

Activation of Spring-Like Muscle in the Body for Healthy Walking and Running

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Abstract

In the field of sports, excellent performance needs elasticity of the muscle. This has been called as the spring-like muscle of the body, which was formerly believed to be from innate gifted sense. Recently, however, adequate exercise can bring such ability by the training of stretch shortening cycle (SSC). Human body has three important spring-like muscles. They are Triceps surae to the Achilles tendon, Gluteus maximus to hamstrings and Iliopsoas. For actual performance, flexibility and stiffness of the muscle would be required. As the practice of relaxing and contracting the muscle, the spring-like muscle stretching method will be useful.

Keywords: Spring-Like Muscle; Stretch Shortening Cycle (SSC); Triceps Surae; Gluteus Maximus Iliopsoas; Flexibility and Stiffness

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Commentary

In recent years, there has been increasing interest in disease prevention and health promotion/ maintenance for all ages worldwide [1]. An increasing number of people pay attention to exercise and diet, running, jogging, and using the fitness gym [2]. However, if the mechanism of walking/running is not be fully understood, some health problems may occur [3]. From the perspective of physiotherapist and sports trainer, the mechanism for spring-like muscle will be explained in this article.

In the field of sports, "spring-like muscle" has been excellent for excellent performance. It was formerly believed to be an innate ability for an athlete [4]. In recent years, however, it has been elucidated that the spring-like muscle can be obtained for any athlete. For the dynamic interaction of the body for the running, classical spring and mass computational model can explain the mechanical power [4]. As a matter of fact, most people do not understand the existence and proper use of springs present in the body. Athletes who can take advantage of this spring mechanism can easily improve their performance [5]. Furthermore, even if the person becomes rather older, one can maintain healthy life, beautiful walk and run by activating this spring method.

What does the spring-like muscle mean? It is essentially the relationship and mutual actual function of muscles, tendons and bones. When you make small continuous jumps like a skipping rope, the calf muscles contract tightly and the Achilles tendon is stretched strongly and quickly [6]. A strong and quickly stretched

tendon stores rubber-stretched energy, which then momentarily shortens to produce great power. This exercise is technically called the "stretch shortening cycle (SSC)" [7]. It plays an important role in running fast and jumping high [8]. For example, the patellar tendon reflex can confirm the presence of SSC and nerve connections.

There are three important springs that we need to recognize and train. They are i) Triceps surae to the Achilles tendon [5], ii) Gluteus maximus to hamstrings [9] and iii) Iliopsoas [10]. These three are the basic spring-like muscles activated for running (Figure 1a). The gluteus maximus pushes the ground and creates forward propulsion, the iliopsoas pulls the foot upwards and swings forward, and the triceps surae fixes the ankle [11]. Thus, the energy produced by the gluteus maximus and iliopsoas communicate efficiently. The mechanism by which the body moves is to apply power to the ground and use the force returned from the ground to move forward. The stronger the power applied to the ground, the stronger the force returned to the body and the faster the speed (Figure 1b). Furthermore, if the spring force can be used to transmit power to the whole body without waste and generate force, it will be possible for the athlete to walk and run even faster [11].

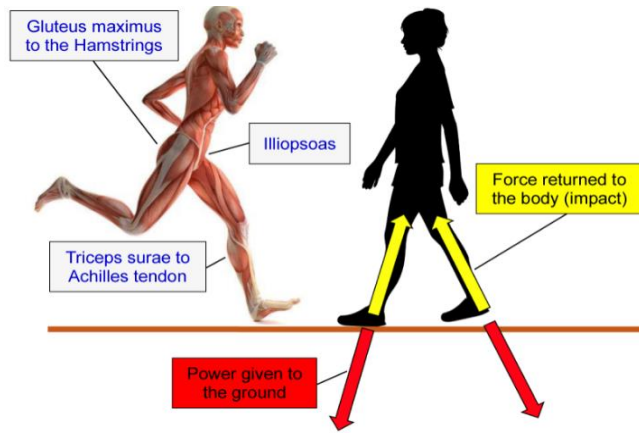


Figure 1: Three basic muscles for running and reaction force 1a: Three basic springs and muscles activated for running. 1b: Power to the ground and reaction force from the ground.

In order to achieve high performance, it is important to balance the flexibility of the muscle and the fixing force mechanism [12]. Flexibility means the degree of relax and contraction of the muscle, and the spring-like function is required to relax and contract firmly for generating large force [13]. The fixing force means the mechanism to solidify the muscle, and the reversed force generated from the ground is efficiently transmitted converting into successive propulsive force. An example can be explained for a spring made of metal substrate. If the spring is too soft, it cannot store the energy. If is too hard, it may be broken after working too many times. SSC and stiffness of lower limb are crucial for elastic energy storage and release [12]. As to our adequate daily life continuing walking and running for long, both of the flexibility and stiffness mechanism will be indispensable.

The training method for the spring-like muscle is shown. The important point is the practice of relaxing and contracting the muscle. For those who have not been exercising recently, gradually increase the exercise level from twice a week. Actually, “the spring stretching method” would be recommended using “standing on one leg” [14]. This method improves the mobility of the scapula and hip joints and the flexibility of the surrounding muscles, which are necessary for smooth walking [15]. If a person practices this with correct way, one can train three springs. Since the loading amount is low and the risk of injury is low, clinical effects will be expected for one month.

The first author actually continued this spring stretch and training for a month [14] (Figure 2). Before and after the exercise, the dash time of 50m running was compared. As a result, the spring-like muscles revealed clinical efficacy. The running form has changed associated with more lifting of the knees and legs upward and forward. The time has improved from 7.15 sec to 6.51 sec, showing drastically running faster. Furthermore, certain confidence was emerged as “I can do it” from social and psychological points of view [16]. This report will be hopefully actually useful for athletes, medical staffs and related people.



Figure 2: Spring stretch method for three target muscles.

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