Distance Running: Injury & Intervention Pearls

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Given that Spring is upon us, many people will be working toward improving their fitness as the weather improves. One of the most common forms of exercise for improving and maintaining one's fitness is recreational running. This Industry Bulletin will focus on: 1) common overuse running injuries; 2) custom foot orthotic design for runners; 3) running shoe selection tips; and 4) the walk-to-run program.

Common Overuse Running Injuries

Over the past 30 years, running has become a popular method of improving and maintaining one's fitness. Along with increased participation comes an improved understanding of injury pattern and mechanism.

It has been estimated that ~27-70% of recreational and competitive runners will sustain an injury in any given year of running (Hreljac & Ferber. 2006). Injury pattern data suggest that the knee is the most common anatomical site of injury followed by the leg, ankle and foot, respectively (Clement et al., 1981; Taunton et al., 2002). Approximately 80-85% of all injuries occur at the knee or below.

The most common running injuries include: 1) patellofemoral pain syndrome (PFPS); 2) iliotibial band friction syndrome (ITBFS); 3) plantar fasciitis (PF); 4) meniscal injuries (MI); 5) tibial stress syndrome (TSS); and Achilles (AchT) and patellar (PatT) tendinopathies (Taunton et al., 2002). When compared to their female counterparts, males reportedly suffer more PF, MI, AchT, PatT, and gastrocnemius injuries. Conversely, females report suffering more PFPS, ITBFS, gluteus medius and sacroiliac injuries (Taunton et al., 2002; Ferber et al., 2003).

Apparent differences in running injury patterns between males and females have led scientists to try to identify biomechanical differences between male and female runners. In recent work by Ferber et al. (2003), the authors reported that female subjects exhibit significantly greater maximum hip adduction and internal rotation, and knee abduction angles. This finding has initiated interest in hip dynamics and muscular strength about the hip. Ferber has reported that many of his clients that present to his clinic exhibit hip muscle weakness and that symptoms markedly improve with rigorous hip muscle strengthening (Ferber et al., 2007).

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This research has led to an interesting discovery regarding the efficacy of hip strengthening in the management of overuse knee injuries. Ferber has reported that of approximately 165 patients who presented to the clinic with an overuse injury (33% PFPS & 25% ITBFS), 90% of the patients exhibited strength deficits in the external rotators and abductors of the hip. With a prescribed exercise regimen to address this weakness (Table 1), approximately 90% of the patients reported decreased pain related to their injury within 4-6 weeks (Ferber et al., 2007).

Table 1: Hip Strengthening Exercises

Hip Abduction Exercises (Figure 1):

- Standing position
- Place opposite foot behind band
- Abduct hip moving involved limb outward
- Controlled movement: 2 sec. ABD and 2 sec. ADD

Hip External Rotation Exercises (Figure 2):

- Seated position
- Externally rotate hip outwards
- Keep knees together
- Controlled movement: 2 sec. ER and 2 sec. IR

Hip Flexion Exercises (Figure 3):

- Standing position
- Hip flexion with knee straight
- Controlled movement: 2 sec. FL and 2 sec. EX

Day	Sets	Reps
1	1	10
2	2	10
3	2	10
4+	3	10

*Note: Exercises are always performed following a run. For more information, please visit: www.runninginjuryclinic.com

Figure 1: *Hip Abduction Exercises*

Figure 2: *Hip External Rotation Exercises*

Figure 3: *Hip Flexion Exercises*

Custom Foot Orthoses for Distance Running

When designing orthoses specifically for running, there a few biomechanical factors that need to be considered. In 2001, we wrote an article in *Clinics in Podiatric Medicine and Surgery* (18(2): 217-223) that provides a great deal of detail on this subject. When designing foot orthoses for distance running, it is important to consider that: 1) the maximum vertical ground reaction forces insulted on the body are 2-3X body weight compared to 1.3-1.5X for walking; 2) the velocity of pronation is 5X greater than during of walking; and 3) increased hip adduction during running leads to a narrow base of support and increased *running limb varus* (Cavanagh, 1987; Ounpuu, 1994).

The net effect of these three biomechanical factors is that: 1) the foot and ankle are subjected to ground reaction forces

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of a greater magnitude; 2) the plantar aspect of the foot exhibits an increased varus attitude relative to the ground prior to contact; and 3) the velocity of pronation increases by a factor of five.

Given the magnitude of forces involved during running, force attenuating properties should be incorporated into the design. This can be partly accomplished by including a full length, cushion top cover material. 3 mm Neoprene or EVA (*Microcel Puff*) are the top covers of choice. In addition, the orthotic shell material and design can enhance force attenuation. With runners who present with an **impact-type injury** and/or **limited range of motion**, we have had success with the *Impact* orthoses (Figure 4).

Figure 4: *Impact Orthoses*

The lab standard *Impact* orthosis consists of:

- Semi-rigid Polypropylene shell with Poron arch fill
- 16mm heel cup depth
- *Functional* shell grind
- 3mm *Puff* top cover with 1.5mm EVA bottom cover

If the goal is to **increase support and stability**, the *Standard Sport* orthosis is indicated (Figure 5). The lab standard *Standard Sport* orthosis includes:

- Semi-rigid Polypropylene shell
- 16mm heel cup depth
- Sport *Functional* shell grind
- Extrinsic rearfoot post with nylon strike plate
- Full length 3mm *Neoprene* top cover

As is always the case, our customers are welcome to choose alternative orthotic shell materials or components.

Figure 5: *Standard Sport Orthoses*

Shoe Selection Tips

In this section of the *Industry Bulletin* we will discuss the expiration, manual testing of integrity, shoe fitting and maintenance of running shoes.

On determining whether footwear has expired:

In order to determine whether the footwear has expired, an inspection should include: 1) the entire shoe from a posterior view; 2) the midsole; and 3) the outsole. By positioning the shoe on a flat surface and inspecting the shoe from a posterior view, the clinician can assess whether the heel counter is perpendicular to the supporting surface or not (Figure 5A). Distortion inwards (eversion) or outwards (inversion) is a sign of fatigue and may provide an indication of running dynamics.

The next step is to have a close inspection of the midsole of the shoe (Figure 5D). Creases or lines in the midsole indicate that the materials have fatigued. Common sites of fatigue include the midsole at the posterolateral corner and inferior to the 1st MTPJ. Lastly, inspection should include the outsole. Marked wear of the outsole will compromise traction and may show signs of a sagittal plane deficiency (Figure 5B).

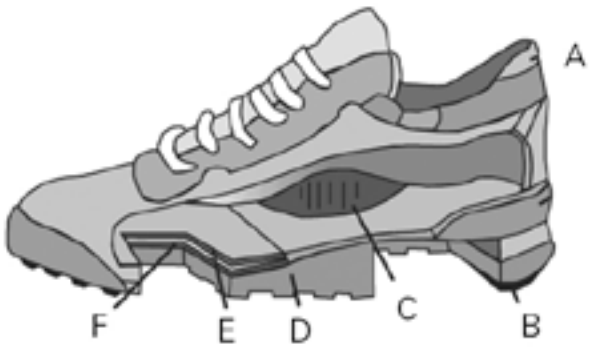

Figure 5: *Shoe Anatomy*