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# Pelvic Mechanics and Prolotherapy

[Townsend Letter for Doctors and Patients](#), Feb, 2001 by [Thomas Dorman](#)

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## Part One

This is the first of a four part series prepared for The Townsend Letter for Doctors and Patients. It will cover some of the basic concepts current in modern Orthopedic Medicine. Future sections will deal with the tools for clinical evaluation in this subspecialty. The last section will deal with new concepts integrating the issue of perceived disc disease and why it is often overemphasized. The references for the first three parts will appear at the end of the third section. The last section will carry its own references.

## Introduction

Back pain has been the starting point for the recent surge in our interest in the function and dysfunction of the human pelvis. The old model of disc disease has been insufficient to account for the size of the problem, the poor correlation between anatomical abnormalities in the discs as seen on modern imaging [33] and the persistence of pain and dysfunction in the face of anatomically corrective surgery. A group of clinicians have found that manipulation and certain injection techniques, including prolotherapy, have yielded clinical results. This has led to an odyssey consisting of some clinical research and a fresh look at some basics regarding form and function. A wonderful interaction has developed between these clinicians and the research department of Erasmus University in Rotterdam under the leadership of Andry Vleeming PhD. A new understanding of the function of ligaments is leading to an appreciation of their role in disease. In fact, a new category of disease is emerging -- that of mechanical disease. Orthopedic medicine is the branch of medicine which deals with these problems.

## Orthopedic Medicine as a Discipline

James Cyriax of London, England, coined the term orthopedic medicine first in 1929, separating the management of soft tissues by nonsurgical techniques from orthopedic surgery. Later he became the father of orthopedic medicine. His were many contributions, but above all he brought a Renaissance approach to the evanescent subspecialty His pristine paradigm applies today just as much as ever. The rest of so-called traditional medicine has drifted somewhat in the last decades of the 20th century into an operational mode of standards of care and set routines, which have developed a slight tendency to degenerate into a stoichiometric relationship between standardized diagnostic groups on the one hand and therapeutic interventions on the other. The orthopedic medical tradition has maintained a dynamic relationship between the patient's symptoms and signs on the one hand and intervention on the other. Each evaluative step is a challenge to the current diagnostic hypothesis. Each therapeutic intervention is in the nature of an experiment. The outcome of the experiment denies or confirms (in that order) the hypothesis which was the clinical point of departure. Accordingly, the management of cases by this approach is one of a dynamic interaction predicated on the intellectual agility of the operator. The physician (operator) bases his work on a continual assessment of the patient and his responses. Each experiment or therapeutic intervention is based on the clinician's understanding of orthopedic medicine, the essentials of which are an appreciation of the behavior of the fascial ligamentous organ of the body (this refers to the combined layers of fascia and ligaments throughout the whole organism, like an envelope), as well as an understanding of secondary phenomena related to the associated organ systems, particularly the central nervous system and the muscular system. The initial clinical findings raise a diagnosis with perhaps a short list of differential diagnoses and from this is set an initial experiment. The experiment might consist of the evaluation of a range of movement, pain provocation by a contracting muscle, a test question. In orthopedic medicine, laboratory and imaging investigations are, by and large, useless. They are, of course, useful in the broader context of a medical evaluation in searching for (and in the context of

orthopedic medicine, ruling out) more serious disease, such as pathological fractures and so on. In the life of the human the degenerative process, as it is called, takes its toll. This degenerative process has counterparts in the external appearance of the organism as well as the internal appearance -- to wit, the findings on images. So, from an orthopedic physician's perspective (and only after the appropriate rule out process has been undertaken), an over-interpretation of images can at times be confusing as it might divert an unwary clinician's attention to an organ which is anatomically abnormal, degenerate, or the like but not the cause of the presenting problem, usually a pain. Accordingly, a guiding rule in clinical orthopedic medicine is to base one's empiric approach on the clinical manifestations. Success in this branch of medicine is predicated on the clinician's ability to imbibe this philosophical approach. The details of the clinical approach are outlined best in the several Cyriax texts [5,6] and secondarily in the writings of this author. [12] In a broader context, the philosophical paradigm is that of Karl Popper, [48] an acknowledged guide to the scientific method which has been the engine for the periodic success of our civilization since Grecian times and during the Renaissance. Orthopedic medicine has not taken hold of the imagination of the medical profession during this century in spite of its fantastic effectiveness. Why? The blame lies in the failure of philosophy. This was pointed out by Ayn Rand. [46] Concepts in Orthopedic Medicine

### **Pain Patterns**

On the basis of clinical experience, a number of rules have been defined regarding pain. First, we should dwell briefly on this word rules. In the English language, this word serves double duty. Here, we are discussing observed patterns in nature, not the dictates of morals or governments. These patterns within nature are based on observation and, for the clinician, on clinical observation. Advances in science are predicated on observation, even when these observations contradict expectations. Accordingly, the orthopedic physician evaluates pain patterns based entirely on the accumulated experience of the empiric approach. In the 30's of this century, J.J. Kellgren, a teacher and researcher in America, used a noxious stimulus (6% saline injections) instilled in various somatic locations in volunteer subjects (his medical students) and asked them to draw pain patterns. This research served the basis for a subsequent understanding of the observed phenomena of referred pain from the fascial ligamentous (musculo skeletal) system. The obvious next step was to identify similar pain patterns in injured individuals and attempt to relieve their pain (at least temporarily) with local anesthesia injected at the same sites. This was performed by George Hackett, an industrial surgeon active in the Midwest of the United States in the 1940's and 1950's. Resistance to acceptance of these patterns arose early. Anatomical knowledge of the distribution of the nerves, a knowledge of embryological development and patterns, as well as the concept of pain distribution in the anatomical counterpart of nerve roots, divisions of the brachial or lumbar plexus, and peripheral nerves prevailed from anatomical knowledge. Kellgren's and Hackett's patterns did not correspond with this expectation. The term unscientific was applied. In fact, these observations were the quintessence of the empiric method. They were based on clinical observations.

An attempt at treatment followed. With the recognition that fascial layers can be strained and ligaments relaxed from the mechanical 'wear and tear' of the moving parts of the body, attempts at refurbishing these structures with prolotherapy were made. It was found -- again, empirically -- that it was possible to abolish a large portion of the painful syndromes with which the patients presented. In addition to confirming the effectiveness of proliferant injections in experimental animal models, [27] Hackett also reported a 90% clinical improvement in the patients whom he managed in his capacity as an industrial surgeon. [25,26,28] It was during this period that a collation between the clinical recognition of pain patterns on the one hand and the empiric use of proliferant injections on the other was brought together with the initial salutary results, marking the second landmark in the evolution of the specialty of orthopedic medicine.

### **History-taking**

The orthopedic physician takes a history with an inquiring mind. On the one hand, he has ready in his subconscious a portmanteau of familiar pain diagrams, recurrent patterns the body responds with when injured, an understanding of the

mechanics of the fascial ligamentous (tensegrity) organ, a knowledge of secondary manifestations from the response to chronic pain, the neurological, muscular and psychological secondary phenomena, which are often dominant historically, an understanding of the mechanisms of injury from falls, thrusts and the like, and, finally, a familiarity with the response of soft tissue to injury, which, in certain areas of the body, is peculiar. With this array of keys, the patient is approached in an attempt to unlock the puzzle. Every clinical presentation in orthopedic medicine is such a puzzle. The skill of history-taking is, on the one hand, simple and, on the other, represents the highest degree of clinical sophistication. The most difficult instruction to trainees is not to jump to conclusions and maintain a neutral posture versus the diagnostic keys which come to mind first from the history. The quintessence of the empiric method is one of disproving an hypothesis and only when the disproof fails can a diagnosis be accepted. Accordingly, the tests of the diagnosis include further probing questions and, finally, intervention. A diagnosis is not established until after the cure is achieved and an adequate follow-up time of observation has passed. Accordingly, a section on 'history-taking' (anamnesis) in orthopedic medicine is impossible to write. No two cases are identical and there is no ritual, catechism, or litany to follow. The golden rule is never to ask direct questions when indirect questions are possible. Questions should be phrased so as to deny an hypothesis, if possible, because the outcome of the empiric approach in the clinical setting in orthopedic medicine is always the response of the subject, an alteration in pain being the most common. History-taking should, however, include a detailed account of the mechanics of an injury. In the situation where machinery or automobiles are involved, it is advantageous to learn about matters such as speed of impact, amount of damage to the vehicles, site of damage to the vehicles and the presence or absence of restraints. When pain arises, the time of arrival of pain in relation to the time of injury should be noted. (It is a characteristic of ligament injuries that there is a delay between the injury and the onset of the resultant pain.)

### **Tensegrity**

The one-eyed man is blessed in the land of the blind. On the other hand, not every seer is truthful. Modern scientific research has shown us that some paradigms are confirmed objectively and, yet, are counter-intuitive. Examples of this from physics are the notion that matter and energy are interchangeable or that wave forms and particles both represent the same things. Skepticism in the face of counterintuitive new concepts is healthy. Contrariwise, rejecting them merely because they are counter-intuitive denies us great benefit. Into this category of counter-intuitive yet valuable concepts we need to place tensegrity. The term was introduced in 1929 by the famous architect, Buckminster Fuller, [21] composed from the words tension and integrity. There are instances in our daily lives where we have come to accept the transfer of mechanical forces diffusely. Instances of this are the transfer of the weight of an automobile via air and rubber (we call it the inner tube and tire sitting of the in of the wheel o f the car) to the ground, or the observation that a truss is stronger in supporting weights than the sum of its parts. Structural engineers will confirm that tension reinforced concrete supports cantilevered weight and changing stress better than the amorphous material. Biological structures are found to be tensegrity models uniformly. Forces are dispersed through the system diffusely, tension and compression acting in an integrated way. The familiar example is the geodesic dome seen in exhibitions where the center of gravity is right in the middle where nothing exists at all. The fascial ligamentous skeletal system, which is the framework of our bodies, is such a tensegrity model. The importance of this concept to the orthopedic physician is that it helps explain commonly observed associations. Forces are transferred diffusely through a system. Forces tend to concentrate or accumulate at sites of increased mobility or where the direction of mobility changes. Examples of this are at the sites of the axial skeleton where the mechanics change -- to wit, both ends and the thoracolumbar junction. Strains accumulate at the sites where the fascial layers are firmly attached to the periosteum, i.e., the compression members. Examples of this are the lateral epicondyle of the humerus, the tips of the transverse processes of the vertebrae, the posterior superior iliac spine, the whole of the iliac crest and its three lips on both sides, the shin bone and so on. (The astute reader will note a correlation between these areas of attachment and the 18 sites defined as tender spots in fibromyalgia.)

## **Fault Propagation**

Another concept which needs to be familiar is that of fault propagation or crack propagation. It is a common experience that when fabric begins to fray, for instance, in front of the knee in a pair of trousers, with worsening decay of the fabric, the one hole enlarges indefinitely while the rest of the fabric remains relatively well preserved. Once a weakness occurs and passes a certain threshold of enlargement, further progression of the weakness at the site is rapid. This is a phenomenon characteristic of many materials. It is also true for the fascial-ligamentous envelopes of the body. In contrast to the fabric of trousers, the natural healing process of the body combats our internal fault propagation. However, when the balance of destructive forces exceeds the reparative capability, the concept is applicable. This, together with the torque arising from asymlocation (qv) of the sacrum, characteristically causes ligamentous and fascial strains at remote sites after an interval. These sites are usually the neck and the thoracolumbar junction, in that order. Repeated strain eventually passes the threshold whereby fault propagation occurs. Accordingly, it is usual to find that a person with a low back injury develops neck pain after an interval, typically of three months. The several faults in the fabric of the fascial-ligamentous-diffuse-organ may become fixed. The body eventually heals the injury in the newly displaced forms -- hence, the change in body contour with aging. When this phenomenon occurs irregularly, prolonged periods of fascial strain at the 'weak points' occurs. It is responsible for persistent and recurrent exacerbation of pain.

## **Posain**

It is a common experience of patients with ligamentous and fascial injuries that they are unable to maintain one position or another for a long time. Typically, an individual with low back pain will state that he is unable to sit more than half an hour without being compelled by his pain to get up and move around. On occasion, other positions provoke this pain. [44] What, one might ask, is the reason? When any ligament is placed under stress, even a mild stress, after an interval it becomes a source of pain which gradually becomes intolerable; the individual is compelled to move. How is it, then, that adopting what would normally be an acceptable comfortable position provokes this positional pain, i.e., posain, in injured people? The cause is that in these individuals torque is transferred through the system. This is somatic dysfunction, an internal derangement of the symmetry and correct alignment of the axial skeleton. It is the exaggerated asymmetry which provokes the unusual strain. These patients usually report a pain in one side of the back -- for instance, over one SI articulation posteriorly. It may radiate via the buttock down the leg. The term posain (from positional pain) was introduced by this writer about a decade ago as a convenient 'language handle' for this phenomenon.

## **Nulliness**

Another common experience -- a law of nature, if you like -- is that individuals with posain also suffer from 'numbness,' by which they mean a sense of numbness, but when examination is performed no anesthesia is identified, however careful the neurological examination. This might even include nerve conduction studies, evoked potential studies and the like. This false sense of numbness is, however, real to the patients, and, when asked to draw diagrams of the distribution of this phenomenon, it is found to match the patterns discussed earlier and first identified clearly by George Hackett. This phenomenon has been defined by this writer as nulliness in an attempt to coin a word that would imply a numb-like sensation without an objective counterpart. Since this author proposed the term nulliness a decade ago, it has gained wide acceptance as a distinct characteristic of strained ligaments. These patterns of nulliness are referred. Each ligament has a characteristic pattern or patterns of its own. Each ligament has a limited repertoire of patterns. When the sensory input from the ligament is reduced, as for instance with the application of local anesthesia at the site of strain, this symptom disappears. A characteristic of nulliness is that the patient reports that stroking the affected area (site to which the symptom is referred) is either pleasant or neutral. It is not unpleasant. Contrariwise, when stroking an area of the body where numbness is present following neurotmesis, the patient

reports showers of pins and needles and an unpleasant sensation from the stroking. This is a strikingly useful clinical differentiating point.

### **Form and Force Closure**

The importance of friction in the function of the SIJ's has been conveyed through the introduction of the contrasting concepts of form closure and force closure. Form closure refers to a stable situation with closely fitting joint surfaces. In an idealized model of form closure, weight bearing (and the transfer of other forces) would be achieved through snugly fitting geometrical forms alone. Functional analysis of living joints shows that various mechanical refinements are usually present in each. In the case of the SIJ's, the additional factors are distinct. On first inspection the sacrum appears to be wedged between the ilia. It has, however, been shown that, on standing, the closed kinematic chain is predicated on lateral pressures through the rough surfaces of these joints. This has been termed force closure. In the SIJ's both a compressive lateral force and friction are needed to withstand vertical loads. Shear at the SIJ's is prevented by a combination of the specific anatomical features (form closure) and the compression generated by ligaments and muscles acting across the high friction surfaces (force closure). These concepts are represented in the figures.

### **Movement and Governance of the Sacroiliac Articulation**

In the first century BC Hippocrates recognized some movement of this joint in parturition but regarded it as immobile otherwise. [31] Diemerbroch raised the suggestion that the articulation has some movement even in the non-pregnant individual. [8] The joint was categorized as a diarthrosis in 1864 by Von Luschka. The first supposition of a fixed axis of rotation came from research at the turn of the century. A recognition that buttock and leg pain may arise from hypermobility of the joint was raised by Goldthwait and Osgood [23] in 1905. Movement of these joints has been accepted since then. However, in a surprising stampede, the causes of pain in the buttock and leg have been ascribed exclusively to the then newly described complications of disc injuries (by Mixter & Barr [42]) from 1934. Since then interest in the movement of this joint has waned in spite of a number of specific studies. Since 1954, and based on Weisl's work, the presence of some movement normally in the joint has become received opinion. [57] That this movement is appreciable we have come to appreciate only recently. Nonetheless, unsubstantiated statements by some individuals expressing the view that mobility is absent in the SIJ's in adults (outside of the pregnant state), or that if the movement occurs it is so slight as to be immaterial, can still be heard. Movement in living humans has been demonstrated stereophotogram-metrically [54] with radiology by the placement of Kirschner wires in sacrum and ilium [4, 35] and observing the external movement, and through actual measurements of iliac positions with calipers. [38,47] Motion at the SIJ's is maintained even in advanced age. [56] Movement of these joints has been recognized in manual medical circles through methods of palpation throughout the history of osteopathy [23] and well established in physiotherapy circles as well. [9,29] Governance of the joint is seemingly very little by way of the joint capsule itself, but mainly through the tightening of the several periarticular ligaments (of which more later). The capsule of the SIJ has been shown radiologically, frequently, to be incomplete. [1] An analysis of movement at either SI articulation calls into question movement at the other two joints of the pelvic ring. Although interconnected through the soft tissues, the relative movement of each of the bones versus the others in the three directions of space, let alone the interaction with the fascial tube of the whole organism, creates a three-dimensional puzzle of great complexity. The osteopathic profession has labored with the classification of the dysfunctions of the axial skeleton for over a hundred years. A recent classification [24] has brought some order into a subject that was previously marred with terminological turmoil. A reproducible, practical and uniformly applicable form of measurement of the relative movements of the four elements (1) fascia; 2) sacrum; 3) left ilium; 4) right ilium) has not been found. The art of manual palpation has not, so far, yielded satisfactory inter-observer consistency in measurements that are satisfactory for modern statistical analysis. It remains, therefore, an impression, a gestalt, of the admittedly growing cadre of manual medical therapists that these movements can be

palpated and treated. That manual treatment can be beneficial is now official [49] though the modus operandi of the various therapies remains empirical.

What can be said regarding the attendant ligaments and other soft tissue structures surrounding this joint? What role do any of them have in the governance of function? Interestingly, recent research has shown that the large ligamentous bands, recognized of old in the pelvis, play substantial roles in the governance of the sacrum. Finally, to the extent that there is a modal, i.e., most typical pattern of movement round an hypothetical 'axis,' it turns out that the deep posterior interosseous ligaments of the SIJ plays that role. [20,54]

### **Asymlocation**

From the foregoing it might be appreciated that the sacrum can become trapped asymmetrically between the ilia. The adducting forces active in the pelvis are apt to maintain this position even indefinitely. This asymmetry is physiological. With ligament relaxation it is apt to become exaggerated. The demarcation between the normal or physiological asymmetry and an abnormal one, which in turn leads to somatic dysfunction, is not one that can be defined anatomically or physiologically with any precision. It is a clinical (osteopathic) observation, however, that with a partial or complete correction of asymmetry, pain and dysfunction diminish or clear up. Conceptually, therefore, asymlocation is a term this writer has coined for referring to the asymmetry as such. It is intended to be a neutral term which does not define dysfunction per se.

### **Function of Specific Ligaments**

Nutation winds up the dense interosseous ligaments of the SIJ, tightening and approximating the auricular surfaces, inducing the phenomenon of force closure. The very important, and hitherto neglected, long dorsal SI ligament is, however, relaxed in nutation and tensed in counter-nutation. (Nutation is an osteopathic term which refers to a forward movement of the sacrum on the ilium). Clinicians need to keep in mind that pain localized within the boundaries of the long dorsal SI ligament might represent a spinal condition of sustained counter-nutation of the sacrum. Contrariwise, the sacrotuberous ligament is tightened in nutation. It functions as an extension of biceps femoris assisting in the governance of the self-locking of the pelvis. This is how contraction of biceps femoris pulls on the soft tissues at the sacral side of the SIJ, thereby governing nutation. The gluteus maximus, with its broad origin from the posterior and lateral aspect of the sacrum and sacrotuberous ligament below, as well as the fascia above, is inserted predominantly into the greater trochanter of the femur. Its fascial origin is partly contiguous with the thoracolumbar fascia. The thoracolumbar fascia is now known to transfer force across the midline in concert with the contralateral latissimus dorsi. Increased tension of the sacrotuberous ligament will preclude normal nutation of the SIJ. It can be seen, therefore, that all these large flat muscles and their fascial components work in conformity.

### **Muscles**

Judging by their attachments, various muscles are probably involved, directly or indirectly, in force closure of the SIJ's. The indirect effect is by modulation of the tension of ligaments and fascia. Each of these muscles has been shown to have a somewhat variable 'function' depending on the position of the two SIJ's. It should be remembered that these articulations are braced in nutation on stance, a situation which alternates between the sides in optimal healthy function. The SI articulations tend to manifest some degree of bracing at most times. This is inherent to the tensegrity model. The degree of nutation/counternutation, interacting with the tension of the soft tissues around them, is variable. It affects, and is altered by, muscle action. The demarcation between normal and pathological (positioning) is inconstant and has led to some terminological confusion. The common tendency for the articulation to drift into the suboptimal chronic position of an 'anterior ilium' (i.e., a counter-nutated position) on one or both sides has been classified clinically [9] as pathological, though an objective confirmation for this is still unavailable. An analysis of 100 healthy individuals has shown that the abductors of the hip, the gluteus medius

predominantly, come into action when the ilium is rotated posteriorly, presumably at the moment of heel strike during walking. [14] Additionally, four muscles will be analyzed as examples of modulators of fascial tension: 1) The erector spinae through its extending effect on the spine and its substantial sacral attachments might be expected to promote nutation. As the muscle is a summation of many intersegmental units (catalogued under one name), it is likely that facilitation of select subsegments of this group of motoneurons might fire independently in certain situations. Here is one of the many instances where it is difficult to ascribe a prime movement to a trunk muscle because of the integrated function of the whole trunk. 2) The gluteus maximus muscle is another example of interest. First, one might note its large size in the biped upright human stance in contrast to its diminutive mass in monkeys, which are essentially quadruped. [39] Some of the horizontal fibers of the gluteus maximus might be expected, on contraction, to have a direct compressive effect on the SI articulations. The fibers attached to the sacrotuberous ligament are more interesting (the terms origin and insertion are more confusing than helpful here). When these fibers contract and raise the tension of the sacrotuberous ligament, self-locking is promoted and nutation governed. This is another example where, besides the 'prime function' of the muscle, one must recognize its role in modulating the tension of ligaments and fasciae. The effect of increasing the tension in the sacrotuberous ligament on the sacrum is variable. It depends on posture and the existing degree of nutation. 3) The latissimus dorsi muscle is linked across the midline through the thoracolumbar fascia to the gluteus maximus of the other side. They seem to function in concert in trunk rotation. The thoracolumbar fascia can be tensed itself by the erector spinae muscle. [55] A correlation between the developmental mass of the erector spinae and tension in the thoracolumbar fascia has been demonstrated. An image of some of the interactions can be gleaned from Figure 7.4) Biceps femoris. This muscle will serve as an example of a limb muscle acting on what has traditionally been called its origin, also as a tensor of a ligament. The biceps femoris muscle has been shown in the experimental situation to alter the tension of the sacrotuberous ligament. In some specimens the attachment to the ischium was minimal, demonstrating again that the main function is one of integrated tension modulation on the soft tissues, thereby controlling the main clutch of the trunk, the SI articulations, [58] with incidental contact via a 'toggle,' the ischium. Not surprisingly, the measured tension in the ligament was affected by the degree of nutation of the sacrum and position of the rest of the body, which by inference is thought to affect the resting tension of the fascial ligamentous 'tube' of the trunk.

Do any muscles maintain a state of continuous contraction to maintain the state of force closure -- bracing -- of the SI articulations? From a biomechanical perspective, something akin to a spring is needed to maintain the loaded closure pressure. It seemed, therefore, paradoxical that in unconstrained sitting and standing EMG testing showed the gluteus maximus and biceps femoris to be silent. [51] In this form of standing, it turns out that the internal oblique abdominal muscles are under continuous tension. It is an observation that voluntary muscles tend to relax cyclically (when they don't relax fatigue, spasm and trigger points develop). Nature's solution emerged from an experiment designed to falsify the hypothesis of muscle contributions to self-bracing. It turns out that when the legs are crossed the internal oblique abdominal muscles relax. (Figure 8) It seems that the trunk is rotated slightly, placing the fascial tube of the body under slight tension. It is this tension which maintains compression of the pelvis. One ischium is subject to increased weight bearing and the tensions measured in the latissimus dorsi of one side and the gluteus maximus of the other is increased. This balance can be maintained for some time, but creep in the soft tissue is apt to give enough slack after an interval, which will reflexly 'wake up' the 'guardian' internal obliques. It is now that the sitting subject instinctively reverses, changes over to crossing the other leg, an experience we have all noticed subjectively. [51] It would be surprising if force closure were dependent on muscle action at rest, e.g., sitting. Therefore, the observation that adequate tension is generated in the fascia and ligaments to ensure force closure of the SI articulations by passive stretching, i.e., by crossing the legs, is a reassuring and subtle instance of energy conservation.

## **Walking**

We see, therefore, that the ligamentous and fascial surrounding structures (augmented by the large, flat musculature on both sides of the body) are importantly responsible for ipsilateral force closure of the SI articulation. The posterior layer of the thoracolumbar fascia acts as a large transmission belt. It is almost certain that in walking integrated action occurs between these

several separately named anatomical entities. Additionally, if, for one reason or another, function of one component of this conglomerate is less than optimal, the role is taken over by the remaining functionally intact elements. The compression members (bones) of the pelvis might be said to toggle with each step. There is alternating locking and release of the SIJs in stance and swing. If one of these functions remains locked, or is otherwise impaired, walking can still take place because of the independent reserve function of the peripheral joints and muscles. It is proposed here that there is a complex interaction between all these elements in stance and swing, including: 1) storage and release of elastic and 2) antigravitational energy, [18,19] 3) interactive complex motion of the compression and tension members of the pelvis, and 4) the surrounding ligaments and fasciae. The momentum in walking is a uniquely human physiologic process predicated on the peculiar anatomy of the SI articulations. The joint can be thought of as a multidirectional force transducer integrating the several functions of the pelvis discussed herein. The transducer involves an induction of energy and forces. [53] This integrated function calls for a new concept. Accordingly, it has been proposed in a recent article that a new term be coined for this purpose. This would facilitate further discussion on the subject. The term offered was transduction. [15] Transduction is the process of the transfer of forces, both elastic and gravitational, between the pelvic components in kinetic motion.

### **Recapitulation**

The pelvis is central both anatomically and functionally in the human frame, which from a functional point of view can be analyzed as a walking machine. This article has brought together evidence for a new understanding of the role of the SIJ as the key element in the pelvis. It allows the 'walking machine' to transfer forces back and forth between the components of this 'machine.' Stance is afforded through force closure, which ensures stability. The joint allows the transfer and modulation of forces on the swing side. The integrated function of the whole pelvis facilitates efficient alternation of self-locking and energy transfer between the sides with each step. In order to comprehend this article, a number of new concepts are required. In summary they are: 1) Force closure is a new concept defining the clutch-like bracing of a link in the closed kinematic chain of stance through friction; a function peculiar to human SIJ's. It differs from form closure. 2) Effective self-locking of the SI articulation is achieved through both form and force closure. Nutation winds up most of the ligaments in the area. Without nutation, effective self-locking would not occur. Note that a 'flexed' (or non-loaded) spine increases counter-nutation tending to destabilize the pelvis. 3) Locomotion transfers antigravitational and elastic energy back and forth between the moving parts. This is an essential function in walking because of the need to step, in contrast to the even movement of rolling stock. 4) The ligaments around the joint play an essential role in its function. 5) These roles include that of storage and release of elastic energy. 6) An additional role is participation in the diffuse transfer of tension forces through the thoracolumbar fascia and by analogy through other fascial layers. 7) The role of all the muscles in the trunk and lower limbs is contributory, mostly as modulators of tension in the ligaments and fascia. 8) The integrated function of these elements and forces is a characteristic of the human pelvis, ideally adapted to walking. It is proposed here that this integrated function be called transduction.

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Townsend Letter for Doctors and Patients, April, 2001 by Thomas Dorman

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## Part Two

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## Syndrome Recognition

Orthopedic physicians recognize a large inventory of syndromes, clusters of symptoms and signs usually matching distinct pain diagrams which characterize specific mechanical dysfunctions. Some of these syndromes are dominated by symptoms which are secondary to the underlying mechanical cause. Many of these have been outlined in James Cyriax's textbook [5] or in the textbook written by this author [11] and could not be detailed comprehensively in this chapter. A few illustrative examples will suffice.

### 'My Back Goes Out'

In this syndrome, patients report episodes where unexpectedly and suddenly following a slight movement, most characteristically rising from a stooped position with a slight degree of rotation in a casual manner and without a great weight, severe, sudden onset, asymmetric back pain occurs, usually with radiating pain via one buttock down the leg. The patient is unable to stand straight. When examined acutely, these individuals are unable to form the normal lumbosacral lordosis, are able to flex forward, have marked asymmetry in side bending and rotation at the lumbopelvic level, frequently suffer from marked straight leg raising limitation on the painful side, may have secondary weakness due to pain, but do not suffer reflex suppression or sensory deficits. These individuals are frequently responsive to manipulative therapy. In its absence, the episodes typically recover in two weeks to two months, but individuals with this phenomenon are prone to recurrences. When examined by osteopathic methods, marked dysfunctions in the pelvis are always identifiable in the acute position.

It is the thesis of this chapter that the phenomenon is one whereby the sacrum becomes entrapped asymmetrically. Forces acting in the soft tissues, particularly in the upright human, are adducting. (This becomes obvious from viewing the sacrum as suspended between the ilia). The pelvis, being a tensegrity ring, functions as a whole. When pain occurs, secondary muscle spasm disallows relaxation and restoration of symmetry of the sacrum between the ilia. The natural resolution of such an episode typically occurs in about two weeks. It is proposed here that the mechanism(s) of this resolution include one or more of the following factors: 1) either bone and ligament molding occurring within two weeks, 2) natural slippage of the displaced parts can occur, or, 3) the parts return to normal through relaxation of the soft tissues, or, 4) through manipulation or 5) through a combination of all of these.

### Toggling Pain

It is this writer's clinical observation over 20 years that a characteristic of low back pain associated with a dysfunction of the pelvic ring is its asymmetry. The pain may be sensed over the midline in the low back, but in these cases invariably also over one SI articulation in the buttock. And when it is referred, the pain is referred down the lower limb and is on the same side. Another characteristic is that if the pain abates, recurrences sometimes occur on the other side, although most individuals with these episodes of pain suffer from it predominantly on one side. Most frequently, the other side is affected occasionally. This is because

an unstable sacrum between the ilia can get entrapped in more than one way, putting strain on the ligaments of the other side, which become the source of posain and nulliness.

### **Sacroteruberous Ligament**

This ligament, or distal 'stay' of the pelvis, is often strained in SIJ dysfunction because it is further out in the radius of the pelvis. (Figure 1.) It should be remembered that more than one pattern of pain occurs and that individuals may vary as to how it affects them. Nonetheless, the repertoire of patterns is small.

### **Iliolumbar Ligament Sprain**

This ligament, being the major stay of the relationship of the pelvis to the lower lumbar vertebrae, is also frequently involved as a source of pain in pelvic dysfunctions. (Figure 2.) Of interest is that an asymmetry in physical findings is usual on examination when the subject is tested standing. It will be found that side bending to one side provokes the pain while rotation to the other does so. (Note that one has not specified in which direction it is provoked. The ligament is a twisted three-dimensional structure, and the only consistent finding is that side bending is painful in the direction opposite to which rotation is).

### **Sciatica**

This term implies pain in the low back with radiation down the lower limb posteriorly via the buttock. It is well recognized that radiculopathy, usually due to pressure on the dural sleeve of one of the lumbar nerve roots, can be responsible for this pain. On the other hand, 'sciatica' is more often due to referred pain from the sacrotuberous ligament. In this case, the pain may 'skip' the popliteal space, but often the patterns of pain are indistinguishable on pain diagrams. Straight leg raising is also not a useful discriminant, though stretching the sciatic nerve in the popliteal fossa or through dorsiflexing the foot at a strategic position of straight leg raising is less poor a differentiator. (Both maneuvers stretch the fascial sleeve of the leg and the branches of the sciatic nerve.) The association of neurological signs, the presence of tenderness at the attachment of the sacrotuberous ligament at the inferolateral angle of the sacrum, as well as historical clues, such as posain and nulliness, are more useful.

### **Gluteus Medius Syndrome**

As the gluteus medius has a specific role in locking the SI articulation on the stance side, it is subject to reflex inhibition when the ilium on the affected side is in a forward position." This can be manifested clinically by an alteration in its contraction visible over the buttocks as an individual bends forward, but also identifiable on examination in the side-lying position. [13] Tenderness is found on deep palpation just under the rim of the iliac crest as well.

### **Piriformis Syndrome**

As the piriformis muscle plays a major role in stabilizing the pelvis and is an important muscle traversing the SIJ, it is not surprising that it is strained at times when the pelvis is dysfunctional. The patient reports pain in the middle of the buttock, down the middle aspect of the thigh to the level of the popliteal fossa, affected by certain movements. Testing the muscle when maximally stretched provokes severe pain and yields the diagnosis.

### **Slipping Clutch Syndrome**

This newly recognized syndrome is characteristic of about 15% of subjects suffering from back pain due to SI ligamentous dysfunction. [13] The patients report episodes of giving way of one leg. The phenomenon of giving way is painless, although occasionally they are injured after a fall. Not all the patients, in fact, fall down as they often catch themselves. The phenomenon of

the limb giving way occurs invariably as the affected side enters into stance and is thought to represent slight slippage due to failure of the force closure of the joint which should occur normally at this moment. As force closure is dependent, amongst other things, on the normal elastic function of the posterior SI ligaments, it is not surprising that relaxation of these structures can be responsible for mechanical dysfunction, as well as a source of pain. These individuals respond to therapy with prolotherapy. In fact, it is through the healing effect of therapy that this syndrome came to light recently by serendipity.

### **Sacroiliac Joint Pain**

Pain over the joint, at times with radiation posteriorly via the inferior aspect of the buttock and the posterior part of the thigh, is a characteristic feature of a sprain of the posterior SIJ ligament and occurs not infrequently in isolation. It has the characteristic of posain, is aggravated at the end of the day after an individual has been physically active, and also responds to injection therapy.

### **The Response to Manipulation**

Most of the syndromes surrounding the pelvis, as well as those created remotely through the axial skeleton through the tensegrity and fault propagation phenomena discussed earlier, are due to a single cause. This is relaxation of the ligaments controlling the tensegrity unit we call the pelvis. This is the source of all mechanical dysfunctions. The dysfunctions themselves lead to, or aggravate strains of fascia and ligaments. A vicious cycle develops. Muscle spasm is secondary. Its manifestations are well recognized in pain management circles. Patients with these dysfunctions frequently report that manipulation in the hands of a manual therapist allows them temporary, intermittent relief from pain. Not infrequently, the situation worsens gradually over the years, so that patients seen after one or two decades of recurrent episodes of pain report that the pain has become continuous. Nonetheless, the hallmark of this syndrome is that the pain was intermittently, temporarily relieved early in the history. The improvement from manual therapy is due to a realignment of the pelvic bones. The recurrences are due to ligament relaxation which allows recurrent dysfunctions. The specific characteristic of the dysfunction at one time might vary. It is proposed here, however, that the episodic improvement with manipulation is the hallmark of the ligament dysfunction in the axial skeleton, usually in the pelvic ring.

### **Common Factors in These Syndromes**

The thrust of the discussion so far is that all of the above clinical phenomena arise from one underlying phenomenon: that of ligament relaxation and asymlocation in the pelvis. This is the term used to convey the concept that in the tensegrity model, which we call the human pelvis, the sacrum is held or trapped between the ilia. It is prone to being held in a somewhat asymmetric position between them. This tends to place an asymmetric strain on the soft tissues, the fasciae and ligaments. With a certain degree of relaxation of the ligaments, there develops a tendency for this asymmetry to advance to a point of exaggeration akin to the phenomenon of fault propagation in mechanics. When this threshold is passed, recurrent entrapment of the sacrum asymmetrically amounts to a mechanical dysfunction, i.e., to somatic dysfunction in osteopathic terminology. This in turn is apt to provoke secondary phenomena which have been listed here as the 'mini' syndromes characteristic of the human pelvis. Some of these show themselves with ligament symptoms alone, some by muscle dysfunction or spasm, and some through the phenomenon of transfer of torque through the axial skeleton are manifested in the neck or the thoracolumbar junction. The underlying fault is in the soft tissues of the pelvis. An understanding of the role of the pelvis in locomotion and the attendant dysfunctions is, in this writer's opinion, the third great landmark in orthopedic medicine. The first being the introduction of testing soft tissues by altered tension (Cyriax); the second, the recognition of pain patterns in scleratomes and the introduction of prolotherapy (Hackett).

## Ongley's Technique

From the discussion in this chapter so far, the reader will have drawn the logical conclusion that the optimal management should be one of restoration of symmetry followed by some measure or other to maintain the improved position. This, indeed, is exactly what is achieved with Ongley's technique. It goes without saying that the steps in this routine start with diagnosis. The diagnosis has to be based on a clinical assessment of the cause of the back pain, followed by a manipulation that should be so vigorous as to restore the pelvis to full symmetry and abolish any tendency for recurrence, which might be due to adhesions. Accordingly, it is an advantage if the patient can be maximally relaxed. A manipulation by the more popular and more gentle techniques of muscle energy, or even gentle thrust techniques, might be quite sufficient to restore a patient to temporary comfort but not restore the joint to optimal alignment nor completely release any adhesions which might be formed from prolonged malalignment. With this technique, therefore, the manipulation is vigorous. In order to facilitate this manipulation (and it is intended to be performed once only), there is an advantage if dilute lidocaine (local anesthesia) is injected into the soft tissues guarding the pelvis, particularly the posterior SI articulation, but also the ligaments around the lumbosacral junction, the iliolumbar ligaments, and the capsules of the zygoapophyseal joints at the two lowest levels of the spine. The details of the injection routine are detailed elsewhere. [12] At times, individuals suffer from marked pain from a peripheral fascial strain, such as along the iliac crest, such, for instance, as the fascia overlying the gluteus medius muscle. This can be relieved on this occasion with a local anesthetic injection, usually including small amounts of triamcinolone (an injectable steroid). It is important, however, not to place steroid injections into mechanically essential ligaments, for instance, the posterior SI ligaments. A manipulation which is a modification of an osteopathic technique, is used next, restoring the pelvis to as much symmetry as possible and in turn this treatment is followed with proliferant therapy injections to the stabilizing ligaments of the pelvis, in particular, the three layers of the posterior SI ligaments with particular attention to the deepest and central part. Droplet infiltration of proliferant injections are also placed along the iliolumbar ligaments, the zygoapophyseal joint capsules of the two lowest levels of the lumbar spine, and along the transverse processes to make contact with the intertransverse ligaments at their periosteal attachments, into the supraspinous and interspinous ligaments of the lowest levels, and the fascia over the erector spinae at the upper level of the sacrum is also treated. This can also be achieved through a single needle insertion point in the midline opposite L5. For details of the injection techniques, the reader is referred to the relevant texts. [12,16] Finally, the patients are encouraged to perform full range of movement 'exercises' to encourage healing in the natural lines of strain. This concept is based on an understanding of Julius Wolff's law. [59] This routine, as practiced by a number of doctors in California, was found to have a salutary effect, and, under the guidance of its author, M.J. Ongley, a double-blind clinical study was conducted. This study confirmed the initial clinical impression of the experimenters of its benefit. [44] A criticism (which in the view of this writer was inapplicable) was leveled at the study in that it measured four variables -- to wit, manipulation, local anesthesia, select use of triamcinolone and prolotherapy. It is this author's belief that the study evaluated a method and that a logical separation of the components is inappropriate. This criticism, however, was accepted by two of the coauthors. and a second double-blind study was conducted to evaluate the single variable of prolotherapy. Not surprisingly, the results were also meaningful in a statistical sense, but the disparity between the groups was much less than in the first study. These studies, however, represented a clinical landmark tending to confirm the hypothetical framework which is outlined herein. The theoretical basis for the study included a number of tenets: 1) The SI articulations move normally in life. 2) The SI articulations can become entrapped asymmetrically -- asymlocation. 3) Management by Ongley's technique promotes or restores a return to symmetry. [38] 4) Injections of irritants into ligaments do in fact produce a proliferating effect. 5) The benefit of the proliferating effect exceeds any disadvantage such as prolonged inflammation or scarring. 6) The benefit is apt to last for long periods, warranting the use of this invasive routine. These individual issues have been tested.

## **Prolotherapy**

To the histologist the process of repair of connective tissue is simple. Therefore, it has not been a subject of recent publications. The inflammation which precedes and initiates the repair process of connective tissue was described first by Eli Mechnikoff [11] and more detailed descriptions of the dynamic process elaborated by Cohnheim, [3] who studied the process microscopically in the living capillaries of rabbit ears, which due to the thin nature of the tissue lent itself to such a live study. Modern pathological preparations of (dead and fixed) histology allows us to study an imaged representation of a moment in time and only through serial histological studies of parallel situations can we approximate an understanding of the dynamic process. Nonetheless, enough information is available from a combination of these methods to state unequivocally that healing in connective tissues is a dynamic process initiated by the injury. Through a combination of the humoral agents of inflammation liberated by the cells at the site of the injury and an interaction with the mesenchymal migrant cells, both from the hemopoietic system and of mesenchymal origin such as fibroblasts, the cascade of healing is initiated. What is the end point of healing? The end point of healing differs depending on variables. These include: 1) The extent and severity of the injury; 2) Whether the damage to tissue was permanent or repairable; 3) The nature of the injured tissue. (Some tissues respond differently); 4) The strength of the healing stimulus; 5) The duration of the stimulus.

An extraordinary observation of the healing process in almost all tissues is the phenomenon of cessation of healing. Experiments have shown that after resection of half a liver in experimental dogs the remaining tissue grows appropriately to the right size, mass and biochemical capacity. Regeneration then ceases. The servomechanism by which the intact organism regulates the termination of the healing process is unknown. This specific question, the cessation of healing, is a subcategory of the more general issue of morphogenetics. The whole process of maintenance of size and form appropriate to the age, size and biochemical requirements of organs remains an enigma in contemporary biological sciences, an enigma marked by the extraordinary absence of discussion of the problem in scientific circles. (In case the reader has doubt, the genome, genetic information transmitted through the DNA, is inadequate in addressing this whole issue.)

The process of inflammation initiates repair following injury in the mesenchym. Connective tissue, which is of interest in the context of this review article -- to wit, collagenous tissue such as ligaments, fasciae and tendon -- is subject to repair through the same mechanism. There is no mystery in this subject. As discussed elsewhere in this review, it is a clinical observation that the repair process of these ligamentous fascial structures is at times deficient or incomplete. These terms deficient and incomplete are relative in the sense that clinical experience has shown that enhancement of the repair process yields superior clinical results. Accordingly it is assumed in orthopedic medical circles that the natural healing process following certain injuries may be inadequate or abnormal. Be that as it may the provocation of hypertrophy of collagenous ligamentous, fascial and tendinous tissue is a confirmed observation. In summary, prolotherapy is the provocation of the laying down of increased amounts of normal collagenous material in ligament, tendon or fascia, which enhances the function of these tissues at the site concerned. The process is achieved by relighting, by provoking inflammation at the concerned site.

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# Pelvic Mechanics and Prolotherapy

Townsend Letter for Doctors and Patients, May, 2001 by Thomas Dorman

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## Part Three

### Historical Review of **Prolotherapy**

The first description of the provocation of scar formation intentionally is found in Hippocrates' writing two and a half millennia ago. [31] Hippocrates describes the insertion of searing needles into the anterior capsule of the shoulder in order to stabilize shoulders in javelin throwers, the warriors of Sparta. It is interesting that shoulder instability amongst contemporary sportsmen is still recognized and still responds to proliferant therapy. Since the advent of the hollow needle, the need for searing (technique also used in racehorses called firing) is no longer necessary. The irritant can be introduced in a more sophisticated manner through a hollow needle by injection to the appropriate site. The modern use of sclerotherapy hails to the herniologists of the era which antedated antiseptic surgery. In 1837 Valpeau of Paris described the use of scar formation in hernias for their repair. The genealogy of herniology, and later the management of hydroceles and a variety of vein sclerosis techniques, was reviewed extensively earlier this century by Yeomans [59] and the tradition of vein sclerosis persists into contemporary medical times. Earl Gedney, an osteopath from Philadelphia familiar with the sclerosing techniques of herniologists and venologists, was the first to introduce injection techniques for ligaments in 1937. [22] Gedney injected a 'hypermobile SIJ' first with salutary results. The term sclerotherapy continued to be used for about two decades until the mid-1950's when the great organizer of **prolotherapy**, George Hackett, MD, acquired the skills of injection techniques from the osteopathic profession, evaluated its benefit in an initial series of studies, and published a number of articles about his experiences. This culminated in a short textbook, the third edition of which was published in 1958, and the tradition of his textbook has been maintained into modern times. [25]

### Optimal Healing

Scar tissue has a number of mechanical properties which differ from those of normal connective tissue that are considered disadvantageous. Scars can be recognized histologically as different from normal connective tissue. It was Hackett who realized that in situations where ligaments are relaxed (his term for ligament insufficiency) hypertrophy of the ligament represented an advantage, contrasting with scar formation which would be a disadvantage. Was there any prospect of achieving ligamentous hypertrophy without scar? In setting out a therapeutic 'road map,' Hackett envisioned (as far as we know) that the injections should: 1) Be effective. 2) Provoke as little pain as feasible. 3) Be safe. 4) Be easy to learn and perform. 5) Require the minimal number of repetitions. 6) Work generically, i.e., be effective in as many subjects as possible. 7) Yield hypertrophy of normal tissue. 8) Avoid scarring.

### The Therapeutic Window

Following this 'road map,' there evolved quite rapidly in the 1940's and 1950's a series of informal empiric trials, first in animals and later in patients with injured ligaments, in the use of a number of sclerosing agents which were now renamed proliferant agents by Hackett, and it transpired that a great deal of benefit could be achieved clinically by the use of a number of agents. As elsewhere in therapeutics, it has been found that synergy can be achieved with a modicum of

polypharmacy. A number of agents used in the past include extracts from several plants, the least unfamiliar being psyllium seed extract or Sylnasol, a product no longer available, and an extract from fish oil, still available in the pharmacopeia - sodium morrhuate. The chief proliferant agents as judged by the frequency of usage are, however: 1. Glucose, 2. Glycerin and 3. Phenol. They are usually used in the following combination:

phenol 1.25%

glucose 12.5%

glycerin 12.5%

made up with 0.5% of lidocaine for local analgesia in water. (This preparation is also called P25G or P2G).

Klein [36] and Banks [2] have classified the injectable proliferating solutions that initiate the wound healing cascade into: 1) Irritants, which cause a direct chemical tissue injury, which attract granulocytes. Phenol, quinine and tannic acid are agents in this category, 2) Osmotic shock agents, which cause bursting of cell membranes leading to local tissue damage. Hyperosmolar dextrose (12.5 to 15% maximum) and glycerin are examples of the most commonly used agents in this category, 3) Chemotactic agents, which activate the inflammatory cascade. Sodium morrhuate is a prototype of this group. These compounds are the direct biosynthetic precursors of the mediators of inflammation, i.e., prostaglandins, leukotrienes, and thromboxanes, 4) Particulates, such as pumice flour, which are small particles on the order of 1 micron, which lead to longer-lasting irritation and the attraction of macrophages to the site.

### **Evidence of Proliferant Effect**

An extensive literature exists documenting the histological scar formation in the mode of sclerotherapy. [60]

This old research has not been subject to contemporary confirmation in a scientific mode, but every pathologist will report scar formation from time to time in biopsies obtained for a variety of purposes in routine surgical and medical practice. This subject is considered as accepted general knowledge. Research in the context of the use of proliferant therapy needs to be seen therefore as a caveat, an addition, to the established body of knowledge regarding the healing of connective tissue. George Hackett reported in the 1950's on the histological changes of the tendo Achilles of rats treated with proliferant therapy. These were uncontrolled studies and were considered entirely satisfactory proof of the proliferant effect in the limited circles which had adopted these techniques, the Sclerotherapy Society. They were ignored by the rest of the medical establishment. The next landmark in the study of **prolotherapy** was a blinded animal study combining histology, electron microscopy and mechanical evaluation of rabbit ligaments. King Liu [34] and his team used sodium morrhuate in the medial collateral ligaments of rabbit knees and published their findings in 1983. The histological and mechanical beneficial effects of proliferant therapy in this experimental model were established categorically. The remaining, and it seems to this writer, minor question of a parallel phenomenon on human tissue was established with the taking of biopsies [37] of posterior SI ligaments which were performed before and after treatment in three patients with chronic low back pain. Treatment consisted of a series of six weekly injections into lumbar and SI ligaments, fascia, and facet capsular sites using a connective tissue proliferant (dextrose-glycerinephenol) combined with mobilization and flexion/extension exercises. Posttreatment biopsies three months after completion of injections demonstrated fibroblastic hyperplasia on light microscopy and increases in average ligament diameter on electron microscopy from a pre-treatment of .055 [+ or -] 0.26 micrometers to 0.087 [+ or -] 0.041 posttreatment (P[less than].001). Range of motion significantly improved post-

treatment in rotation ( $P < .001$ ), flexion ( $P < .015$ ) and side flexion ( $P < .001$ ) as did visual analogue pain ( $P < .001$ ) and disability ( $P < .001$ ) scores. Figures 3 & 4 illustrate the histology of human ligaments before and after **prolotherapy**. Figures 5 & 6 are electron-micrographs of the same samples.

### **Mechanics and Ligament Proliferation**

Accepting, then, that **prolotherapy** provokes hyperplasia of ligament tissue, an increased amount of collagen and the absence of damage as far as can be judged histologically, an assessment was needed regarding the mechanical effect of **prolotherapy** in human ligaments to match the mechanical observations made by King Liu referenced above. This issue was addressed through the treatment of the joint capsule and injured ligaments of the knees of athletes who had suffered injuries from athletic misadventure. The study was conducted during a nine-month period in a private orthopedic office. Thirty patients with knee pain were seen during the enrollment period, but in the cases of only five knees (in four patients) was it possible to obtain measurements after treatment because the equipment was available only for nine months and many of the athletes, after clinical improvement, failed to return for repeat measurements. All the selected subjects had substantial ligament instability. All measurements were taken by one researcher. The patients underwent multiple injections. The patients were followed routinely and within nine months repeat measurements were obtained. Subjective symptoms were obtained at entry and exit from the study. Ligament stability was measured by a commercially available computerized instrument that measures ligament function objectively and reliably in a complete three dimensional format. [43,50] It consists of a chair equipped with a six-component force platform and a six-degree freedom electrogoniometer. With computer integrated force and motion measurements, a standardized series of clinical laxity tests can be performed and an objective report obtained. Prior studies have compared clinical testing with objective tests [7] and have established reproducibility. [30] The proliferant solution used in these cases was P25G. The proliferant injections were 'peppered' into the lax ligament(s) usually at two weekly intervals, each offending ligament being treated an average of four times. A total of between 30 and 40 cc of the proliferant solution is injected into the appropriate portion of the joint ligaments. Details regarding the injection technique can be found in the original publication. [45]

### **Wolff's Law**

It has been established since the turn of the last century that the mechanical components of mammalian bodies, that is to say, the musculoskeletal system, which, of course, includes ligaments, fasciae and tendons, respond to the lines of force through reinforcement. [59] This has been called Wolff's Law after the scientist who described the lines of force in bony trabeculae first. This is a time to remind ourselves that the laws of nature are observations scientists and physicians make about patterns characteristic of nature. This observation of the nature of healing in mesenchymal tissues in the presence of forces and movement is, by and large, the basis on which modern early mobilization after disease and the use of exercises and mobilization in rehabilitation and physiotherapy have gained a wide (and rightly deserved) reputation. The use of exercises and mobilization in orthopedic medicine is no exception. Though the observation that healing in the presence of movement is an advantage with the use of prolotherapy, it is but, an, empirical observation, this issue not (yet) having been subjected to experimental proof. It is a strong impression of this writer based on 20 years of clinical experience that this statement has veracity.

## Summary

In summary, it can be stated that the 'road map' set out by Hackett has been achieved. The style and routine of the use of proliferant injections have been defined elsewhere, [12] The safety of the proliferant injections has been confirmed, [16] and the mechanical and clinical outcome also established. [44] It can therefore be stated in summation that the technique of the injections of irritant material into connective tissue -- to wit, ligament, fascia and tendon is now known to provoke hyperplasia of normal connective tissue which enhances the function of these tissues. These functions represent mechanical strength (binding) as well as the storage and release of elastic energy, enhancing the efficiency and also the normal range of movement.

## Elasticity of Ligaments -- A New Understanding

Conventional wisdom has it that ligaments serve as binds between bones and their function is merely that of holding the structures together. It was a clinical observation of this writer, however, that individuals whose backs were treated with proliferant therapy improved in their agility, in their range of movement, and the facility with which they functioned after treatment, raising the possibility that the efficiency of movement had been restored (quite independently of the fact that they had become pain free). This, together with the recognition by podiatrists that elasticity is stored and released in the lower limbs with walking, and combined with the recognition of the role of ligaments as stores of elastic energy in running and galloping animals, [40] seemed to point quite obviously to the role of elastic recoil in the ligaments of the pelvis as contributors to the efficiency of human locomotion and walking. A theoretical construct was developed therefrom postulating that the human frame is an integrated mechanism for efficient walking and that energy is stored and released and transferred back and forth within this mechanism in a manner somewhat analogous to the restoration of antigravitational energy by a descending pendulum in a long case clock. The additional horological analogy of release of elastic energy in a spring seemed to apply to the torque of the torso and almost certainly to the torque of the ligaments controlling the pelvis as it became recognized that with each step the iliac bones move on a diagonal axis. Even though the movements are of low amplitude, the mass of the ligaments concerned cumulatively seemed to store a substantial amount of energy. This hypothetical model led to experiments aimed at measuring the contribution of the movements of these various parts to the efficiency of walking. This in turn was measured by assessing the oxygen consumption at the maximal speed of walking of ten experimental subjects, [17] and these experiments confirmed this hypothetical construct. Finally, a similar experiment with oxygen consumption was undertaken with patients before and after treatment with Ongley's technique. This showed an average increase in efficiency of walking after treatment of 38% as measured by oxygen consumption at a maximum walking speed. [18] This experiment closed the circle, so to speak, bringing the clinical management of patients and the theoretical concepts regarding the function of ligaments and the role of the pelvis in the physiology of walking together. From these observations put together, the following conclusions are drawn:

- 1) Internal movement occurs in the human pelvis with every step. The SI articulation closes (force closure) on the stance side and opens on the swing side.
- 2) With this movement, energy is stored elastically in the soft tissues, predominantly the posterior SI ligaments. This energy is released in the swing phase and contributes to the efficiency of walking.
- 3) The role of the pelvis is to transfer the energy of locomotion, both the antigravitational swing of the pendulae (the four limbs) and the torque from the soft tissues including the trunk. The term transduction has been coined to convey this concept. [15]
- 4) Ligament relaxation can be responsible for asymlocation, at times progressing to dysfunction in the pelvis, which in turn can lead to:
- 5) A series of

painful syndromes in and around the human pelvis, as well as: 6) The transfer of torque through the tensegrity mechanism to other sites in the axial skeleton, particularly the cervical spine and the thoracolumbar junction. 7) Restoration of normal **mechanics** through manipulation is effective. 8) When ligament relaxation alone or associated with fault propagation at a proximal or remote site has led to permanent changes in ligaments or fasciae, treatment with **prolotherapy** is restorative. 9) The management of these conditions is dependent on the clinician's understanding of concepts in orthopedic medicine.

## **Conclusion**

1) Clinicians dealing with pain and dysfunction in the musculoskeletal system will benefit from acquiring an understanding of this organ system as a ligamentous fascial system. The fasciae are continuous. Mechanical factors regulate this organ. Disorders in the **mechanics** lead to clinical counterparts which are recognizable through traditional medical approaches -- to wit, syndromes and diseases. The clinician's tools for management are a) history-taking, b) an understanding of the **mechanics** of injury, c) recognition of pain patterns, anatomically and temporally, d) an understanding of the physiological role of the human pelvis and disordered **mechanics**. On this basis, clinical diagnoses should be made in all cases, leading to rational therapy.

2) Mechanical considerations include recognition of asymlocation, abnormal entrapment within the tensegrity adductor mechanism of the pelvis, of normal, and at times abnormal, position leading to the secondary phenomena of **pelvic** somatic dysfunction.

3) Ligament attenuation, weakness or relaxation is a contributory underlying mechanical cause, which in turn is aggravated by the increased tension on the dysfunctional ligaments.

4) Ligaments can be refurbished with **prolotherapy**.

5) Dysfunctional pelvises lead to a number of distinct clinical syndromes, all of which have a mechanical cause, often aggravated by secondary muscular and neurological phenomena. Definitive treatment is predicated on recognition and correction of the mechanical causes, using secondary measures for the associated muscular and neurological phenomena if they are maintained through a vicious cycle.

6) The predominant tools for management of orthopedic medical problems are manipulation and **prolotherapy**.

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## Pelvic Mechanics and Prolotherapy

[Townsend Letter for Doctors and Patients](#), June, 2001 by [Thomas Dorman](#)

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This is the fourth and last article in this series dealing with contemporary issues in orthopedic medicine.

### **Pars Pro Toto**

This is a Roman expression used in common logic when a part of a subject is used as a substitute for whole. [1]

### **Introduction**

In this essay I shall unfold ideas that have been growing in my mind for the last 20 years that might be described briefly as the problem of the disc. I will outline how I believe that the discovery of problems with the disc was an important contribution to understanding certain cases of back pain; it is, however, a classic example of pars pro toto. I will propose that the major cause of back pain is failure of ligaments. Indeed I have proposed this before, but I shall develop this concept in the context of disc disease. Finally I will propose that disc disease is a special case of ligament failure, that the underlying cause is torque and most importantly that the source of abnormal and disease causing torque arises in the human pelvis. This is a phenomenon characteristic of our species alone. Modern so-called science and medicine has failed to recognize this problem because: 1) The epidemic of this problem is fairly new, and 2) the underlying cause, failure of collagen, has not been recognized as the proximal responsible factor, and 3) the modern research paradigm does not lend itself to studies over long periods because of the administrative characteristics of modern research. Parenthetically, one

might comment that these are a result of what I have called the Religion of Science which is increasingly coming to serve the golden calf, i.e. its master - profit. Physicians have strayed from Hippocratic Oath when they fall into this religion.

### **A Typical Scenario...**

"I have two discs in my back, and I am told I need surgery. I don't want an operation because a friend had it and was no better. I have heard of **prolotherapy**. Can you fix my disc?"

Now that I make myself available to answer questions on e-mail, both to patients in the practice and to members of the public at large, this model question is common, indeed. Let me first give you my typical answer. "It is not possible for a physician to make a diagnosis or formulate possible treatment without evaluating the person physically. You will need an appointment in the office. The person who has nerve damage as a result of pressure from a disc and in whose case the nerve damage is either progressing, very painful, or interfering with an essential function, and particularly if it's apt to become progressive if not treated, should have an operation promptly. In some cases, the situation constitutes a surgical emergency. I am not a surgeon. However, if the predominant problem is pain in the back, possibly with radiation via the buttock, down the leg, and assuming there is no significant neurological deficit, it may be that the comment about your discs is anatomically correct but not the cause of your pain. Additionally, a common scenario is that a person has some episodes of pain directly attributed to pressure from damaged, fragmented or bulging discs and multiple episodes of pain more directly from ligament failure and abnormal torque in the pelvis, sometimes called somatic dysfunction by the osteopaths. If you find that your condition is improved repeatedly temporarily by manual means such as a manipulation, an adjustment or a mobilization, it is more likely that the immediate cause of your pain is a sprain of a ligament somewhere in your back. Parenthetically, one might comment that the disc is made of a pulpy center and a ligamentous (collagenous) periphery called an annulus. Damage to it is usually, in my opinion, secondary to ligament problems in the low back, and in the pelvis in particular. Therefore, if that matches your scenario, you may wish to come for an appointment."

### **Incidence**

Roundly speaking, 80% of Americans in modern times have at least one episode of severe back pain that incapacitates them and interferes with their lifestyle at least for a defined short period. Something on the order of 300,000 laminectomies (simple back operation to remove pressure from a nerve in turn' pressed upon by a disc) are performed in America each year and this incidence is higher than in any other country (adjusted per capita). Nonetheless, the statistics from the Workman Compensation files of all jurisdictions show an increase in the trend towards more back sprains and typically America leads (if lead is the right term) in this regard.

### **Cure Rate with Surgery**

There is an interesting dichotomy. Many individuals benefit strikingly promptly and sometimes permanently, from an operation on a disc, and yet disc surgery has a terrible reputation at large. Why is this? It is this writer's opinion that the problem lies in failure of diagnosis. A skillful orthopaedic physician can admittedly recognize, probably with 99% certainty and based on clinical examination alone, whether a person is likely to have disc disease as the primary source of an individual episode of pain or ligament sprains. In many regards these two causes mimic each other; at times, they coincide, so the picture can be confusing. Nonetheless, they can be separated by the skilled orthopaedic physician. Physician readers

are referred to this practitioner's textbook. [2] The layperson simply needs to find a physician who is skilled in making the correct diagnosis. [3]

### **Mobility in the Pelvis**

In 1925 Helweg [4] identified abnormalities in the buttock muscles by palpation and described atrophy (wasting) from dysfunction. He recognized local tenderness and radiating pain, which he ascribed to lesions in the back and buttock muscles from isometric contraction caused by an abnormal flexed posture associated with osteoarthritis of the hip and other conditions. In other words, he recognized that soft tissues in the buttock were responsible for a great deal of pain in the low back with radiation down the lower limb. We now have a slightly more sophisticated understanding of this phenomenon. It is my belief, however, that Helweg was on the right track for the majority of cases. It is interesting how in history certain events or personalities can turn the tide. I'm certain this applies to the history of science, as well. The landmark we are concerned with was the description of fragmented discs as a cause of low back pain with sciatica in 1934. [5] It would be niggardly to either deny the importance of the discovery or fail to congratulate the surgeons and the patients who benefit from the treatment when this diagnosis is recognized in the right cases. On the other hand, it is also true that the tide of opinion has turned with their discovery, so much so that Helweg's evanescent work was neglected and were it not for the osteopathic profession, and later chiropractors, we in our society today would have no knowledge or recognition of the very important contribution of alignment of the body to the correction of these pains.

### **Why is Alignment Necessary?**

Amongst the osteopaths, only a few have recognized the great importance of fascia and ligaments in controlling the alignment of the skeleton. They speak in their literature about somatic dysfunction, motion segments, the importance of optimal alignment, but we hear very little about the regulating organ and tissue for this alignment—the fascia and the ligaments. An important contributor to the concept of the diffuse action of the fascia and ligaments and to their relationship to the flow of fluids and energy within the body, was an osteopath from Canton, Pennsylvania, Gordon Zink, DO who wrote a few sentinel, though unfortunately neglected articles about these concepts. He particularly recognized the importance of the major muscle of the body, the diaphragm, in contributing to the interactive flow of the whole system. He also recognized the movement of the whole axial skeleton in synchrony with breathing, breathing being not only metaphorically but literally, the mainstay of life, because diaphragmatic movements contribute and control all living functions. [6,7] More recently the specific mechanical dysfunctions of the fasciae have been recognized by another osteopath, Stephen Typaldos, DO, [8] who is an assistant clinical professor in the Department of General Family Practice, Texas College of Osteopathic Medicine. He has compared the function of fascia to the zip-lock on a plastic bag. This analogy helps explain the wonderful effect of certain deep tissue techniques such as Rolfing [6] and massage therapy.

### **Two Paradigms**

You can see, then, unfolding, before us two paradigms in parallel. I shall call these 1) The reductionist paradigm, 2) The holistic paradigm. In the reductionist paradigm, accuracy and specifics, and verification of single variables are the conceptual tools. In the holistic paradigm, the recognition of the interactive phenomena in life and the *elan vital* of the integrated process, if you like, the hologram, are the conceptual tools. Advancement in our knowledge, and understanding, has occurred through both of these paradigms. The great challenge for the human mind is to integrate them, This difficulty is with us most poignantly in the saga of the disc.

## **Pars Pro Toto**

The unquestionable result of disc injuries and its provocation of pain by pressure on sensitive parts, particularly the dural sleeve of a nerve root, can be catastrophically painful, at times deforming, and frequently relieved with operations. This is the pars (That is to say, the part). The total scenario (the holistic perspective, if you like) is that the fascial-ligamentous organ, [10] when in a state of disarray, can allow forces to concentrate in a Newtonian or mechanical sense, in one small location and cause the damage. This contrasts with the normal function of the body where the forces are distributed through the tension members diffusely more or less evenly. The hierarchical distribution of forces through the tensegrity system is clearly a fact of nature. It is true that it is rarely discussed. It is true that few people understand it. It has the disadvantage of not being easily identified intuitively. Stephen Levin [11] and I have written on this extensively, [12] but this is clearly not enough because, alas, most practitioners, and virtually the whole of the lay public, are still thinking in the paradigm of transferred forces through pillars, levers and cantilevers. These models are very useful in analyzing architectural problems, engineering problems, and occasionally have an analogous usefulness in reviewing certain aspects of body mechanics; but the simple experiment, known as 'the weightlifter's paradox' is, at least in my opinion, conclusive evidence that this model is woefully inadequate in explaining body mechanics and function.

## **The Weight Lifter's Paradox**

It is known that the vertical compression of a cadaveric human lumbar spine, when loaded heavily, will cause fracture of the end-plates of the vertebrae; that is to say, the bony part, while the discs (the soft cushions between them) remain intact, proving that the tension members -- namely, the annulus of the disc -- is stronger than the supposedly hard surfaces of the vertebrae. The paradox is that the weight at which the vertebrae on the bench collapse is much smaller than the weight a strong man can lift in a snatch. One has to conclude that somehow the additional weight is borne by the soft tissues. When torque is added to this model, it is possible to simulate the phenomena we see in living people -- that of disruption of the disc with the unpleasant consequences we are all familiar with. [13,14] The just referenced authors elegantly calculated the relationship between tension on the ligaments at the periphery of the disc and the force concerned. What is relevant here is the important and, alas, neglected observation that torque is the essential component in the disruptive process.

## **The Origin of Torque**

Is it not logical that we should now ask -- whence the torque? This writer has spent the major portion of his clinical-cum-scientific development testing hypotheses that imperfect alignment of the human pelvis occurs naturally, and, when exaggerated, is associated with pain. The pain usually arises right there -- in the posterior sacroiliac articulations -- but as the pelvis governs the whole muscular and ligamentous walking mechanism, the tension and sprain might concentrate in one or other of these structures predominantly (this is part of the phenomenon of fault propagation) and be the main pain generator in any one scenario. [15]

## **The Collation of Observations**

You will see where I am leading you. I propose that the natural phenomenon of torque on the lumbar spine provoked by the asymmetric alignment of the ilia, which is a normal human condition that, when exaggerated, produces essentially two phenomena -- 1) asymmetric strains on the structures of the pelvis itself, namely the posterior sacroiliac ligaments, the sacrotuberous ligament, the sacrospinous ligaments, the iliolumbar ligaments, and the fascia around the major muscles of

the buttocks and hamstrings, and 2) torque in the spine that affects the walking subject. This torque is asymmetric. Take the situation that is common -- where the right ilium is rotated anteriorly. [16] When this distortion becomes exaggerated (probably due to collagen failure, in turn associated or aggravated by what is now called cumulative trauma and perhaps enhanced by episodic severe exercise in relatively sedentary individuals) this phenomenon of torque is enhanced.

### **Torque and Cumulative Trauma**

It is my proposal (and at this time is merely theoretical) that it is normal for movement to enhance healing and, by extending Gordon Zink's concept of enhancement of generalized healing through the facilitation of fluid flow -- blood, lymph, etc. -- through the body, one might say that walking is not only the primary function of the human frame but also its most important functional healing mechanism. It is also an observation that when the organ is balanced correctly, function is symmetrical. With the phenomenon of collagen failure, aging, fault propagation, and what we frequently call osteoarthritis, failure of correct alignment tends to be progressive. This can, of course, be provoked by specific instances of injuries but almost certainly recurrent strains in one direction, in one rotational force versus another (for instance, when the right ilium is rotated anteriorly, torque at the lumbosacral disc is predominantly clockwise (as seen from above), it seems very likely that this is apt to create an imbalance between the wear and tear of certain diagonal fibers of the annulus, on the other hand, and the natural healing and repair mechanism on the other. Next, the disc is disrupted with the well-known sequelae.

### **The Role of Pelvic Asymmetry in Back Pain**

Volumes of osteopathic literature have been written on the subject. The observation is simply summarized by the usual osteopathic aphorism that somatic dysfunction anywhere in the axial skeleton is always associated with dysfunction in the pelvis and the manual therapist's responsibility is to correct that dysfunction with whatever else he is doing. This structural truism is neglected by therapists of the axial skeleton, to their shame and their patient's peril.

### **A New Proposal**

My proposal is that the phenomenon of asymmetric torque on the lower lumbar discs and, for that matter, on the discs elsewhere in the axial skeleton through the tensegrity system, is responsible for the wear and tear of the annulus with episodic disruption and hence the pressure on the dura and the dural sleeve, the back pain, the deformity, the neurologic deficits, let alone the radiating pain, the radiculopathy. The reductionist approach of dealing strictly with a deformed disc and the consequences ignores the underlying cause which is failure of the fascio-ligamentous organ overall, and particularly, failure of the core system in the human walking machine, the pelvis with its key components -- the sacroiliac joints.

### **The Role of Prolotherapy**

The experience we have accumulated over about 30 years in using Ongley's technique for the diagnosis of pelvic dysfunction and its treatment with a combination of a manual correction, mostly mobilization, and the strengthening of the key collagenous tissue, the posterior sacroiliac ligaments as well as the symptomatic associated panoply of syndromes arising in the pelvis, has yielded the gratifying benefit for hundreds, nay, thousands of patients who have found the few practitioners who have followed Ongley's technique and benefited from this approach. This holistic approach, which takes its essential concepts from the early osteopaths, of looking at the mechanics of the body as a whole, analyzing dysfunctions specifically (based on the tradition started by James Cyriax) and codified in a textbook by this writer. [18]

## **So What are We to do With Back Pain?**

Any individual episode of pain has a pain generator. That is so self-evident that it is hardly worth mentioning. It is, however, very much worth emphasizing because recent guidelines from various consensus committees, etc., have told us that diagnosis is what we should not be making, at least not in the first instance. We should wait for the natural healing process and graciously, and perhaps somewhat cynically, these guidelines producers have recommended that physiotherapists should cater to the patient during a waiting period of at least three months. Individuals who are not improved and who have put in what I shall call a penance can now be subject to images such as MRIs, etc. It is my experience that clinical examination is honored in the breach. Most diagnoses (if that is a fair term for them) are made through imaging. What do we observe in these images? We observe damaged, compressed, desiccated and bulging discs. This is part of the normal phenomenon of aging; and, yes, it is true that an individual episode of disc disruption may be the cause of pain, but it more true that the underlying cause is the phenomenon of wear and tear on the fascio-ligamentous organ, including the annulus of the several discs. What are we doing to these patients? We are treating the anatomical abnormalities with what I can only describe as a reductionist approach. Various forms of removal, injection, ablation, heating, cooling and electrically buzzing of the various damaged parts are undertaken. The outcome, in select people, is temporary improvement in their pain. And the underlying condition? Nothing is done about it. These poor patients are, of course, ligamentous disasters waiting for their next accident. Typically these accidents are minor movements that would not ordinarily be expected to provoke dysfunctions and pain; however, that is exactly what happens. Typically the patient reports that with a minor awkward movement, or very often rising from the stooped position with slight torque, "My back went out," there is severe pain and dysfunction. The etiology is usually dysfunction of the sacrum between the ilia and occasionally a disrupted disc.

One of the points I am attempting to make is that though it is possible to be specific in the diagnosis for an episode, usually based on clinical examination, what is really important is to understand that the whole panoply of phenomena of back pain arises from this generalized failure of the fascioligamentous organ. This is particularly well brought out when a physician like myself takes a detailed history of patients who have longstanding back 'problems'. It turns out that most of these people had an original injury that is followed by comfort with episodes of dysfunction and pain, usually with temporary deformity, usually corrected with manual means, these episodes become more frequent and then chronic pain supervenes, and very often all the secondary phenomena of depression, work failure, and family failure follow in their wake. People in chronic pain are tortured and are not good members of our society. I propose here that we need to recognize that this is an holistic problem; holistic to the fascioligamentous organ. Its essential mechanical part is the pelvis, and absent an improvement in pelvic function, the cascade of aggravation and deterioration is, let's face it, inevitable.

## **What Should be Done?**

Clearly the most important problem, in dealing with this epidemic, is to identify its causes and eliminate them. I propose to outline in the future what some of these causes might be from a general nutritional and toxicological perspective. For now, let us leave this important matter with the statement that the problem is physiological and epidemiological. What can an individual do for his/her back? The answer is clearly **prolotherapy**. We have excellent evidence that the use of injections of irritants into the essential ligaments of the fascioligamentous organ, the posterior sacroiliac ligaments and surrounding ligamentous structures (not muscles, not nerves, not bones, not fat, not skin) provokes an hypertrophy -- a true growth of the tissues. These elastic tissues, when growing (I need to emphasize this is true growth and not scar formation) leads not only to proven improved function but also a markedly improved prognosis. This physician has followed patients for about 20 years now, who have been treated on these lines and found this statement to be true in general. Official surveys of the

outcome have not been performed for periods beyond five years for the practical reason that it is hard to track people in modern America for so long. The longest survey of the use of **prolotherapy** hails to an oral surgeon, Louis Schultz, who followed the patients he treated at the temporomandibular joint with this technique, with wonderful outcome. How many clinicians can report a 20-year follow-up in their own practice with such a technique? One understands that in his old age he burnt his papers in sore disappointment in the failure of humanity to recognize his important contribution. Why is it that we Human Beings are so neglectful of the geniuses and of the thinkers who do so much for us? I would like to take a moment here to salute the memory of Louis Schultz. [19, 20] Readers interested in my comments on him in the past may wish to refer to an article on my web page regarding the temporo-mandibular joint, entitled Biting on Paint that I wrote a decade ago. [21]

## **Disinformation**

At the opening of this article, I quoted a typical question from patients. A continuation of this modal dialogue would be "...But what about my MRI that shows two discs in..." and "...can 'your' **prolotherapy** repair a disc?" and "...I am told I need surgery because I have bone-on-bone." From my perspective, the body functions as a tensegrity system. It is tension of the ligaments that maintains form and function. More interestingly, it also maintains the relationship between parts during movement. This miraculous quality of living organisms to move while maintaining form and function is a dimension that we as scientists have neglected because it is difficult to measure. The propensity to simplify an experimental model, in order to test some specific hypothesis, has unquestionably yielded a large harvest of benefits. Its main disadvantage is that it has set the mind of the scientist into the reductionist mode, which is exactly where it should not be. Accordingly, the images that show diminution in joint space, disc space, etc., are indeed a reflection of a pathological process -- the process is that of failure of ligaments. Stuffing something into the joint, such as artificial material, or abolishing the joint through fusion, may indeed resolve the specific pain at that site temporarily, but it is unlikely; and, indeed, follow-up studies have shown that it does not lead to long-term solutions. The long-term solution has to come from addressing the proximal causes of the problem -- namely, the failure of collagen in the fascioligamentous organ. Before concluding these remarks, I need to make an additional comment on images -- X-rays, MRIs, etc. I propose to you, dear reader, a contrarian perspective that I express in the phrase images are dangerous. I am not talking about the danger of radiation or magnetic influences from the MRI; I'm talking about the distortion of the perspective of the individuals who read these images and draw conclusions; conclusions of a reductionist nature, which does not look at the underlying general problem. Absent a careful examination of the patient at the time of the pain, conclusions from images may be misleading. We know that deterioration, aging, wear and tear, arthritis -- whichever of these phrases you prefer -- is a normal phenomenon. In itself, it is not associated with pain. Therefore, observing an abnormal image at some disc space or joint is not in and of itself diagnostic of the pain generator. It is, of course, quite useful for confirmation if an operation is planned; but the decision for the need for an operation should be based on skilled clinical examination. This skill is the business of the orthopaedic physician.

## **The Orthopaedic Physician**

The skill of an orthopaedic physician in understanding the concepts of form and function of the musculoskeletal system and the clinical counterparts, is indeed a wonderful discipline. Help to the public is immense and professional gratification, at least for those who enjoy helping the public and not merely enriching themselves, is immense. These skills are available. These skills are known. These skills have been written up. There is a tradition of orthopaedic physicians who have the know-how. The leading names include Cyriax, Hackett, Ongley, Mennell, Zink, Greenman. Is there any chance that the increasingly fossilized and bureaucratized establishment of medicine will recognize some of this so that physicians can

perform their function for people with musculoskeletal problems? I'm somewhat skeptical. Louis Schultz clearly dedicated part of his lifetime to this, then burned his papers. Will I burn mine? Who knows. On a positive note, however, at least one general textbook of medicine has included some of this clinical know-how between its covers. I strongly commend this textbook to medical students who wish to learn to be good doctors. Doctoring is predicated on the correct concept of disease processes, a familiarity with all the rare conditions that may crop up infrequently, and always, always, a close orientation to the patient's symptoms and signs. The use of images and laboratory should always be secondary. Our responsibility as a Hippocratic profession is to our patient/client, always for their particular problem at any particular time and never, ever to averages, government mandate, consensus, opinions or practice guidelines, though all of these can have a benefit for epidemiological studies and bureaucratic planning.

### **Pointers to Physicians**

In this section, physicians will find a few pointers to the assessment of the patient with back pain. First, we should remind ourselves that although most back pain is of a ligamentous nature -- sprains and strains -- it is clearly the cardinal responsibility of each physician dealing with an individual patient to evaluate that patient and his back pain; not to assume that the statistical average applies. Individuals with patterns of pain that vary may not have a musculoskeletal (or fascioligamentous) origin; however, if the pain diagram is characteristic of specific ligament injuries, the odds in favor of that diagnosis rise. In other words, I start by reviewing the patient's pain diagram and, if an opportunity arises, I like to see pain diagrams from several separate periods when the patient was in pain. Now, it is true that the pattern may change; for instance, a dysfunction in the pelvis might lead to pain over one sacroiliac articulation with radiation down the buttock and leg on that side and, on another occasion, the pain may be on the other side. Nonetheless, the distribution is characteristic of a sprain of the posterior sacroiliac ligaments, sacrotuberous ligament, etc. On the other hand, when pain patterns do not correspond with recognized ligamentous distribution they might well have another origin. Another interesting observation is that people with longstanding ligamentous insufficiency in the axial skeleton very frequently get a spread of the phenomenon to other parts of the spine; for instance, a person with a back injury may suffer back pain for periods of months or years and later develop neck pain or thoracolumbar pain, or the combination. Very often the pains zigzag across the spine. This, of course, is because of the tensegrity model and the transfer of forces. The reader will begin to get the sense that once distinct patterns of pain become recognized, the physician finds himself gradually approximating the first diagnosis from a combination (a collage, if you like) of these observations.

It is important to start at the beginning. This may seem oversimple or pedantic, but I find that this simple rule is sometimes neglected. It is always important to ask the patient what were the circumstances when the pain began - was there an injury, for instance; did the pain come on seemingly spontaneously? Did it come on gradually, or did "my back went out," by which people usually mean that there has been a sudden displacement in the alignment of the pelvic bones that they are unable to correct themselves; in other words, somatic dysfunction (by osteopathic classification). Quite often a person will report a fairly disruptive injury, such as being rear-ended in a vehicle while wearing a seat belt (This puts serious forces across the pelvis), but having pain develop some time later. This always surprises people and always creates conflict with insurance adjusters but in fact, is a very characteristic feature of ligament injuries when they affect the alignment of the skeleton. In any case, a sprain on a ligament needs to be maintained for some time before the pain is provoked. Presumably, there is a relationship between the duration of the pain, the magnitude of the force and the amount of intermittent relief from changing position, but these are hard to quantify. To the clinical historian, however, the delay is a distinct hallmark of ligament injuries. As we all know, in contrast, a fractured bone hurts right away. James Cyriax reminded

us that soft tissues could remain inflamed for long periods. This observation is as true these days as when he made it in the '30s. And a ligament sprain can persist for many years.

If a person reports an injury, it is important to analyze the mechanical forces acting on the person's body and attempt to form an impression of which structures might have been disrupted. This is simpler than it sounds, once one becomes familiar with the patterns, because the patterns of injuries in the human axial skeleton are fairly repetitive and it is interesting that most of these injuries (that is to say, those that affect the ligamentous structures) tend to occur in an unguarded moment; hence, the frequency of injuries from rear-end collisions when the driver is not expecting the impact. Falls, however, constitute another important source, particularly falls on the buttock, and a third important category is the person who almost fell but caught himself. These unusual jerking movements, when the body attempts to protect itself in an unbalanced way, often provoke strains within the axial skeleton which are not within the normal repertoire of coordinated movement. An example a lot of people are familiar with is a sneeze which "put my back out," and the patient usually has a sense of extreme offense that such a minor event should cause so much pain. We need to remember that the body functions in an integrated way. There are hundreds, probably thousands, of moving parts which synchronize their activity perfectly with each movement we make and, when there is an imbalance, an incoordination, an injury, or a jerking movement (such as the previous example of a sneeze), forces can occur within the system that are within the normal pattern. These disruptive forces are particularly prone to affect the human pelvis. The reason for this is the peculiar shape, form and function of the sacro-iliac articulations. These dysfunctions tend to persist in the pelvis. The reasons are connected with the form and function of the sacro-iliac joints. Interested readers will want to pursue some of the articles referenced for a deeper understanding of this unique joint in the animal kingdom.

### **Examination**

Regarding the examination, it is my contention that it contributes on the order of 20% of the assessment. James Cyriax used to say that he could make most diagnoses over the telephone; but let me focus here on a few observations regarding the pelvis, which seem to be unfamiliar. These words are not intended to replicate osteopathic texts, and practitioners of orthopaedic medicine need to incorporate that knowledge which is, of course, available from several excellent sources. When evaluating a patient with back pain, it is best to start the examination with the person standing, preferably in no more than brief shorts and perhaps a bra. Is the alignment of the skeleton symmetrical? Is the center of gravity centered between the feet? Does it vary whether the person is standing with his feet together or apart? (I like to use a mirror with scores on it so I can visualize the alignment of the person from the front and the back with a single glance). Are the iliac crests of equal height? (They usually are, but when they are not, it is worth noting). Next, we test for mobility. I like to evaluate the patient's lumbosacral extension actively and passively (In other words, the physician assists the movement and senses the end-feel). The person whose lumbosacral extension is full, painless, and has a normal end-feel, is not an individual with displacement in the pelvis on that occasion. (Please remember, however, that the displacement can occur intermittently, so the absence of an abnormality at the moment of the examination does not exclude episodic serious dysfunctions.) Contrariwise, if you find limited lumbosacral extension, fairly severe pain on the attempt, and an abnormal, painful and springy end-feel, it is likely that you are dealing with significant somatic dysfunction in the pelvis. Examination for side bending is a little less useful but always worth checking. When testing side bending, I place my hand on the individual's shoulder and assist the side bending while keeping my eye on the lumbar spine; does it curve evenly, smoothly? Is the curve the same when bending to the left? Often we find that the focus or fulcrum of bend is concentrated predominantly at one level, on bending to the right, and at another on bending to the left. Here is a clear hint that the spine is not functioning smoothly and evenly, and somatic dysfunction will be identified at the points of the asymmetric bends. As

the osteopaths correctly teach, the tendency for the motion segments is to alternate between loose and tight, but this is usually predicated on an improper alignment somewhere in the axial skeleton and, in 9 out of 10 cases at least, this dysfunction is in the pelvis. Next, it is worth asking the person to bend forward. Does the lumbar spine unfold naturally, or does it go through a series of irregular rotary movements (you can see that from the movements of the spinous processes as the person bends forward). If so, this is further reinforcement of the impression implied in the last sentence. What is the range of movement? It is always worth noting how far the fingers reach in the attempt to stretch forward. There is an extraordinary variability amongst normal human beings as to the degree of flexibility; however, when it is restricted from what the patient would expect his/her range to be, one should take note. Correct treatment to the axial skeleton will loosen up the ligament slack that has been taken-up through somatic dysfunction and increase range of movement on re-examination. This is an easy way to check on whether your treatment is effective. Having done that, I like to examine the patient by palpation. Is the pelvis symmetrical? I will not deal here with standard static and dynamic osteopathic examination, as I have nothing to add to what the osteopaths have taught us so well in the last 100 years. I will confine my comments in this article to additional issues.

Ligaments that are sprained are often (but not always) tender to the touch. You need to palpate the lumbosacral junction with pressure. The experienced examiner will find that the ligament that is sprained has a softer feel to it, more give, than the normal ligament. Palpate the interspinous ligament with a gentle pressure at each level. Gradually increase the pressure until either you have pressed quite hard and satisfied yourself that the area is not tender, or until the patient complains of pain. As Robert Maigne has taught us, there is an advantage to challenge the spinous process from the side in each direction, both in the lumbar and thoracic spines. Is there tenderness over the posterior sacroiliac sulcus? If so, on which side? And if on both sides, is there a disparity? Does that tenderness correspond with the site of the pain the patient indicated in the diagram? Next, you will want to palpate the ligaments that regulate the pelvis and that are often secondarily sprained when there is pelvic dysfunction. These structures are more peripheral in the radius of activity of the pelvis and include predominantly the iliolumbar ligaments, the sacrotuberous ligaments. (This is best palpated in the side-lying position by pressing, via the buttock, onto the lateral aspect of the inferolateral angle of the sacrum.) Pressure at these sites usually elicits tenderness. The pain diagram reflects the distribution of the referred pain (or often pain that is aggravated by maintaining one position for a long time, i.e., postural). It should be remembered that pressure on these sensitive points does not provoke referred pain in a manner that we recognize when stretching the dural sheath of a nerve root, that does provoke referred pain. In other words, if the patient reports referred pain, as opposed to local tenderness, assume you are dealing with a nerve problem.

## **Discs**

As outlined in the body of this article, the main thrust of my argument is that episodes of disc dysfunction are incidents in the ligamentous degenerative process; however, if you see a patient during such an episode, it behooves you to recognize that condition at that time. Orthopaedic and neurological textbooks are replete with information about this. My comments here, therefore, will be confined to a few refining points that are not widely recognized. First of all, the presentation of a person with an acute disc problem is more acute, as a rule. Secondly, when the disc alone is the cause of pain (at this time), lumbosacral extension is usually full, normal and painless. This is an important point. Contrariwise, flexion is often severely restricted (in the standing position), and patient reaches a point where he can bend no further quite acutely and dramatically. Side bending will be asymmetric, as a rule (depending a little on where the fragment of the disc is displaced and, in contrast to ligament injuries, the acute and severe restriction in range of movement is dramatic). Un-weighting the

patient, i.e., lying down or using traction, usually gives them prompt relief although unfortunately when traction is released, particularly when that is done suddenly, the pain can be aggravated severely.

The presence of neurological signs speaks for itself. I have noticed that many practitioners, for some reason, neglect to evaluate the L4 root level, so I shall make a brief comment on it. It is important to evaluate the patient's strength in dorsiflexion and eversion of the foot and compare it with the good side. This is best done when the patient is supine, the knee flexed and the heel resting on the examining couch. A slight weakness here can be an important telltale sign. Nerve root pressure from a disc more frequently causes motor dysfunction than sensory dysfunction but when present, sensory dysfunction usually reflects a two-level disc problem and is associated with true anesthesia. This phenomenon is rare; however, the phenomenon of a numb-like sensation, which I have called nulliness, is common. This is a referred ligament phenomenon. It may coincide with disc disease because disc disease is secondary to ligamentous disruptions, in the first place. Unfortunately, this observation has been an endless source of confusion in conventional neurological and orthopaedic circles.

Straight-leg-raising testing is valuable in the context of disc disease to evaluate severity and for confirmation. When the person can raise his leg no more than 30 degrees from the supine position, it is a strong confirmatory sign. On the other hand, the sprain of the ligaments in the back, or somatic dysfunction in the pelvis, often also provoke limited straight-leg-raising with referred pain, although usually that pain is less commanding and usually not so restrictive as with severe acute disc problems. One should, however, point out here that the test is not a reliable discriminatory one.

## **Summary**

These are not all the 'tricks of the trade.' The arborizations of the considerations for the fine points of examination get extremely complex. There is no stoichiometric relationship between any physical sign and any disease. The clinician needs to look at the pattern of the illness and draw conclusions from the whole unfolding scenario and pastiche of observations; however, it is my experience that in orthopaedic medicine the patterns do have very characteristic modes; and when the practitioner has learnt to think in the conceptual framework of the orthopedic physician with terms such as 1) Examination for resisted movements; 2) Units of contraction, 3) Understanding of the capsular pattern, 4) Understanding somatic dysfunction, 5) Understanding the difference between these two, 6) Recognizing the characteristic behavior of injured ligaments. 7) Understanding mechanical issues of the human body, particularly those affecting the back, thoracic spine and neck, 8) Integrating one's thought processes with the integrity model, 9) Recognizing the usefulness, nay, the cardinal need for analyzing pain diagrams, and finally, 10) Maintaining a degree of humility in accepting patients' accounts of their illnesses even when the physician is surprised at the account. The physician should always have an open mind. If the first diagnosis which comes to mind does not fall into some practice guideline he should not be deterred. As James Cyriax reminded us: Every therapeutic intervention is in the nature of an experiment. The diagnostic process is one of trial and refinement, step by step. In orthopedic medicine the experimental 'dialogue with the moving parts' is continuous. That is one of the reasons that cook-book-medicine, or practice-guidelines work particularly poorly in this branch.

Although, we speak of diagnosis before intervening, in orthopaedic medicine, we should remember that the diagnosis is tentative. Confirmation of the diagnosis, or its denial, will come from a therapeutic intervention. The physician should be ever-ready to have his diagnosis denied if the therapeutic intervention does not yield the expected outcome, and he should then proceed with another hypothesis. This has become very difficult in modern times. When an insurance adjuster, who has not the slightest inkling of the nature of the process, is acting as a gauleiter.

In conclusion, it is the proposal of this article that the unique function and form of the human pelvis as the center of the locomotor mechanism of your body, is predicated on strength and elasticity of ligaments. Ligaments are prone to failure. Hackett referred to this as relaxation. I regard this as an insightful phrase. Though there may not be a microscopic cellular counterpart to this in the pathological mode which Virchow (1821.1902) [23] fathered when he established the profession of pathology, mechanical failure, there certainly is in these ligaments. Should we not allow ourselves a new category of disease? The mechanical category?! We are encountering claims of pathological changes reported with certain MRI techniques. For myself, I think it is much more effective to palpate and stretch ligaments to judge mechanical failure than to image them. This writer is not expert in the field of imaging, however one has had many occasions to treat people with **prolotherapy** for one condition, when the MRI reports indicated another, and have excellent clinical outcome. Relaxation can usually be recognized by history taking with an understanding of the mechanics and very often appreciated through palpation. Is it not time that doctors started to examine their patients again?

It is the proposal of this essay that torque generated in the pelvis is responsible for disc disruption. Disc disruption is typically episodic and incidental to the ligamentous failure of the axial skeleton in general and the pelvic ligaments in particular.

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- (22.) Sapiro's Art and Science of Bedside Medicine. Second Edition. Jane M. Orient. Lippencott, Williams & Wilkins. 2000. Philadelphia. USA, ISBN 0-683-30714-2.
- (23.) Rudolf Carl Virchow was a German pathologist and statesman and one of the most prominent physicians of the 19th century. He pioneered the modern concept of pathological processes by his application of the cell theory to explain the effects of disease in the organs and tissues of the body.