Building a Strong Foundation® ~

Neuromuscular Training for the Endurance Athlete

by Carmen Bott, MSc. CSCS and Tara Keller, RK, MES

Introduction

Strength training for the endurance athlete should focus on addressing the neuromuscular (NM) system. This system refers to the communication highway between the brain or spinal cord and the muscles responsible for producing and controlling movement. Addressing the neuromuscular system through strength training elicits a different adaptation from traditional hypertrophy training, where athletes may lift weights to gain mass and maximum strength. Adaptation does not lead to an increase muscle fiber size, which would be detrimental to an endurance athlete's performance, when power to weight ratio is a key performance variable. Instead, it is about facilitating movement patterns that will have the most functional relevance for the athlete, thus improving performance and decreasing potential for injury.

When we imagine how our muscles fire, they do so in a crescendo-type fashion, where one muscle group is turned on and all of the fibers within the muscle contract, signalling more muscle groups further along the body's chain to contract as well. It is essentially a domino effect where one contraction leads to an other. If this chain of events is smooth and stabilizing muscles along the way restrict excessive joint movement, the athlete may move with efficiency and fluidity. High levels of neuromuscular control are absolutely necessary for dynamic joint stability. When an

athlete is suffering from a neuromuscular imbalance, essentially he/she has a muscle activation pattern that leads to an increase in joint load. Increasing joint load can lead to all kinds of overuse injuries such as patellar tendonitis, tibial stress syndrome and hip bursitis. Neuromuscular imbalances will limit the effectiveness of the active muscular control system in working synergistically with the passive joint restraints (ligaments and tendons) to create dynamic joint stability.

Neuromuscular imbalances can present themselves in three forms:

1. Ligament dominance – when the ligaments absorb a significant portion of the ground reaction forces (impact) versus the lower extremity musculature
2. Muscle group dominance – an imbalance between opposing muscle groups, i.e..: quads and hamstrings, where strength and/or firing speeds are very different
3. Unilateral limb dominance – a side to side imbalance in muscular strength, flexibility and coordination. Over-reliance on the dominant limb can place greater stress on that limb or place greater stress on the weaker limb.

Identifying or perhaps more importantly, anticipating neuromuscular imbalances may offer the greatest potential for intervention in the endurance athlete. This means a program must be designed specifically with the goal to train the neuromuscular system. A specific strength training regime, in the long term, will reduce loads placed on

the joints, or improve stability around a joint so it can move with more precision and strength throughout its available range of motion.

Identifying Neuromuscular Imbalances

The first step in advancing performance in an endurance athlete, given that dysfunctional movement patterns can inherently decrease efficiency and result in energy leaks, is to identify NM imbalances. Imagine trying to ride a bike with wheels out of alignment: Unnecessary energy would be expended trying to balance the bike with each wheel rotation and the tires would wear down more quickly. Similarly, when our body is compensating for muscular imbalances, much of our energy is wasted trying to overcome off-set joint motion and dispersing of energy through rotational forces rather than efficiently driving momentum forward. These inefficiencies not only decrease the athlete's performance, but the excessive shearing and compressive forces experienced at the joints can create adaptive changes to muscle, articular surfaces, joint capsules and connective tissue that result in debilitating injury.

In endurance athletes, one common NM imbalance is seen in the response of gluteus medius and other muscles that attach to the ilium. Gluteus medius function is crucial for approximating the hip joint by locking the femur into the acetabulum, stabilizing the pelvis on the load-bearing femur during closed kinetic chain motion and contributing to anterior stability of the hip during hip extension. Poor elicitation or weakness of this muscle can initiate a myriad of compensatory strategies, though it is often identified only during single-leg stance as the opposing hip response shows inferior/lateral rotation of

the pelvis, or dropped-hip (otherwise known as a positive Trendelenburg sign). However, in effort to compensate for this weakness, the body will find its own means of countering the aberrant joint motion. As the gluteus medius is meant to assist the tensor fascia latae (TFL) in stabilizing the pelvis on the hip, most bodies will respond with greater tensile activation of the TFL which, through its insertion on the iliotibial band, can increase both medial and lateral stress at the knee joint. Gluteus medius effectively has three muscle attachments from the posterior, middle and anterior portions of the iliac crest. Weakness, therefore, also creates a postero-to-anterolateral instability and effects rotation of the pelvis on the femur. When the pelvis does not rotate effectively, the femur itself will often attempt to gain stability by eliciting help from the piriformis, adductor muscles and medial hamstrings. The quadratus lumborum and internal obliques may also work excessively to stabilize the pelvis from above. Furthermore, shearing forces are increased at the sacroiliac (SI) joint through this excess rotational stress. Are you wondering why so many runners and cyclists experience knee, hip, back and SI joint pain? Beevor's Axiom, the principle idea that the brain knows nothing of individual muscle action, but only movements, is always at play and crucial in understanding joint adaptation and subsequent muscle response to stress.

BSF® Strength Training Methodology

Once the NM imbalances have been identified, athletes must learn to avoid their compensatory patterns so that they drive power from a base of stable joint motion that elicits the correct response in the agonist and antagonist muscles. It must be

remembered that aberrant movement patterns are a trained response; that is to say that your body has found the movement on its own volition. Retraining begins with conscious awareness and movements must be rehearsed and practiced to replace the trained aberrant pattern with the newly trained corrective and stable movement pattern. The athlete must first learn how to elicit motor control around the joint. This often requires active release of tissues that are inhibiting the desired movement, such as tightness of the piriformis, adductors and iliotibial band, prior to eliciting the motor response of the weak muscle, in this case, the gluteus medius. Based on Beever's Axiom, we know that isolated strengthening of the gluteus medius will not be an effective means to establishing joint stability or a corrective NM response when the body is in motion. Once the athlete is able to initiate the desired motor response about the joint, such as stabilized hip abduction, the NM system must be challenged further to support appropriate CNS response during changes of velocity, direction and load or force surrounding the joint(s) in question. The goal of retraining is to appropriately facilitate movement patterns that will have more functional relevance for the athlete, thus improving performance and decreasing potential for injury.

One method of targeting the NM system is through proprioceptive training techniques. Proprioception is the awareness of joint movements and positions. Proprioceptors are nerve/muscle/sensory receptors that respond to joint movement and joint position. The proprioceptive system responds to receptors in the joints, joint capsules, ligaments, muscles and skin to detect spatial awareness. When an athlete is injured and there is instability or inflammation surrounding the joint, proprioception is impaired. Selective

incorporation and integration of proprioception training techniques can be used to address the specific neuromuscular imbalances in endurance athletes.

When prescribing this type of a training plan, an athlete should be exposed to movement patterns that encourage dynamic joint control of both the core (trunk) and the extremities (knees, hips and ankles). In essence, we are developing protective spinal reflexes and multi-joint neuromuscular engrams which are muscle memory cards. These memory cards help to more effectively manage the ground reaction forces during running. Proprioceptive training also teaches athletes to develop something called a feed-forward mechanism which is essentially an anticipatory response where stabilizing muscles pre-set themselves to increase stability of a joint on contact. This mechanism helps to decrease joint motion and protect the ligaments from high stress loading. For example, muscles surrounding the ankle joint can be trained to stabilize prior to the foot making contact with the ground to ensure the joint is more stable and the ligaments are not taking all the abuse.

The secret to an improved and highly functioning neuromuscular system comes with good coaching and perfect practice. Clinicians, trainers and strength and conditioning coaches must prescribe exercises with specific goals in mind and should encourage athletes to maintain perfect technique for as long as possible. An athlete should be instructed to stop an exercise if form is suffering as bad habits will lead to incorrect muscle memory cards. This type of training is contrary to the miles the athlete swims, bikes and/or runs each week; **it is not about volume, but rather about quality**

and perfect practice. This is critical in achieving successful outcomes from the training program.

In sum, the curriculum of BSF® focuses on improving the athlete's resistance to injury by maximizing joint stability and improving core strength, which relates directly to more efficient movement strategies. How do we do this? Each week we progress our clients through more challenging drills and exercises that compliment the volume of endurance exercise they pursue in their training program. For further information on the BSF Instructor Manual and Certification, contact info@humanmotion.ca, or visit www.humanmotion.com.

Author Bios:

Carmen Bott is the president of Human Motion Inc., an athlete performance and fitness education firm. Carmen holds a Master's of Science, focusing on human performance and muscle physiology. She lectures internationally in the field of sports science and teaches part-time at the university level.

Contact info:
Email: carmen@humanmotion.ca
Phone: 604.908.1321
Website: www.humanmotion.com

Tara Keller is the founder of Essential Kinetics, a company that provides specialized exercise programming for individuals with aberrant motor patterns and special health considerations. She is a Registered Kinesiologist and Medical Exercise Specialist and lectures nationally on functional movement assessment and corrective exercise programming.

Contact info:
Email: tara@essentialkinetics.com
Phone: 778-838-8272
Website: www.essentialkinetics.com