

# Flat Grounding by Consciousness of Plantar Triangle with Decreased Impact

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**Keywords:** Flat grounding; Athletics; Anterior transverse arch (ATA); Biaxial line; Deep transverse metatarsal ligaments (DTML).

**Abbreviations:** ATA: Anterior Transverse Arch; MLA: Medial Longitudinal Arch; LLA: Lateral Longitudinal Arch; DTML: Deep Transverse Metatarsal Ligaments.

## Introduction

In recent years, various discussions, disagreements and opinions are seen in the field of athletics. For example, in long distance such as marathon, the recommended way of running has changed. In other words, it has been said that landing with the heel is good before, but recently there is some information that the first-class runner is landing on the toe [1].

On the other hand, there are various opinions even in a short distance. The running way was believed to be good to kick with a toe before. However, a method of pushing over the sole of the foot has been recommended without giving force to the toes. These discussions are found at various levels, ranging from top-notch Olympians to top athletes, university to elementary school students in lots of countries. The correct answer is not limited to one, but it depends on the player and various situations [2].

The authors have been involved in sports medicine and rehabilitation. Especially in relation with the athletics competition, we have been giving advice on practice, guidance and method [3]. The subjects included masters' athletes from young to older ages and others [4]. Among them, we have continued the lecture and workshop for years, concerning how to run without injury or disorder function.

Under such circumstances, flexibility and motion mechanism must be considered to minimize sports injuries [5,6]. In this article, we would like to show the importance and hints on the fundamental method recommended from short to long distance. For example, it is from 100 m dash to 42 km marathon.

Firstly, the important point is that the principle of foot movement is the same and common, from short to long distance running. The short distance makes the body tilt forward deeply, then the foot length becomes wider [7]. Medium distance is moderate which is between short and long distance. Further, in the case of long distance such as marathon, the degree of forward lean is small, the stride is narrow, and the speed is about half of the short distance dash.

Secondly, the place to put both feet on the ground is not on the uniaxial, but biaxial line [8]. Walking method on one axis line is rarely seen as a gait pattern when a female professional model walks. The place where both feet touch the ground is on a single line, associated with somewhat twisting the pelvis. On the other hand, walking on biaxial line are observed in normal walking and running.

In the human body, there is an acetabulum of the pelvis, where the femoral head enters, from which the femur and tibia extend downwards and support the weight and various movements. Therefore, the place where both feet

touch the ground are apart to the left and right to some extent, and this is the natural position. When a person walks or runs, the position where the feet are placed is always found on the biaxial line.

The third is about the angle of both feet contacting the ground. When a person is sitting, standing, walking, running, the position and angle of the hip joint, knee, ankle change in various ways. For running on biaxial line, recommended angle of both feet would be that outer lines of both feet are parallel (Figure 1). In this case, the axes of both feet will face slightly inward. This angle would be natural for relaxation without muscular tension [9]. Furthermore, hip anteversion and retroversion angles are also important.

Actually, the positions and movements of the knees and feet certainly differ depending on the person. In addition, there are several cases with various features such as X legs and O legs. However, the adequate principle would be that outer lines of the feet are roughly parallel and the tips of both feet are slightly inward [10].

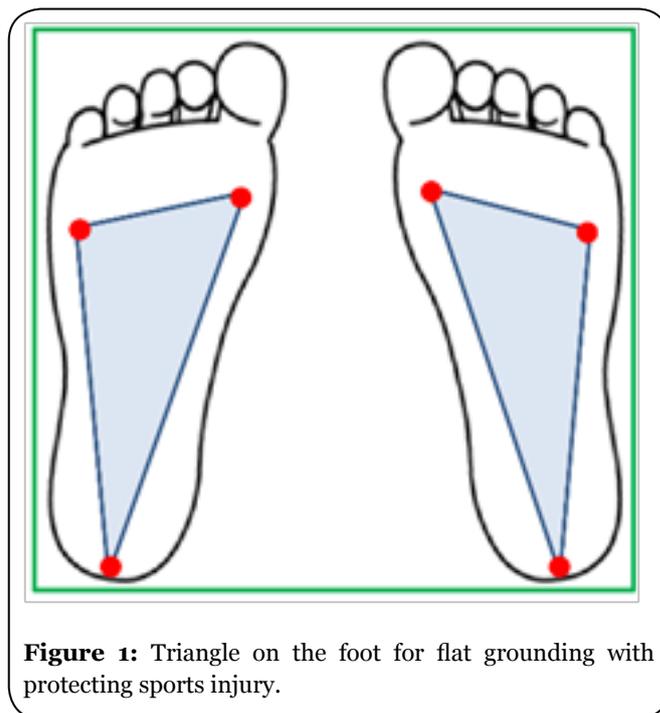
The fourth is the combination of 1, 2, and 3 mentioned above. As shown in the Figure 1, it is important to be conscious of the triangle for running. When contacting the land, flat grounding would be always tried instead of toes or heel. There are three arches on the foot, which are anterior transverse arch (ATA), medial longitudinal arch (MLA) and lateral longitudinal arch (LLA) [11]. The triangle has three sides and vertex. The forward side corresponds to the ATA, which has strong ligaments from 1st to 5th of the MP joints, called deep transverse metatarsal ligaments (DTML). ATA plays a role of absorption and decrease of impact force from the ground during running. Further, the roles of subtalar and midtarsal joints are important, because their positions determine the characteristics of foot kinematics during walking.

The position and angle of joints are different in each person. The degree of angle between bilateral toes can affect the way of running and muscle tension. When bilateral feet are situated as rather ideal as Figure 1, flat landing is possible with lower possibility of sport injury [12].

On the other hand, when both feet contact the ground with the toe wide open, the situation is different. In such case, weight load and impact will be given to the outer LLA at first. After that, a load is applied to the frontal ATA, the inner MLA, and finally the 1<sup>st</sup> MP joint in order. Twisting the foot to a certain extent from a series of actions, and possible kicking with the thumb finger finally, there is increasing possibility of injury of lower extremity [11,12].

Three important arches are present in the foot, which

are MLA, LLA, ATA [11]. Among them, MLA and LLA are constructed on the sagittal plane from the forefoot to the rearfoot, and ATA is formed on the coronal plane in the forefoot. ATA consists of five metatarsal heads. Although few studies on ATA have conducted, some studies reported the importance of the forefoot [12]. Frequently, foot pain occurs in the forefoot, which may be related to superior sprint performance [13]. Thus, the forefoot and also ATA would be part to be paid attention and studied further.



**Figure 1:** Triangle on the foot for flat grounding with protecting sports injury.

In summary, this article described the important of flat grounding with decreased impact. For various opportunities of lecture and workshop, we have advised athletes to be conscious of the triangle. Continuous practice, research and education would lead to successful development of significant sports life and best aging

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