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ARTICLE Healthcare and Sports from the Perspective of Qi, Fascia, and Taijiquan

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ARTICLE INFO	ABSTRACT
Article history Received: 16 June 2021 Accepted: 21 June 2021 Published Online: 15 November 2021	The slow-motion practice of Taijiquan, operationally, cultivates the cognitive perception of fascia tension as it is being harnessed to discipline body motion to be in accord with Yin-Yang Balance. The ideal motion that results, bestows liveliness of change and harmonizes body momentum, the hallmarks of maneuverability and force potential for performance. The paper puts forth the proposition that the manifestation of Qi in Taijiquan is primarily the cognitive perception of fascial tension in the functional efficacy of bipedal balance for performance. Though the cultivated cognition may be subjective, the process of Qi nurturing is grounded on the reduction of the errors of imbalances, which carves a practice path to balance with tangible effects. The force that arises from body motion so imbued with Yin-Yang Balance, is of the phenomenon of internal strength or <i>neijin</i> —consummate, of the right force vector in spontaneous response and rooted in balance. Taijiquan practice nurtures Qi for both health wellbeing and <i>neijin</i> as the body's core strength, depending on the practice efforts put in.
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1. Background

Traditionally, Taijiquan (Tai Chi Chuan) is presented as a practice to nurture Qi (Chi) energy guided by the principles of Yin and Yang. It is difficult to articulate what Taijiquan is as the underlying concepts of Yin and Yang and Qi are foreign to the West. While one may not relate to the theory, there is nothing burdensome about the art in practice—the body relates to it readily. Anyone, young or old, can pick up the art with no prerequisites. The practice is as it appears, without strenuous physical demands besides that of moving in balance. And interestingly, before long, practitioners enjoy clear health benefits, which keeps the practice going. It is this simple efficacy of health welfare that is driving the worldwide popularity and acceptance of the seemingly alien art. The United Nations body, UNESCO, recently honored Taijiquan, listing it as an Intangible Cultural Heritage of Humanity.

The practice of Qi nurturing, referred to generally as Qi energetics or Qigong, goes back to ancient times. Qi theory holds that good health is a measure of robust Qi coursing through the body interconnecting the internal (Zangfu) organs in harmony. The health benefits of Taijiquan are thus presumed in the art as a Qi nurturing practice, and they have been studied extensively in scores of research papers.

However, the traditional theory does not present Taijiquan as a health exercise. Rather, the classical literature touts it as a martial arts par excellence. Incongruous as the slow-motion

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practice may be to the speed and power in combat and boxing, Taijiquan bills itself as a kungfu art of the highest order. Taiji kungfu skills are underscored by the principle of "using softness to overcome hardness" (*vi rou ke gang*). These skills are characterized by softness, such as "guiding an in-coming force away to emptiness" (*vin jin luo kong*) and "using four ounces to repel a thousand-pound force" (*si liang bo qian jin*). They beguilingly indicate that the strength used in the kungfu techniques is not borne necessarily of phenomenal musculature. Taijiquan's kungfu prowess finds its basis in *neijin* or "internal strength."

Qualifying *neijin* strength as "internal" is to distinguish it from li, the strength of normal physical training. The cultivation of Qi in Taijiquan practice is primarily to develop *neijin*. This highly refined strength is built by infusing Qi into li in the training. For practical convenience, one can think of *neijin* as equal to Qi plus Li or as Qi-inspired Li. The aesthetics of the Taijiquan form are grounded on the expression of *neijin*.

The long cherished belief of Taijiquan's martial superiority was unceremoniously shattered in a fight in April 2017, when a Chinese Mixed Martial Artist (MMA) fighter thrashed a self-styled Taijiquan grandmaster in 10 seconds, and harangued that Taijiquan combat was mostly fake. The sacrosanct *neijin* was desecrated as bogus. In one fell swoop, the cultural heritage of Taijiquan was shaken at its core, and it whipped up such an uproar in the Chinese cyberspace that it shut down the internet portal.

Subsequently, vying for fame and fortune, some other self-proclaimed Taijiquan and Wing Chun masters who challenged and fought MMA fighters, were handily defeated as well. The venerable Chinese martial arts kept being thrust in the public eye as being ineffectual. The old and secretive kungfu theories in the classics that had served to inspire the arts were ringing hollow. A good part of the debate lamely pushed aside the combat issues by emphasizing the culture (*wen*) of the art. But the martial elements are in the Taiji DNA, which is what sets it apart from being a dance form.

It is therefore imperative that the role of Qi in *neijin* and Taijiquan be resolved at the fundamental level. *Neijin* can be unpacked in terms of the change in momentum, the principle of levers, and the balance of bipedal functionality to elucidate the highly lauded kungfu skills of Taijiquan. These and other combat issues are addressed in the author's papers, *Taijiquan's Enigma* ^[1] and *Is Taijiquan a martial art or a dance* ^[2]. However, the discussion skirted the core concept of Qi itself, taking it as given in Chinese Medicine.

Qi is a foundational concept in Traditional Chinese Medicine (TCM), but neither Qi nor TCM are built on scientific constructs; they predate science. Although it may serve to think of Qi as a bioenergy, it remains undefined in terms of Science. Thus the discourse of *neijin* and Taijiquan often becomes stymied.

The significance of Qi is in its functional forms, not as a bioenergy per se. Though it is not measurable as a scientific quantity, Qi is cognizable as a sensation. Music is not appreciated by the study of the physics of harmonics and tones. The crux lies in the perception of Qi as a bioenergy coupled with the efficacy of its functionality. What is crucial is that one can cultivate cognitive perception of Qi, making it pragmatic and decipherable without measuring instruments. This is the defining feature of Qi, which is explicated more fully in the author's recent paper, *Science in Qi*^[3].

The present work may be regarded as a supplement to this paper as an application to Taijiquan and *neijin*. The phenomenon of *neijin* is manifested in the musculoskeletal framework, thus subject to biomechanics and the laws of physics. The paper studies fascial tension in Qi's key functional role in the Taiji discipline of body motion to develop *neijin*. In the function, we see the fascial tensional network of the body as providing a medium for Qi, and thus a concrete representation of Qi. More consequentially, the science in Qi can help one reach the rarefied heights in the art of Taijiquan.

2. Qi and Fascia

Fascia is a continuum of connective tissue that wraps around muscles and envelops internal organs and other structures, providing a body-wide web of physical connectivity with viscoelastic properties. Although the components that make up fascia are the same, namely, protein fibers (collagen and elastin), ground substance (fluid content), and fibroblasts (cells), they vary in composition and form depending on its function.

The deep fascia that surrounds individual or groups of muscles, separating them into fascial compartments, is a dense connective tissue with a higher proportion of collagen fibers. The fascia of loose connective tissues which envelop and support organs is more fluid with a larger content of ground substance and lesser protein fibers; it spreads throughout the body, filling the spaces between structures and surrounding the blood and lymph vessels.

The ground substance is usually a fluid consisting of water, polysaccharides (hyaluronic acid), and proteins. The protein fibers are embedded in the ground substance, which together with the fibroblasts form the extracellular matrix that makes up the fascia. When muscles move, the fascial sheath allows them to glide over one another with no friction. The innocuous-sounding ground substance magically offers no shearing force in the fascial function of gliding. Its structure changes at the microscopic level and adapts organically to its singular function of gliding, as captured in Guimberteau's video, a most remarkable representation of differential equations in motion ^[4]. The gliding, made friction-free by the structural changes, guides the collagen and elastic fibers of the fascia to align in the direction of muscle extension, producing tensile force—the fascial tension.

2.1 Fascial Manipulation

Massage therapists have long known that applying proper physical pressure on the body can bring relief to muscle aches, soreness, and tightness and improve the range of movements caused by fascial dysfunction and restriction. Luigi Stecco, a physiotherapist, found that there was a functional link between the fascia and the muscles and joints it connects. Stecco's insight was that muscle ailments could be caused by impediments to the gliding function of the fascial planes. He developed a fascial manipulation technique that applied deep manual frictional pressure on the muscle fascia at a series of therapeutic points referred to as centers of coordination, some of which he noted, coincided with acupuncture points. The mechanical action of friction within the layers helps to release the fascia, making it more fluid and thus improving its function. This is the gist of the method of the Stecco Fascial Manipulation method^[5].

Earlier and separate from Stecco, Dr. Ira Rolf had also introduced her fascial manipulation system (Rolfing Structural Integration). Together they and others have forged a new field of musculoskeletal therapy, finally giving fascia its rightful place in medical science as more than just a packing material ^[6].

Fascial manipulation techniques are preceded by the TCM therapy of cupping. The world was set abuzz by the prominent reddish round marks on Michael Phelps' shoulders during the swim meets at the Rio 2016 Olympics (Figure 1). He had been treated with TCM's cupping therapy which relaxed his muscles and eased his joints and movements. He credited the therapy for helping him achieve his athletic best again at the ripe old age of 31, adding 4 more golds to his unimaginable career total of 23 Olympic golds.

The cupping therapy creates a vacuum that pulls a portion of the body's flesh into a suction cup as a mini mount, which effectively manipulates the fascia. TCM explains it as pulling blood-Qi to improve circulation. There are other TCM modalities that can be viewed as manipulation techniques of the fascia as well, namely, moxibustion, scraping (*Guasha*), acupuncture, and *tuina* massage ^[7]. The body-wide network



Suction pulls the flesh into the cups



Cupping marks on shoulders

Figure 1. The Cupping Therapy manipulates the fascia by pulling the flesh into the suction cups

of fascia offers a physiological framework for Qi flow in the meridian system. It is found that in acupuncture treatment, the fascia grabs onto the acupuncture needle as it is twirled (a micro-level example of the Weissenberg Effect of viscoelasticity), with the pull measurably stronger at some acupoints, which led Langevin to propose that Qi pathways reside in fascial folds ^[8]. That manipulation of the fascia by acupuncture needles could stimulate Qi flow in the body has been observed earlier (1992 Kimura, et al. ^[9]).

2.2 Fascia's Role in Generating Strength

Fascia and Qi are linked more directly in their roles of generating strength. Although muscles and fascia are of two different tissue types, they are integrated in the function of body movements. When a muscle contracts it extends the tendon attached to the bone, creating a tension. To ensure the safe and smooth transmission of force and motion, the stretch and speed are monitored by the proprioceptors of muscle spindles, and the tension, by the Golgi tendon organs. Coupled with the action of an agonist-antagonist pair, there is a constant exchange of muscle contractile force and fascial tension, which is the "aliveness" activity that maintains the toning tension for force transmission in the muscle-tendon unit (Figure 2). The muscle and tendon work in synergy to sustain the oscillation between active muscle force and passive fascial tension. The metabolic energy fires the muscle contraction, loading the viscoelastic fascia, which then recoils at muscle relaxation, regulated by nerve receptors. However, because of anatomical constraints and the limitations of viscoelasticity, the muscle and tendon-fascia cannot be weaponized as a catapult or a bow that stores potential energy on extension ready to launch a projectile or an arrow upon release. The body's powerful action is propelled by contractile muscles, primed and harmonized in conjunction with the fascial tension.



Figure 2. The aliveness of muscle-tendon tension is maintained at all times

Generating strength in sports or work requires a discipline of the movements of the different segments of the body, which necessarily involves both muscles and fascia. The role of the lumbodorsal fascia in generating strength was well explained in Serge Gracovetsky's illuminating lecture at the First Fascia Research Congress in 2007^[10]. At the same Congress, Robert Schleip described the fascia as forming "a continuous tensional network throughout the human body." The fascial tensional network provides the means for the discipline of body motion. Stecco views the role of fascia "as a conductor of an orchestra playing a symphony of movement, where it synchronizes the crescendo of some muscles and the diminuendo of others." How do we harness fascial tension and master the role of conductor in the art of body motion? The answer is in the nurturing of Qi in Taijiquan.

2.3 Fascia-Qi Hypothesis

Before the advent of the current research in fascia, there is very little mention of the role of fascia in sports training, except of course when sidelined by fascial injuries. Strength training at the gym is still primarily of weight-lifting and resistance exercises, driven by muscle development. However, sports training is not devoid of fascial conditioning, as it is found in warm-up and stretching routines, as well as in footwork and agility drills.

The slow-motion methodology of Taijiquan of developing internal strength (*neijin*) eschews muscle development. Indeed, permeating the training culture is the guiding mantra of "using mind-intent, not using force" (*yong yi bu yong li*). The training is focused on nurturing Qi energy associated with balance and harmony, and the harnessing of Qi to discipline body motion to develop *neijin*. That is, by operational default, Taijiquan training is harnessing the fascial tension to discipline body motion.

First of all, there must be awareness of the sensation of fascial tension for it to be cognizable in its functional efficacy. The fascia is rich with mechanoreceptors; the periosteum has nociceptive nerve endings, and the tendon, proprioceptors, all of which are sensitive to manipulation. The awareness is induced by the attentiveness to the breath and movements and the slow-motion practice—the meditative component of the practice.

A cognitive perception of the fascial tension develops in the awareness, coupled with the functional effects of the discipline. This represents the nurturing of Qi that cultivates the Qi-cognition of the fascial tensional network, which is harnessed to guide and harmonize body motion. This leads to the *Fascia-Qi Hypothesis* in Taijiquan training.

Fascia-Qi Hypothesis

Fascial tension gives rise to Qi when it is harnessed in the discipline of muscle actions. Implicit in Qi is a functional dimension that is accessed through cognitive development via a combination of sensory receptors. Cognition of fascial tension is a cultivated perceptual sensation that captures the functional effects of the discipline of body motion, specifically that of the balance factors. This bypasses mathematical analysis and leads to the art in science—the Fascia-Qi Hypothesis in Taijiquan.

The art of Qi nurturing in Taijiquan cultivates the cognitive perception of the fascial tensional network in the discipline of body motion.

Cognition of the functional effects of fascial tension elevates it to Qi (as force or energy), called fascia-Qi. Taijiquan practice cultivates this Qi-cognition as it is being harnessed to discipline muscle actions.

2.4 Bridging the Gap between Command and Action

In Taijiquan, the practice mantra of *yong yi bu yong li* ("using mind-intent not using force") is both perplexing

and gratifying at the same time. It is bewildering because the admonition of "not to use li" is directed at an appearance of physical exertion of muscular force in practice as error. It is frustrating because motion is not possible without the contractile forces of muscles. Yet it is gratifying because the body responds and relates to the mantra in delightful comprehension. The methodology induces a restraint of reactive muscle activations that is conducive to the discipline of body motion.

The command to execute an action triggers the motorneurons to send signals to the muscles to contract, moving the body segments that sum up to the action. The action follows our command, but there is a gap between command and action-we have no control over how the muscles are recruited or activated. Thus we find that the performance of the action may often not be satisfactory, as in a golf-drive, due to the gap of control of the multiple pathways between the command and the final action ^[11]. The issue is to make sure that the action executed is tapping the force potential that the body is capable of in the performance. The strength depends not only on the active contractile forces of the muscles but crucially on the reactive tensile forces of the tendons and aponeuroses. The slow-motion methodology of Taijiquan operationally appeals to the role of the fascia to bridge the gap.

The operation of Qi in Taijiquan that bridges this gap in the discipline of body motion is described by the principle of "the mind-intent conducts Qi, and the Qi drives body motion" (*Yi yi dao qi yi qi yun shen*). The mind-intent of *yi* conducting Qi encompasses the command of the action and the motor-neuronal signals to the muscles; and the Qi driving the motion consists of the contractile muscle force and the fascial tension, namely, the fascia-Qi by the Fascia-Qi Hypothesis. With the proposition of fascia--Qi, the *Yi-Qi-Motion* paradigm of Taiji theory finds a physiological basis in the neural cortico-spinal pathway of muscle activation.

Importantly, what must not be overlooked is the cognition of the functional effects of Qi in the pragmatic guidance of body motion. As it turns out, because balance is paramount in bipedal functionality, generating strength can be reduced to the discipline of balance. Taijiquan develops the cognition of Qi by its functional factors of balance and harmony, which is pursued next.

3. Qi and Yin-Yang Balance

What are we doing in the practice of Taijiquan? The traditional answer, couched in metaphysics, is that Taijiquan is a practice to nurture Qi by disciplining body motion to be in accord with the Principle of Yin-Yang Balance. This goal is the raison d'etre of the slow-motion methodology that characterizes the practice, described poetically as a meditation in motion. What never ceases to tantalize and beguile is that the easy-going practice promises to deliver kungfu skills of the highest order. The theory is that the Qi cultivation in Taijiquan develops *neijin* as the body's core strength. And *neijin*, the stuff of physical strength (Li) plus Qi, forms the basis of Taijiquan's much touted phenomenal kungfu.

Martial prowess does not operate outside of science. Balance and a prerequisite of core strength are necessary ingredients, without which combat skills no matter how great cannot be executed with effectiveness. The biomechanics of kungfu skills is not just about strength but the agility of change in application, executed in spontaneous response with the right force direction and magnitude. This is the consummate force of *neijin* that ensues from the ideal Taiji motion, imbued by the Principle of Yin-Yang Balance.

3.1 Functional Efficacy of Balance

We can think of Yin-Yang Balance as "internal balance" and add quickly that its foundational basis is the balance in body motion, between the internal forces of muscle actions within and the external forces, primarily, of gravity. It is the principle of balance that gives us our bipedal functionality in range, versatility, strength, and precision. However, balance does not accord the same functional efficacy.

For example, you are in balance in a standing posture and you take in a deep breath, as when asked to by a physician with a stethoscope on your chest. Inadvertently, you heave up your chest, causing your abdomen to hollow and your body to be top-heavy. While still in balance, you will topple easily under a gentle nudge. Your balance becomes functionally less stable. The science of balance governs the art of body motion.

The action of balancing an arm stretched out to the side may just be a balance between the muscle forces adjusting to gravity. But working the levers of the arm in balance are the fascial tension and muscle forces of a varying combination of muscles of the shoulder, chest and arm the deltoid, trapezius, pectoralis, rhomboids, rotator cuffs, biceps and triceps, and many more.

Holding the arm in balance without moving, the muscles may seem to be at rest. But certain muscles might be acting excessively, requiring adjustment from countering muscles. The balance support can often be made by lesser muscle actions overall internally. Indeed, we have a sense that certain combinations of muscles are preferred, namely, those that give us less stress in the support. This gives us cognition that there is an error in balance and a differentiation of a better balance as well.

Although we have voluntary command of skeletal muscles, we cannot allocate muscle forces, so much here and so much there, to find a preferred combination of a better balance. However, abiding by the mantra of "not using *li*-force," the innervation of muscles becomes less associated with the action. This induces the relaxation mode of the muscle loading cycle to let the fascial tension attend more positively to find a better balance, like in tuning a stringed musical instrument.

We learn to cognize stress and associate it with the errors of muscle actions—too excessive or too lax—at the joints by sensory receptors in the tendons and fascia. Not only can we cultivate this cognition, we can also respond to adjust to a preferred combination of less stress by simply "letting-go" of the muscle actions for them to resettle. Taijiquan takes this rudimentary functional response and develops it into a sophisticated organic tool called *fangsong* (relaxation by "letting go") to resolve the stress of muscle-action imbalances at a joint.

3.2 Relaxation, Fangsong and Qi

The *fangsong* effect can be simulated by enlisting someone to hold a finger and letting the arm hang like a cable. This works to restrain the dominating muscle actions, and brings about a resettling of the muscle forces and fascial tensions that adjust the excessiveness or deficiency in the support; it thereby reduces the errors of the tensile forces of the arm and induces a sensation of ease by a lesser stress. Concomitantly, one gains a body comprehension of the joints and the weight of the arm, which builds up to a fasciatensional connectivity, cognized as Qi. In practice, *fangsong* is also simulated by another practice mantra to "sink the shoulder and drop the elbow" (*chen jian zhui zhou*).

The fangsong tool works by a simple pragmatic rule to reduce the errors of muscle actions: relax by lettinggo (namely, *fangsong*) at the perception of excessiveness (stress of the dominance of muscle forces), or when the arm is lax or droopy (the perception of deficiency) stretch internally by fascial tension to connect to the fingers. The attentiveness of the practice cultivates cognition of less stress in the arm balance and the associated fascial tension as Qi. The process of Qi cultivation also serves to refine the tool of *fangsong* organically to further reduce the margins of error better, carving the practice path that leads to the goal of internal balance. In short, the Qi nurturing associated with the *fangsong* reduction of errors in the discipline of internal balance is a tuning to harmonize the internal dynamics of fascial tension and muscle forces against the external force of gravity. This enlivening of fascial tension gives cognition of fascia-Qi, and realizes the Fascia-Qi Hypothesis.

3.3 Fangsong and State of Muscle Rest

The muscle retracts at rest when the contraction ends. At the micro level, the basic contractile unit is a sarcomere, which lines up one by one in a microfibril of a muscle cellfiber. The sarcomere contracts when its thick filaments (myosins) pull in the thin ones (actins) in a crossbridge action, with the expenditure of adenosine triphosphate (ATP) energy. Alongside this array is a third filament, titin, a polypeptide, that functions as a spring that resists the shortening and lengthening of the sarcomere unit. The titin filaments restore the sarcomere at rest, thus engendering muscle retraction with no further energy cost (Figure 3).

The operation of *fangsong*, a relaxation of letting-go, induces the muscles more to a rest state in the resettling of the muscle actions. *Fangsong* manipulates the cycles of muscle contraction and retraction together with the fascial tension to bring the muscles in the balancing function to a more restful state. Also, the contractile force of the sarcomere unit is at the maximum at the length from about 2 micron to 2.35 micron, the optimal fiber length, which range is around its resting length (see graph in Figure 3). The *fangsong* process of relaxation not only engenders a more restful state for muscles in the support of balance but enhances the functional strength as well. These qualities accrue to the core strength of the *neijin* being developed. The restful state is cultivated in standing meditation, the practice of standing in stationary postures, for example in Figure 5.

The electromyography (EMG) readings cannot distinguish the different standing postures because the muscles are at rest state. However, a standing posture in balance may not have the same functional efficacy, as discussed earlier. *Fangsong* elicits muscle rest, but the state of muscle rest does not imply the function of *fangsong*. That is, *fangsong* brings about a better state of muscle rest. While the postural muscles may be EMG silent, Qi-cognition is nurtured in Taijiquan practice to differentiate the functional differences towards a better balance.

3.4 Fangsong in the Whole Body

Extending the *fangsong* discussion from the arm to the whole body, we see that there are multitudes of muscles that can produce the same body action from which we seek the preferred combinations of less stress or disharmony. This entails resolving muscle actions at hundreds of joints. The task is compounded by the tensile integrity of the skeletal frame where resolution at one joint could affect that at the other joints, thus requiring a



The titin filaments function as springs that restore the sarcomere length at rest



The contractile force achieved is maximum at the sarcomere length range of about 2 to 2.35 micron, which is around that of the sarcomere at rest.

Figure 3. Sarcomere length and force

recalibration each time, rendering the *fangsong* work nigh impossible.

This is where the art of Taiji steps in with a practical solution path to a complex mathematical problem of resolving imbalances of muscle actions at the matrix of joints. The methodology prescribes the solution of simplifying the myriad joints into pairs of three correspondences, which can then be further subdivided. The *fangsong* resolution is then applied systematically, starting with the major pairings of the shoulder and pelvis, elbows and knees, and hands and feet. The *fangsong* resolution unifies each pairing, guided by the *Principle* of Three Unities (Sanhe), which is articulated in a 19th century classical text, *Ten Essential Principles*, by Chen Changxin (1771- 1853)^[12].

The *fangsong* of the shoulder-and-pelvis pair works to resolve the tensile forces of the muscles and fascia at the joints towards a better balance, building a functional integrity and cognition of the torso. This is then extended to the elbows and knees, and then further to the hands and feet. In this way, the *fangsong* process gradually integrates functionally the major joints in the pairings, thus instilling cognition and body comprehension of the whole body, which is then harnessed to harmonize the tensile forces of the muscles and fascial tension against gravity and other external forces.

Not all joints are created equal. The sacral iliac joint (SIJ) and the pelvic joints that form a triangle of joints are bestowed a preeminent status as they control the movements of the spine and legs via the pelvis. Taijiquan refers to the complex of the pelvis and the triangle of joints as the *kua*. The *kua* serves as the hub of force transfer between the upper body and the legs and ground ^[13]. The role of the *kua* is central in generating the force needed for performance in martial arts, sports or work.

3.5 *Kua*, the Complex of the Pelvis, and the Triangle of Joints

Pivotal to the discipline of body motion is the role of the *kua*. Working as the center of the *kua* is a point called the *dantian*, which is located at about three-finger width below the navel and a third of the way inside. Taijiquan's ingenious solution to the unwieldy *fangsong* resolution of the matrix of joints is to inculcate a role of centrality in the *dantian*. This is done by applying the *fangsong* resolution at the joints relative to the *dantian* and *kua*, thus developing a Qi-cognition of the fascial tensional connection between the joint and the *dantian* by the Fascia-Qi Hypothesis.

The constant reference to the *dantian* and *kua* means that the *fangsong* is working each time on the muscles of the waist, groin and abdomen with the fascia and aponeuroses to settle in balance and on the cognition of the cultivated Qi "sinking to the *dantian*," ^[14] and on the Qi-cognition of the fascial tensional network. This builds a body-wide web of Qi connectivity of the joints centered at the *dantian*.

The fascial tensional network is thus harnessed as it is being cognitively developed to form the body-wide Qi connectivity, affirming the Fascia-Qi Hypothesis. It is crucial to note that the centrality of the *dantian* is not just a point of reference but is actualized as a control center operating via the triangle of joints in the discipline of internal balance. The maturing of Qi development represents the refined harnessing of the fascial tensional network, empowering one as a conductor, as described by Stecco. This reduces the discipline of Taiji motion to the play of the *kua*.

To the question of what we are doing in Taijiquan practice, we can now add that it is about cultivating Qicognition of the fascial tensional network that forms a body-wide web of Qi connectivity centered at the *dantian*, which provides the basis for the discipline of body motion to be in Yin-Yang Balance (Figure 4).

To recap, Taiji's *fangsong* practice of constantly settling the body into a state of better balance inspires a most comprehensive balance. The continual refinement of the practice produces precision leading to a consummate balance that keeps the base solidly rooted under any situation, a most advantageous asset in a combat interaction. Qi's role in generating strength and force reveals a lot more of physics in Qi, which is reviewed next.



The Taiji posture appears *rou* "soff" but it is not droopy like a wilted plant. It inspires the *gang* "hardness" of the tensile strength of fascial tension in balance, functionally like the tuned strings of a musical instrument. The cultivation of cognition of the fascial tension as Qi develops a body-wide network of Qi-connectivity centered at the *dantian* by the Fascia-Qi Hypothesis. Taijiquan harnesses a well-tuned fascial tensional network to discipline the body to move in accord with the Principle of Yin-Yang Balance. The vibrancy of the Taiji form reflects the aliveness of fascial tension (*peng jin*) which harmonizes with muscle forces internally against gravity and other external forces so that balance is kept intact and the response is spontaneous, of the right force vector in an encounter at all times.

Figure 4. Balance in Taijiquan posture

4. Qi and Force

The body produces two kinds of forces. The first is the contractile force of muscles, which can only do one thing, to produce motion, as in a punching action. The second is the force created when the body's motion is obstructed or resisted. This is the force that inflicts damage and it rides on the quality of the motion. Taijiquan offers that the force that ensues from motion disciplined in accordance with the Principle of Yin-Yang Balance is consummate—of the right force vector in response.

The same punch does not produce the same force. It depends on what is struck. If the fist is directed at a concrete slab at the speed of a trained karate expert, the slab will break. The KO that excites fans, results when it strikes the head squarely. But if it misses, then there would be no force to speak of—it would remain the motion of a punch.

4.1 Sequential Kinetics and Momentum of Body Motion

Force is the phenomenon of a change in motion, or more precisely, a change in momentum (Momentum = Mass x Velocity), which is given by Newton's Second Law of Motion:

Average Force =
$$\frac{\text{Change in Momentum}}{\text{Time duration of the change}}$$

To increase the magnitude of the force potential in an action, the first order is to produce a larger momentum in the motion, with more speed or more mass. The more momentum that can be brought to bear, the greater the force potential.

The body is a structure of many segments linked at the joints, which can move independently. For their momenta to align in motion, the segments must not move out of kinetic sequence. However, in the anxiety to throw a fast punch, the muscles closest to the punching action, namely those of the arm and shoulder, tend to dominate, causing the fist to jump ahead in the action. This would cut the muscle power and momentum of the other parts of the body from contributing, reducing greatly the force potential.

We are not wired to prioritize momentum in physical actions. The command to strike does not necessarily lead to body segments moving in the right order of sequential kinetics. Quite to the contrary, the motor-neural circuits often activate muscles that would undermine sequential kinetics and degrade the output of force potential. The physics is easy to understand, but how do we get the segments to move in harmony that aligns momenta?

To induce the right kinetic sequence, Taijiquan training

inculcates a Qi-cognition of action in three sectional functions: "the extremity section leads, the middle section follows/guides, and the root section drives." For example, in the punching action, the fist as the extremity leads/ points, the root section at the shoulder joint drives, and the elbow in the middle follows/guides. This is the *Principle of Three Sections (Sanjie)*, a part of the afore-mentioned *Ten Essential Principles*. That imposes the discipline of sequential kinetics aligning the momenta of the three sections in an action^[15].

4.2 Body's Rotational Motion

An object's motion is described by the motion of its center of mass (CM) and the rotation about an axis through its CM. The functionality of the object's motion depends on the harmony of the two motions. If a football is thrown not spinning in the long axis, it will tumble along in an erratic path. The motion of the human body is the sum of the motions of its many segments, each with a rotational mode to complement the motion of its CM. The hand turning the palm facing up to palm facing down is a self-rotation which complements the arm's circular motion in tracing an arc.

The rotational mode is fundamental to body motion and is most evident in performance arts. The discipline of harmonizing the rotational modes in body motion is incorporated at the core of Taijiquan training, referred to as "silk-reeling" or *chansi gong*, so called as it evokes silk being twirled and pulled gently without breaking. This develops the silk-reeling energy, called *chansi jin*, the gem of the core strength of *neijin*. *Chansi jin* is key to the performance of body motion whether it be martial arts, sports or work.

The discipline of silk-reeling instills the rotational mode in body motion. Integrated with the discipline of Yin-Yang Balance, following the pragmatic rule of *bu diu bu ding* ("neither lax nor resisting"), the principle of silk-reeling underlies the ideal motion of Taijiquan. *Chansi jin* is discussed more fully in the author's book ^[16].

Ode to Chansi Gong

Hidden in the depths of the I-Ching Mystic energies are said to delve But to seek the dharma of Taijiquan Walk the path of chansi gong

4.3 Obstacle to Aligning Momenta

Here we see the paramount importance of the *kua* borne out again. The *kua* and shoulder define the torso which represents the largest mass, thus the most crucial

component in the body's momentum. The generation of waist power relies on the torso turning as a whole. However, the torso is not habituated to turn as a whole. In daily bipedal functionality like walking, the chest and the abdominal segment rotate in opposite orientations in zeroing out their angular momenta to stabilize the gait. This is a remarkable energy-saving feature of our bipedal locomotion, which is facilitated by the engineering design of the spinal curvatures. The lordosis causes the spine to twist in opposite directions at the thoracic-lumbar vertebrae whenever the pelvic girdle tilts, the effect of the spinal engine ^[17].

The inadvertent effect of the spinal engine is the main obstacle to getting the angular momenta of the chest and abdominal region to stay aligned for the torso to turn as a whole.

The discipline of the trunk rides crucially on the discipline of the midsection to maintain the levelness of the *kua* and keep the lordosis in the sagittal plane, that minimizes the spinal engine action. This involves the abdominal muscles (the external and internal obliques and the transverse abdominis) which wrap around as a corset, attaching to the abdominal aponeurosis on the front and the thoracolumbar fascia at the back. These muscles, unlike those of the biceps and triceps that attach to the bones, are not easy to relate to in discipline. The discipline of the torso must also incorporate the fascial tension harmonizing the muscle tensile forces of the rectus abdominis and the erector spinae, together with the iliopsoas muscles, to keep the trunk erect.

This highlights the crucial role of the thoracolumbar fascia and the abdominal aponeurosis of the fascial tensional network. The muscles of the *kua* and abdomen are attached either directly or indirectly to the thoracolumbar fascia ^[18]. The *fangsong* operation disciplines the chest and the abdominal segment to stay aligned in momentum. This cultivates cognition of the fasciae on the front and back, thus developing a fuller Qi associated with the discipline. The cognition of the *fangsong* relaxation is perceived as Qi filling the pelvic bowl of the abdominal region, centering at the *dantian*. This reinforces the Qi "*sinking to the dantian*," and is perceived as developing *dantian Qi*. The *dantian* Qi is harnessed to discipline the torso to turn as a unit.

4.4 Central Status of the Dantian

The practical import of *dantian* Qi is that the unwieldy task of balancing the myriad joints is reduced to one of cultivating *dantian* Qi, and the mastery of the art is reduced to the establishment of "*the central status of the dantian*" (*yi dantian wei hexin*), as concisely and insightfully articulated by Chen Xiaowang [19].

Cultivating *dantian* Qi instills in the *dantian* the role of asserting control over the trunk's rotational momentum via the triangle of joints, the thoracolumbar fascia, and the aponeuroses. The *fangsong* tempering of the abdominal and *kua* muscles in the discipline of balance develops cognition of the lordosis staying in the sagittal plane as it maintains the levelness of the *kua* movements. The Qi sinking is the disciplining of the midsection, thus the torso, to settle and rest on the *kua*. This translates to Qicognition of the torso mass hanging on the shoulders and resting on the *kua* support as a column.

The ultimate Qi development in Taijiquan is to achieve the fullness of *dantian Qi*, which signifies the establishment of *the central status of the dantian*. This means that the control of the ideal Taiji motion is asserted at the *dantian* center via the body-wide fascia-Qi network, namely, the actualization of the *dantian* as the control center. The fullness of Qi means that Qi is extending to the far reaches of the body's extremities, as described in the *Principle of Four Extremities (Sishao)*, yet another one of Chen Changxin's *Ten Essential Principles*. With the fullness of *dantian* Qi, Chen Xiaowang's standing meditation posture exudes the functional *jin* of balance (*peng jin*) from the core strength of *neijin* (Figure 5).

In the posture, the body perceives the shoulder-*kua* connection of the torso, the anchoring of the feet-base on the ground, and the control at the *dantian-kua* via the fascial tensional network. This represents the enlivening of the thoracolumbar fascia that disciplines the alignment of momentum in the transference of force between the ground and the upper body. And it elaborates on the role of the fascia in the force distribution between the ground and upper body as noted by Gracotvetsky, "The viscoelastic property of its collagen has a direct impact on the way the muscles are used and forces are channeled from the ground to the upper extremities." ^[20].

With the fascial tension guiding the clarity of kinetic sequence, the execution of waist power (*dangyao jin*) can be articulated as the *jin*-force action at the *kua* coiling up the torso to shoulder, through the elbow to the hand, thus the momenta are synchronized. At the same time, the reaction *jin*-force at the *kua* is coiling down through the knees to the feet in the opposite orientation to anchor solidly on the ground in support. All the while in the force transmission, the body's balance is kept intact by the principle of internal balance. Disciplined thus when the motion is accelerated, the power of the action that ensues, called *fajin*, is explosive and graceful at the same time, as can be enjoyed in the video clip of Chen Xiaowang's Fajin^[21].



Zhan Zhuang is a practice of mindful attentiveness to the body settling into the *kua* in balance, centering at the *dantian*. The process develops cognitive perception of Qi filling the pelvic bowl concentrating at the *dantian*. This cultivates the fullness of *dantian* Qi that establishes the central status of the *dantian*. This achievement accords unity to the body frame of the three correspondences of the shoulder and *kua*, the elbows and knees, and the hands and feet, and extends to the far reaches of the body, via the body-wide fascia *tensional* network, centered at the *dantian*. In the depth of tranquility, the posture exudes the core strength of *neijin*, in ever readiness of response in the right force vector.

Figure 5. Grandmaster Chen Xiaowang in Zhan Zhuang Standing Meditation

5. Conclusions

Stripped of the esoteric of Yin and Yang, the discourse has been about strength, balance, and body motion. It is about the theory of the functional relationship:

Strength + Balance = $\frac{\text{Functional Efficacy of}}{\text{Body Motion}}$

Whether it be sports or martial arts, performance lies in the functional expression of body motion in the spontaneous response of the right force vector in competition. The issue in training is how to translate the command of action such as a golf drive to muscle activations that produce the motion of the action that is satisfactory. Taijiquan resorts to the nurturing of Qi that develops cognitive perception to overcome the neural gap between command and action, which is put forth in this paper as the harnessing of the fascial tensional network. This is the cognitive perception of fascia-Qi by the Fascia-Qi Hypothesis, which is an integration of the body senses, grounded on the efficacy of functionality.

Sports training can draw from the age-old methodology of strength training by the art of Taijiquan. Sports can certainly benefit from a training that produces a spontaneous response of the force of *neijin*, of precision and timeliness. Certain sports have adopted fascia training. It is hoped that this paper will lead to an integration of Taiji methods in sports training.

While Taijiquan's methodology is focused on the cultivation of the core strength of *neijin*, it is based on the Qi energetics of the ancient art of *daoyin tuna*, which promotes the Qi harmony of the internal organs, and thus health wellbeing and longevity. Indeed, the *Ten Essential Principles* of Taiji theory refers to the functional harmony of the internal organs in the *Principle of Wuzang* ("Five Internal Organs"). The permeating harmonizing effects of Qi find its basis in the body-wide fascial tensional network, which envelops all the internal organs. Taiji practice thus is maintaining the homeostasis of the body's organ systems, the passport to health ^[22].

Specifically, the practice of Taijiquan helps maintain a stable and healthy gait. What with harmonizing the muscle forces and fascial tension against gravity and of fangsong constantly settling of the body into a better state of balance, it is no wonder that Taiji practice mitigates fall injuries as the body responds, as a matter of course, to settle into balance. And balance in mobility is most vulnerable in old age. ^[23].

Finally, back to Taijiquan, the perceptual insight of Qi cognition is instilled by the practice-process of cultivation that entails analyzing the physics of body kinetics, guided by the soft logic of Yin and Yang under the tutelage of a master. That is to say, the practice of nurturing Qi in Taijiquan is necessarily a self-cultivation of Yin-Yang Balance. Taijiquan effectuates the right physics in the body's response via the mastery of Qi—the art of Taijiquan in science. The upshot is that the force that arises from the ideal Taiji motion—one in accordance with the principle of Yin-Yang balance—is consummate and of the right force vector in spontaneous response. The science in Qi brings clarity to the practice which can inspire the body to reach its full potential in the art of Taijiquan and in sports.

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