

Conceptualized Framework of Spinal and Pelvic Stabilization using Alternative Methodology of Pilates and Yoga

Documented research in Pilates and Yoga is almost exclusively land-based. The challenge is applying the research and the implications for therapy and rehabilitation of low back issues to a water environment. The intrinsic properties of water offer distinct advantages to patients at risk for additional injuries in the land environment. According to Cole and others, the elimination of gravitational forces directly related to the properties of water allows patients to train with decreased, yet variable, axial loads and shear forces. The benefits of aquatic stabilization programs include:

- “Minimization of segmental trunk motion and shear forces

- Reinforcement of lumbar control

- Encouragement of hip, knee, and ankle propulsion

- Development of head and neck stability

- Establishment of arm control and strength” (Cole & Becker, pp. 180, 181)

Based on the premise that Pilates and Yoga have been proven effective interventions for low back pain, moving selected exercises into the warm water pool provides additional advantages of land application. Water is also an enabler for those unable to participate in Pilates or Yoga instruction of land. The core stability developed from these programs is also central for swimmers recovering from the many diagnoses of low back and spinal issues.

Pilates as Therapeutic Stability for Low Back Pain and Aquatic Possibilities

From a clinical perspective, the multiple muscle synergies in Pilates include isometric, concentric, and eccentric muscle contractions and co-contractions. According to Smith & Smith, “Pilates emphasizes lumbo-pelvic stability, segmental mobilization of the spine, mobilization of the shoulder, hip, and other extremity joints, joint stability, precision, muscle stamina, coordination, and balance.” (p. 3) Water immersion requires continuous muscle activation with static positioning. Resultant benefits include reinforcement of lumbar control, postural awareness, increased core strength, and lower extremity strength.

Relating Panjabi’s conceptual framework for spinal stabilization as a system is delineated into specific subsystems that are interdependent: passive, active, and neural. With Pilates-based training, this relates to the coordination of the active and neural systems, minimizing stress on the passive subsystem. Dysfunction in one of the subsystems finds stabilization of the spine is affected secondary to adaptations in one or both of the other subsystems. According to Panjabi, the spine’s neutral zone exists when an area of normal intervertebral motion occurs and there is minimal stress to the passive subsystem and the spine is in equilibrium. He hypothesized that clinical instability occurs when there is an increase in the neutral zone and an inability to maintain normal intervertebral motion with spinal dysfunction. (Panjabi)

Comparing protocol of land and water requires addressing the essential elements that require core stability before beginning unsupported work. Adherence to the concept of bio-motor integration indicates that all movement performed unsupported while on the feet requires an integrated combination of:

- Balance based on proper alignment

- Coordination with postural alignment

- Flexibility resultant of balance and coordination

- Endurance to include full range of motion on a stable pelvis

- Power/Speed with full range of motion in all extremities while maintaining proximal pelvic stability

- Strength for functional specific movements

Progression through the basic elements results in agility leading to conditioning that permits functional movement of the body while maintaining pelvic alignment. Considering the importance of proper alignment, we know that the prime movers supporting the joint cannot function properly if brain senses joint instability and losing balance means loss of functional strength while regaining balance. Core strengthening is purported to reduce injury rates and risk and lead to more efficient, powerful movement. Research demonstrates that neuromuscular control of the torso can impact balance, joint stability, and proprioception training via muscle co-contractions. (Akuthota & Caraffa)

Bergmark defined spinal stabilization from a muscular perspective. He defined the muscles of spinal stabilization as either local or global systems according to anatomical location and function. According to his definition, muscles of the local system include the transversus abdominus, lumbar multifidus, interspinal, intertransverse, internal oblique via thoracolumbar fascia attachments, and lumbar portions of the iliocostalis and longissimus muscles, which contribute to intervertebral stiffness and regulation of intervertebral motion for spinal stabilization. The global muscles are spinal mobilizers and trunk stabilizers that consist of the lateral portion of the quadratus lumborum, thoracic portions of the iliocostalis and longissimus, rectus abdominus, and external and internal oblique muscles. They assist with force transference between the ribs and the pelvis. (Smith & Smith citing Bergmark)

A conceptual model for teaching lumbo-pelvic stabilization with focus on the musculofascial complex spanning from ribs to pelvis was identified by Richardson and Hodges. Muscles of this model are categorized as the inner or outer unit. Muscles of the inner unit include the TrA, pelvic floor, diaphragm, and multifidus and provide lumbar segmental stabilization through their synergistic action as evidenced in the literature. Outer unit muscles contribute to general trunk stabilization and should be trained after the inner unit. (Smith & Smith) Another conceptual model for pelvic girdle stabilization was introduced by Snijders and Vleeming. They identified a pelvic girdle stabilization model of the sacroiliac joint that included components of the osteo-ligamentous and muscle systems to provide stability through form and force closure mechanisms.

Proprioception is a focus of core strength training because it enables the body to transmit a sense of position, analyze the information, and react to stimulation with proper movement. Water therapy with the profoundly weak must address the lack of balance and core stability before beginning an unsupported protocol in the pool. The buoyant body will have equal difficulty walking in water because it will be unable to maintain verticality against the torque/buoyancy of the water.

The goal of Pilates in the water is to begin with a supported core strengthening program of corrective exercises similar to mat Pilates on land. Muscle re-education uses abdominal bracing in a seated position against the wall of the pool. Cole refers to this as the "Wall Sit." (Cole & Becker) The six points of the back against pool wall protects back, enables point of reference for maintaining neutral pelvis, and provides tactile input. The Lumbopelvic region should be in neutral with scapulae retracted and depressed. The rib cage is drawn downward and inward and the sternum stays lifted. This position allows the low back pain patient to maintain the position longer. The efficient organization of the spine allows for corrective exercises with stabilization and articulation for controlled, precise, and geometric segmental movement.

The basic wall sit develops isometric strength primarily in quads and hamstring group. It trains abdominal muscles to hold an appropriate neutral spine posture. Upon mastering the Wall Sit, initial Pilate's exercises along with upper and lower extremity movements can begin. The lead-in to the Hundred with symmetrical arm pumps is oppositional arm pumps. Additional moves for the arms include Ai Chi floating, uplifting, and enclosing; clapping in front; windshield wipers; and alternate straight arm pumps. Beginning moves for legs include alternate toe taps; heel slides; knee extension.



Wall Sit

Single Leg Circles add additional challenge to the wall sit. They train abdominal muscles to hold an appropriate neutral spine. From chair position at side of pool, left leg supports. Extend right leg and make 5 counterclockwise circles, then 5 clockwise circles. Challenges are to the contra lateral gluteals, ipsilateral hip flexor, and Para spinal muscles. To co-activate the deeper Para spinal, obliques, and TrA muscles, use abdominal bracing or hollowing.



Single Leg Circles

Single leg stretches continue as in the wall sit. They train abdominal muscles to hold appropriate neutral spine, and challenge contra lateral gluteals, ipsilateral hip flexor, and Para spinal muscles. To co-activate the deeper Para spinal, obliques, and TrA muscles, use abdominal bracing or hollowing. Ribcage is slightly elevated without restriction on natural, relaxed breathing. Depression of rib cage or protrusion of abdominal wall usually indicates technique has been performed incorrectly and the rectus abdominus rather than the deeper abdominal muscles are predominating in the co-contraction pattern. Lumbar & pelvic stability appear to depend on optimal coordination between diaphragm, pelvic floor, & TrA. If diaphragm does not push down on the viscera on inhalation, the TrA and pelvic floor muscles stay in continuous position of active insufficiency.



Single Leg Stretches

Once these exercises are correctly mastered in the Wall Sit position, progressive resistance is added before moving away from the support of the wall. The following is an example of a progressive program.

Lumbar Stability Progressions

TrA contraction demonstrated on land.

Level 1 – Sitting against pool wall – abdominal bracing, legs hip width apart, knees over ankles, feet and knees pointed straight in front, 6 points of back against pool wall, immersed to neck depth.

Maintaining static position

Arm movements

Ai Chi – contemplation, floating, uplifting, enclosing
Clap hands
Windshield wipers
Alternate arm pumps
Simultaneous arm pumps

Leg movements

Alternate toe touches, heel touches
Alternate heel slides
Alternate hip flexion (limited)
Leg stretches
Leg circles – both directions
Single leg stretches – progressive
Wall slides

Level 2 – Repeat Level 1 adding progressive buoyancy/resistance equipment. Challenge further with different buoyancy on each extremity and different positions in front of body. (Gloves, wands, Styrofoam circles, weights, cords)

Standing and facing wall

Single leg kicks

Squats

Side to wall – Side Kick series

Level 3 – Free standing in cube position, repeat Level 1 as appropriate. Any improper movement requires going back to the wall. Gradually move to a narrowed standing stance.

Add One legged moves – progress adding arms, time, and speed

Water walking – varied directions, arm movements and patterns

Squats

Lunges – using arms and with hands on hips

Level 4 – Repeat Level 3. Add buoyancy equipment (untied noodle) for all exercises. Hold just under water – promotes fast-firing of segmental muscles. Add (when appropriate) diagonal patterns, PNF, and triplanar movements. (Kickboards added for resistive moves, aqua fins, bells, water walkers, knotted noodles)

Yoga as Therapeutic for Low Back Pain and Aquatic Possibilities

When practiced correctly, yoga appears to be effective in treating a wide variety of health conditions. Iyengar yoga is most commonly found in therapy as it strives for precise anatomical alignment and uses various props to assist positioning. The attention to precise anatomical positioning makes it well-suited to back pain, where dysfunctional alignment may be either contributing to or causing the problem. A growing yoga division is yoga therapy. Yoga therapy can be used as a complement to traditional therapy and medicine. It is a holistic approach working the body, mind, and spirit and is distinct from traditional yoga classes commonly available. The addition of these elements and increased body awareness distinguish yoga from general stretching and callisthenic activity.

Yoga links back pain to posture, muscle tightness, and muscle weakness, as well as to a lack of body awareness. Beyond abdominal crunches, and tight hamstrings, many people have tight hip rotators in the pelvis and weak back extensors. The yogic approach is to determine which muscles need strengthening and which ones need stretching. Independent of the effect on individual muscles, asana (poses) movements help back pain by improving the circulation that brings nutrients to the intervertebral disks while removing toxins. The disks that cushion vertebrae and act as gelatinous shock absorbers do not have their own independent blood supply and depend on movement of the surrounding structures to aid in the delivery of nutrients. Movement causes the disks to be compressed, which squeezes out stale disk fluid, and then to expand, bringing a fresh supply. (McCall)

A review of literature on research addressing yoga and low back pain is land-based, but applicable to the water in many ways. A 1983-84 study at the London-based Yoga Biomedical Trust, run by Robin Monro, PhD surveyed 2700 people between 31 and 60 who used yoga therapeutically. They were required to have practiced yoga for at least 2 hours a week for a year or longer. Of the 1142 participants reporting, 98% of back-pain sufferers found yoga helpful. (McCall)

The *Yoga Journal* (May/June 2003) introduced a program launched "Back Builders" by Vijay Vad, MD, a specialist in sports medicine at the Hospital for Special Surgery in NY combining yoga, breath work and Pilates. He theorized that lower back pain is really a mind-body problem, closely related to stress. All participants took the medications Celebrex and Vicodin. After 6 months, Vad found that 80% of those in program experienced markedly decreased pain, compared with 44% on medication only. Only 12% of the yoga practitioners experienced another acute episode of their injury, compared with 56% of those on medications alone. Another significant result showed reduction in pain medication use of those doing yoga declined by 40%. The basic idea behind Back Builders is to build core strength and flexibility and lengthen the spine to create space between the vertebrae, thus minimizing pressure on the disks and allowing them to heal. The program eliminates potentially harmful poses such as sitting postures and forward bends which can compress the vertebrae of the lower spine. Program emphasizes asanas that build support for the spine by strengthening the abdominal and back muscles. Hip-opening poses encourage spinal length as do postures that stretch the hamstrings and calves. This has direct application to practice in the water because of the properties of water assist the specifics he addressed.

In the *Annals of Internal Medicine* (Dec. 2005) Loren Fishman, MD, specialist in back pain with a rehabilitation clinic in NYC and author of [Relief Is in the Stretch: End Back Pain Through Yoga](#) published a randomized, controlled clinical trial with low back pain that showed that yoga not only did yoga work, but it worked so well that it surpassed even traditional physical therapy exercises.

Researcher Karen Sherman at the Group Health Cooperative in Seattle studied 101 adults suffering from chronic low back pain and randomly assigned them into 3 groups. One group attended weekly yoga classes for 12 weeks, following a therapeutic yoga routine developed specifically for lower back pain. Participants were expected to also practice at home every day. A second group attended a once a week program of stretching and strengthening exercises developed by a physical therapist with expected daily home practice. The third group received a self-care book that included some stretches and relaxation exercises. The yoga participants had less pain and were better able to go about their daily activities than people in either of the comparison groups. Follow-up at three months showed the yoga practitioners continued to have less pain and better function and needed fewer pain medications.

Reported in the *International Journal of Yoga Therapy (2003)*, Kimberly Williams at the WVU School of Medicine compared effects of an adapted regimen of Iyengar yoga on patients with chronic low back pain to a group that received a weekly informational newsletter. Forty-two of 66 subjects completed the study. The yoga group attended 16 weekly classes. Compared to control subjects, the yoga group experienced a 64% reduction in pain, a 77 % reduction in "functional disability" and a 25% improvement in perceived control over pain. They also gained significantly in hip flexibility. Those taking pain medication at the beginning of the study found 88% of the yoga group either reduced their dose or eliminated medication entirely as compared to 35% in the control group.

Elise Browning Miller has done extensive work with yoga and scoliosis. Scoliosis is classified as either structural or functional. Structural is more serious than functional and develops as a result of unequal growth of the 2 sides of the vertebral bodies and usually appears during adolescence. Functional scoliosis is more common and affects the muscular back. It does not alter the body structurally and can result from poor posture or repeated unbalanced activity such as carrying heavy objects always on one side. In yoga for scoliosis, the goal is to stretch muscles that have tightened and strengthen muscles that have become weak from asymmetrical imbalance.

Examining yoga poses that are most often included in therapeutic land yoga that transfer to the pool, we find some direct correlations. Supporting the proposal of aquatic yoga we recognize that poses have a calming effect on the nervous system and help to alleviate stress. They can facilitate harmony between the muscular and nervous systems of the body possibly resulting in more fluid movement and relief from muscle tension. The buoyancy of the water enables many to continue an exercise program in a supportive, positive environment resulting in improved coordination and balance, increases flexibility and strength, and an overall feeling of well-being.

General benefits of aquatic yoga include increased flexibility and balance, increased range of motion in the joints, improved muscle tone, and isometrically work most of the body's muscle groups. The range of motion in these poses is adjusted to the ability of the patient on the particular day. Holding the pose not

only challenges balance, but requires moderate strength through correct body alignment and awareness, and cognitive attention to the posture's position to enhance key areas relating to Activities of Daily Living.

Poses moved to the water can begin at the wall for support and moved to chest depth water when lumbar stability is proven. Some can be incorporated into Pilates exercises such as Straight Leg Stretch (Supta Padangusthasana), Cross Over Stretch (Jathara Parivartanasana) and Eye of Needle. On your back on land, or against the pool wall, pull the right knee toward the chest. Keep both shoulders grounded while using the left hand to assist the right bent leg across the body. Right arm is extended to the side.



Cross Over Stretch

Eye of Needle - Sitting in chair position against pool side, left foot stays on the pool bottom. Right ankle crosses to top of left knee. Assist stress by applying pressure on right thigh. Repeat on the opposite side. Caution - not for hip replacements.



Eye of Needle

Examples of progressive postures include chair and tree – two-legged balance to one-legged balance and multiple movement planes.

Tree – Vrkasana – Begin with knee to the front and open to side. Arm position progresses as balance improves. Problems include lack of gluteus contraction, hip juts to side/hip hike and forward or downward looking head position.



Tree

Chair – Utkatasana – From the front standing position - feet hip-width apart and pretending to sit in a chair - squat position. Begin with extending arms forward and progress to extending arms in line with ears. Maintain a flat back.



Chair

Spinal Rotation – Marichyasana – Stand facing the side of the pool. Cross one leg over the other and rotate from the waist to look behind you toward the side with the leg in front. Shoulders stay level. Axial elongation and cervical rotation assists with releasing pressure on spine. Chin up remains up.



Spinal Rotation

Warrior I – Virabhadrasana I Step into wide stance. Turn right foot toward right and left foot slightly in. Right thigh should face same direction as right foot. Exhale and bend right knee checking alignment of right knee over right ankle. Rotate body to right and bring arms overhead with palms facing or together. Inhale and straighten right leg. Repeat to other side. This is very similar to a lunge. Begin with hands on hips on edge of pool for alignment and balance.

This can be done facing the edge of the pool or with the back towards the pool wall so that the outside edge of back foot can be against pool wall to further proper weight bearing on both legs and to assist stability. Problems include hips not square, rib cage not lifted, and the back is hyper extended.



Warrior I

Warrior II – Virabhadrasana II – Step into a wide stance with right toes turned to side. Bend the right knee, left leg is straight. Torso remains looking forward and upright. Arms extend at shoulder height with shoulders down and relaxed. Look to the right. Body stays erect. Equal weight bearing on both legs is essential. Outside of back foot can push against pool wall to assist. Knee positioning is a key element. For alignment of hips and upper body, face wall and bring hands on the wall. Draw knee away from wall over outer heel as you descend tailbone down toward pool bottom. Keep hips parallel and upper body centered over legs using pool wall for alignment. Problems – torso square/geometric, shoulders are not even, weight shifted toward forward leg – think plumb line – arms and chest not open – pull bow string back.



Warrior II

Half Moon – Ardha Chandrasasana – You can lift into half moon from either Warrior II or Extended Triangle. It is best to learn this pose against the wall, both on land and in the water. Opening back into the wall releases the back and assists with lower back pain.



Half Moon

Straight Leg Stretch to Side – Parivartanasana – The arms pull forward with the exhale. The front leg straightens as you reach forward maintaining a flat back to feel the stretch through the legs. Problems – hips don't shift back, back curves and does not lengthen



Straight Leg Stretch to Side

Timothy McCall, MD listed steps for approaching yoga as therapy in the *Yoga Journal*, Nov/Dec, 2004.

1. Rule out serious causes;
2. Treat initial injury with caution – when tissues are acutely inflamed or when feeling a lot of pain, important to proceed slowly. Try breathing exercises and a gentle asana practice as soon as the first day of pain.
3. Balance Strengthening with Stretching – too many abdominal crunches and other abdominal exercises can increase tightness in the hip flexors (psoas) potentially exacerbating back problems. The yogic approach is to determine which muscles need strengthening and which ones need stretching and to design a program to address those specific needs.
4. Make Yoga your Ally, not your Enemy – Avoid poses that could make problem worse – lumbar disk be careful with forward bends, esp. those including a twist.
5. During transitions, avoid sudden changes of position.

Progression to Deep Water Exercises and Swimming

Any type of deep water exercise is progression from shallow water. Upon demonstration of lumbar stability, the usual first progression is to demonstrate stability supported by a noodle under each arm. Progression can be support with one noodle encircling the back to a floatation belt of proper buoyancy for the

patient. Adding a floatation belt to someone with low back issues changes the alignment of the lumbar area in deep water.

This is an example of a deep water progression:

Level 5 – Deep water with 2 noodles for flotation – one under each arm. Watch for any shoulder impingement.

Vertical hang without feet touching, evaluate for alignment and stability

Alternate marching – knee and hip flexion

Double leg flexion (chair)

Walking – first

Bicycling – second

Cross-country ski – finally

Consider Bad Ragaz

Level 6 – Repeat Level 5 using flotation belt.

Level 7 – Introduce UE strength exercises on Aquatrend Water Workout Station.

Level 8 – Burdenko Water Walkers with flotation belt (progress from slow pace to changing tempos – slow and medium, finally slow – medium – fast (15 sec – 1 minute)

Vertical hang

Alternate marching

Double knee flexion (chair)

Walking with breast stroke arms

Walking with alternate arm swing

Bicycling with breast stroke arms

Bicycling with alternate arm swing

Running with arm swing

Cross country ski with arm swing – easy legs to long levers

Walking with alternate arm sweeps

Vertical hang to knee/hip flexion with quarter turn and return to vertical.

Progress to half turns.

Diamond legs maintain lumbar alignment and stability.

Diamond legs and kick alternate boxing kicks

Level 9 – Suspended Pilates with a noodle (start shallow and progress to deep)

Hundred

Single leg stretch

Double leg stretch

Single leg circles

Bicycling

Scissors

Teaser

Level 10 – Return to standing depth, progressive balance activities using yoga, adding uneven surfaces, cords. Begin conditioning exercises.

Swimming for Therapy

Swimming for those preferring to swim begins after progression to stabilization is demonstrated. Initially, gentle kicking in supine with proper amount of floatation is recommended. If there is discomfort or pain, this is not appropriate. Next sculling is added and the arm stroke of the Elementary Breast Stroke as these are symmetrical activities.

Readiness to begin water work in the prone position is demonstrated by performing the quadruped with mask and snorkel. (Cole & Becker) When initially beginning to swim or kick on the front, it is essential to use a snorkel to prevent hyper extension of the back. Exercises now include static and progressive dynamic swimming drills reinforcing alignment in horizontal position. When the patient begins swimming on the front, it should be with a snorkel to maintain proper alignment. As stroking progresses, body roll along the axial elongation of the body is practiced. The best example of this is from Total Immersion swimming.

An interesting side note is that scoliosis is usually evident in the entry of the hands and the power phase of stroking with one hand/arm entering in front of the shoulder and one crossing the center line. This is sometimes the first indication of recognition of scoliosis in a person.

Swimmers, especially competitive swimmers, are known to be aggressive in returning to swim workouts. Regardless of preferred strokes, a low back pain patient should begin with swimming on the back before progressing to the front. Back stroke and freestyle are the preferred strokes. Breast stroke arms with a modified kick are gradually introduced, but full stroke is not recommended until pain free with performance and after exiting the pool. The Butterfly should be avoided until rehabilitation is complete and a complete core strengthening program is achieved as it puts added stress on the low back.

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