



Using Eccentric and Functional Training to Prevent Running Injuries: Incorporating PRIMFIT based Modifications.

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Abstract

Promoting functional and eccentric strength in runners is one way to prevent injuries. We identify common running injuries at specific sites of the body, such as lower back, hip, knee, ankles, and between body segments. Through the use of examples and illustrations of both functional and eccentric training, we suggest activities performed with commonly used modalities of body weight, machines, medicine balls, and stretch bands while highlighting necessary modifications using a PRIMIFIT unstable surface product. In addition, we identify preventive mechanisms of the specific injuries, training modifications, and reasons for their effectiveness.

BACKGROUND

There are numerous benefits for including strength training in a weekly running regimen (Tan, 2010). Considering that participants in routine running activities are susceptible to overuse injuries, due to biomechanical factors such as running form and foot striking pattern, at least some type of strength training is necessary (Kulmala et al, 2013; Thompson et al, 2016). In addition, prior examination of running injuries, form, mileage and foot wear points towards the necessity of strengthening of the musculoskeletal tissues, through some form of resistance training (Herzog, 2012). However, the challenge for most athletes and coaches, is to distinguish between two types of strength training (functional and eccentric). A combination of both eccentric and functional training is recommended as one type may not always be effective. Our paper expounds on the terminology and provides illustrations and examples for both types.

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3 Eccentric strength is derived from the repetitive shortening and lengthening of muscles
4 leading to its elongation. The popularity of eccentric training is surpassing many other in the
5 field, and practitioners such as coaches need to carefully assess its merits and drawbacks
6 (Tinwala, et al, 2017). In running, the eccentric strengthening phase of the quadriceps and
7 hamstrings is vital, as they are necessary for the complete running cycle. Eccentric strengthening
8 is not only vital for muscles but yields benefits to the joints associated with those muscles.
9 Optimizing the stability of the joints of the knee, hip, and ankle complexes is vital in prevention
10 of injury in running. In fact, the prevalence of injuries in runners has been previously
11 substantiated to be high in recreational runners, especially those preparing for endurance events
12 (Bredeweg, et al, 2013; Buist, et al, 2008; Buist et al, 2010). An estimated overuse injury rate
13 for recreational runners has been estimated close to the 90th percentile (Agresta et al, 2014). It is
14 also very common for many recreational runners to self coach and design programs that might
15 ignore aspects of any type of strengthening.
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34 Functional training as a type of resistance training involves the usage of various training
35 modalities to aid and supplement the acquisition of strength and basic fitness. Modalities used in
36 functional training can include stretch bands, medicine balls, dumbbells, exercise machines, and
37 your own body weight. The use of one's body weight to strengthen leg muscles is common in
38 exercises such as toe raises, knee lifts or knee hug drills. However, these could also be modified
39 with other modalities. Functional training allows for the promotion of both mobility and stability
40 for muscles and joints. In terms of mobility, engaging muscles and joints in strength that imitates
41 the actual leg motion during running is vital. Stability and mobility in functional training of
42 runners should address the major joints of the hip, knee, ankle, and phalangeal bones that are key
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3 in running. Often, the lack of stability and functional limitations predispose many runners to
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5 injuries.
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9 A PRIMFIT injury preventative program incorporates the PRIMFIT stability and balance
10 protocol to offer proven modifications to increase the athletic and functional capacity of various
11 segments of the runner's body. This protocol is based on performance of specific exercises using
12 the PRIMFIT unstable surface product that is worn as a shoe. This is, of course, after a thorough
13 examination of different gait parameters through initial screening that incorporates the dynamic
14 PRIMFIT product, as an emulation of movements on unstable surfaces. A PRIMFIT product
15 allows an athlete to perform dynamic movements which are not possible with many other
16 stability training protocols, due to their mostly stationery nature.
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27 28 *PRIMFIT Unstable Balance Product*

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31 (Fig 1)
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34 Improving function at other parts of the athlete's body such as the lower back involves
35 stabilization of the core, especially for athletes at a risk of lower back pain. In addition to routine
36 functional training, eccentric strengthening of different segments through a thoroughly designed
37 program is vital. A combination of eccentric and functional training, if done properly and
38 following a consistent and routine injury prevention screening and strategy can reduce injury and
39 re-injury among athletes (Chinn & Hertel, 2010). In addition, various athletic programs routinely
40 consider strength training as part of their training. However, another of the many challenges is
41 that some of the chosen strengthening and injury programs are not evaluated for their
42 effectiveness (Concealed Reference), and in addition, some of the programs often lack
43 modifications for athletes. Our paper highlights common running injuries, prevention
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3 mechanism and our suggested modifications using PRIMFIT. We start by identifying common
4 injuries between specific joints of the hip, knee, ankle and toes that have high prevalence in
5 running, and then we identify functional and eccentric strengthening routines that are key to both
6 prevention as well as re-injury avoidance.
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13 **Lower Back and Hip**

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16 Lower back and hip pains are common in athletes. Among the many injuries in this area is
17 Piriformis syndrome, a condition that can cause pains arising from overuse and inflammation of
18 a muscle close to the sciatic nerve. For this particular segment of the body, we suggest both
19 weight related strengthening activities and stretches. Low level plyometric exercises and core
20 strengthening using activities such as planks can provide basic strengthening of the lower back
21 and hip. Weight based resistance training in form of gluteus extensions, leg press, squats, and
22 back extensions using machines can elicit strengthening of this area. Athletes could also modify
23 these by engaging in single leg deadlifts, as they target same muscles and joints. Incorporating a
24 modality and unstable surface challenges the athlete while allowing for the maximization of their
25 training benefits.
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40 *Single leg deadlifts with PRIMFIT*

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43 (Fig 2)

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46 Functional based training that could strengthen the athlete's lower back, hip, and upper leg
47 musculature could involve performing exercises such as single leg or "Romanian" dead lifts
48 coupled by holding a medicine ball or dumbbell. This mechanism allows for the use of body
49 weight in the forward and backward movements on a single leg. It also allows for the preparation
50 of the leg muscles to overcome various terrains. In addition, the athlete could work on
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3 strengthening through promoting stability and balance while using an unstable surface compared
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5 to regular running shoes.
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9 Stretching as a functional training approach, enables the elongation of various muscles
10 and improve flexibility. Several types of pigeon poses (sitting, reclining and forward) provide
11 strengthening and flexibility of various areas such as the pelvis. However, not all runners are
12
13 flexible enough to perform pigeon poses. One can modify the pigeon poses, by using the
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15 modified- seated leg crossed position or a squatting pigeon pose. To increase hip flexibility and
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17 strengthen the iliotibial band, athletes can slightly lean forward and hold for 10-15 seconds. This
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19 could be attempted 3 times before switching to the other leg. The modifications are necessary to
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21 avoid any accidental injury while allowing for gradual improvements in function. The PRIMFIT
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23 based modification can also strengthen other segments of the leg musculature. Squatting and
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25 seated modifications of pigeon poses allow for gradual improvements in function of the hips.
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32 *Modified Positions for Pigeon Poses (Seated and Squatting)*
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36 (Fig 3)

37 **Hip to Knee**

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41 The area between the hip and the knee is known to contain the largest anterior and
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43 posterior musculature of the human leg. These muscles are the prime contributors of various
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45 forms of human locomotion. In activities such as running, hamstring and quadriceps muscles
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47 generate force and aid in the execution of leg movements in running. This body segment is
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49 susceptible to a variety of injuries ranging from anterior knee pain, illiotibial syndrome, and
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51 patellofemoral syndrome (Verhagen, 2012) leading to aggressive knee pain with movement.
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55 Tight hip flexors also often arise from a variety of conditions ranging from weak gluteus to stress
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3 fractures. In addition, the section that contains the femoral bone might potentially have gait
4 challenges due to wider q-angles that are common in female athletes. Gait related disorders
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6 coupled with the increased mileage for runners account for higher incidences of musculoskeletal
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8 injuries in this specific area (Verhagen, 2012). Through activities such as leg press or squats that
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10 are commonly used, athletes can strengthen these areas. These could be modified by vertical
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12 jumps as well as stair jumps to elicit muscle strengthening of the gluteus muscles as well as
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14 strengthening other upper leg musculature. In addition, stretches can allow the increase their
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16 function. Regardless of the type of exercise chosen, a thorough screening and specific
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18 preventative routine is necessary. Stretches are also commonly used as a way of relieving
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20 tightness and tension.
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26 27 **Knee to Ankle**

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30 The segment between the knee and ankle contains the lower leg muscle commonly referred to as
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32 the calf. This area is comprised of the soleus and gastrocnemius. Common injuries in this section
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34 include Achilles tendinopathy and medial tibial stress syndrome (Verhagen, 2012). This segment
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36 is also susceptible to Chronic Compartment Syndrome (CCS) and its differential diagnoses of
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38 shin splints, stress fractures, and calf strains. There are several preventative exercises that
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40 promote elongation while strengthening the calf. The most commonly used is the toe raises or
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42 calf raises. Alternatively, calf raises can also be performed on a leg press machine, but purposely
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44 targeting the calf. There are no necessary modifications for this exercise, unless under a
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46 contraindication that is aimed at preventing further pain or injury. Continual injuries of the
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48 Achilles tendon are thought to lead to Achilles tendinopathy, a condition that is common in
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50 runners, who might experience it as a result of overuse injuries of that tendon (Yu, 2014). There
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52 are several suggestions for strengthening this body segment.
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Calf Strengthening

Lower leg strengthening for runners is vital, and would involve activities such as calf raises and calf drops. Perform 3 sets of 8-10 calf raising exercises, by standing on the ball of the feet and lowering back to flat surface. Position yourself standing on a flat surface. Place your feet closer together and raise your body upwards while pushing your heel off the ground. This allows the entire feet to extend while elongating muscles in your foot. Lower your heels back to the original position, and repeat this consecutively depending on ability. This is a typical heel raise intended for strengthening the gastrocnemius and soleus muscles that make up the entire calf muscle.

Alternatively, leg bounding and hurdle hops could also serve as calf eccentric exercises.

Athletes could also possibly reap strengthening benefits through a stability regimen for the lower body, and particularly targeting the calf using a combination of other modalities. A PRIMFIT product and protocol (Concealed Reference) could be utilized specifically to improve both eccentric and functional strength of the joints and muscles between the knee and ankle. Performing knee lifts while wearing a PRIMFIT product, and holding a medicine ball through extension and flexion of the arms, also allows for strengthening of other areas, such as the core musculature, while offering a challenge aimed at stability and balance.

Single leg and High Knee

(Fig 4)

Ankle to Toes

The area between the ankle and the toes is another important body segment for runners. This section accommodates the force generated from the foot striking the ground, propelling the body off the ground and in a repetitive motion. Although the majority of runners use mid foot strike

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3 (Thompson, et al, 2016), one can imagine, how strong, mobile, and stable the muscles and joints
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5 in this section need to be to prevent overuse injuries. A common injury in this location is
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7 plantar fasciitis (Verhagen, 2012). Although this form of inflammation is most prevalent in
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9 runners, individuals who are obese can also experience this condition. For long distance runners,
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11 we suggest several functional approaches that include cross training and other non-weight
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13 bearing activities for athletes that have history of this condition. This is in addition to lowering
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15 the total weekly mileage. Other suggestions include using band exercises that promote flexion,
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17 extension, inversion, and eversion of the ankle. Applying force towards the location of the band
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19 on the foot, affords the athlete different challenging scenarios that improve mobility of the ankle.
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24 *Ankle Band Exercises*

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27 (Fig 5)

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31 Alternatively, athletes can gain stable ankle, foot joints and musculature through
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33 performing a series of exercises supported by the PRIMFIT unstable surface product. Drills can
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35 be designed to improve ankle stability can incorporate cones, as well as single leg knee lifts with
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37 pulses.
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41 (Fig 6)

42 43 44 **CONCLUSION**

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46 The ability to apply the knowledge of strength and resistance training is vital for injury
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48 prevention. Coaches and athletes not only need the knowledge on proper injury prevention, but
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50 also the applicable strategies and modifications. The strategies we identified allow participants to
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52 enhance their regular training routines and are vital for continued participation with lower risk of
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54 injury.
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Figure 1



Figure 2



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Figure 3



Figure 4



Figure 5



Figure 6

