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Dynamic Ligaments

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The Revolutionary Re-Vision of Jaap van der Wal

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We are in the midst of a radical rethinking of how the musculo-skeletal system works. It is ever more clear that 'the muscle' is an outdated and un-physiological concept and that the understanding of the fascia as a body-wide regulatory system will yield the next generation of effective hands-on interventions.

This new explanation of how life moves will take a while to show up in the textbooks; until those who write them – still mired in the 'muscles move the skeleton' model – figure out what is really going on. Meanwhile, we who practice manual therapy can cut to the chase and take advantage of it now.

Some of this shift is coming from findings in the neurology of movement that fly in the face of some of our most cherished concepts.[1] Much of the rest is coming from the increased exploration of the mechanical role of fascia and the extracellular matrix (ECM) – the 'Cinderella' of body tissues that is finally getting its due in research being exposed at the Fascial Research Conferences.[2]

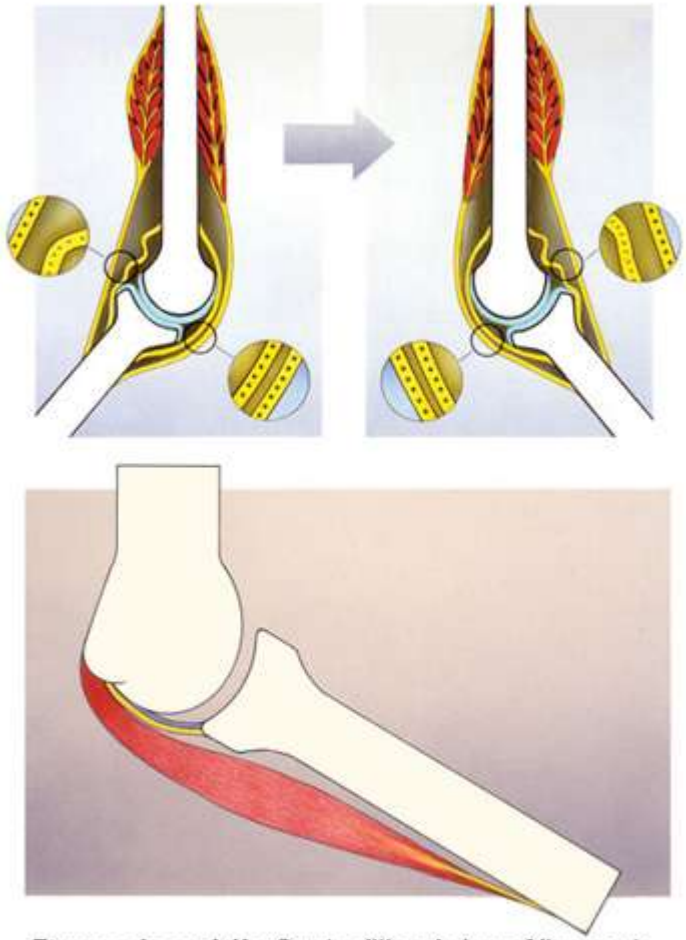
"So, wait a minute, I spent all that time with the Trail Guide learning the muscles to get certified – if the individual muscle is not an accurate rendering of the architecture of human movement function, what is?"3

In the most recent conference, a startling paper and talk by Dutch anatomist Dr Jaap van der Wal, M.D., Ph.D, (Fig 1) shoved us right through the looking glass into this new wonderland with no looking back.[4] Jaap's work overturns our understanding of the interplay between muscles and ligaments across the joints.


Dutch anatomist Jaap van der Wal, M.D., Ph.D., described the dynament, or muscle and connective tissue working together to create joint stability

Although Jaap's seminal paper was published for the Amsterdam conference in 2009, his original work was published way back in the mid-'80's. At that time, his findings were simply too radical for the prevailing wisdom, and was given the standard scientific treatment: his work was ignored, shelved, and dismissed. Even now, his ideas present a significant challenge to our understanding. Once grasped however, his logic has that obvious, 'of course it's that way!' inevitability.

Our common view – a view that I shared and promoted even in my own attempt to revise standard anatomical concepts [5] – has muscles and ligaments working in parallel (Fig 2). In this universally held model, the ligaments are tough passive collagenous structures that run over the joint from one bone to the other. When the joint is bent toward the ligament, that ligament lies passively lax near the joint capsule. The muscles – farther out from the joint and dynamically controlled through the nervous system – stabilize the joint through its range of motion until the end. Only when the joint is at its full extent do the ligaments come into play, tightening suddenly to prevent further extension or damage at the end range of movement.



Figures 1a and 1b: Our traditional view of ligaments sees them arranged parallel to the muscles, but only really coming into play when they are fully stretched at the end of joint range.

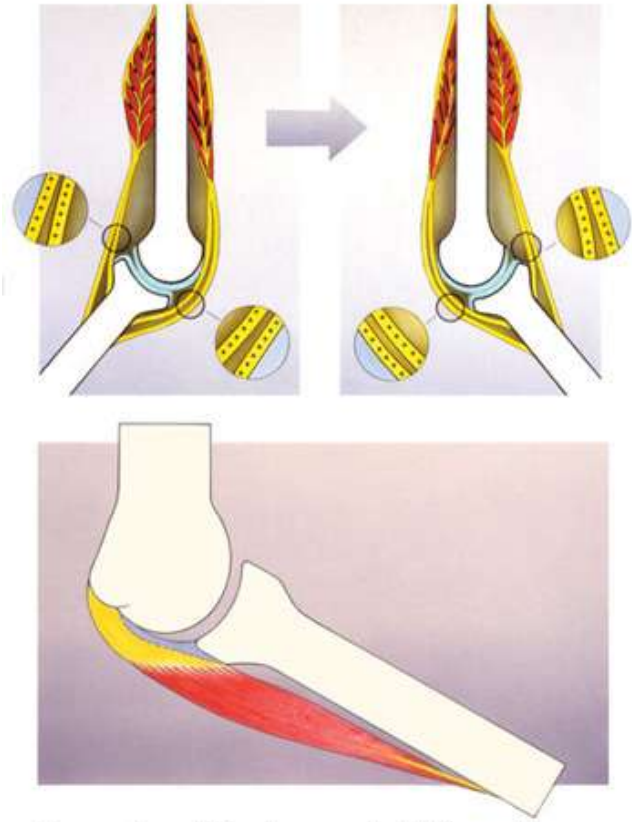
An easy example is the elbow: We expect the biceps and brachialis to control the stability of the joint through a preacher curl. Only when we let the weights back down to full extension would the ligaments be tightened to prevent further extension of the joint. As they tighten, the nerve endings in the ligaments communicate (sometimes quite loudly) to the spine, which acts to turn the muscles off or on to prevent damage to the joint.

If we are 'double-jointed' (ligamentous laxity) the elbow will continue to open past 'straight' until the point of the olecranon gets stopped by the humerus. In these cases, the joint is more at risk because the untightened ligaments do not tell the spine about being near the end of the movement, and besides, the ligament itself is supposed to provide a 'brake' to the movement before the bones collide. So far, so good, yes?

But what if this view is not the 'truth', but an artifact of how we dissect, a concept arising out of how we wield the scalpel, not how the body organizes itself?

In our attempt the make structural sense out of the mess that the human body presents to the dissector, we slipped our scalpel around the muscles, lifted them out and cleaned them off, and gave them names like biceps and brachialis. That pesky connective tissue binds everything together anyway; what we were looking for was a coherent picture of the organs within it – and the muscles numbered among those organs we separated out.

The tissue that was left under the muscle after removal was called a ligament, and presumed to be a parallel structure for stopping joints from hypermobility as described above. According to this view, the ligaments do not come into play until we reach that limit of available motion.



Figures 2a and 2b: Jaap van der Wal's careful observation of fascial continuities led him to conclude that the muscles and ligaments are actually arranged in series, and reinforce each other. He named this common arrangement a dynament.

The truth appears to be a little less simple, but much more functional. What we ignored is that in situ muscle tissues are continuous with the underlying bone-to-bone tissues.

Jaap did a careful dissection of the elbow area in which he did not cut out each muscle with its fascial envelope, but instead extracted only the muscle tissue, leaving the fascial envelopes and their local connections intact. By carefully following the fascial connections, Jaap was able to determine that in most cases, what we call ligaments were mostly linked with the muscles in series, not in parallel. (Fig 3)

In other words, muscle contractions, which tense the muscle and its myofasciae (epimysium, perimysium, endomysium, and tendon), also tense associated ligaments because they are part of this same series of fascia in which the muscle was contracting.

This means that the ligaments, far from being active only at the moment of the greatest elbow extension in your preacher curl, are dynamically active in stabilizing the joint all through the movement, during both concentric and eccentric contraction. This muscle-ligament combination Jaap termed a 'dynament' (by a contraction of 'dynamic ligament') and the implications of his findings are profound.

For one, it redefines our whole concept of functional units within the body. Take one area where we already get the concept: the rotator cuff of the shoulder. The four muscles of the rotator cuff end distally in tendons blending with the ligamentous capsule around the shoulder. In dissection, it is quite hard to tell where the tissue stops being a tendon and starts being a ligamentous sleeve. (It was us not God, after all, who labeled them – in fact the

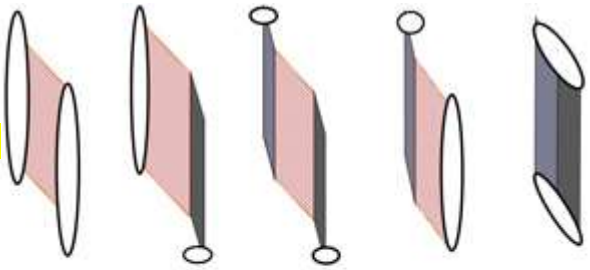


Figure 3: Dynament constructions: The pure (and rare) ligament, like the cruciates, is described on the right: bone-fascia-bone. Most 'ligaments' are in series in various configurations (option 1 to 4 on the left): bone-fascia-muscle-fascia-bone, as in the hamstrings or rotator cuff.

entire fascial net develops and remains as a single unit.)

If muscles are necessary to stabilize the loose ligamentous capsule of the very mobile shoulder joint, extend that idea to the rest of the body. While there are ligaments that are not connected to the overlying muscles – the cruciate ligaments in the knee are a prime example of ligaments as we have always thought of them – most of our named ligaments are part of the continuous dynament system.

In fact, most muscles lie within a dynament series that can be described as bone, fascia, muscle, fascia, bone. (Fig 4). The muscles near the elbow Jaap studied in detail are a good case in point, but representative of many similar situations in the limbs and spine.

The 'pure' (and rare) ligament like the cruciates is described on the left: bone-fascia-bone, but most ligaments are in series: bone-fascia-muscle-fascia-bone, as in the hamstrings or rotator cuff.

At the proximal end, near the elbow, both the antebrachial flexor and extensor groups arise not from the humeral epicondyle itself, but from 'leaves' of fascia that arise from the condyle. These leaves (intermuscular septa) form the origin of the muscular slips that passes down the arm toward the wrist, narrowing to individual tendons that are attached to more specific areas at the other end. The concept of the isolated 'muscle' makes more sense at the tendon end than it does back up at the meaty origin.

Take the erector spinae, or the muscles of the lower arm and lower leg – all these complexes arise from complex leaves of heavy fascia that join the muscles together with each other and with the ligaments beneath them. The dynament is a much more functional way of thinking about how the body organizes movement. Even the hamstrings, those icons of singular muscles, are now understood to be both continuous with the sacrotuberous ligament, and to be complex dynaments with the string and membranes within them.

Long story short: we simply cannot divorce the muscles and ligaments. They are linked in series and part of one joint stabilizing and moving system. The relevant architecture of the fascia / muscle arrangement is the dynament, not the muscle.

Getting stuck in the cul-de-sac of 'muscle' as a functional unit is an understandable conceptual error – it fits our mechanistic worldview and is very convenient and logical. Just wrong. It is not an easy task for us, with all our training, to back up and take another route. Even with my gray hair and years of trying to think outside its box, I still think in terms of muscles. But our children, the next generation of hands-on and movement therapists, will start out with a new unified vision, built from the kinds of ideas we are debuting here. Hats off to Jaap van der Wal, harbinger of the future.

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1. Doidge, Norman 2007 The Brain That Changes Itself, Penguin, NY
2. http://www.fasciacongress.org/index.htm for a summary description and publications. The next conference is in Vancouver, BC on March 28 – 30, 2012: http://www.fasciacongress.org/2012
3. For up-to-date (and useful) guides to the outmoded concept of the single muscle, one can delve into (in ascending order of complexity): Trail Guide to the Body, 4th edition, Andrew Biel: http://www.booksofdiscovery.com; The Muscular System Manual, 3rd edition, Dr Joseph Muscolino: http://www.learnmuscles.com, or the Thieme Atlas of Anatomy: http://www.thieme.com
4. Van der Wal J 2009 The Architecture of the Connective Tissue in the Musculoskeletal System – An often overlooked Functional Parameter as to Proprioception in the Locomotor Apparatus; article in Fascia Research II: Basic Science and Implications or Conventional and Complementary Health Care, Munich: Elsevier GmbH – or see a similar article in Journal of Bodywork and Movement Therapies, Vol 2, No. 9, 2009.
5. Myers T 2009 Anatomy Trains, 2nd edition, Edinburgh: Churchill Livingstone, pp 41 – 44 outline an elegant image of the relationship between muscles and ligaments now outmoded by Jaap's findings. "There is nothing so sad as the destruction of a beautiful theory by an ugly fact" – Thomas Henry Huxley

Comments

Jaap van der Wal
March 2, 2011 at 12:39 pm

Sorry, dear Tom, but here is your referent speaking.
Figure 3 has a wrong subtitle and legend and is not clearly interpreted.
In principle a 'dynament' is a 'bone-fascia-muscle-fascia-bone-unit'.
A 'classical' ligament can be thought in this model as a dynament 'without muscle tissue'.
This situation is interpreted on the RIGHT in figure 3.
In figure 3 the 'typical bone-fascia-muscle-fascia-bone-unit', which should be in the center, is missing / absent.
Moreover four presented configurations (should be five) are presented twice (double).
Jaap van der Wal

Revision 30 maart 2011 by Erik Dalton

Jaap van der Wal
March 31, 2011 at 9:14 am

Thank you for repairing the obvious 'whoops' like me mentioned as 'Dutch osteopath'.
I have some dedication in my work as embryology teacher to the Osteopathy but it is too much honor to call me an osteopath.
Also figure 3 now looks better.
Thanks Erik.
Jaap

Commentaren op de website tot 30 maart 2011

Tony Babarino March 2, 2011 at 3:12 am
…GREAT stuff! As a professional Personal Trainer, I really dug deep and aggressively into Joints since 2001. What a great time to be “ahead of the game” and find THIS info too! I would image that all Personal Trainers (who are sincere) should read and understand Joint Structure & Function, 4th Edition (Levangie/Norkin) and they would REALLY dig this information in this post!!!!
Thanks Tom! Always dig your stuff!
It’s almost like you read my mind and wrote this stuff in a more beautiful, smart, and fullfilling way. Keep going man!

admin March 8, 2011 at 2:58 pm
Thanks for your great comments. Always glad to offer (and read) information that is of use to the bodywork community.
Erik Dalton

Tony Babarino March 2, 2011 at 3:13 am
PS: By “dug deep and aggressively into Joints”… I meant deep into EDUCATION ! Not the Joints literally. Ouch.

admin March 2, 2011 at 4:47 pm
Yes… thanks for the clarification… Erik

Brian Abelson March 2, 2011 at 5:49 am
Great article. I had the pleasure of meeting Dr. Van Der Wal in Amsterdam. I was very impressed. Most definitely, hats of to this visionary.
Reply

Travis Alligood March 2, 2011 at 11:57 am
Tom,
Great article, and thanks to Jaap, his findings are being investigated. I do not think the of any of these great Drs. studies should be dismissed at all or stored away on some shelf. Great future ahead ! Thank-you Erik for posting article.

Jan Loomis March 12, 2011 at 9:35 pm
Because I do myofascial release energetically, I’ve always maintained that it has a lot more to do with the fascia than ever it has been given credit for. Thanks to you and van der Wal for setting it straight.