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Flat Foot Deformity, Q Angle and Knee Pain are Interrelated in Wrestlers

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Abstract

Introduction: The aim of this study was the surveying of Relationship between flat foot deformity with Q angle and knee pain in Iranian freestyle wrestlers.

Material and methods: For executing this study, twenty subjects from Iranian national wrestlers with mean age 19.11 ± 0.86 yrs, weight 70.5 ± 18.4 kg, height 173.2 ± 9.1 cm, sportive experience were selected. Navicular depression (with Brody method), goniometer and pain score used for flat foot, Q angle and knee pain measurement. Pearson correlation coefficient was used for statistical analysis ($\alpha \leq 0.05$).

Results: Results indicated that there is significant relationship between flat foot deformity and knee pain in wrestlers (r=0.686). There is significant relationship between Q angle increasing in dominant leg and knee pain (r=0.949). Also there is significant relationship between Q angle increasing in dominant leg and flat foot deformity (r=0.278).

Discussion and conclusion: With regard to this study results, we concluded that based on kinetic chain system, flat foot deformity may resulted in patella lateral rotation and Q angle increasing that this agents fortunately resulted in knee pain.

Keywords: Kinetic chain system; Knee pain; Flat foot deformity

Introduction

The basic systems of function that react together within the body chain are the nervous, muscular and skeletal systems as supported by the cardiovascular system. Functionally combined, they are termed the Neuro Musculoskeletal (NMS) system. Millions of nerves, hundreds of muscles and bones are delicately integrated within the human body to react together and form the functional chain of human biomechanics. Biomechanically understanding the interrelationships of the NMS system requires functional knowledge of the interaction of the NMS system within its environments. Knowing why and how the chain reaction of the NMS system occurs in order to produce all forms of function is the key to understanding and taking advantage of functional biomechanics [1].

Human function is referenced relative to the required or desired functional activities within the given environment. Global functional activities include hygiene and dressing activities, household and job activities, training and conditioning activities, recreation and sporting activities as well as therapy and rehabilitation activities. Core functional activities need to be successfully integrated in order to perform the required or desired global functional activities. A multitude of core functional activities must be considered as the essential basic components for all of human global function [1-3].

Janda noted that due to the interactions of the skeletal system, muscular system, and CNS, dysfunction of any joint or muscle is reflected in the quality and function of others, not just locally but also globally. Janda recognized that muscle and fascia are common to several joint segments; therefore, movement and musculoskeletal pathology are never isolated. He often spoke of muscle slings, groups of functionally interrelated muscles. Because muscles must disperse load among joints and provide proximal stabilization for distal movements, no movement is truly isolated. For example, trunk muscle stabilizers are activated before movement of upper or lower limbs begins; therefore, it might be possible that shoulder pathology is related to trunk stabilization or trunk pathology is related to shoulder movement [1,4].

The human body possesses the biomechanical characteristic of tensegrity defined as the inherent stability of structures based on synergy between tension and compression forces. This means that the structure of the body provides it with inherent stability as it rearranges itself in response to changes in load. Increased tension in one area is accompanied by a change in tension in another, allowing constant stability with changing structure. For example, the body can change from standing to squatting while maintaining stability of the lumbar spine by increasing tension around the trunk. Janda also acknowledged the importance of the entire sensorimotor system as a neurological chain, noting that pathology in the sensorimotor system is reflected by adaptive changes elsewhere in the system. Further, Janda recognized two distinct systems of muscles that are linked neuro developmentally, the phasic and tonic systems. This recognition eventually led to his muscle imbalance paradigm. In general, chain reactions can be classified as articular, muscular, or neurological; however, remember that no system functions independently. The type of chain reaction that develops depends on the functional demands, and its success depends on the interaction of these three systems.

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Pathology within a primary chain may be linked to dysfunction in a secondary chain, or vice versa [5-7].

Kinetic chains are most commonly recognized as the concepts of open kinetic chain and closed kinetic chain activities, in which focus is on movement of the joints. These kinetic chains are easily identified through biomechanical assessments such as gait assessment. The chain reaction of the lower extremity during gait is well known by its obligatory and sometimes compensatory movements. For example, foot pronation causes tibial internal rotation, which causes knee valgus and hip internal rotation. During gait, the neuromuscular system must control these linked kinetic motions. Often, pathology is related to a dysfunction in compensation in the kinetic chain: Through the kinetic chain, foot pronation may cause faulty lumbar positioning, requiring additional trunk stabilization. Therefore, clinicians must look away from the site of pain for possible biomechanical contributions. For example, orthopedic surgeon Ben Kibler used kinetic chains to describe both function and pathology of the shoulder. He noted that in the overhead throwing motion, force is summated throughout the kinetic chain via force production at various joints from the lower body to the hand. Kibler recognized that any change in timing or force generation may result in poor performance or pathology at another level within the chain. This demonstrates the principle that the kinetic chain is only as strong as its weakest link. Muscular chains are groups of muscles that work together or influence each other through movement patterns. There are three subtypes of muscular chains: synergists, muscle slings, and myofascial chains. Each type of muscular chain interdepends on both the articular and the neurological systems [8,9].

Patients with chronic musculoskeletal pain continue to experience pain after a period of time that a peripheral pathology would normally resolve. This persistent pain suggests a persistent peripheral input. These patients also exhibit altered pain processing in the CNS. Evidence for the central influence of pain on the CNS is seen in the phenomenon of pain centralization, which often occurs in chronic pain patients. Pain stimuli can alter sensitivity to the central perception of pain and can alter the afferent signal at multiple levels. Curatolo and colleagues demonstrated centralized hypersensitivity to pain in patients with chronic neck pain resulting from whiplash. They found lowered pain thresholds in healthy regions throughout the body, regardless of the type of nociceptive input. A simple algometer can be used to quantify a patient's response to painful pressure by measuring the Pressure Pain Detection Threshold (PPDT); a lower threshold means greater sensitivity to painful pressure. Changes in the PPDT both at the site of pain and elsewhere in the body indicate altered pain processing in the CNS. Patients with chronic musculoskeletal pain in fibromyalgia and low back pain exhibit altered pain processing throughout the body. Further evidence of CNS influence of chronic musculoskeletal pain comes from the finding that muscle dysfunction often occurs in both the symptomatic side and the contralateral side. This finding has been confirmed by experimental pain studies demonstrating CNS mediation of chronic pain. Thus clinicians should evaluate and treat chronic muscle imbalance and chronic musculoskeletal pain as a global sensorimotor dysfunction [1,10].

Janda believed that muscles, as opposed to bones, joints, and ligaments, are most often the cause of chronic pain. Direct causes of muscle pain include muscle and connective tissue damage, muscle spasm and ischemia, and tender points or TrPs. Janda stated that most pain is associated with muscle spasm but is not the result of the spasm itself; rather, the pain is caused by ischemia from the prolonged muscle contraction. Prolonged muscle spasm leads to fatigue, which ultimately decreases the force available to meet postural and movement demands. Indirect causes of muscle pain include altered joint forces due to muscle imbalance influencing movement patterns. Joint dysfunction without spasm usually is painless. For example, Janda showed that subjects with SI joint distortion (faulty alignment) but no pain demonstrated significantly greater inhibition of the gluteus maximus and gluteus medius during hip extension and abduction when compared with subjects without faulty alignment. Undoubtedly, the lower extremities are important to human gait and function. The lower-extremity skeleton includes the hemipelvis, femur, tibia, fibula, and bones of the foot, and the lower-extremity joints are the hip, knee, and ankle. The antigravity role played by the lower extremity demands several functions of the musculoskeletal system, including muscular, biomechanical, proprioceptive, and transfer functions [11-13].

Powerful muscles capable of significant eccentric function include pennate and multipennate fiber arrangements to allow for significant force production during short arcs of ROM with long levers. The large bulk of the antigravity muscles used for power generation and transfer are evident in the size of the gluteal muscles, quadriceps, adductors, hamstrings, gastrocnemius, and soleus. An oblique and transverse arrangement of muscle groups such as the gluteus maximus, hamstrings, popliteus, and peroneus longus allows for efficient transverse motion during normal function. Biomechanically, the lower extremity requires a rapidly changeable lever system that allows for alternating flexibility and rigidity during the gait cycle. In addition, the lower extremity requires the ability to control its segments in space on a stable lumbopelvic unit; this is referred to as an open chain function. The ability to support the more proximal segment of the lower extremity on a stable weight-bearing tripod of the foot with the ideal control of mass by the hip and pelvic musculature (sometimes referred to as the reverse open chain function) is also necessary for proper function. In particular, control of pronation and supination are important for gait [1,14,15].

The lower extremity also plays a role in proprioceptive function. Afferent information from the foot is important for controlling posture and gait. The phenomenon of biped ambulation in humans is characterized by an intricate timing of biomechanical events presided over by subcortical programs and reflex reactions that can be modulated depending on the circumstances under which movement occurs. Walking on a gravel surface or slowly scaling a hilly terrain requires different strategies of feed-forward planning and feedback adjustments as opposed to sprinting, during which there is little time for feedback and subsequent adjustments. Even during normal uninterrupted gait, the system runs on autopilot. It is thought that supraspinal pathways integrated with spinal cord CPGs are responsible for adult locomotory gait, rhythm, and perpetuation [1,16].

A network of ligaments and tendons that store and release energy creates a system of force transmission from distal to proximal segments of the lower extremity. This system is intimately linked to the trunk and upper body. The pelvic stabilizers, the stabilizing core of abdominal muscles, the respiratory and pelvic diaphragms, and the axial spinal musculature and fascia are also crucial to lower-extremity function. The transfer of energy from the lower body to the trunk to the upper body is an excellent example of chain reactions occurring in the lower extremity [1].

During stance, the foot must be able to adapt to the ground surface, aid in shock absorption, and transition to a rigid lever to propel the body forward during push off. Proper foot motion, specifically subtalar pronation and supination, is critical to achieving these functions.

Upon weight acceptance, the foot moves into pronation and achieves maximum pronation in midstance. With pronation, the midtarsal joint unlocks, and the foot becomes more flexible to adjust to the underlying surface, assisting in maintaining balance. Conversely, the midtarsal joint becomes locked in supination to maximize foot stability and provide a rigid lever for push off. Although the normal foot effectively transitions between pronation and supination to optimize adaptability versus stability as needed, foot malalignments that negatively affect foot mobility may diminish the ability of the lower leg to function optimally during weight-bearing stance [3,17,18].

Balance has often been used as a measure of lower extremity function and is defined as the process of maintaining the center of gravity within the body's base of support. To maintain upright stance, the central and peripheral components of the nervous system are constantly interacting to control body alignment and the center of gravity over the base of support. Peripheral components in balance include the somatosensory, visual, and vestibular systems. The central nervous system incorporates the peripheral inputs from these systems and selects the most appropriate muscular responses to control body position and posture over the base of support. Because balance is maintained in the closed kinetic chain (the foot being fixed beneath the base of support) and relies on the integrated feedback and movement strategies among the hip, knee, and ankle, balance can be disrupted by diminished afferent feedback or deficiencies in the strength and mechanical stability of any joint or structure along the lower extremity kinetic chain. Considering that the foot is the most distal segment in the lower extremity chain and represents a relatively small base of support upon which the body maintains balance (particularly in single-leg stance), it seems reasonable that even minor biomechanical alterations in the support surface may influence postural-control strategies. Specifically, excessively supinated or pronated foot postures may influence peripheral (somatosensory) input via changes in joint mobility or surface contact area or, secondarily, through changes in muscular strategies to maintain a stable base of support [2,19-21].

An excessively supinated foot, characterized by a high arch and hypomobile midfoot, may not adequately adapt to the underlying surface, increasing the demand on the surrounding musculoskeletal structures to maintain postural stability and balance. Further, it has been suggested that the cavus foot has less plantar sensory information to rely on than the normal or pronated foot. Conversely, excessive pronation is characterized by a flattening of the medial arch and a hypermobile midfoot but may also place greater demands on the neuromuscular system to stabilize the foot and maintain upright stance. Researchers examining orthotic intervention in those with excessive pronation support this contention, finding changes in muscle activity at the ankle, knee, and hip when the degree of pronation is altered sufficiently [21,22].

The implications of a hypomobile or hypermobile foot and associated neuromuscular changes on peripheral input and balance have received little attention to date. In their work comparing single-stance postural control in individuals with different foot types as defined by the degree of forefoot and rearfoot varus and valgus, Hertel et al. [5,6] found individuals with a cavus, or supinated, foot type had significantly larger center-of-pressure excursions than individuals with pronated or normal foot types. They noted no postural deficits in those with a pronated foot posture. However, their findings were limited to testing in a static stance with eyes open. Although the influence of orthotic intervention on dynamic balance in subjects with different foot postures was subsequently examined, analyses and discussion focused primarily on changes in balance resulting from orthotic wear. It is unclear from the results whether significant differences in dynamic balance existed among different foot postures. Further, whether postural deficits secondary to excessive foot pronation or supination would be noted or magnified in static stance with greater challenges to the support surface via loss of visual feedback (i.e, eyes closed, relying more on somatosensory input) has not been explored [2].

Poor foot position sense is thought to hinder accommodation between the plantar surface of the foot and the support surface, thus requiring postural adjustments more proximally to maintain upright posture and balance. Although investigators found static and dynamic balance to be adversely affected by changes in peripheral input secondary to joint injury and changes in the stability of the surface on which one is standing, far less attention has been focused on whether more subtle alterations in the surface, stability, or peripheral input of the support foot may also affect balance in those with different foot types. Other than the work by Hertel et al. [5,6] we are not aware of any other studies that have examined balance as a function of foot type [2].

Understanding this relationship is important for 2 reasons. First, this information may aid in our understanding of factors inherent to individual subjects that may influence and confound measures of balance when these measures are used to assess potential deficits related to injury mechanisms (e.g, effects of mild head injury or ankle injury). Second, this information may further elucidate the potential influence of anatomical alignment on the neuromuscular and biomechanical function of the lower extremity. Hence, our purpose was to further clarify the effect of foot type on measures of static balance (center of pressure, stability index, and postural sway) and dynamic reach. We hypothesized that those with supinated and pronated foot postures would have greater difficulty with balance than those with a neutral foot type. Finally, the aim of this study was examining the relationship between flat foot deformity with Q angle and knee pain in Iranian freestyle wrestlers.

Material and Methods

The protocol used in this study was reviewed and approved by Tehran University's Institutional Review Board prior to participant recruitment and all participants provided written informed consent prior to beginning the study. As assessed by a medical history questionnaire, each participant was free of cardiovascular and neurological diseases, severe musculoskeletal injuries and low back pain. Firstly Subjects were tested between 8:00 and 10:00 h, according to the regular training. Participants attended having performed no vigorous exercise in the 24 h prior to testing and with diet standardized for 48 h proceeding in each test. Subject's characteristics are shown in table 1. From the Iranian freestyle wrestlers participated in Ciracow international tournament 10 persons (50 %) have pronated foot in guard leg (dominant leg) that these wrestlers selected as a flat foot group (N=10) and wrestlers (N=10) set as subjects with normal foot arch group.

For executing this study, twenty subjects from Iranian national wrestlers with mean age 19.11 ± 0.86 yrs, weight 70.5 ± 18.4 kg, height 173.2 ± 9.1 cm, sportive experience were selected. Navicular depression (with Brody method), goniometer and pain score used for flat foot, Q angle and knee pain measurement (in each foots).

Navicular drop measurement

Navicular drop was measured using the Brody (1982) method.

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The subject sat in a chair with their bare feet flat on the ground. The examiner held an index card on the floor and marked the point of the subject's navicular drop. The subject then stood up and the position of the navicular tuberosity was again measured. The examiner then measured the distance between the two points [5].

Quadriceps angle (Q-angle) measurement

Q- Angle is the angle of incidence of the quadriceps muscle relative to the patella. The Q angle determines the tracking of the patella through the trochlea of the femur. As the angle increases, the chance of patellar compression problems increases. The angle of alignment of the quadriceps; a Q angle of ≥ 20° is considered abnormal and creates a lateral stress on the patella, predisposing it to pathologic changes; contrarily, a normal Q angle does not preclude regional problems e.g., it may underestimate the lateral force on the knee where there is an imbalance between the vastus medialis and lateralis muscles. In this study the Q- angle measured in supine position for each foots [15,20] (Figure 1).

Q-Angle in supine with quadriceps contracted

The line between the ASIS of pelvis and midpoint of patella is only an estimate of the line of pull of quadriceps. If substantial imbalance exists between the vastus medialis and lateralis muscle, the Q-angle may underestimate the lateral force on the patella because the actual pull of the quadriceps muscles no longer on estimated lines. The quadriceps contraction varies the Q-angle. The pull of vastus lateralis muscle is normally 12° to 15° lateral to the long axis of the femur with even greater obliquity of its lower fibers. The pull of vastus medialis longus muscle is approximately 15°-18° medial to femoral shaft with Vastus Medialis Oblique (VMO) pulling 50°-55° medially. As the weakness of VMO has been proven to be one cause of patellofemoral dysfunction its role in patellar positioning while measuring the Q-angle should not be neglected. Excessive lateral force causes a lateral deviation and tilt of patella and thus measuring the Q-angle with quadriceps contracted will give a more clear idea of patellofemoral tracking and malpositioning of patella. Hughston advocates measuring Q-angle with quadriceps contracted [15,22].

Also, in this study the Visual Analogue Scale (VAS) used for pain measurement [8].

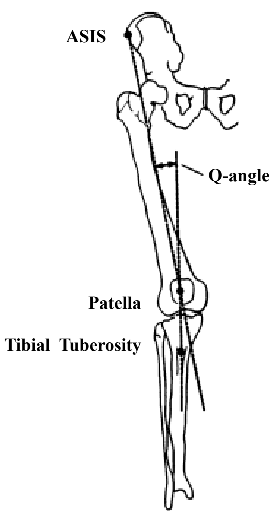

Figure 1: Quadriceps Angle (Q-Angle) Markings.

Statistical analysis

Pearson correlation coefficient used for evaluation of relationship between flat foot deformity with Q angle and knee pain an alpha level of (0.05) was used in determining statistical significance using the SPSS program for Windows, version 19.0.

Results

The demographic characteristics of subjects shown in table 1.

Based on information showed in table 1, there aren't significant differences between Demographic characteristics of subjects in 2 studied groups.

In all subjects Right foot was dominant. Also in present study the 10 person of subjects have pronated foot in right foot (dominant or guard foot).

Results of tables 2 and 3 indicated that there are positive and strong relationship between Navicular drop, Q-Angle and right (guard) knee pain. Whereas, there aren't the meaningful relationship in left leg.

Discussion

Several mechanisms known that is responsible for the creation of skeletal disorders based on the kinetic chain system that these are: [15,17]

Distal parts from the injured or portion with dysfunction for compensating the disruption caused in function and it may cause interference pattern due to improper distribution of weight and pressure and can cause more damages.

Due to creation of injury in one part of body, muscle imbalance to come around the joint and this factor will lead to subsequent dysfunctions. This imbalance has been amply reported in the area of shoulder injuries, knee and hip. In fact, muscle imbalances affecting the whole body and leading to disorganization of kinetic Chain.

Scar tissue and adhesions caused by previous injuries can also be other causes in creation disorder in kinetic chain. Scar tissue resulting in impaired joint range of motion and motion mechanisms that this factor puts people at risk of subsequent disorders.

Variables Groups	Age (years)	Height (cm)	Weight (kg)	Exercise experience (years)
Flat foot group	19.20 ± 0.78	172.2 ± 10.63	71.9 ± 19.6	7.1 ± 1.9
Normal foot arch group	19.2 ± 1	175.1 ± 7.68	69.1 ± 17.25	7.3 ± 1.94

Table 1: Demographic characteristics of subjects.

Variable Groups	Navicular drop		Q-Angle		knee pain	
	Right foot	Left foot	Right foot	Left foot	Right foot	Left foot
Flat foot group	1.25 ± 0.15	0.79 ± 0.39	12.4 ± 1.26	8.1 ± 1.66	6.4 ± 1.5	3.6 ± 0.96
Normal foot arch group	0.61 ± 0.11	0.62 ± 0.22	9.5 ± 0.84	8.1 ± 1.1	2.8 ± 1	3 ± 1.15

Table 2: Mean and standard deviation of Navicular drop, Q-Angle and right and left knee pain in Flat foot and Normal foot arch groups.

Navicular drop	Q-angle of Guard knee	Relationship between variables
R=0.278	-	Q-angle of Guard knee
R=0.686	R=0.949	Guard knee pain

Table 3: Relationship between Navicular drop, Q-Angle and knee pain in dominant or guard leg of subjects with Flat foot.

Improper Movement Patterns: movement patterns such as gait, extension and knee flexion, hip abduction extension and Curl up and Etc affecting the persons other movement patterns and will lead to Misalignment and subsequent musculoskeletal disorders. Improper movement patterns affect the activation patterns of nervous and muscular motor units and lead to subsequent problems (dysfunction). To determining Weakness of movement patterns, manual muscle testing should be performed.

Genetics: the inheritance of early discussions about the creation of movement disorders and kinetic chain is based on different types of physical and genetic structures of their own, creates impairment in kinetic chain systems [15,17].

A pronated foot is an excessive unwinding of the osteoligamentous plate. If the foot biomechanically functions in constant pronation the entire leg undergoes excessive internal rotation. The internal rotatory stress or position of excessive internal rotation of the leg may result in several possible problems around the knee, including excessive angulation of the patellar tendon and excessive pressure of the lateral patellar facet. A pronated foot may be the result of a functional leg length inequality if the problem is asymmetrical. This is because pronation of the foot can lower the ankle joint axis and result in a slight reduction in overall limb length. Lowering the arches also tenses the plantar ligaments and the plantar aponeurosis (planter fascia). Prolonged stress on these structures can result in a cycle of microtears, pain and inflammation [2,15,17].

The excessive internal rotation causes a range of altered biomechanics in the pelvis, sacroiliac joints and spine. The prolonged internal rotation of the leg causes the iliopsoas to become tight and facilitated. If the iliopsoas becomes tight and facilitated due to reciprical inhibition the glutes will have neurological stimulus sapped from them. In a movement like a squat this will be a problem because the glutes are unable to contract to their full potential or to the required degree that that particular squat requires for the movement to take place, so for the body to carry on through the range of motion other muscles have to take over the job. This is called synergistic dominance and in the example of the glutes not being able to contract fully in a squat we will get the hamstrings and erector spinae being synergistic dominant. The hamstrings and lower back are not supposed to do this job so they are more prone to injury and the more the movement is done with glutes not playing their full role, the weaker they will become in relation to the hamstrings and lower back [2,5,15,17].

Another problem with tightened iliopsoas is increase of lumbar lordosis resulting in separation of the pubes and costal arch, causing stretching and weakening of the abdominal muscles, jamming of the apophyseal lumbar joints, stress on the posterior discs and eventual compensatory posture of a thoracic kyphosis and forward head with all of its related consequences.

A tightened overactive iliopsoas also substitutes for the abdominals during a sit-up this will further make it difficult to strengthen the already lengthened abdominals to help pull the pelvis back into the correct position. Correcting the problem at the obvious area or dysfunction by methods such as inhibiting the tight and/or facilitated muscles (hip flexors, lower back) and strengthening the muscles that are loose and/or inhibited (glutes, abs) is a plausible practice but not the only and most complete way of doing it [17].

This is because the problem was originally routed from the feet being in constant pronation so correcting something further up the body will only undo itself due to the foot pronation. Corrective exercise and therapy should start at the foot at the very least. The most common form of flatfoot is termed a flexible flatfoot and is marked by an arch that reappears when the foot in non weight bearing. Treatment is focussed around prevention of excessive pronation when the foot is loaded by controlling eversion of the calcaneus. The entire lower extremity should be considered as a whole rather than as individual joints and segments because of the complex chain reactions occurring throughout. These complex motions are often evident during gait. A detailed description of gait is beyond the scope of this chapter; however, a brief review will demonstrate the complex chain reactions occurring during ambulation [12,15,19].

Ambulation consists of cyclical and alternating swing and stance phases. A full gait cycle lasts approximately 1 s, about 38% of which is swing phase and 62% of which is stance phase. Pronation and supination are the two main aspects of kinetic and arthrokinematic movement during the stance phase. The stance phase is initiated by a chain reaction of calcaneal eversion and subsequent talar motion through inertia of the leg and ground friction at heel strike. The swing phase is a true open chain, the goal of which is to transform ground reaction forces into forward momentum. This momentum assists in supination of the contralateral stance limb, clearing the ground, and preparing the swing limb for the ensuing stance phase. Since the swing phase of gait is governed only by muscular effort and is free of the ground reaction constraints that govern the stance phase, a milder and altered form of pronation and supination occur in the foot, and talar involvement is minimal [5,15,17].

Pronation of the foot allows for energy storage, shock absorption, terrain adaptation, and balance maintenance. Supination, on the other hand, is more active, requiring concentric muscle activity and momentum of the swing leg combined with arthrokinematic mechanisms that force the foot toward osseous stability and predominantly concentric muscle activity for propulsion. If the timing, the degree of pronation and supination, or the strength of the involved muscles changes, the coordinated alignment of the bones becomes inefficient and the achievement of stability on demand becomes impossible. For example, weakness of the hip may lead to an inability to externally rotate the femur. This may in turn lead to an inability to achieve ideal resupination of the foot. Thus the screw-home mechanism (the coupled arthrokinematic relationship of extension and external rotation of the tibial plateau on the femur) needed for knee stability is compromised and patellofemoral pain may result [12,17,19].

Several obligatory motions are seen in the closed kinetic chain reactions of the lower extremity. These reactions can occur distally to proximally or proximally to distally, and their obligatory motions include (1) pronation that leads to tibial internal rotation that leads to knee valgus and flexion that leads to hip internal rotation and (2) supination that leads to tibial external rotation that leads to knee varus and extension that leads to hip external rotation. Because these movements are obligatory, any deficit in motion at one segment must be compensated for by another segment. Without compensation, the deficit may prevent necessary motions. For example, increased pronation in the foot during the foot-flat phase of gait facilitates femoral internal rotation; however, terminal extension of the knee before push-off requires external rotation to complete the screw-home mechanism [15].

Practical Implications: With regard to this study results, we concluded that based on kinetic chain system, flat foot deformity may resulted in patella lateral rotation and Q angle increasing that this agents fortunately resulted in knee pain. This process and other same process can imposed some of the athletes to change your athletic life. So it is necessary for athletic trainers to instruct optimal posture benefits and try to relive the lower extremity misalignments for better performance in athletes.

Advice for Athletes and Coaches: due to the highly rate of incidence and furthermore side effects of lower extremity misalignments on athlete's posture and performance, it suggested that athletes and their coaches consider the missed and serious mal-adaptations in own athletic life and if necessary decrease their excessive side effects.

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