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Occurrence of right vs. left side injury location in elite sprinters who train on an oval 400m track

By Thomas R. Ayres, Marc S. Gottlieb

ABSTRACT

The aim of this review is to establish whether a correlation exists between curvilinear running on a 400m track and injury location among elite sprinters. Case files of 20 elite sprinters from four different countries were analysed for the location of subjective complaints. The athletes were grouped into long sprinters (200-400m), short sprinters (200m and less), and hurdlers by their primary competition event. Areas of complaints were categorised into multiple right and left lower extremity areas, general low back and right-sided vs. left-sided lower back pains. Multiple trends were noted among the groups studied. The most prominent trend was that of posterior hip and thigh complaints (hamstring group). In this category, the left-sided complaints outnumbered the right-sided complaints by more than two to one in both groups of sprinters. The authors conclude that there may be a relationship between counter-clockwise curvilinear running among elite sprinters and complaints of injuries to certain anatomical regions.

AUTHORS

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Introduction

Familiarity with sports-specific injuries is a valuable asset to any practitioner who works with athletes. The more aware one is of potential injury locations, the more prepared the clinician will be to treat the injury, as well as to make recommendations to the athlete and the athlete's training staff to help avoid potential injury.

The "World-Class" or "Elite" athlete brings many additional challenges for the clinician due to the intensity and duration of the training, as well as the athlete's motivation to participate while injured. The primary author

noticed certain similarities, both upon field assessment and during office examinations, with this group of athletes, regarding the event for which the athlete trained and the location of the complaints they reported. With this in mind, a retrospective case review was conducted to determine what, if any, correlation exists between the area of complaint reported by the athlete and the event for which the athlete was training.

Clinical features

Elite sprinters, like most elite athletes, incorporate various training methods to improve the performance of their respective event. Strength, plyometric, speed, and endurance training are a few key elements in this practice. While some of these activities can be performed off the track, in a weight training facility, for example, most training takes place on a 400m track.

A standard 400m track is oval in shape and consists of eight or more lanes, each with two straight and two curved aspects. The track is essentially flat with lateral slope allowance of 1:100 for water drainage and a 1:1000 allowed in the direction of running[1]. Competitions for races above 200m take place with athletes running counter-clockwise; therefore, training primarily takes place in the counter-clockwise direction.

It has been suggested by several elite athletes and coaches that the unavoidable inward lean experienced while running the curved aspect of the track lends itself to injury to the lower left side of the body[2,3,4]. Previous studies have suggested that curvilinear running may create an asymmetrical change in lower limb strength or muscle imbalance[5]. The authors performed a Medline search of English language references and are unaware of any studies that address the occurrence of injuries in elite level sprinters with regard to the side of reported complaints.

Clinical notes from the primary author's office were reviewed, including files of 20 elite sprinters from four different countries spanning a three-year period. Thirteen males and seven females, ranging in age from 20-35 years old, with self-reported lower extremity and/or lower back complaints that required physician evaluation and treatment were included.

One hundred eight (108) separate complaint episodes were classified. An "episode" was considered an uninterrupted period of treatment for a specific complaint. Separate complaints, for example, left foot swelling and right posterior hip and thigh pain experienced during the same time period, were each considered as individual episodes and were classified separately.

The retrospective case study group included six current world record holders, five world champions, and eight Olympic gold medallists from the 2000 Summer Games. For this report, an elite sprinter is defined as a runner who has participated in at least one international competition of 400m or less (including hurdles).

Cases were separated into groups based on the predominant event the athlete trained for, as well as the body location of the subjective complaint. Events were grouped into short sprinter (200m or less), long sprints (200-400m), and hurdles. Subjective complaints were grouped into general categories (see Table 1).

Table 1: Complaint categories

- Non-specific lower back pain
- Left anterior hip and thigh
- Left posterior hip and thigh
- Left lateral hip and thigh
- Left medial thigh
- Right anterior hip and thigh
- Right posterior hip and thigh
- Right lateral hip and thigh
- Right medial thigh
- Left leg, ankle, and foot
- Right leg, ankle, and foot
- Left-sided lower back
- Right-sided lower back

Results

Findings revealed the reported number of complaints in short sprinters were higher per athlete (6.88) than the number reported by long sprinters (3.85) or hurdlers (4.75) for the period evaluated.

The greatest single complaint among short sprinters was that of non-specific lower back pain accounting for 22 of the 62 (35%) complaints reported. With regard to the total complaints reported in all groups, short sprinters accounted for 70% of medial thigh and 79% of leg, ankle, and foot complaint episodes.

With regard to side differential, short sprinters with left medial thigh complaint episodes outnumbered those with right medial thigh complaint episodes 5:2. No significant difference was noted in this area in the long sprinter or hurdler group.

In both sprint groups, left-sided posterior hip and thigh complaint episodes had a greater than 2 to 1 ratio over right-sided posterior hip and thigh complaint episodes (7:3 in short sprinters, 3:1 in long sprinters) (see Figure 1).

No group demonstrated prevalence in anterior hip and thigh complaint episodes or in left to right leg, ankle, and foot complaint episodes.

Hurdlers were the only group with complaint episodes involving lateral hip and thigh, and all complaints were on the left side. It should be noted, however, that no conclusions could be established from this small group.

Right-sided versus left-sided lower back pain revealed that long sprinters had 80 percent of complaints listed on the left; short sprinters had the exact opposite finding.

In long sprinters, left-sided lower back complaints combined with left posterior hip and thigh complaints accounted for 37% of the total of all complaint episodes reported (see Figure 2).

Discussion

Sprinting has become extremely technical in recent years[3]. Mechanically, sprinting on an elite level can been broken down into five specific phases (see Table 2).

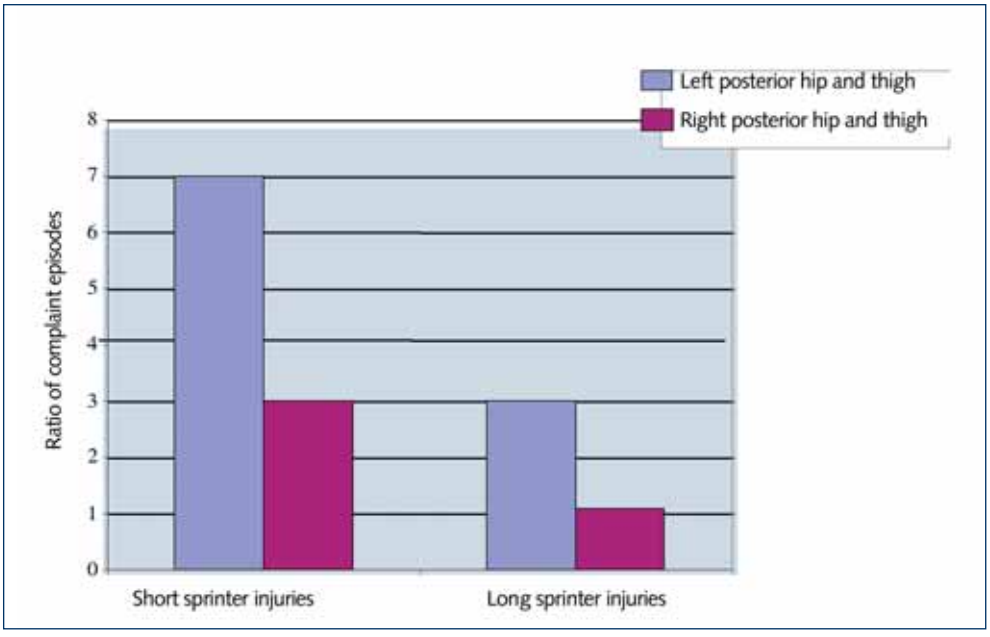

Figure 1: Ratio of left-to-right posterior hip and thigh complaints

Table 1: Sprint race phases

1. Clearing the blocks (the start)
2. Drive phase
3. Transition phase
4. Acceleration phase
5. Deceleration phase

While it is not within the scope of this paper to elaborate on the mechanical aspects of sprinting, each technical phase stresses various parts of the body. Running into a turn on an oval track at high speed requires the athlete to lean inward in order to counteract the forces of inertia, which will, in effect, create uneven stress forces that are transmitted up the kinetic chain of the lower extremity, from the feet upward through the legs and thighs, into the trunk. GREENE[6] has shown that this inward lean not only causes a speed reduction due to increased foot contact time with the track, but is also dependent on which lane the athlete competes in. According to Greene, athletes running in the outer-most lanes of a conventional 400m track have a distinct mechanical advantage with regard to speed over those running in the inner-most lane by up to 0.123 seconds in the 200m race and up to twice that amount in the 400m race[6].

With regard to injury, research supports the premise that sprinters tend to suffer acute musculo-skeletal injuries more often than other runners[7,8]. Our study suggests short sprinters are injured more frequently than their longer sprint counterparts. Training for explosiveness and power, which allows the athlete to reach top speed quickly, may be the reason for this higher incidence of acute musculo-skeletal injuries in the short sprinter group. Because an explosive start is such an essential aspect of the short sprint event, training for the start is done on a fairly regular basis and may account for the higher incidence of medial thigh complaints in short sprinters. This is most likely due to the sudden, forceful activation of the hip flexor and adductor muscles in this region being used in initiating movement from the four point starting position of the first phase of sprinting[9].

Muscle energetics are also different for short sprinters compared to longer sprinters and should be considered as well. Athletic events, such as short sprints, have explosive energy demands that utilise the phosphagen system to create energy, whereas those events requiring high energy exceeding 10 seconds and up to three minutes need to create energy by both the phosphagen system and by anaerobic glycolysis[10]. Whether this plays a significant role in injury occurrence is not yet known.

The frequency of injuries of the leg, ankle, and foot is known to be higher in distance

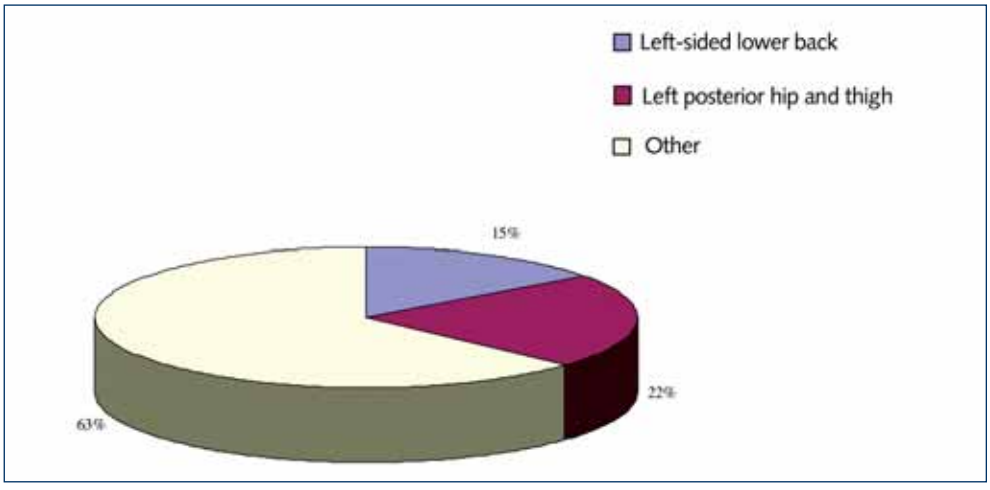

Figure 2: Long sprinter complaints

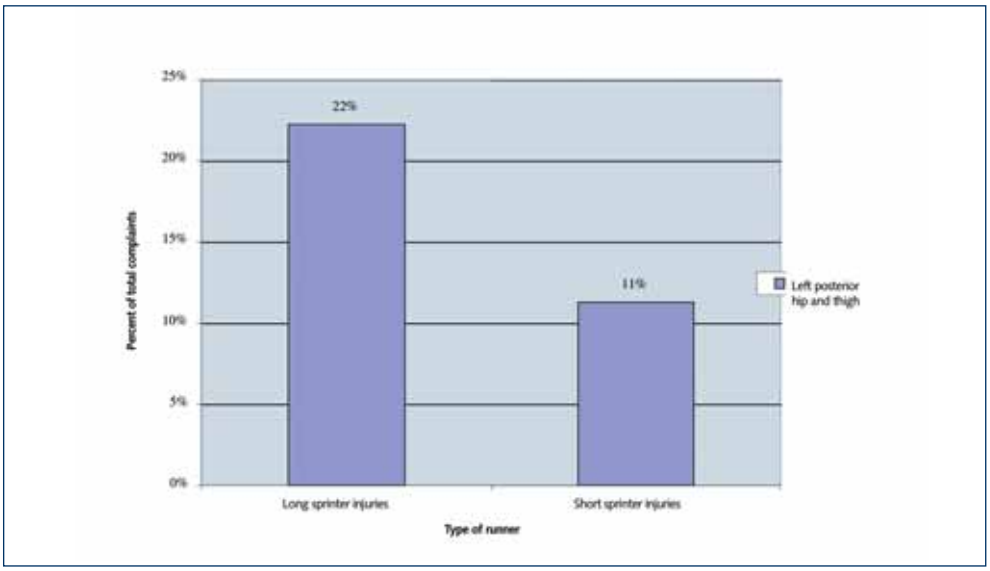

Figure 3: Left posterior hip and thigh complaints

runners and are most commonly associated with repetitive stress[7,8]. Our study revealed that complaints of the leg, ankle, and foot (12 of 14 incidents) dominated with regard to short sprinters. Explosive training, as opposed to repetitive stress, is felt to be the causative factor involved in this finding.

In a 12-month study of musculo-skeletal injuries in track and field, BENNELL[7] points out that sprinters and hurdlers sustain significantly more hamstring injuries than other track and field athletes. He also attributes this to the explosive and dynamic nature of the event. Our review goes further in specificity, noting that complaint episodes of the left posterior hip and thigh predominate over the right posterior hip and thigh in both groups of sprinters. This may represent the effect of increased stress up the left lower extremity and into the pelvis created by inward (left) leaning while running the curve. Most long sprinters train by running on the curve more than short sprinters, as the longer race will require this aspect of running twice as often[3]. It is not surprising that left-sided hip and thigh complaint episodes make up a larger percentage of total complaint episodes in long sprinters (22 percent) compared to short sprinters (11 percent) (see Figure 3).

The majority of posterior hip and thigh complaints seen by the primary author were diagnosed and treated as hamstring injuries.

With regard to side specific lower back pain, we expected to see similar findings among all the groups due to left-to-right sheer force differences affecting sacroiliac joint laxity and possibly the facet joints of the lumbar spine as a result of curvilinear running, but we did not. Long sprinters did complain of left-sided lower back (or sacroiliac joint) pain 80 percent of the time. However, 80 percent of the short sprinters complained of right-sided lower back (or sacroiliac) pain.

While evaluation of running injury complaints must address dysfunction in the lower limb kinetic chain, one must be careful not to overlook the importance of the abdominal musculature. RICHARDSON'S[11] biomechanical model of spinal loading emphasises the transversely oriented abdominal muscles (transversus abdominis and lower portions of internal oblique) in stabilising the sacrum between the ilia under a load. Richardson believes this stabilisation, along with co-contraction of multifidi, is beneficial in relieving pain and lowering

disability in patients with chronic lower back pain. Focusing on specific exercises that target transversely oriented abdominal muscles in sprinters could potentially reduce not only the incidence of injury to the lower back and pelvis, but also reduce injury to muscle groups associated with lumbo-pelvis-hip dysfunction[12], such as the hamstrings, hip adductors, iliopsoas, tensor fasciae latae, piriforis and others. This should be considered for future study.

Conclusion

The data collected in this review seems to support the correlation between curvilinear running in a counter-clockwise direction on an oval track and a higher incidence of left-sided lower extremity injuries with regard to certain muscle groups. Future studies may wish to investigate alternative training and rehabilitative techniques that consider the potential injury locations this review suggests are common among elite sprinters.

It should be noted that while no final conclusions can be made due to the limited group size and retrospective nature of this review, some interesting trends for further investigation were elucidated.

Acknowledgments

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