, without an apparent cause. My impression was that it was bite related, but minor adjustments did not bring sustained relief. That tooth eventually abscessed and was treated with root canal therapy. Around that time, I was taking substantial additional training in Occlusion. (How teeth fit together with respect to the TMJ, not independent of it.) I checked to see if his ideal joint closure position matched his actual full tooth closure position. It did not, and was substantially off. I believe the nerve in the tooth died as a result of this discrepancy, because that tooth was a significant offender in the shifting of his mandible. We did an equilibration to get the joints and the teeth in sync, and the patient was delighted to have significant relief (95%) from his TMJ pain. He also attributes it with improvement in his athletic skills, which can be substantiated by a study that was done with Olympic weight lifters. When wearing dental appliances that balanced their TMJ's, they were able to lift much more weight.

MV WITH HEADACHES AND NECK PAIN

Though MV was in her mid 70s, she was extremely active. Her only complaint was terrible neck pain with tension headaches. The headaches were primarily occipital in location. Typically her headaches were associated with neck pain. She was initially treated with Prolotherapy and had about 90% relief of her neck pain and headaches, but the pain returned after a year. While another course of Prolotherapy relieved the majority of her pain, it could not relieve it all. She was referred to Dr. Coffey for a dental assessment.

Dr. Coffey's assessment: This 74 year-old patient presented with a chief complaint of neck pain that woke her from sleep and 15-16 headaches per month. It is rare for a 74 year-old patient to have all of her natural teeth. This patient did. When I positioned her jaw with my hands, and mechanically tapped her teeth with **my** motion alone, her right side touched first. That almost always indicates a shifting of the mandible during closure, which can cause neck pain and headaches. Because this patient did not live within an easy commute of my office, I chose to try reversible procedures first. I had the patient sleep with an "Aqualizer" appliance (a very soft temporary appliance that keeps the posterior teeth apart). If she had no relief from that, I was reluctant to treat. (This patient lives in another state). The patient phoned in 10 days with all neck pain completely resolved. She returned to have me make permanent splints to sleep with, and is very pleased with the results. Note: When I do an equilibration, I like to have the patient available during the next few days in case we stir up a hornet's nest. I want to be able to "fine tune" the adjustment in case the patient is bruxing. Because this patient did not live close, had a dentist in her state who would not be able to fit new dental work into her adjusted bite satisfactorily, had worked with her dentition all of her life, and was satisfied with her comfort level, I stopped there.

BC WITH ATYPICAL FACIAL PAIN

BC is a 40 year-old, long-time Prolotherapy patient. Over the course of several years, BC had been treated for numerous injures to various body areas, each with a very good response to the treatment. In 2005, she developed what was diagnosed as trigeminal neuralgia (primarily on the right side). This caused severe and disabling lanciating pain in her face, mouth, scalp, and chest. She was treated with numerous Prolotherapy and neural therapy treatments to her face, which would temporarily relieve her symptoms. However, the pain would eventually return. In addition, BC suspected a dental cause, and had work by other dentists which included a root canal, followed by the pulling of the root canal, and having a bridge put in. She has also seen a multitude of specialists and clinicians including an ENT doctor and neurologist, because of the incapacitating pain, which was not relieved, even by strong medications, including anticonvulsants and pain relievers. BC was referred to Dr. Coffey for an assessment.

Dr. Coffey's assessment: This patient has had severe shooting facial pain that has been disrupting her life for about five years. Although she initially felt that it was coincidental, she had significant unsuccessful dental work on her left posterior teeth right before the onset of symptoms. She eventually had a tooth extracted and a very large, very wide permanent bridge placed in the lower left quadrant. She had major bite discrepancies, too numerous to list. We tried a spot, limited adjustment to see how it affected her. She had initial improvement, and then a return to symptoms. That is viewed as a positive result, and we continued on with the full equilibration. The patient had initial improvement again, and then a return of symptoms, but misunderstood the directions to call and advise us if she had problems. In a major bite adjustment case, the mandible will "settle" several times and need slight fine tuning. We had not performed the fine tunes on this patient. When I was able to speak with this patient, I remembered how bulky and ill fitting her lower left bridge was, (I remembered this off the top of my head, so imagine how bad it was, considering I see teeth all day long!). I requested that she return to my office. We both agreed to remove the existing bridge and to make a temporary bridge that could be easily adjusted repeatedly. The patient had noticed a positive change, which is what we are looking for. For long standing pain patients with significant bite issues, we are looking for positive changes with each fine tune, which this patient is achieving. I have advised this patient that I strongly believe we are on the right path. First, is it coincidence that she gets quadrant dentistry done, and then develops severe pain? I think not. Second, patients with long standing pain often develop parafunctional jaw habits as a way to tolerate pain. Those patients are sensitive to one hundredth of a millimeter bite discrepancies, and take longer to treat. As of the writing of this article, the patient reports waking up with less jaw, chest and facial tightness/soreness in the morning. The patient is "cautiously optimistic."

DAWSON-TRAINED DENTISTS

Physicians can call 800-952-2178 to reach the Dawson Center, for the name and number of a Dawson-trained dentist, based on the patient's location. This is a number for medical professionals only. ■

WONDER WHY?

Case Study on Meniscal Injuries

Jack Henry, DC, DACBR

ABSTRACT

Case study of a 55 year-old female with right medial knee pain. Meniscal injuries are relatively common and may present clinically different due to mechanism of injury, patient's age, and orientation of tear.

Journal of Prolotherapy. 2010;2(3):454.
KEYWORDS: Knee pain, normal and abnormal menisci.

The menisci are fibrocartilaginous crescent-shaped structures. The menisci are thickest peripherally and narrow centrally. This shape allows compensation to transmitted forces uniformly throughout the medial and lateral joint compartments, reducing isolated or focal compression to the articular cartilage. The normal medial meniscus is slightly larger than the lateral meniscus. The medial and anterior horns attach at the anterior intercondylar area of the tibia. The medial meniscus is intimately attached to the deep layer of the medial collateral ligament.

Meniscal tears can be described by signal intensities on MR that can be directly related histologically. Sagittal slices demonstrate the meniscus as elongated signal void rectangles or triangles depending on relationship to the sagittal cut. Normal adult menisci are devoid of signal due to poor vascularization. Children and young adults may demonstrate intermediate to high signal depending on persistent vascularity. This may be confused with meniscus degeneration.

Tears are further classified by morphological characteristics generally: vertical, horizontal, and complex tears. Each classification is further subdivided: vertical tears, peripheral tears, capsulomeniscal separation, and bucket handle tears, for vertical type meniscal injuries. Horizontal tears may be termed horizontal clefts, redial tears, oblique and parrot beak tears. Complex tears are a combination of variable tears and fragments. Intrameniscal tears may or may not communicate with the articular surface. Meniscal degeneration results from axial loading with chronic shear stresses. Meniscal cysts may develop secondary to synovial fluid forced through a meniscal tear.

What does all this mean to the clinician? The patient's age, mechanism of injury, type and orientation of tear will drive the treatment protocol. The physician's experience and training will also be critical to the treatment option.

This non-contrast MR case study demonstrates pan compartmental degenerative joint disease. There are complex tears of the medial and lateral menisci with resultant subchondral reactive bone marrow changes. In addition, there is increased signal of the lateral collateral ligament suggesting sprain. A suprapatellar joint effusion is present. (*See Figures 1-4.*) ■

Figure 1. Complex tears of the medial and lateral mensci.

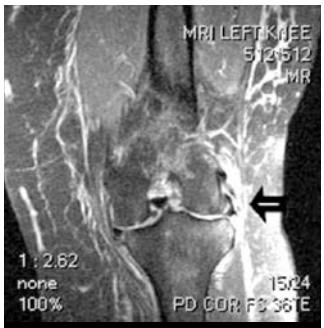


Figure 2. Lateral collateral ligament sprain.

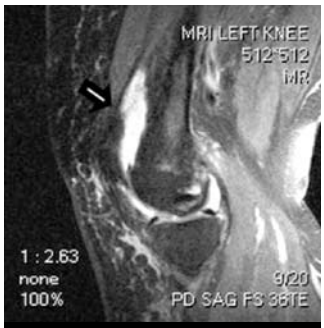


Figure 3. Moderate suprapatellar effusion.

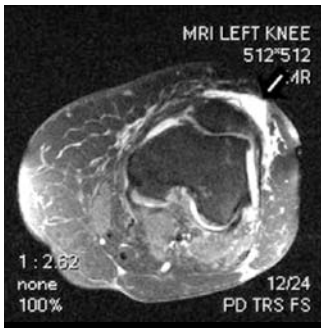


Figure 4. Prepatellar bursitis.

FOUR-LEGGED PROLOTHERAPY

Spinal Cord Injuries in Cats and Dogs Treated with Prolotherapy

Babette Gladstein, VMD

ABSTRACT

Acute Spinal Cord Injuries (SCI) in both canines and felines remain an ongoing area of controversial and invasive surgical options. Prolotherapy serves to offer a viable treatment modality. Prolotherapy is both a cost effective and humane solution for (SCI) in our animal population. This article reviews cases of SCI treated with Prolotherapy.

Journal of Prolotherapy. 2010;2(3):455-456.
KEYWORDS: Prolotherapy, spinal cord injuries.

Cases pertaining to spinal issues in the canine and feline are rather problematic and often difficult to diagnose without benefit of an MRI. Myelograms are often used with radiography to diagnose spinal compression. Myelography is invasive because of a spinal tap and infusion of radio-opaque material into the subarachnoid space. An MRI is costly and this equipment is usually only available at large veterinary medical hospitals. Many clients face the unfortunate decision that back injuries in both the canine and feline are often too expensive to properly diagnose, and animals are euthanized. Steroids are used to stop spinal cord congestion, but they are not without side effects. NSAID (Non-steroidal anti-inflammatory drugs) narcotics or opioids are used for pain management. These too have numerous side effects. In the September 2008 issue of the *Compendium*, a well respected Veterinary journal, their conclusion in a Continuing Education article "Managing Acute Spinal Cord Injuries," stated, "At this point, there is no proven treatment for SCI (Spinal Cord Injuries) other than decompression or stabilization surgery when indicated."

Over the years, I have found that treating back problems with a combination of acupuncture with electric stimulation, ultrasound and laser therapy, with added supplements, has saved at least 75% of my back cases from needing surgery. This usually is an ongoing therapy treatment that, in many cases, continues for the remainder of the animal's life. In the past several years, I have combined these modalities with Prolotherapy. In many cases, I have seen the cessation of clinical signs, including pain, on a more conclusive basis—over several months, rather than multiple treatments encompassing years.

This article cites two cases I have treated. But first, I will mention one case that, in fact, was not successful. The case was a 9-year-old male, neutered boxer with severe spondylosis. He improved dramatically with ultrasound and Prolotherapy initially, but within several weeks reverted back to the initial presented pain. I suspect that the severity of the spondylosis is an issue, since many other back cases have responded. I would like to see more Veterinary comments on this particular subject.

CASE ONE

Bella, a 3½-year-old female, spayed shih tzu came to the Humane Society for euthanasia. The owner had been told she had only a 10% chance of walking again. She was paralyzed (hind limbs) and in pain along the back and neck areas. The owner reported that there had been prior incidences of back problems and that had progressively worsened over time.

Radiographs indicated and read by Dr Van Knox of Susquehanna Veterinary Imaging indicated "C6 vertebral body tipping and C4–C5–C6–C7 intervertebral spaces slightly wedged. C4–C5 is narrower than C3–C4 and C5–C6. Mineralized disc material occupies the C3–C4–C6–C7 spaces." And his diagnosis read as "possible cervical spine intervertebral disc disease C4–C5 > C5–C6 > C6–C7." His recommendation; "Myelography, CT and /or MRI would be needed to evaluate the spinal cord compression from the ligamentous hypertrophy or intervertebral disc extrusion." (*See Figure 1.*)

Bella's family was not in a position to afford further diagnostics much less the estimated $10,000 dollars for back surgery. On November 29, 2009, we started treatment of laser therapy and Prolotherapy under light sedation (.3cc Telazol®). Small amounts (⅛cc) of Prolotherapy solution (¼ dextrose, ¼ lidocaine, ¼ traumel, ¼ Vit B12), was injected in the intervertebral spaces from C3–L3 on either side of the spine. This was followed by acupuncture and electric stimulation for 30 minutes while Bella was still waking up. This procedure

Figure 1. C6 vertebral body tipping and C4–C5–C6–C7 intervertebral spaces slightly wedged. C4–C5 is narrower than C3–C4 and C5–C6. Mineralized disc material occupies the C3–C4–C6–C7 spaces.

Figure 2. C5–C6 and C6–C7 intervertebral spaces repeatedly narrow. Spondylosis deformans present at C7–T1. Narrow C5–C6 and C6–C7 intervertebral spaces and chronic instability at the C7–T1 intervertebral space.

was followed up by a supplement regimen of bromelain, omega 3, and probiotics, along with physical therapy (hand held neuromuscular stimulation and exercises).

We repeated this procedure four times at weekly intervals, adding Prolotherapy of the right knee on three of those sessions. We then waited three weeks and did sessions five and six supplemented by ACell's Matristem® injections.

The dog's progression was quick. By the second treatment session she was standing, albeit wobbly. By the third session she was walking a few steps on her own and by session four, it was evident she was well on her way to total repair. She was cage confined all of this time. By session six, which was two months later (January 29, 2010), we confined her one week after the last treatment and then let her loose to resume her life.

CASE TWO

Mattie, an 11-year-old male, neutered maltese. In this case, the dog fell off a luggage cart when going to the airport to board the private plane to Cabo, Mexico. He presented the next day to me in severe pain. He was moving very slowly, limping right hind and the pain was palpable on the lower cervical area. Radiographic findings read by Dr. Van Knox at Susquehanna Veterinary Imaging indicated "C5–C6 and C6–C7 intervertebral spaces repeatedly narrow. Spondylosis deformans present at C7–T1." His diagnosis was narrow C5–C6 and C6–C7 intervertebral spaces and chronic instability at C7–T1 intervertebral space." His recommendation: "To evaluate the above spaces further to see if there is spinal cord or nerve root compression – CT, MRI or myelography is needed." (*See Figure 2.*)

The owner refused further diagnostics because of the dog's age, and proceeded with Prolotherapy within several days after the injury. We did four sessions, each a week apart. We started each treatment with laser therapy, then Prolotherapy was administered. Small amounts (1/8cc) of Prolotherapy solution (1/4 dextrose, 1/4 lidocaine, 1/4 traumel, 1/4 Vit B12), was injected in the intervertebral spaces from C3–T3 on either side of the spine. The fourth session we also administered Prolotherapy in his right knee because of patella luxation (common in the breed). All sessions were followed by acupuncture and electric stimulation. This procedure was followed up by supplementation of weekly Adequan® injections alone. The owner refused to cage and confine the dog in between sessions. By the third session, Mattie was walking and playing normally without pain. (*See Figure 3.*)

Figure 3. Mattie (13-year-old Maltese) and his female companion on the beach at Cabo, enjoying his "Bark Mitzvah" (13-year-old boy dog) thanks to Prolotherapy.

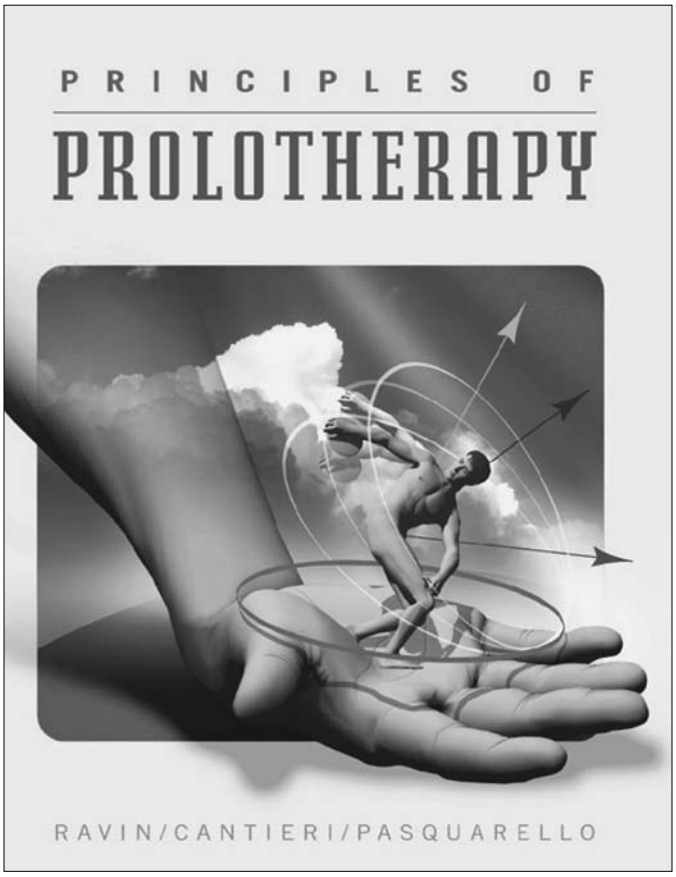
In Conclusion, Prolotherapy has its place in a wide range of Veterinary applications. As these cases prove, it is a viable treatment in Acute Spinal Cord Injuries for four-legged creatures. ■

BOOK REVIEW

Review of *Principles of Prolotherapy*

By Thomas H. Ravin, MD, Mark S. Cantieri, DO, FAAO, & George J. Pasquarello, DO, FAAO

Ross A. Hauser, MD



One of the most frequently asked questions from a physician learning Prolotherapy is "how do you know what and where to inject?" The book *Principles of Prolotherapy* by Thomas H. Ravin, MD, Mark S. Cantieri, DO, FAAO, and George J. Pasquarello, DO, FAAO provides this information! The book is extremely well written and can be easily understood by both the expert physician and the lay person interested in Prolotherapy. The book is produced in four color and most points are wonderfully illustrated.

The book begins with an introduction to Prolotherapy and explains in great detail the wound healing and tissue repair cascades. The authors explain clearly that Prolotherapy is the purposeful iatrogenic stimulation of the body's capacity to heal wounds and repair injured tissues. Prolotherapy stimulates healing of ligamentous laxity, chronic enthesopathy, or tendinosis, by initiating an acute inflammatory response. This is then illustrated by light microscopy photographs of a sacroiliac ligament pre and post Prolotherapy.

The authors of *Principles of Prolotherapy* all have clinical practices in which they also perform manipulation. They are well-known instructors and possess an immense knowledge of anatomy, which is evident in the book. The chapter on postural models makes the reader realize how the whole body is influenced by its various parts. They explain that "in Prolotherapy, the use of the degenerative postural cascade model can help predict when and where ligaments will commonly fail." Injury to one ligament, such as the iliolumbar ligament in the lower back, they illustrate, can lead to all kinds of muscles tightening in the lower back and pelvis leading to increased thoracic kyphois, increased cervical lordosis, and rotation at various transitional junctions in the spine. Based on this model, the treatment of ligament laxity is as critical to restoring function as the reestablishment of muscle tone, fascial balance, and biomechanical integrity.

The majority of the chapters in the book are divided into the various body parts, including the cervical spine and temporomandibular joint, thorax and rib cage, shoulder, elbow, wrist and hand, lumbosacral spine, pelvis and hip, knee, and ending with ankle and foot. The book is filled with extremely detailed and colorful anatomic illustrations showing all the pertinent anatomy, along with where to inject and where not to inject. The book does a nice job of illustrating where the various nerves are located in relation to the ligaments and structures where the Prolotherapy injections are reaching, so as to avoid them. For the doctor just beginning to add Prolotherapy to his/her practice, the sections on anatomical danger zones should be well-appreciated!

In *Principles of Prolotherapy*, the pertinent clinical history is discussed. Following this is a section discussing how to

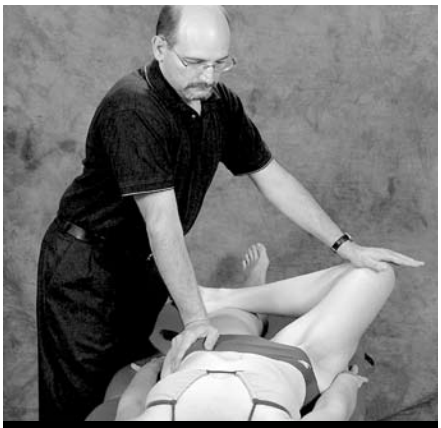


Figure 1. Photograph demonstrates the FABERE test of the right hip. Figure 10-18 from *Principles of Prolotherapy*. Used with author permission, 2009.

Figure 2. Photograph shows palpation of the proximal adductor tendons. Figure 10-19 from *Principles of Prolotherapy*. Used with author permission, 2009.

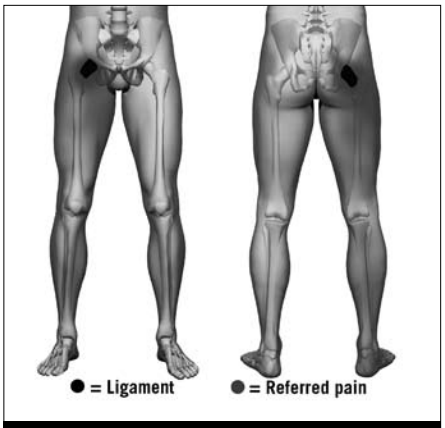


Figure 3. Image illustrates referred pain patterns from the anterior (a) and posterior (b) hip capsule ligaments. Figure 10-10 from *Principles of Prolotherapy*. Used with author permission, 2009.

clearly outline how the patient and clinician can know exactly which structure is injured on physical examination. (*See Figures 1 & 2.*)

Principles of Prolotherapy clearly illustrates the various ligaments and their referral pain patterns which can be seen in *Figure 3*.

For those clinicians who utilize manipulation in your practices, osteopathic manipulative treatment is well documented for each body part. One of the main highlights for everyone reading this book will certainly be the tremendous illustrations demonstrating Prolotherapy to the various injured body parts superimposed on clear anatomic drawings. (*See Figures 4 & 5.*)

Figure 4. Photograph shows the injection technique for the posterior hip capsule. Figure 10-35 from *Principles of Prolotherapy*. Used with author permission, 2009.

Figure 5. Photograph shows the injection technique for the lateral hip capsule. Figure 10-36 from *Principles of Prolotherapy*. Used with author permission, 2009.

These illustrations are the best I have ever seen to show the patient, as well as both the experienced and novice Prolotherapy physician, what structures are injected with each of the various Prolotherapy injections.

For the physician desiring to truly know how to accurately diagnose the cause of their patients' pain and how to document that by physical examination, *Principles of Prolotherapy* offers a truly comprehensive and illustrative explanation. For both novice and expert physicians utilizing Prolotherapy in their practices, *Principles of Prolotherapy* is a much-needed guide illustrating the injected structures, as well as how to safely perform these injections. For anyone involved in Prolotherapy, especially the physicians using the procedure in their practice, the book *Principles of Prolotherapy* is a must-have. It is a book that will stand the test of time and be used for generations to come. ■

TEACHING TECHNIQUES

Pubic Symphysis Treatment by Prolotherapy

Rodney S. Van Pelt, MD

Injuries to the pubic symphysis and pubic ramus are common. They occur in many sports and can be associated with pregnancy and following delivery. These injuries often cause severe pubic/groin pain and profound tenderness around the injured area. These injuries account for a great deal of disability and discomfort and are generally overlooked. Many athletes resign themselves to a permanent retirement, after several rounds of physical therapy are unsuccessful, but shouldn't have to. Pubic symphysis injury is quite treatable, and typically resolved with Prolotherapy!

Pain and injury at the pubic ramus and symphysis, while debilitating, are readily treated by Prolotherapy. The exam of the patient reveals marked tenderness at the injured site, either at the symphysis centrally or at the pubic ramus more laterally (and not uncommonly both). In fact, the tenderness is so substantial that many patients dislike the identification of the structures by palpation more than they dislike the injections!

In regard to anatomy, centrally located are the pubic symphysis and the pubic symphysis ligament. More laterally are tendon attachments of the abdominal muscles (superiorly) and thigh adductor muscles (gracilus and adductor longus muscles). (*See Figure 1.*) To begin treatment, discuss with the patient that you will be giving them injections in the "very low abdomen." Also discuss that these shots are important to the resolution of their pain and restoring their activities (this part is very important because of what you are about to tell them next!). Shots into this area hurt a lot!

The patient is then positioned supine with a pillow under the knees and the knees near each other. The drape is lowered to just below the pubic bone. The skin is cleansed. A few blebs of 1% lidocaine are infiltrated over the injured areas.

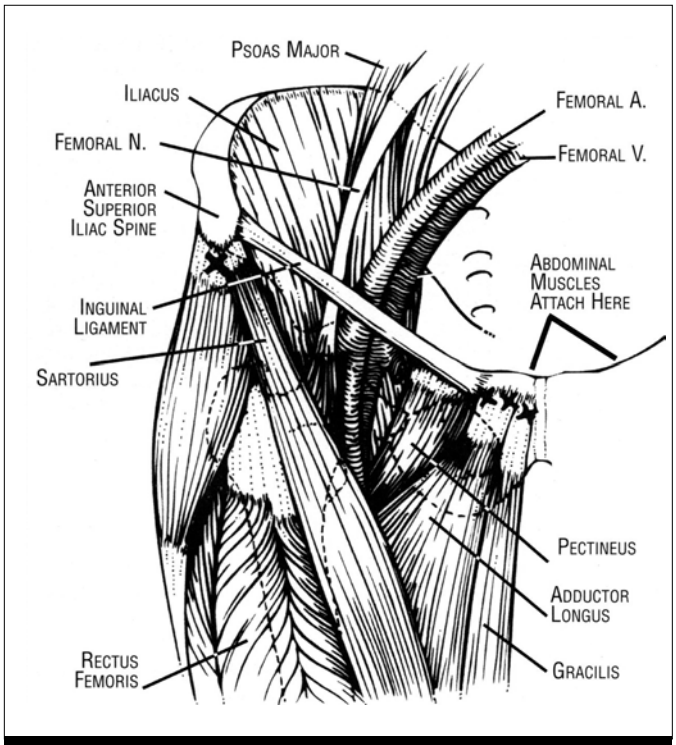


Figure 1. Common injection sites for pubalgia.
The attachments of the thigh adductors and abdominal muscles at the pubic symphysis and ramus are treated with Prolotherapy when tender.

Used with permission of Beulah Land Press © 2001 Oak Park, IL. *Prolo Your Sports Injuries Away!*, fig. 21-14.

For treatment of the pubic symphysis, I will use standard Prolotherapy solution. In selected cases, this may be augmented with stronger proliferants as the patient tolerates. I will straddle the pubic symphysis with my index and long fingers. Using a 10cc luerlock syringe with a 25G 2-inch (these injections are shallow and will not need all 2 inches.) needle we will then "pepper" (*See A.*) 5cc of the Prolotherapy solution at the fibro-osseous junction just laterally to the symphysis on each side (four shots on each side). (*See Figure 2.*) We will finish the 5cc by peppering two injections into the symphysis itself. (*See Figure 3.*)

A. Peppering *is a technique where an area is peppered with injections of 0.5cc of solution. The technique is begun with an injection of 0.5cc into the injured structure then the needle is partially withdrawn and redirected slightly and reinserted around the injured area and another 0.5cc are injected there. This is repeated multiple times thus "peppering" the fibro-osseous insertion of the tendon or ligament.*

Treating the pubic ramus calls for another 6cc of Prolotherapy solution for each involved side. Palpation can reveal injured tendon insertion sites. (*See Figure 4.*) While straddling the tender pubic ramus between my index and long fingers, the injections are administered by peppering six to eight injections to the pubic ramus at the points of tenderness. I will use appropriate caution for the femoral nerve, artery and vein which lie laterally at the inguinal canal. With knowledge of the involved anatomy and good technique, this is a very safe and effective treatment that routinely restores athletes and non-athletes alike to full activities without pain! ■

Figure 2. Injection of the pubic symphysis.

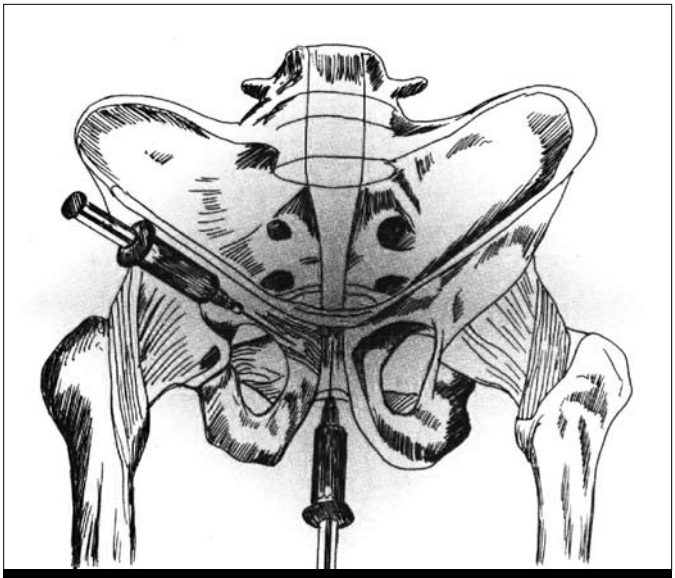


Figure 3. Prolotherapy of the pubic symphysis. This is a very effective treatment for sports injuries causing groin pain.

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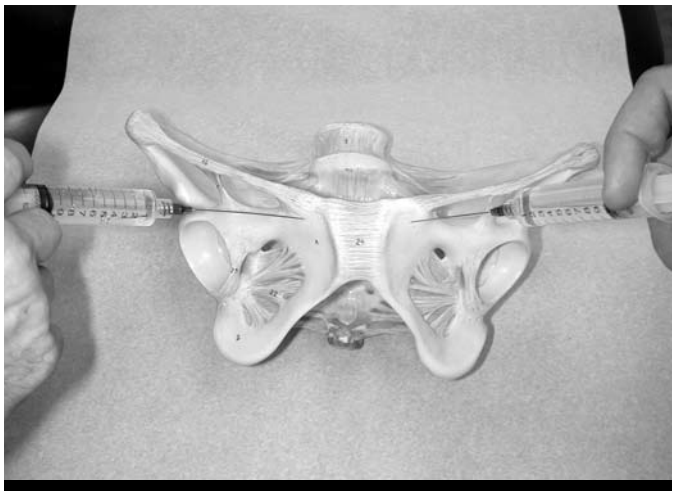

Figure 4. Model showing pubic symphysis and needles at superior pubic ramus.

IT'S A WIDE WIDE WORLD

Aromatherapy as an Adjunct for the Management and Treatment of Pain: Therapeutic Grade Aromatherapy Essential Oils for Pain

Wanona Wellspring, DN

ABSTRACT

Essential oils of Peppermint, Eucalyptus, Lavender and Myrrh contain neuro-depressive qualities for blocking pain as suggested by several studies in recent years. Also unique in their pain-relieving properties are Helichrysum, White Fir, and Douglas Fir. There are several factors in pain sensation resulting from trauma (both physical and emotional), nerve damage, joint dysfunction, arthritis, and surgery. Most of the research has been done in France and has not been translated into English. However, there is substantial documentation to support the safe and effective use of therapeutic grade essential oils for many health related maladies, including pain.

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KEYWORDS: aromatherapy, essential oil, pain.

INTRODUCTION

Of the many nerve fibers of the human body, the nociceptors comprise a large number and are located primarily within moving joints, and innervate various tissues within the body. There is a protective nature of the sensation of pain to help prevent injury to ourselves, staying within our pain "threshold," and to signal the brain to compensate for a previous injury. Nature has supplied us with a natural plant aromatic oil that has the ability to suppress substance P, a neurotransmitter that signals pain within the brain. Other essential oils from plants help muscles relax, heal bone, repair tendon, and calm the otherwise stressed sympathetic nervous system that keeps us in the pain-spasm-pain feedback loop with no relief.

FORMULAS

The primary pain formulas used varies from person to person although the same basic formula keeps repeating.

Pre-Prolotherapy Pain Control Formula:
10 drops Valerian
10 drops Vetiver
5 drops Clove
5 drops Helichrysum

Post-Prolotherapy Pain Control Formula:
20 drops Valerian
20 drops Vetiver
10 drops Helichrysum
5 drops Clove
5 drops Idaho Balsam Fir
5 drops Peppermint

Instructions: Make the formula and place into 00 capsules (00 is the size of the capsules.). Take as often as needed, or three to four hours apart.

Pain Formula for Trauma:
19 drops Valerian
2 to 3 drops Clove
2 to 3 drops Peppermint

Instructions: Take internally in an 00 capsule, two capsules at night are good for about five hours of pain relief.

Placing essential oil drops into 00 capsules.

BACKGROUND

When plants are selected for essential oils they undergo a stringent process to verify their purity and potency. They are grown in the best of conditions verifying their organic and wild-crafted nature. Many are grown in areas where the soil is extremely rich and have never received chemicals of any kind. They are harvested at their peak to insure that the quality of the oil in their leaves is the highest. Then they are diffused at a temperature that will allow the oils to be extracted into the steam, but not so high a temperature that the healing components are degraded. This is often the case with casual perfume companies who adjust the oils with chemicals to make them appear to be pleasant to the nose, but have no true therapeutic properties.

Select few companies have taken it upon themselves to provide pure therapeutic grade essential oils that are potent, organic and contain the highest quality ingredients according to scientific standards set by professional aromatherapy laboratories.

The chemistry of essential oils consists of simple hydrocarbons, oxygenated hydrocarbons, and their isomers. The oxygenated compounds of essential oils give them their most satisfying aroma and quality. Monoterpenes and sesquiterpenes fall into the category of Terpenes and contain groups of hydrocarbons responsible for their therapeutic effect in cells. There are an estimated 1,000 different monoterpenes and as many as 3,000 sesquiterpenes found in essential oils.

Both Valerian and Helichrysum contain sesquiterpenes: gamma-Curcumene in Helichrysum (helichrysum italicum) and alpha-Farnescene in Valerian (Valeriana officinalis). Sesquiterpenes are a fundamental class of plant compounds containing three isoprene units per molecule and are found in about 50% of all plant oils. Myrrh (Commiphora myrrha) contains 90% sesquiterpenes and is well known for its fixing property.

Ketones are composed of a carbonyl group with a hydrocarbon attached. They emit a strong aroma and aid in nerve sedation, as well as promoting healing. Valerian (vetiveria zizanioides) contains a ketone known as alpha-Vetivone.

Both Valerian and Vetiver contain small amounts of carboxylic acids. The presence of acids in essential oils is so rare and unusual that many of them are named for their parent plant, valerinic acid and vetiveric acid are found in valerian and vetiver respectively. The acid molecules carry a benzene ring giving them a higher resonance energy giving them electromagnetic frequencies. Valerinic acid when combined with the aldehyde valerianal gives valerian its unpleasant smell. The sedative properties of valerian however comes from the sesquiterpenes present in the oil. It has been used as a tranquilizer in Germany and to treat insomnia. The aldehydes in oils provide an antiviral and anti-inflammatory quality as well as calming effect to the nervous system. Working on the parasympathetic system they reduce blood pressure by dilating blood vessels, and relieve emotional stress.

Essential oils being applied topically.

Lavender is one of the more well-known essential oils used in aromatherapy for relaxation.

Helichrysum (helichrysum italicum) is also known as Everlasting. It contains less than 0.1% essential oil content and is costly to obtain. It contains the sesquiterpene gamma-Curcumene. Sesquiterpenes delete faulty information by correcting transcriptase function in DNA replication. The largest element found in helichrysum is the ester Neryl Acetate, up to 38%. Esters are known for their relaxing effect, analgesic and strong affinity for acetylcholine receptor sites. This may explain why muscle relaxation occurs as the ester occupies the space of the muscle receptor site and slows down the contraction of muscle fibers. Other well known esters are found in Lavender, Roman Chamomile, Onycha, Cardamom, Jasmine and Spruce.

Peppermint (mentha piperita) contains a high concentration of Menthol (34-44%) and is never mistaken for other oils of the mint family. The flavor of peppermint will dominate the blend. It will fight against invading microbes and fight off bacteria and viruses while offering pain relieving qualities. Peppermint will suppress the production of substance-P neurotransmitter in response to pain. It is a popular ingredient to freshen mouth, soothe digestive difficulties, and relieve colic and indigestion.

In addition to its effectiveness in pain relief, clove (syzygium aromatica) has also demonstrated itself as an anti-inflammatory and a blood thinner. It has a higher ORAC (Oxygen Radical Absorbance Capacity) value of over 10 million. By comparison the ORAC score of blueberries is only 2,400, 1,260 for spinach, 750 for oranges, and 210 for carrots. Clove has been used as an oral anesthetic by dentists for more than 500 years. The phenolic compounds found in clove clean receptor sites, eat up free radicals and protect us from viruses and harmful bacteria. Clove contains more eugenol (75-80%) than any other essential oil, giving it the anesthetic quality when used topically. Jean Valnet, MD, a French physician, reportedly found clove beneficial for many purposes including nausea, bronchitis, arthritis, acne, halitosis, headaches, insect bites, mouth sores, warts, lymphoma, and prevention of contagious disease.

CONCLUSION

Using therapeutic grade essential oils when there are symptoms of pain or as a protecting agent, and to prevent pain from a medical procedure, has been reported successful and warrants investigation. The scientific data justifies the use of specific oils which have been tested by health practitioners and patients with great success. Whether a person is preparing for Prolotherapy, a simple dental cleaning, or other medical procedure, the use of even a few essential oils may help reduce the pain and inflammation, as well as protect against infection and emotional stress a patient may be experiencing. ■

RESOURCES

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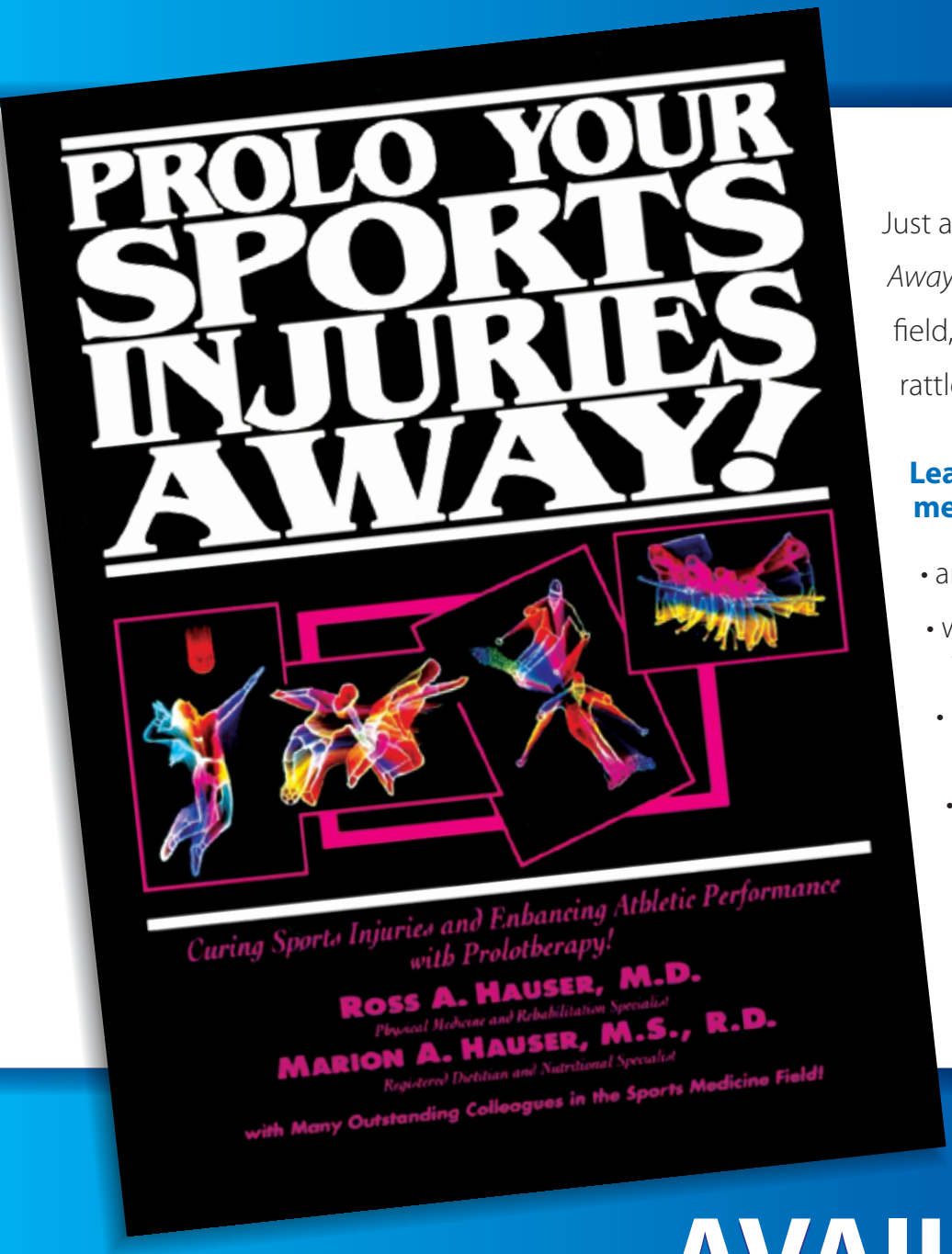

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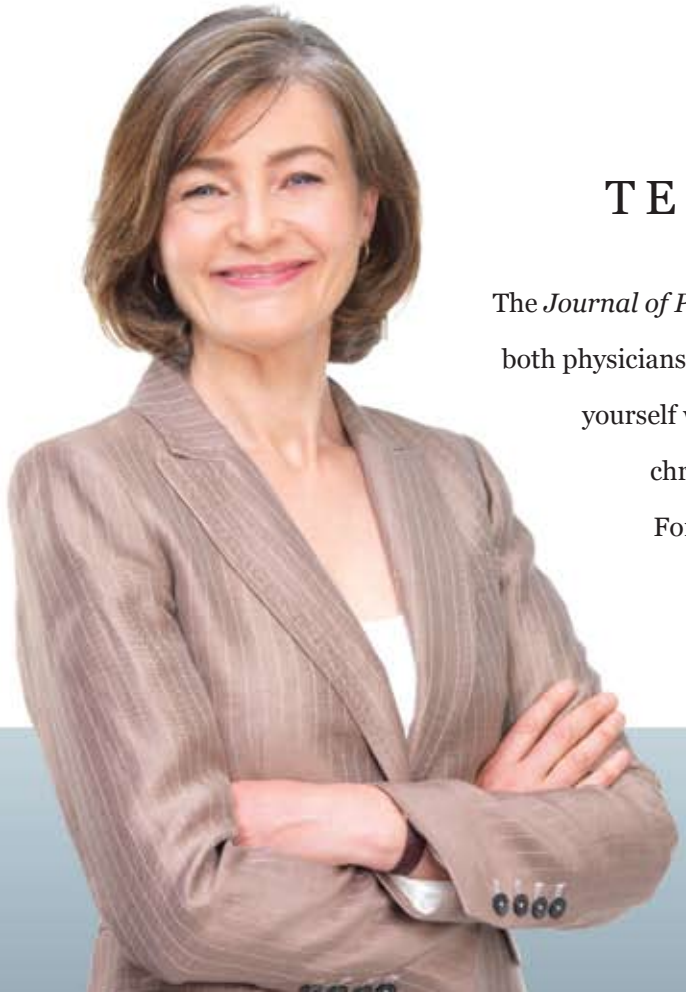

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