Running Medicine: A Clinican’s Overview

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ABSTRACT

Background: Running is a popular activity which is associated with unchanged injury levels since the development of the modern running shoe in the 1970s.
Method: This paper provides an evidence based overview of the more common running injuries encountered in practice, the mechanical and technique deficiencies associated with running injuries and describes the different types of foot striking patterns.
Conclusion: It is important for primary care physicians to be aware of the injuries a runner presents with, why these injuries occur and the role foot striking plays in the injury process.

Keywords: Running; Clinical Practice; Injury [Chiropr J Australia 2016;44(1):9-16]

INTRODUCTION

Running is associated with a variety of sports, but as a stand-alone activity its popularity has exploded. Running is an efficient way to increase physical fitness and lose weight. As a result there has been a rise in charity fun runs and races [1, 2]. Today the number of recreational runners far exceeds competitive runners [3].

Like all physical activities there are injury risks associated with running, with injuries rates reported from 19-79% of participants per year [4]. Despite the great advancements in shoe technology and materials since the inception of the modern running shoe in the 1970s, running injury rates have remained largely unchanged [5].

Acute injuries in running are generally rare, with 80% of all injuries due to overuse. 37-56% of runners are expected to endure an overuse injury each year [1,6]. The most common injury sites in runners are the knee and Achilles tendon, which account for nearly 20% of all running injuries [6]. When expressed as a percentage of body part, the knee accounts for 25% of all injuries, followed by the lower leg (20%), the foot (16%), ankle (15%), upper leg (10%), hip/pelvis (7%) and the lower back (7%) [7].

The most prevalent injuries seen in runners are Achilles/calf injuries, iliotibial band injuries, meniscal injuries, patellofemoral pain syndrome, hamstring and quadriceps injuries [2]. Running injuries are associated with 2 consistent predictors, total miles run and previous injury [6].

With such high participation rates and high injury rates there is a strong probability that primary care physicians will see patients with a running-related injury. It is therefore important to understand the types of injuries runners have, the potential biomechanical and technique related-causes associated with running injuries and the different foot striking patterns runners adopt. This paper will provide an overview of the more common running injuries encountered in practice, the mechanical and technique deficiencies associated with running injuries and the different types of foot-striking patterns.

DISCUSSION

Common Running Injuries Seen In Practice

There are scientists who believe we were born to run [9]. This was created out of a need to hunt for prey to survive and it is this belief that has driven the trend of barefoot running. When shoes are removed one can appreciate the anatomical complexities involved with running. This primarily involves the great toe, heel, ankle, knee, hip, pelvis and lower back. These are the areas which assist in absorbing the ground reaction forces associated with running, and higher ground reaction forces may be associated with a greater risk of injury [10,11].

Running injuries can be linked to overuse, higher ground reaction forces, previous injuries, orthotic inserts, and biomechanical and technique deficiencies [1,6,10,11]. These may result in complaints such as tendinopathies, tendon and muscle strains and tears, stress reactions and fractures [2,12,13]. Table 1 shows some of the more common running injuries seen in clinical practice.

Since 80% of running injuries are associated with overuse, it is important to establish the potential cause(s) of the injury, with many injuries being multifactorial [14-16]. Stress reactions and fractures are related to higher ground reaction forces, which are often associated with running kinematics. Mileage, improper footwear, training surfaces and poor musculoskeletal conditioning are associated with tendinopathies and strains.

Common Clinically Seen Biomechanical Deficiencies

Biomechanical and technique deficiencies have been identified as potential risk factors for running injuries [13,17,18]. One of the most common running injury, patellofemoral pain syndrome, which accounts for 17% of running injuries [19], has been linked to several different biomechanical factors, including reduced muscle strength and altered

mechanical loading, lower limb kinematics and muscle activation patterns during running [20].

Table 1. Common running injuries

Body Region	Anatomical Location	Complaint
Forefoot	Great Toe	Hallux Rigidus, Sesamoiditis
	Metatarsals	Stress fracture
Midfoot	Navicular	Stress fracture
	Cuboid	Cuboid syndrome
Heel	Plantar Fascia	Plantar fasciitis
Ankle	Posterior calcaneus	Achilles tendinopathy, bursitis, calf strains and tears
	Lateral ankle	Peroneal tendinopathy
	Medial ankle	Tibialis posterior tendinopathy
Shin	Medial tibia	Medial tibial stress syndrome, tibial stress fracture
	Anterolateral compartment	Compartment syndrome
Knee	Lateral knee	ITB syndrome
	Medial knee	Meniscal injury
	Anterior knee	Patellofemoral pain syndrome, patellar tendinopathy
Thigh	Posterior thigh	Hamstring tendinopathy, hamstring strains and tears
Hip	Lateral	Gluteus medius/minimus tendinopathy, trochanteric bursitis
	Medial	Femoral neck stress fracture, FAI, labral tear
Lower back	Lower back	Mechanical lower back pain

Lower limb kinematic studies tend to investigate the hip angle (flexion, adduction, drop, internal rotation), knee angle (flexion) and ankle angle (flexion, eversion, inversion) [21]. These joints are most prevalent in absorbing ground reaction forces and as a result, deficiencies here will lead to injury. Tables 2 and 3 show some of the deficiencies runners may have.

Table 2. Biomechanical deficiencies [22-24]

Body Region	Deficiency
Great toe	Reduced flexibility results in reduced push off power, altering the take off gait and results in more heel strike when landing. Increasing the risk of plantar fascia and Achilles pain.
Ankle	Reduced flexibility of the ankle increases the tightness in the calf, resulting in potential Achilles pain and calf strains.
Knee	Weak knee stabilisers can lead to greater knee valgum resulting in patellofemoral pain and increased loading of the medial compartment.
Hip	Hip drop due to weak glutes can lead to ITB and anterior knee pain as the ITB attaches to the patella and distal femur resulting in a tugging effect of the ITB.
Pelvis	Increased anterior pelvic tilt can be due to reduced hip flexion, due to tight hip flexors and/or anterior hip capsule.

Since running injuries are multifactorial, treatment should focus on addressing all of the deficiencies involved with the injury. This may include rehabilitation and strengthening, changes in training habits, correcting technique errors and/or footwear, changes in step rate and alterations to foot strike [2,6,27].

Striking Patterns

Striking patterns refers to how a runner hits the ground with their foot. Runners can be a rearfoot striker (RFS), a midfoot striker (MFS) or a forefoot striker (FFS). RFS strikers account for 75% of all runners in traditional shoes, MFS 24% and FFS 1% [28]. RFS and FFS strikers exhibit differing load absorbing behaviors of the lower limb which can potentially lead to injuries or can potentially be used to help prevent injuries [26,28]. MFS impact loads sit in between RFS and FFS [28].

RFS have been shown to exhibit higher vertical impact peaks and load rates which have been associated with tibial shock,

Table 3. Technique deficiencies [25-27]

Deficiency	Effect
Bouncing stride	Increases ground reaction forces.
Foot strike in front of body	Increases risk of patellofemoral pain.
Forefoot striking in cushioned shoes	Results in more plantar flexion and inversion which stretches the Achilles.
Long stride length	Increases lower extremity stress.
Reduced or poor gluteus maximus activation	Potentially reducing propulsion.

stress fractures, plantar fasciitis and patellofemoral pain [11,29,30]. RFS are also associated with increased loading of the muscles in the anterior compartment as a result of the dorsiflexed ankle. This may then lead to hypertrophy and increased pressures in the anterior compartment, and ultimately to exertional compartment syndrome [31].

To combat the injury risks associated with RFS, a FFS pattern has been suggested as a way of reducing running-related injuries [26]. FFS has been shown to reduce patellofemoral contact force and patellofemoral stress [26]. There is also limited evidence to suggest that during the braking phase of the gait cycle, there is lower eccentric quadriceps work compared to RFS, potentially resulting in lower knee loading [32]. However, FFS results in greater plantar flexion of the ankle and this causes higher plantarflexion movement and Achilles strain, compared to RFS, which may increase the risks of foot and ankle injuries [25,33,34].

Step rate change (the number of steps per minute), has been associated with lower ground reaction forces and has been suggested as a possible avenue to help reduce the risk of running injuries. Forefoot running is closely associated with barefoot running and evidence suggests barefoot runners have reduced rates of loading compared to RFS in shod shoes, as well as a shorter stride length, which also has a load reducing effect [28]. Increasing the step rate by 5-10% helps to reduce bounce, lower extremity stiffness and moves the striking foot under the body. Reducing energy absorbed by the hip, knee and ankle and reducing the energy in the patellofemoral joint; however, it may increase the impact loading of the tibia if the rate is greater than 164 steps per minute [27].

CONCLUSION

Due to the high participation and injury rates seen in runners it is important for primary care physicians to be aware of the more common running injuries, the deficiencies that potentially contributed to the injury and how foot strike pattern may contribute to injuries

but may also be beneficial in treating running injuries. When working with runners a multifactorial approach is required to improve lower limb strength, correct any malalignments and reduce ground reaction forces through strategies like changes to training habits, strengthening programs and changes to step rates and foot striking.

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