

Recent Fundamental Perspective of Effective and Safer Movement for Running

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Abstract

Athletes often have injury from running methods. They are generally divided into two ways, which are kicking at the toes and pushing method with flat grounding. The latter seems to be safer with less injury. There are several important points for the background. They include forward leaning, instant weight removal operation, reaction power from the ground. Recently, unloaded squat exercise is effective for running training. Human seems to have three spheres, including head, chest, and pelvis. They show mutual connective relationship, where relaxed situation would be recommended for some rotation in three spheres and maintained intra-abdominal pressure (IAP).

Keywords: Forward leaning; Weight removal operation; Reaction force; Unloaded squat exercise; Intra-abdominal pressure (IAP)

Introduction

A variety of athlete is often injured and has to rehabilitate [1]. There are different causes, associated with three groups for running, jumping, and throwing [2]. Among them, the basic movements include the practice of running. The running method can be roughly divided into two categories. One is a conventional method of kicking the ground with the toes, where the quadriceps femoris, hamstrings, and triceps surae muscles are deeply contracted with great force at the moment [3]. Therefore, injuries are likely to occur [4]. The other is a flat grounding method of pushing the ground with plantar area [5]. By relaxing three joints contraction including ankle, knee and hip joints, the entire weight can be loaded to the ground at the moment. Then, a large reaction force returns from the ground to the body, leading to push the body forward. The muscles do not contract so much in the moment and then it gives rare injury or impaired physiological function.

The authors and collaborators have provided several guidance's to various subjects for years [6]. Those included clinical treatments, rehabilitation treatment, sports workshops, and so on [5]. Targets include general public people, sports athletes from elementary school to college, professional baseball and football players, and Masters Athletics with all range of ages 18-88 years. The contents include stretching [7], pole exercise [8], biaxial running and flat landing [9] and so on. The difference between kick running and push running methods were investigated, which are almost same as forefoot and rearfoot running [10]. Comparing these types, the latter method seems to be safer and better than the former [11]. One can easily run fast, even if it is sprinting short distance or running medium to long distance.

There are three important points here in the following. The first is forward leaning and instant weight removal operation. In the push running, the entire body is leaning straight forward [12]. This leaning can bring to use the energy of the body weight effectively. Just after the foot touches the ground, the ankle, knee and hip joint are relaxed and flexed in a timely manner, causing the center of gravity of the body to fall forward and downward. The detail mechanism includes that i) the ankle joint relaxes and ii) the knee joint instantly falls forward and downward, iii) the position of the hip joint advances forward. Thus, since the sole of the foot is fixed to the ground, the pelvis can move smoothly forward.

Consequently, the body of the runner can move forward with less additional power by leaning forward and flexing and extending these

three joints [10]. From the above, the potential energy of body weight can be efficiently converted into the power to move forward. On the contrary, if the ankle, knee and hip joints should be in a stiff state, one cannot use the power of own weight [13]. Then, one has to move forward by using the muscle power instantly to rather high degree, which might be too strong for the muscle itself.

The second is the reaction of weight removal operation and reaction force. When the sole of the foot touches down to the ground, the leg joints bend momentarily to catch the fall of the center of gravity [12], at the moment, the force generated by the extension reflex of the stretched muscles and tendons (mainly hamstrings) is loaded to the ground [14]. Then, the great force of reaction force from the ground is returned to the runner [15]. In this way, rhythmic high-speed driving is realized with forward propulsion like a spring. For amateur runners, the contact time with the ground is long and slow. On the other hand, leading athletes usually have very short contact times with the ground [16]. Consequently, it can allow skilled runner to receive relatively large power from the ground.

The third is squat and three spheres. The squat means the one not with heavy load, but one with no loading using just only the body. It is continuous unloaded squat exercise. This operation can be performed associated with the first and second movements mentioned above. It is an efficient training for better running. Feeling the reaction power from the floor at the plantar region of the foot, the training can be continued with less muscle tension as if the body may be an elastic spring coil.

The human structure in itself seems to have three spheres, including head, chest and pelvis [17]. These three connection and rotation degree in front-back direction suggest important relationships with all movements. When combined the both of squat posture and three spheres, the concept of standard perspective is shown in Figure 1. There are some effective tips in the following. Regarding the direction line of sight, it is better to look diagonally on the floor. In this posture,

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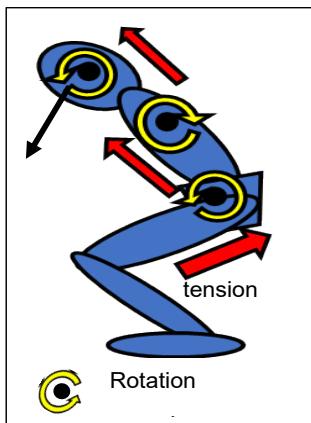


Figure 1: Perspective of recommended posture of head, chest and pelvis for squat exercise.

the head tends to be rotated forward and the neck becomes relaxed. If one tries to open the chest bilaterally, the shoulder and back will be tense, which has to be avoided. It is advisable to pull the upper end of the sternum upward. Then, the chest tends to rotate backward and back becomes relaxed. Similarly, to try to raise the hip upward would be beneficial for better posture of the pelvis with rather forward rotation [18].

This chain of the body will bring adequate tension on hamstrings and abdominal muscles [19]. Further, this posture makes the pelvis to be fixed and move, with maintaining intra-abdominal pressure (IAP) and holding the pelvis for up-right position [20].

In summary, non-loading squat can contribute improved body movement. It can be applied to sprint or jump on one foot or both feet [21]. This article will hopefully become some reference for medical practice and research.

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