Iliotibial Band Syndrome: Treatment of Hip Kinematics and Muscle Imbalances, a Biomechanical Approach

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Introduction:

Iliotibial band syndrome was first described by James Renne in 1975 as a painful and disabling condition in the lateral knee during military training.[1] He observed sixteen cases among one thousand recruits, all exhibiting a limp and pain during walking or running. The symptoms were aggravated with running over two miles or hiking over ten miles. Symptoms eased with straight leg walking. He described a painful range of 30 to 40 degrees of knee flexion.

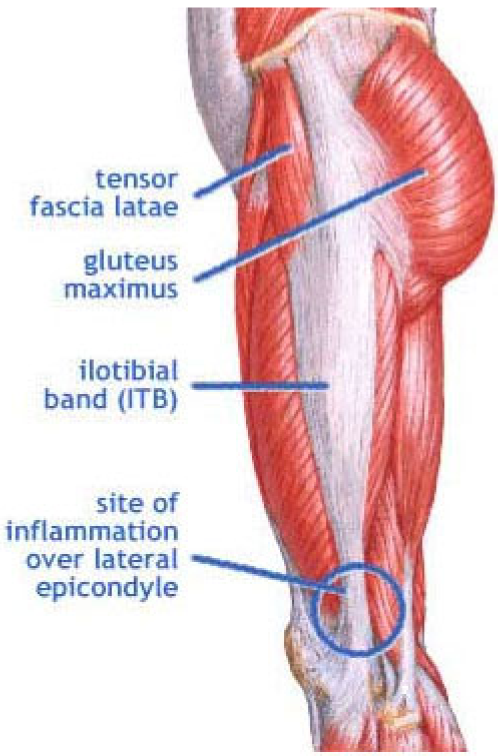

Figure 1: The circle marks the iliotibial band at the lateral epicondyle of the femur. Note the relationship of the gluteus maximus and tensor fascia latae as lateral hip stabilizers, and interrelationship with the iliotibial band. Note the extensions to the iliac crest, patella, and below the knee.

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Tauton et al. performed a retrospective case analysis of 2002 running injuries and reported iliotibial band syndrome as the second most common injury to patellofemoral pain.[3] Tauton reported a frequency of iliotibial band pain as 3% of male runners and 5% of female runners. The incidence of iliotibial band syndrome is approximately 1.6% to 12% in running[4-7] and 15% in cycling.. [8, 9]

Risk factors for iliotibial band syndrome focus on the thirty degree flexion strain area on the lateral epicondyle of the femur.[3-5, 10-13] In 1980, Noble used the thirty degree knee flexion compression test over the lateral epicondyle to formally diagnose iliotibial band syndrome in one hundred cases.[14] Orchard described the problem as an impingement zone around 30 degrees knee flexion during the deceleration phase after heel strike.[13]

The iliotibial band is a fascia tissue extending from the iliac crest to the distal femur and proximal tibia. [11, 15-17] The fascia connects into portions of the gluteus maximus, minimus and tensor fascia lata muscles.[15, 16] Fairclough et. al. analyzed the functional anatomy through dissection of 15 cadavers, and magnetic resonance imaging of six controls and two athletes with acute iliotibial band syndrome.[15] The strong and fibrous insertions into the distal femur occurred just proximal to and sometimes into the lateral epicondyle of the femur. The femur insertion was distinguished by oblique orientation and adipose tissue underneath. Fairclough suggested that this insertion functioned as a secure tendon, without sliding anterior to posterior as suggested by other researchers. He concluded that iliotibial band syndrome was not a friction syndrome. Rather the strong insertion encountered compression evidenced by the magnetic resonance imaging and finding of pain sensitive adipose tissue under the insertion.. Inflammation of this adipose tissue was proposed as a pain generator. Given adipose tissue pain and inflammation rather than tendinous soft tissue injury, the use of transverse friction massage at the injury may be less effective. [18]

Fairclough described the distal extension into Gerdy's turbercle and the patella as a ligamentous tissue that tightens with posterior tibia motion.. The proximal tibia moves posterior with knee flexion.[19]Concurrently, the tibia will internally rotate with walking and excessive toe in will add tension to the iliotibial band..[20, 21]

Research supports an etiology that is multifactorial with both extrinsic and intrinsic contributing factors. [9, 21, 22] Orchard et. al. described factors extrinsic (i.e., training distance and intensity) and intrinsic (i.e., tightness and alignment). Messier et. al. compared normal and injured subjects and observed that training mileage and breaking force were discriminatory factors. [6] He suggested that overall strength may be a factor in distance running and iliotibial band syndrome.

Central to intrinsic factors is the finding of maximum compression of the iliotibial band into the lateral epicondyle of the femur at 30 degrees of knee flexion as confirmed on MRI studies by Fairclough.[11, 15] Fredericson et. al. described risk factors in terms of reduced eccentric control of the hip after heel strike due to weak hip abductor muscles.[4, 12] Niemuth et. al. reported weakness in the hip abductors in a variety of running injuries to the knee. Noehren et. al. found increased hip adduction and knee internal rotation after heel strike to mid stance in females with iliotibial band syndrome. [23, 24]Hamill et. al. observed increased iliotibial band strain rate and slight association to increased hip adduction and internal rotation during stance phase.[25]

Compared to running, cycling has lower impact force and less impingement time per cycle, but greater repetitions at 4800 repetitions per hour (6600 repetitions total) in a 1.25 hour ride versus 4800 repetitions in a 10-km jog.[8, 9] Another difference between cycling and running is the fixed foot position and related bicycle fit issues.[9, 21] The bicycle fit is an extrinsic factor that can position the iliotibial band in the impingement zone under increased strain (i.e., toe in). Training factors exist in both sports such as increased risk with training on hills and sudden changes in the mileage, as well as experience and skill level.[6, 8]
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Varus alignment of the knee has been cited as a biomechanical factor.[17] Tauton et. al. reported varus alignment in 33% of cases with iliotibial band syndrome.[3] The varus alignment combined with weak lateral hip muscles creates an accentuated varus moment that opens the lateral compartment and pivots on the medial compartment as described by Andriacchi.[20] Figure 2 illustrates the relationship between center of mass shifting away (right) and increased lever arm and varus moment on the stance leg (left).

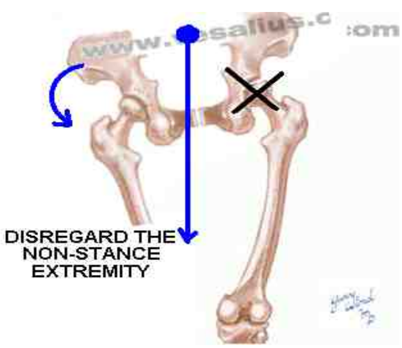

Figure 2 The (X) marks the stance leg. The opposite hip falls because the stance leg has weakness in the hip abductors.

Varus knee related to center of mass shifting away causing a force that pushes outward on the knee, a varus moment.[26].[20] Intrinsic factors such as a weak hip abductor muscle can produce this shift as described in the Trendelenburg test.[27] A similar varus moment may exist in the cyclist during the down stroke, especially if the stroke leg is longer.[21]

In contrast, a valgus knee has been observed in cases of iliotibial band syndrome.[3] Tauton et. al. observed that 25 of 164 cases of iliotibial band syndrome in runners had valgus alignment versus 54 in varus alignment. This observation seems to be explained by excessive strain to the iliotibial band with increased hip adduction and/or femur internal rotation.[14, 23, 25] As illustrated in Figure 2, a weak hip abductor may result in a Trendelenberg sign and excessive hip abduction in stance. The issue of excessive hip adduction and femur internal rotation has been described by Fredericson as weak gluteal muscles in poor balance with the tensor fascia lata.[4, 12, 28]

Understanding the mechanisms that cause iliotibial band syndrome is important for analyzing co-morbidity and functional lifestyles. No study was found that connects iliotibial band syndrome to other knee problems. Although, the underlying factors have implications that suggest medial compartment syndromes are related such as abnormal varus moments and internal rotation at the knee.[20] The biomechanical relationships are worth analysis since medial compartment problems can lead to long term functional loss and costly medical procedures (i.e., total knee replacement).

Summary Points:

1. Strong gluteus maximus and medius muscles reduce risk of iliotibial band syndrome.

2. Control running and cycling progressions.

3. Strengthening may reduce risk by improving deceleration after heel strike.

4. If irritated, avoid training in the impingement zone around 30 degrees knee flexion.

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