From Endurance to Strength to Power by Way of the Water

By
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There has never been an athlete (male or female) I've known, coached, or competed against that didn't want to become as strong as possible. The serious competitors all wanted the have the hallmark defined muscle ("cuts") of a solid athletic build. My venue, starting in the late 1950's, was the pool where "doing weights" was considered a mistake. It was thought that more developed muscle would inhibit flexibility and get in the way of fast swims; the road to aquatic athletic success, as we were constantly reminded by our coaches, was intensely moving our skinny bodies back and forth doing various swim and kick sets. Then in the early '60's strength training was seen by some visionaries more as an aid than an enemy. A few rising stars began to move free weight and pull on resistance cables to increase their strength and add some muscle endurance so they could move more water longer. This was a simple and logical advancement in swim training. This information soon spread to other sports that traditionally didn't incorporate resistance with their sport-specific training.

Throughout this article, I will use this symbol (*) to emphasize take-home points.

Though most aquatic athletes and their coaches didn't realize the absolute differences between endurance, strength, and power and the importance of correct physical preparation and progression to obtain these, they were content to simply add either a few bouts of resistance exercise a week to their in-pool training or an abbreviated session of "dry-land" work on deck each time just before entering the water thinking they were getting one-up on their competition that stayed only in the pool. They were right.

*The three elements in this article's title succinctly outline the appropriate progression we want the athlete to take: first be able to forcefully move a constant resistance again and again over an extended period of time without getting injured (endurance), then be able to safely move an increased amount of resistance (strength), and finally to be able to move that increased resistance quickly; power = strength over time… strength
time
Emphasis here is placed on leg work since most swim training sessions only afford a minor portion to this. There are advantages to water-stressing the

legs that will prove invaluable in close swim races, for the biking and running segments in a triathlon, and as productive cross-training for any athletic adventure that requires leg movement. The importance is such that I recommend cutting swim yardage or other training elements, if need be, to allocate precious time of a tight schedule to perform these leg-specific water-based exercises.

There is also a physiological phenomenon of aquatic training that must be mentioned…sort of a one-way street to increased condition. Training seriously in the water usually produces tremendous benefits for those performing exercises and sports anywhere. Yet land-based exercises only help to a minor degree in water since they can not nearly measure up to in-pool resistance training for those needing increased endurance, strength, and power in aquatic sports. *The message is clear here: if you want to max out your physical potential ANYWHERE, you should work the water.

USING THE WATER TO FIRST BUILD ENDURANCE

The normal physiology of muscle activity (as designed by Mother Nature millions of years ago) allows for some muscle fibers to contract while others relax. We also have been endowed with fast-twitch and slow-twitch muscle fibers in varying percentages. The latter produce less force than the former but have more natural endurance since they have a strong blood supply carrying nutrients and oxygen. The fast-twitch fibers contract more forcefully than the slow-twitch, for the most part, but have no blood supply and can only fire for a relatively short period of time before fatiguing from physiologic acidic build-up and adenosine tri-phosphate (ATP) depletion. This evolutionary fact crudely made use of natural basic endurance by giving our ancestors somewhat of a chance to survive an extended dash to the protective trees in nearby forests to escape being food for larger occupiers of the planet with bad intensions toward us. Unfortunately, this UNTRAINED natural endurance is not enough to carry us through today's sport-specific requirements for an extended period of time. *And it is established physiologic fact that increasing endurance helps to protect against overuse injury by adapting the connective tissue around the joints and muscles to handle the increased loads of physical exercise we plan to endure. *The wise thing to do first…adapt the body by increasing endurance.

*If we bring in aquatic exercise or sports, anything that happens in water requires more than FOUR TIMES THE EFFORT than it does to move on land, yet it spares serious wear-and-tear on the body because of the gravity-free environment water provides. Example: at the world record level it takes longer to sprint-swim 50 meters freestyle (21.64) than it does to sprint-run a 200 meter dash (19.72). *For those needing their legs or to increase their general aerobic and anaerobic condition to tackle land-based exercise or sports, working the legs and various other muscle groups in water is the absolute smart thing to do.

To begin with, the gravitational pounding against an unforgiving medium (roadbed, ground, dirt, etc) for hours (and miles) on end will take its toll eventually on almost everyone by breaking down the support structures with acute and/or chronic inflammation especially at the articular (joint) areas. This is not a matter of "if", but of "when." The athlete, of course, must put time on the ground or on the bike if he participates in running and biking; the body still has to be trained to withstand what we expect to put it through. But a wise use of cross-training will spare body parts and enable the athlete to participate that much stronger longer. But I don't recommend running for my swimmers for just such reason as to prevent needless wear-and-tear on body parts more used to a gravity-free environment. I suggest using the mechanical advantage of a bike, in-doors or out, where the negative stresses are shifted away from joint-pounding.

Most training in the pool to build total body endurance requires swimming laps, no getting around that. It is the perfect activity to increase total body condition and to build on the components of becoming powerful. The benefits of the water have even been incorporated into several professional boxers' routines. And swimming with the correct style of fins allows for these benefits to happen even more quickly and to a higher degree for two reason: (1) *Since the muscle groups of the legs are the single largest to be utilized at any given moment, putting them through various modes of resistive movement in the water forces the cardiovascular and respiratory systems to reach higher levels of capacity to meet metabolic demand…the heart and lungs don't know you have fins on, only how hard and fast you are moving through water, and (2) unlike air which doesn't change, *moving through water releases the phenomenon that as you travel faster through it, water's resistance increases, holding you back more. Due mainly to the physical property of water being 1000 times denser than air, doubling your speed through the former causes it to resist your mobility by SQUARED (2

x 2 = 4) the effort; and this occurs only if you streamline and move through it correctly. Fight the water to any degree or add more intentional resistance, and it holds you back CUBED of the effort (2 x 2 x 2 = 8) which means doubling the effort brings on EIGHT TIMES THE RESISTANCE! Anyone not comfortable and experienced in the water can attest to the fact that flailing through it for more than 10 seconds can bring on a great degree of discomfort both respiratory and muscular, usually in that order.

*Since forcing the body's conditioning enzymes to produce more mitochondria (energy cells) in the vital tissues associated with vigorous exercise is the key to building any increase in the training effect, extending repeated efforts over distances to 300 yards or meters or holding the efforts for four to five minutes elicits the desired adaptive response. This may prove quite daunting to the uninitiated and would drive away most attempting such training. The perceived feeling of being completely out of air in water can humble even the most determined. What works initially is to break the distance or time interval down into segments that allow short recovery periods. During this brief inserted rest, it is more the need to blow off (exhale forcefully) accumulated CO2 rather than the perceived need to inhale more air that allows for the greater recovery. The effort becomes challenging but doable and can be expanded and made more challenging as condition increases.

Below is a listing of ways to increase resistance in the water to help build cardio-vascular, respiratory, and leg endurance and then to maintain it throughout the training season.

(1.) using fins and alternating freestyle and butterfly kicks with a kick board in a straight forward (neutral) position for 100 yards/meters; rest 10 seconds, a 2nd 100 with another 10 seconds rest; finally the 3rd 100; no matter how the legs burn each 100 must be traversed uninterrupted and with the same steady cadence held from the beginning. Eventually the goal is to kick 300 yards/meters straight holding the pace. As condition improves, speed is increased throughout the distance, and two more repeats are added after 30 seconds recovery.
(2.) in deep water, holding the hands continuously above the water line, kicking both freestyle and butterfly at first with NO fins; kicking bout is held for 15- second intervals at first, resting 15 seconds after each, progressing to three by 30 seconds, then 45, then 60; once at this level, USING FINS should bring the athlete to two minutes of straight kicking

with several repeats after 30-second recoveries.

(3.) "water-walking:" performed both with fins and without; this is not typical kicking as would be practiced with swim strokes; this entails quick, smooth alternating repetitive movements of the legs raising the knees up as high as possible toward the chest and then kicking back away from the body with the bottom of the feet pressing against the water; performed on the stomach and on the back with hands folded in a praying position; this works not only all the muscles of the legs but also serves to stretch and develop the hip-flexors. It is the most inefficient way to move through water but the one that brings out the training effect of leg endurance the most. One length of "water-walking" is equivalent in metabolic demand to three to four lengths of traditional swimming or kicking. One-length repeats of 25 yards or meters are worked with 15-30 seconds rest per length; the use of fins requires doubling the distance.

(4.) lastly, the athletes are tied to fastened sturdy latex tubing and are asked to kick with fins against its force starting for 15 seconds; the goal is to continue the kick and hold a set distance from the starting wall while stringing the 15-second segments together to continuously move against the pull-back of the tubing for up to two minutes. A further benefit is derived here: preventing the "cocoon effect."

Normally when the brain perceives movement it expects movement, either forward, backward, or side-to-side; but when the tubing is fully extended there is no longer forward movement, so the brain starts to "short-circuit," and the athlete may panic and feel that he is being swallowed or smothered by the water. If handled properly, this builds mental toughness and the aerobic condition to withstand this most demanding of stresses.

PROGRESSING FROM ENDURANCE TO STRENGTH

To train for increasing strength, every workout procedure listed above needs to be handled in a more demanding fashion. We are less concerned with how long we can hold an exercise than how much resistance we can overcome during a designated length of time.

(1.) to further increase resistance, the board is place in front of the swimmer half submerged with the rounded end up resembling a "tombstone." This DOUBLES frontal resistance. Then we increase resistance by FOUR TIMES original by placing the kickboard half

submerged sideways so it resembles a “snowplow.” A typical exercise bout calls for using one type of kick, alternating the kickboard positions, one length of each: neutral, “tombstone,” and “snowplow.” The speed of the kick is held constant while the resistance is increased. This is repeated four times with a 30-second rest in between bouts. Another exercise demands that all three lengths of the pool are traversed using the “tombstone” configuration, 30-second rest, then three lengths using “snowplow;” three lengths holding the board in neutral position, finally one length each way with the board. Constant speed is something that must be maintained or attempted.

(2.) deep-water kicking is now performed holding a medicine ball with both hands out of the water; recommended starting weight is six pounds for a duration of 20 seconds; this is attempted four times with a 20-second rest in between. As strength increases and condition rises, slightly heavier medicine balls are used toping off at10 pounds while holding the kicking bout for up to 60 seconds. Fins are to be used for free and fly kick but those wanting to train breaststroke kick must do it sans fins.

Upper body strengthening is a welcomed “side-effect” of supporting the ball above the water line.

(3.) “water-walking” with a medicine ball overhead should be done with fins except those wanting to work the breaststroke kick; the already taxing demands of this exercise are magnified by four holding the ball above water. Water-walking forward on the belly holding the ball up is called “presentation” and is the absolute hardest exercise to do; more than twice the difficulty of “walking” on the back.

Stress is placed on the arms, shoulders, trunk and legs and is magnified as the athlete moves down the lane.

(4.) kicking against the pull of latex tubing with an increasing intensity up to a pre-determined point in the pool over a designated length of time, then stopping and allowing the tubing to pull back the swimmer to the starting point; repeating this bout after 30 seconds rest for a total of five.

GOING FROM STRENGTH TO POWER

Now we are least concerned about holding an exercise for time; rather, we want to move whatever resistance is in our way as quickly and POWERFULLY as possible. Short bursts of intense energy are required, and the fast-twitch muscle fibers are tapped in repeated bouts, each after adequate recovery. Per unit time, this type of training is the most demanding and is correctly reserved for the last position in the progression. * You can not be powerful unless you have endurance and strength in place. Go for

power too soon in the training scheme, and injury is more than likely to occur. THERE IS NO SHORT-CUT TO POWER.

(1.) three ways to bring power into the legs: (a.) one-length kicking starting off slowly from the wall and building every three seconds into all-out effort to the finish; (b.) start off slowly from the wall until mid-pool then suddenly all-out kicking till the end; (c.) starting off as fast as possible from the wall then shutting it down midway through the length. Each of these bouts has the kick board at first in neutral position for four lengths, then "tombstone" for four lengths, finally "snowplow" for four lengths; 15 seconds rest for neutral, 20 seconds for "tombstone," and 30 seconds rest for "snowplow."
(2.) deep-water kicking with the medicine ball has now progressed to snapping to one-quarter turns in one direction holding the ball overhead every 15 seconds for a 1-minute total; then execute the same in the opposite direction after a 30-second rest. Then someone on deck in front of the person in deep water throws the medicine ball downward quickly to the kicker who must snap it back. Three bouts of 10 are endured with a 60-second rest in between. Not only are the legs and cardio-vascular systems taxed but also the upper body.
(3.) what we do with water-walking for power is to carry the medicine ball, no fins, and kick as if our lives depending upon it for half a length or 30 seconds whichever comes sooner then the ball is placed down or passed to another athlete who kicks hard with the extra weight for half a length; an easy kicking recovery follows quickly to prepare for the next five bouts.
(4.) being tethered to the latex tubing, the athlete pushes off the wall and initiates intense kicking immediately for a 15-second bout, no longer. This is repeated for a total of 10 bouts; the rest period between bouts is 60 seconds which includes the pulling back to the wall of the extended tubing. All kicks other than breaststroke are done with fins.

Our goal is power. It is a prolonged and challenging process to attain it. If things go well, the athlete will perform up to his potential. But we know how hard he has worked to make it all look so easy.