MAPPING AND RELEASING

SYNOVIAL MEMBRANE FIBROSES

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Abstract

This article gives an overview of my exploration and development of methods to assess and treat fibroses in synovia. Elements of the structure of joint capsules, bursas and tendon sheaths are described with a focus on where and how adhesions form, thereby limiting these glide planes. Consequences of adhesions of this type for alignment and mobility of the body are discussed. Assessment methods are described to precisely find the location and size of these adhesions. Manual therapy methods to remove these adhesions are mentioned.

Origins

This article gives an overview of my exploration and development of methods to assess and treat fibroses in synovia. These explorations began one day as I looked for some illustrations of hip joints while preparing to teach a class. Some of the illustrations I looked at vividly portrayed the great length of hip joint capsule that glides over the full length of the neck of the femur. Remembering that wherever there is a lubricated glide plane, there is also an adhesion opportunity, I began to examine hip joint capsules in my clients for adhesions. I found all my clients had adhesions in at least one of their hip joint capsules, ranging in size from small to nearly complete. I then began to examine other joints for the same types of adhesions, and found them to be quite common. Examining joints in dissection, I saw these common adhesions in cadavers, confirming what I had felt with my hands.

Over the past five years, I have developed methods to assess and release these joint capsule adhesions and contractures. Recognizing there are other synovia in the body, I extended these methods to include bursas and tendons. In my experience, I have observed a marked increase in effectively and efficiently achieving

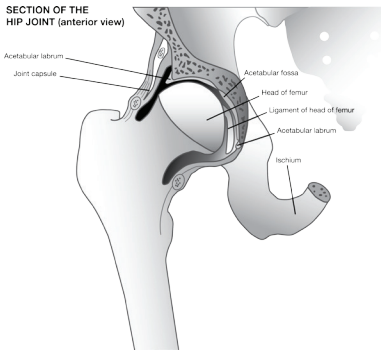
Structural integration goals by working with the synovial portions of the connective tissue matrix. This article summarizes these explorations.

Joint Anatomy

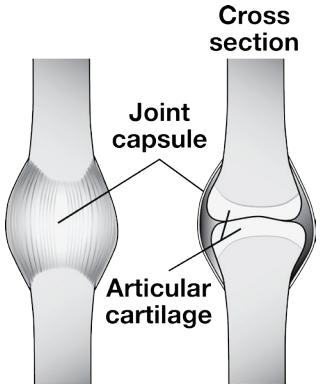
The tissue forming the walls of joint capsules, tendon sheaths, and bursas is known as synovial membrane and is a similar type of tissue in all three areas. The synovial membranes associated with specific body parts are named accordingly: membranes around joints are referred to as joint capsules; the container around each bursa is called the bursa wall; around portions of some, but not all tendons, it's called tenosynovium. Joints, bursas, and portions of some tendons, have sacks filled with a gel-like substance called synovial fluid. The Latin and Greek roots of 'synovial' literally translate to, 'with egg-like,' and the fluid inside these capsules is very egg-like in nature. It has the texture and color of egg whites, and the viscosity of egg yolk.

Synovial joint capsules bridge the bones of a joint, forming a continuous cuff around the circumference. In addition to containing lubricant, the joint capsule provides appropriate limitations to movement, establishing appropriate range and preventing dislocation.

Joint capsules attach some distance back along the bone from the joint line, which is where the bones meet. If the capsule attached to bone right at the joint line, very little movement would be possible; the joint capsule would not adequately span the necessary distance, and would severely restrict range of motion. The distance from the joint line to capsule attachments varies with the size of the joint and range of motion. For example, in inter-phalangeal joints, the attachment of joint capsule to periosteum is just a few millimeters from the joint line, but between femur and acetabulum we find the greatest joint capsule, when referencing length. On the acetabular side of the femoro-acetabular joint, the attachment of the capsule to periosteum is typically about 6mm from the rim of the acetabulum, with the height of the labrum adding additional distance. On the femoral side of the joint, the attachment of the capsule to periosteum is found only at the distal end of the neck of the femur. Depending on the size of the adult, and anatomic variability, the total length of the joint capsule is 40–60mm, with the greater part of it over the neck of the femur.



There are joints that do not contain synovial fluid. One example is the pubic symphysis, which is a cartilage pad adhered between the two pubic bones. Another example would be the joints between both ends of the tibia and fibula; the entire length of space between the two bones is filled with ligament fiber. These joints, while inherently less mobile than synovial joints, can also have too little or excessive movement, and can be assessed and treated similarly to synovial membranes.



Bursas

Bursas protect adjacent structures from eroding each other as they move. Bursas are found between many structures including:

- *Tendon and bone, such as the Achilles tendon bursa*
- *Skin and bone, such as the bursas between each vertebral spinous processes and the overlying skin*
- *Ligament and ligament, such as the bursa between the conoid and trapezoid ligaments of the shoulder girdle*
- *Muscle and bone such as the ischial tuberosity bursa*
- *Bone and bone such as portions of the subscapular bursas*

New adventitious bursas may be created, usually subcutaneously, in areas of the body subjected to prolonged, situational, high stress; such as where limb stubs insert into prostheses.

Tendons

Portions of some, but not all, tendons are surrounded by synovial sheaths. Other portions of the same tendons, and other whole tendons are invested in loose areolar tissue, referred to as the 'Multimicrovacular Collagenic Dynamic Absorbing System' by prominent French hand surgeon and connective tissue researcher Jean-Claude Guimberteau.[1] The connective tissue in these non-synovial portions of tendons can also become fibrotic in response to inflammation, and can be treated with methods similar to those used to treat fibrosed synovia. The transition zone between the synovial and non-synovial portions of a tendon have unique characteristics requiring special analysis and treatment, as the tendon seals to the sheath at the transition. This means that as the tendon glides toward the sheathed portion the sheath is folded inside the sheath, and can become adhered in this position.

Concepts

In my experience, contractures and adhesions (or fibroses) of joint capsules, bursas, and tendons are extremely common. Adhesive Capsulitis is an extreme example of this fibrosis at the glenohumoral joint, and I have found fibrosis is common in all synovial joints. All of my clients have fibrosis in multiple joints, often with serious consequences in movement and alignment.

Inflammation is created by traumatic injury, repetitive strain, infection, or generalized bodily inflammation. Our bodies respond to inflammation through activities such as fibroblast congregation, multiplication, and production. In moderation, this process makes good repairs, but in excess, it makes adhesions and contractures. Generally speaking, the greater or more prolonged the inflammation, the greater the fiber growth response. Joint, bursa and tendon adhesions and contractures are excessive responses of the body healing from inflammation.

In my experience, adhesions and contractures of synovia have several effects on movement. These include, but are not limited to:

- *Reduction of range of motion: Capsular fibroses prevents the joints from moving through portions of their range.*
- *Increased effort to move within the range of motion: While motion is possible in the presence of fibroses, it requires more work. This increased effort to move can have a cascading effect. For example, if overuse, inflammation, or injury increase the effort required to move a finger, the tendons attached to the muscle moving the finger will also be consistently under more load, and may become inflamed leading to further fibroses.*
- *Adhesions or contractures can often skew movement. Because these fibroses are usually unevenly distributed within a capsule, a contracture or adhesion on one side of a joint capsule can cause body parts to veer from normal movement paths. Again, this can have a cascading effect leading to new inflammation in, and subsequent fibrosis of, additional areas.*

Additionally, adhesions and contractures of synovia alter alignment; the following are my observations from several years of clinical practice:

- *Adhesion and/or contracture of the anterior part of the hip joint capsule diminishes the possibility of external rotation of that hip; thus the new center of range of motion is more internally rotated.*
- *Fibroses in the anterior portion of a sacroiliac joint capsule draw the ilium toward a position of medial rotation, known in biomechanics as, 'inflare.'*
- *Adhesion of a tibialis anterior tendon reduces the range of both dorsiflexion and plantarflexion at the ankle joint. With this reduced range of mobility, the usual compensation is to hold that leg in external rotation at the hip, so that*

1 Guimberteau, Jean-Claude, Architecture of Human Living Fascia, Handspring Publishing 2015

oblique roll across the foot from posterolateral to anteromedial becomes a substitute for talocrural joint dorsiflexion and plantarflexion.

- *Adhesion of the subscapular bursas substantially reduces the possibility of glide between the scapula and the rib cage. In this situation, the scapula becomes fixed in any part of its ranges of neutrality, protraction, retraction, elevation, or depression.*
- *Adhesion and contracture of the posterolateral portion of the right C7–T1 facet joint not only reduces ability to left rotate, left side bend and flex at the cervicothoracic junction in the center of the range of motion, it also affects resting position of the joint in a right rotated, right side bent, and extended position. With this deviation at the base of the neck, it is difficult to achieve balance in the rest of the neck.*

Many Variations

Adhesions vary in both size and strength. Adhesions areas can vary from tiny to the size of the whole joint capsule, bursa or length of tendon. Severity of adhesions can be found in a continuum: from a few fibers lightly knitting the formerly gliding surfaces together, to a large number of fibers gluing the surfaces to each other. Even a few fibers can prevent glide. The differences in the extent of fibrosis determines the length of time required to restore mobility.

Treatment Considerations

While there are some "shotgun" techniques, such as the A. T. Still technique reconstructed by van Buskirk[2] which will release portions of adhesions, thorough and effective release of synovial adhesions requires detailed mapping of their location. This fine scale mapping is useful in two ways: it allows the therapist to put effort precisely where it is needed, increasing efficiency, and it also allows re-examination to confirm change and evaluate progress.

2 Van Buskirk, Richard L., The Still Technique Manual, second edition, American Academy of Osteopathy, 2006

For a small and relatively weak adhesion, therapeutic release can be accomplished in seconds. For a large and well developed adhesion, several longer treatments of some minutes each, spaced over several weeks, may be necessary.

It is imperative to tease fibroses open gently. Creation of new inflammation is to be avoided at all costs. Vigorous techniques, or excessively prolonged treatment, will produce mobility in the short run, but lead to new adhesions and contractures in the long run.

Laxity

While this article deals primarily with fibrosis, which I define as a fiber overgrowth contributing to compromised or reduced mobility, it is worth a note about laxity. Far less common than fibrosis, we see laxity, or, tissue which seems too long or loose. Laxity could be due to one of two reasons. Most of the time, laxity is the body's way of restoring some mobility to an area by relaxing smooth muscle cells in connective tissues. This seems to be done when there is neighboring fibrosis that the body is unable to release. In this situation, when we restore the stretch and glide of the related fibrosed tissue, my experience has been that the apparent laxity quickly vanishes as the nervous system engages the previously lax smooth muscle fibers in response. Less commonly, we see laxity which appears to be insufficient fiber to provide adequate support, resulting from incomplete healing of an injury. This type of laxity does not have the same positive response to releasing related fibroses, but instead, responds well to proliferative (Prolo) therapy. Prolo can be defined as an artful new injury initiated by a doctor to restart the healing process.

Pathology

Joint Capsule Adhesions

I find most joint capsules in clients' bodies have some level of adhesion to periosteum too close to the joint line, and occasionally, also to articular cartilage. In addition, the material of joint capsules is frequently adhered to itself, forming a pleat, with several possible variations of structure and orientation to these pleats.

Joint Capsule Contractures

I have observed joint capsule contractures have several different forms. Any portion of a joint capsule may:

- *Be thickened, with variable loss of elasticity, ranging from mild to severe*
- *Have a loss of elasticity reducing ability to lengthen, but only slightly thicker or neither thickened nor shortened*
- *Be pulled short with a reduction in ability to distend. This is a contracture in the truest sense of the word, and may or may not be accompanied by much thickening.*

Adhesions and contractures in the same area of a joint capsule

Any variant of adhesion may co-exist with any version of contracture. It is essential to know what combination of fibrosis types are present in the same part of a synovial membrane or in other parts of the same membrane.

It is imperative to remove joint capsule to periosteum and joint capsule to articular cartilage adhesions before attempting to release pleat adhesions in capsule walls. The pleats are nearly impossible to separate if they are also adhered to periosteum. Both adhesion to periosteum and self-adhered pleats must be released before attempting to reduce contractures. In my experience, it is impossible to lengthen a joint capsule that is stuck to bone.

Bursa Adhesions

In response to inflammation of bursas, (bursitis), fibroblasts grow new fiber to repair the wall of the bursa. All too often, excess fiber grows through the synovial fluid to the opposite wall of the bursa. In this condition, the bursa still provides abrasion protection between the tendon and bone, or other structure pair, but instead of the gel-filled rolling sack facilitating movement, the fiber stabilized gel-filled sack limits range of movement, and increases the energy cost of movement.

Like joint capsule walls, bursa walls also commonly form self-adhered pleats. These pleats may occur along with fibrosis through the synovial fluid to the opposite side of the bursa or they may exist independently. In either event, pleats reduce the span of the material in the bursa wall, limiting mobility in their own right.

Bursa Contractures

Like joint capsule walls, bursa walls are routinely:

- *Thickened, with variable loss of elasticity, depending, perhaps, on the relative quantity of elastin and collagen in the thickening*
- *Stiffened, without great thickening*
- *Pulled short: a loss of length as well as elasticity, with or without notable thickening.*

Tendon Adnexa Adhesions and Contractures

Tendons and their neighboring structures exhibit fibrotic pathology similar to bursas and joint capsules, but with additional features, creating a more potentially complex picture. Some of these features are:

- *Within the tenosynovial sheath portions of some tendons, there is a sheet of meso-tendon membrane, collinear with the tendon, flexibly anchoring the length of the tendon to the non-superficial side of the tendon sheath. In addition to all the features of fibroses described for bursas, and for joint capsules, we must also assess for fibroses of this mesotendon.*
- *At the transitions between the tenosynovial and non-tenosynovial portions of a tendon, there are additional adhesion opportunities specific to this location.*
- *In the non-tenosynovial portions of tendons, excess fiber often infiltrates the loose areolar tissue surrounding the tendons, with attendant loss of elasticity.*

Distortions May Be Simple or Complex

It is important to note that fibroses for any synovium may be a single focal distortion or more complex. A joint capsule may have two or more separate areas of adhesion, and/or two or more areas of contracture. Contracture and adhesion may occur at the same portion of a synovium or separately.

Assessment of Joint Capsules

This section gives an introduction to mapping fibroses in joint capsules. Similar methods apply to bursas and to tendons and their adnexa.

Detailed assessment of the location and type of fibrosis is essential to guide the order and specificity of treatment; I like to use the analogy of tangled rope. When one has a tangled rope, the order in which untangling operations are done is important. Approaching tangled portions in random order is inefficient at best. It is essential to find the more open areas that can readily be spread out to make room to approach the tighter areas. Trying to work on the tightest parts of a tangled rope first will not only fail, but may be counterproductive. In this way, we also approach the fibrosis from the most available areas to areas of greater restriction.

Using several methods when assessing fibrosis is like comparing X-ray, MRI and ultrasound imaging of the same area. There is overlap in the information provided by each of these three imaging methods. Thus, one imaging procedure may seem to confirm a finding from another. However, each of these imaging methods may also provide some false information, and any of these imaging methods may provide some correct information none of the others provide. Collectively, these three imaging methods give us a picture more complete and believable than can any one method when taken alone. In a similar manner, there are several mobility and palpatory tests used to determine the precise nature of synovial fibroses and to map their location to about 1mm. Again, while one method may provide different information than another, combining methods yields more accurate results.

Assessment Methods

Active Range of Motion

- *First, ask the client to move the area of interest without specific instruction. Notice how the client prefers to move that area. Noticing what actions the client does is as important as watching what they don't do.*
- *Next, ask for specific movements, and again observe what can the client can and cannot do.*
- *In each case, whether or not the client's movement is directed by the therapist, looking for certain characteristics is important : What does the range of motion appear to be? How effortful is the movement? What neighboring areas are recruited to achieve the movement? This last indicator is an interesting one, since in normal movement we never use a single joint. Rather, joints always move in concert. The question is not whether neighboring areas are being recruited, but is whether the symphony of joint movement is efficient and comfortable?*

Passive Range of Motion

Move the joint for your client. Ask the client to participate as little as possible. Gently but firmly grasp bones near the joint line. Provide stabilization to avoid letting neighboring joints move. By restricting neighboring joint movement, we separate movement from normal global biomechanics, and gain information about the mobility of a specific joint. Move the joint slowly through normal ranges of motion. What does the range of motion appear to be? Compare this to contralateral and neighboring joints, and to your observations from all similar joints you have tested. What portions of the range are not available? How much effort is required to move through the available range? Is there pain in any portion of the range? Does the joint track properly, or is the movement skewed? Limitations in passive motion point toward, but do not fully define, probable fibrosis.

Passive Circumduction

Even if a joint is not normally used in circumduction, some circumduction is often passively possible. For example, the knee is described as a hinge joint, however the more flexed the knee is, the more availability there is for passive side bending in the joint. Combining the available flexion/extension of the knee with side bending results in a path of teardrop shaped circumduction with the apex of the teardrop anterior while the knee is in full extension. Viewed from the side, knee movement follows the curve of the cam shaped femoral condyles.

Combining these elements to visualize the three dimensional path of the circumduction picture, draw a teardrop shaped perimeter on a piece of paper, then bend the paper around the contour of the client's femoral condyles. As you slowly move the joint through circumduction for the client, keep the proximal segment stable while moving the distal segment in a circle, hugging the outer perimeter of that joint's range. If you encounter barriers that will not allow you to hug the expected teardrop shaped perimeter, these barriers point to the location of probable capsular fibrosis.

Approximation Followed by Slow Distraction

Compress the joint along its long or central axis. Very slowly allow it to de-compress. The bones should slowly spring apart along a nearly straight path. If the path of decompression deviates to one side that may indicate a fibrosis on that side. However, if there are two or more areas of fibrosis in the same joint capsule, the deviation shown by this test may be directed between two fibroses rather than at one of them. Compare the result of this test to other tests for clarification.

Glide

Stabilizing a bone near its joint line with one hand, use a finger of the other hand to press into the area near the joint line where joint capsule should be free to glide over periosteum. Arriving at the depth of the joint capsule, engage the joint capsule with your finger, and attempt to glide it over the underlying periosteum parallel to the joint line. Does this portion of the capsule glide or stick? If it sticks, this strongly suggests adhesion. Shift your contact to an adjacent area of the same joint capsule and test its glide over the periosteum in the same way. Proceed in this way around the circumference of the joint noting areas of glide, and areas of resistance. Test in this way on both sides of the joint line. This test is the single most definitive for capsular adhesions, but compare with data from other tests for confirmation.

Texture and Contour

Touching the joint capsule slightly more superficially than in the assessment of glide, sweep slowly over the surface of the capsule feeling for irregularities. Is the thickness of the capsule uniform? Are there local thickenings? Narrow ridges represent self-adhered pleats in the capsule wall; these usually run in the direction of the long axis of the joint, but as they may run in other directions, stay open to any possibility. Broader thickenings are just that: thickenings, not pleats. How wide is each thickening? Where are the boundaries of the thickened areas? Are there sharp edges to the thickenings or do they taper?

Treatment

As mentioned above, it is imperative for manual therapists to reduce fibroses gently. Vigorous attempts at fibrosis reduction will produce inflammation, and inflammation will inspire the fibroblasts in the body to establish new fibroses. After vigorous treatment, mobility may initially be improved, but in the following weeks, mobility will decrease as fibers grow in response to inflammation. Fiber growth in response to inflammation begins promptly, and can continue to accumulate for months.

Synovial membrane fibroses may be reduced by any of several different gentle techniques of osteopathic origin. Two of interest are: reconstructed A. T. Still Techniques[1], and the original functional method of H. V. Hoover DO.[3] Each of these techniques involves precise sequences of maneuvers carefully matched to the characteristics of the tissue being treated. Regardless of the method used, always promptly re-test the area after treatment to assess the immediate effect. Spot-check these areas during subsequent treatments. If fibrosis is found to return, there is an ongoing stressor driving this. Put on your Sherlock Holmes hat, review what you know about the client's life, and start asking questions to find the stressor.

Mildly fibrosed tissue may be released in seconds. More thoroughly fibrosed tissue will take longer, but working harder is NOT the solution. In my experience, gentle work over more time is the only productive way to work. It is imperative to watch for any hint of inflammation while working. Inflammation is usually first recognized by a felt sense of fluid filling in the area. There may also

3 Hoover H.V., D.O., Functional Technique, Yearbook, Published by the Academy of Applied Osteopathy, pp. 47-51, 1958.

be increased warmth, but this is usually preceded by the feeling of fluid. Other familiar indicators of inflammation such as a change in skin color are not usually helpful here; inflammation can occur in the synovia without a corresponding skin color change. Do not persist beyond the first indication of inflammation, rather, stop working on that area, and make a note to recheck it at the next appointment. When you reassess this area, it will usually be freer than you left it, but it may not yet have adequate stretch and glide. If it is not yet free enough, gently treat it again, until it is either free, or the first indication of inflammation is again felt. Return during as many treatment sessions as necessary. When repeated treatment is necessary, two or three episodes will usually free an area; although occasionally, more are needed.

Additional Pathology and Referrals

When these methods do not fully restore joint mobility and position, there may be articular cartilage defects, osteophytes, labral tears, joint capsule tears or other orthopedic problems. For clues, consider etiology - what is the age and history of the client? Make appropriate referrals to assess for conditions beyond the scope of our work. Orthopedists may be good referrals, some sports medicine doctors are quite adept at assessing and working with these types of pathologies, and in cases of unresponsive laxity, qualified prolotherapy doctors may be an excellent resource. Get to know the doctors in your area.

Looking Forward

This article is an introduction to my treatment methods. There is much more detail than I can offer here, and there are the additional applications of these principals to the hundreds of diverse joints, bursas and tendons in the body. I am beginning to offer classes on this for structural integrators, as I continue the search for additional assessment and treatment methods to further increase effectiveness and efficiency in this arena.

For more information see www.jeffreyburch.com Classes may also be listed on the RISI and IASI websites.