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Review Article / Derleme

Intrinsic risk factors associated with iliotibial band syndrome: A systematic review

İliotibial bant sendromu ile ilişkili içsel risk faktörleri: Sistematik derleme

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ABSTRACT

Objective: Iliotibial band syndrome (ITBS) is the second most common running injury and the leading cause of lateral knee pain. Despite the numerous investigations on the subject, the intrinsic risk factors that may be involved in the syndrome have still not been highlighted and no consensus has been established in the literature. The objective of this systematic review is to investigate intrinsic risk factors associated with iliotibial band syndrome in order to provide an algorithm for future research and clinical guidance.

Material and Methods: A systematic review of the literature was carried out according to the PRISMA guidelines, in the PubMed and ScienceDirect databases in order to identify studies investigating different parameters on patients with the syndrome since 2015; the date of the last systematic review on the subject.

Results: Ten studies met the inclusion criteria of this review: cohort (n=1), cross-sectional study (n=8), case-control study (n=1). The results show that subjects with iliotibial band syndrome show atypical frontal plane kinematics in the hip and knee joint, a more prominent lateral femoral epicondyle, thickening of the iliotibial band, femoropatellar abnormalities and less resistance to fatigue of the gluteus medius muscle.

Conclusion: This review offers opportunities in the management of ITBS. Some morphological, neuromuscular, muscle strength and biomechanical factors have been identified specific to ITBS patients. However, this work has several limitations; a small number of included studies, a lack of high-level studies, and methodological biases. Further studies, including randomized controlled trials and prospective studies are needed to reveal strong relationships between intrinsic risk factors and the onset of the syndrome.

Keywords: *Iliotibial band syndrome, iliotibial band friction syndrome, intrinsic risk factors, runner's knee*

ÖZ

Amaç: İliotibial band sendromu (ITBS), ikinci en yaygın koşu yaralanmasıdır ve lateral diz ağrısının önde gelen nedenidir. Konuyla ilgili çok sayıda araştırma olmasına karşın, neden olabilecek içsel risk faktörleri hala kesin olarak tanımlanamamış ve bugüne kadar bir fikir birliği oluşmamıştır. Bu sistematik incelemenin amacı, gelecekteki araştırmalar ve klinik kılavuzlar için bir algoritma sağlamak için iliotibial bant sendromu ile ilişkili intrinsik risk faktörlerini araştırmaktır.

Gereç ve Yöntemler: Konuyla ilgili son sistematik incelemenin yapıldığı tarih olan 2015'ten bu yana hastalarda farklı parametreleri araştıran çalışmaları belirlemek için PubMed ve ScienceDirect veri tabanlarında PRISMA kılavuzlarına göre sistematik bir literatür taraması yapılmıştır.

Bulgular: Bu incelemenin dahil edilme kriterlerini karşılayan on çalışma bulunmuştur: Kohort (n=1), kesitsel çalışma (n=8), vaka kontrol çalışması (n=1). Sonuçlar, iliotibial bant sendromlu deneklerin kalça ve diz ekleminde atipik frontal düzlem kinematiği, daha belirgin bir lateral femoral epikondil, iliotibial bantta kalınlaşma, femoropatellar anormallikler ve gluteus medius kasının yorgunluğa karşı daha az direnç gösterdiğini göstermektedir.

Sonuç: Bu gözden geçirme ile ITBS tedavisi konusunda öneriler sunulmaktadır. ITBS'li deneklere özgü bazı morfolojik, nöromüsküler özellikler ile kas kuvveti ve biyomekanik faktörler tanımlanmıştır. Bununla birlikte, bu çalışmanın sınırlamaları vardır; dahil edilen çalışma sayısı azdır, üst düzey çalışmaların eksikliği ve metodolojik farklılıklar söz konusudur. İntrinsik risk faktörleri ile sendromun başlangıcı arasındaki ilişki hakkında daha güçlü sonuçlara varmak için randomize kontrollü çalışmalar ve prospektif çalışmalar dahil olmak üzere daha ileri çalışmalara ihtiyaç vardır.

Anahtar Sözcükler: *İliotibial bant sendromu, iliotibial bant sürtünme sendromu, içsel risk faktörleri, koşucu dizi*

INTRODUCTION

Iliotibial band syndrome (ITBS) is a common overuse injury in runners, cyclists, and military recruits. ITBS is recognized as the leading cause of lateral knee pain in runners, and is the second most common cause of running injuries (1). Patients do not mention any traumatic history associated with this pain and describe it as strong, acute at the level of the lateral femoral epicondyle (LFE), during flexion-extension movements, when the knee is flexed between 25° and 35°, forcing the cessation of physical activity (2). Diag–

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nosis is usually based on a characteristic history and clinical examination.

Two theories are put forward regarding the emergence of ITBS. The most widespread theory recognized by many authors (3-8), characterizes the ITBS as an excessive friction of the distal segment of the iliotibial band (ITB) on the LFE, during the flexion-extension movement of the knee. This theory is challenged by studies describing the compression model (9-11). This theory asserts that ITBS arises due to an increased compression of the richly innervated and vascularized fatty tissue located between the ITB, the LFE and the periosteum. The theory of compression is currently more accepted even though the evidence provided by the literature is not sufficient to refute previous hypotheses. In any case, the literature unanimously reveals an abnormal increase in the compressive forces of the ITB against the LFE increasing the phenomenon of inflammation, irritation and therefore pain (4,7,10,12).

Some authors support the idea that the syndrome manifests itself with the presence of several extrinsic and/or intrinsic factors that modifies the kinematics of movement, the dynamics of joint angles, and therefore potentially increase tension in the ITB (9,13,14).

The most common extrinsic risk factor, reported in the literature is the patient's training load. Other factors like the training surface, for example are also cited (12,14-16).

With regard to intrinsic risk factors, the different meta-analyses suggest that biomechanical differences exist between runners with ITBS and healthy runners. The results of these different systematic reviews are not consistent and reveal a reduced (16) or increased maximum hip adduction (17) in ITBS subjects. Van der Worp et al. (2) observed an increased internal tibial rotation in ITBS patients in contradiction to other researchers (16) who reported a decrease in internal tibial rotation.

In one study, researchers observed a significant decrease in eversion of the hind foot during heel strike in ITBS patients (18). One of the meta-analyses also showed an increase in the ipsilateral lateral flexion of the trunk in subjects with ITBS but this information does not allow firm and valid conclusions to be drawn (17). Researches on muscle factors are not consistent. Two studies have reported decreased isometric hip abductor strength in runners with ITBS or in a cohort of injured runners including runners with ITBS (19,20) but other studies do not confirm these data since no difference has been observed in isometric or concentric muscle strength between runners with ITBS and healthy runners (21-23). No consensus has yet been reached to systematically highlight the intrinsic risk factors involved in the syndrome and blurred areas remain ubiquitous. These differences do not allow a deep understanding of the pathology and may imply an inadequate therapeutic management in the clinical field. The latest systematic review acknowledges the misunderstanding and contradictory nature of pathology, and recommends other scientific studies that are more rigorously conducted and less biased methodologically (14). This study aims to identify the literature, in order to highlight a precise consensus established by scientific research since 2015 regarding the intrinsic risk factors associated with ITBS.

MATERIAL and METHODS

Data sources and searches

To carry out our systematic review, we relied on the Preferred Reporting Items for Systematic Reviews and Meta Analyses (PRISMA) guidelines (24).

The article search started on October 22, 2020 and was conducted from the Medline and Elsevier databases, using their specific search engine, Pubmed and ScienceDirect respectively. We used different keywords according to the PICO model. The Boolean operators "AND" and "OR" allowed us to develop our various Boolean equations and are as follows: "iliotibial band syndrome" OR "iliotibial band impingement syndrome" OR "iliotibial band friction syndrome" OR "iliotibial band strain", ("iliotibial band syndrome" OR "iliotibial band strain") AND ("aetiology" OR "pathogenesis"), "iliotibial band syndrome" AND ("individual parameters" OR "anatomy" OR "biomechanics" OR "neuro-muscular" OR "strength" OR "kinematic").

Inclusion criteria based on PICOS

<u>Population</u>: a study of patients (>18 years) with or developed ITBS during the study.

<u>Intervention</u>: study aimed at studying the individual parameters of the lower limbs, trunk and pelvis, being involved in the development of an ITBS.

<u>Comparison</u>: a study comparing individual differences between patients with ITBS and healthy patients, regardless of sex.

<u>Outcomes</u>: study looking at least one of the following parameters: anatomical, biomechanics, neuromuscular, kinematics, strength.

<u>Study design</u>: inclusion of meta-analyses and systematic reviews of the literature randomized controlled trials and observational studies (cross-sectional study, cohort study, or case-control study) that scored ≥ 70% on the Joann Briggs Institute (JBI) evaluation grid. Study written in English or French. Studies published from April 2015; date of

the last systematic review, conducted on the same subject (17) until June 2022.

Exclusion criteria

Studies investigating corpses or animals, comparing biomechanical differences between male and female patients, articles not having been validated through a peer review process were excluded from this review.

Study selection and data extraction

Two authors (RE and BC) reviewed retrieved articles independently. The different search equations were submitted to the PubMed and ScienceDirect engines. Additional research was carried out from the reference list of the selected articles. All the resulting items were collected, sorted and filed in an Excel sheet in order to remove duplicates. Then, a double reading was done by both authors; the first author focused on the title, the abstract, the year of publication and the peer-reviewed validation. The second focused on the methodological quality of the articles.

In order to measure the methodological quality of the different studies, the use of the JBI checklist was chosen to build a quality score. The minimum percentage of 70% was retained to include an article in our study.

Risk of bias assessment

The risks of bias were identified through the Cochrane Collaboration tools for assessing risk of bias in randomized trials interpretation developed by the Cochrane Collaboration (25). Two authors (RE and BC) carried out the scoring independently. Consensus was reached by discussion between the 2 authors (RE and BC). A third review author (VTD) was consulted if disagreement persisted.

RESULTS

Search results

Initial searches based on the various Boolean equations led to 834 articles: 340 on Pubmed, 489 on ScienceDirect, and 5 articles identified from the bibliographies of the articles. After removing duplicates, the total number of items was 244. Reading the excerpts, 182 references were excluded, which were deemed irrelevant to our study. At this stage, the remaining 62 references were subject to our eligibility criteria: 38 papers were excluded because they did not evaluate any of the parameters mentioned in our eligibility criteria, 11 did not meet the minimum score of 70% on the JBI reading grid, three articles were also excluded because they compared data between men and women diagnosed as ITBS. Although it met the eligibility criteria one paper was excluded, because its data was not usable due to a lack of clarity in the results according to the authors of this review (Figure 1).

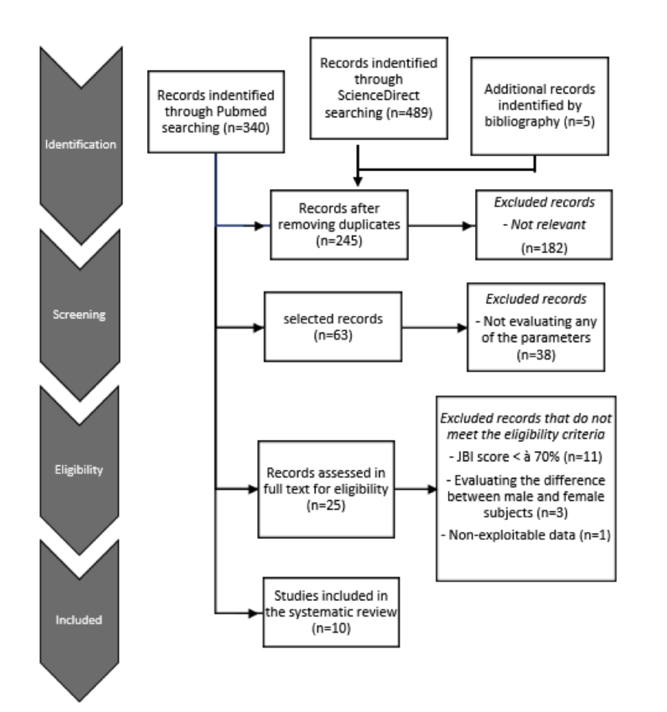

Figure 1. Study selection process

Study selection

Ten studies passed all selection steps and were included in this systematic review. One study is prospective in nature (cohort study), eight studies are cross-sectional studies, and one is a case-control study. All studies, except three of them (26-28) looked at biomechanical or neuromuscular differences between pathological and control groups. The three most recently cited studies analyzed morphological factors (ITB diameter, patellofemoral measurements and LFE size) by comparing healthy subjects and ITBS subjects. Two studies compared pure isometric muscle strength between pathological and control groups (29,30). Finally, three studies investigated whether fatigue affected healthy subjects differently from subjects with ITBS (29,31,32) (Table 1).

Table 1. Characteristics of the included trial

Author(s)	Year	Design	Sample (n)	Analysed parameter	JBI Score (%)
Agridag-Ucpinaret al.	2021	Cross- sectional study	192	Diameter of the ITB via MRI	100
Baker et al.	2018	Cross- sectional study	30	Neuromuscular activity (IVMC) of Gmax, Gmed and TFL, biomechanics of the hip (Add) and knee (Add)	75
Brown et al.	2016	Cross- sectional study	32	Hip biomechanics (Add, Abd, IR, ER) and fatigue esistance of hip abductors	75
Brown et al.	2019	Cross- sectional study	32	sometric muscle strength of Gmed, neuromuscular activity of Gmed and TFL and atigue resistance of Gmed	88
Everhart et al.	2019	Case control study	150	Size of lateral epicondyle	100
Foch et al.	2019	Cross sectional study	36		88
Foch et al.	2020	Cross- sectional study	30	Neuromuscular activity (CMVI) of Gmed, hip biomechanics (Add) and fatigue resistance of hip abductors	100
Hamstra-Wright et al.	2020	Cross- sectional study	17	Isometric muscle strength of hip abductors and adductors, biomechanics of the hip (Add, Abd) and knee (IR, Fl, Abd)	88
Li et al.	2021	Cross- sectional study	47	Patellofemoral measurements by MRI	100
Stickley et al.	2018	Cohort study	33	Biomechanics of the knee (adduction and varus angle)	81

JBI = Joanna Briggs Institute; ITB = Iliotibial Band; MRI = Magnetic Resonance Imaging; IVMC = isometric Voluntary Maximal Contraction; Gmax = Gluteus Maximus muscle ; Gmed = Gluteus medius muscle; TFL = Tensor Fascia Lata muscle ; Add = Adduction; Abd = Abduction; IR Internal rotation; ER = External rotation; Fl = Flexion

Risk of bias and level of evidence

The average score of articles obtained on the JBI reading grid is 89.5%, which represents a moderate level of evidence. In parallel with this reading grid, each article was submitted to the ROBIN-1 tool, from the Cochrane Collaboration, to assess the risk of bias inherent in each study. The risk of bias is assessed as low (+), high (-) or uncertain (?) (Table 2).

Characteristics of the studies

For each study, the characteristics for which data were extracted are presented in Table 3, 4, 5.

Table 2. Methodological quality of the included studies

Study	Confusion bias	Selection bias	Performance bias	Deviation bias	Attrition bias	Detection bias	Reporting bias	Other bias
Agridag- Ucpinar et al. (2021)	+	?	+	-	+	+	+	?
Baker et al. (2018)	+	+	+	-	?	-	-	?
Brown et al. (2016)	+	?	+	-	+	-	?	?
Brown et al. (2019)	+	?	+	-	+	-	?	?
Everhart et al. (2019)	+	+	+	+	?	+	+	?
Foch et al. (2019)	+	+	+	+	+	-	+	?
Foch et al. (2020)	+	+	+	+	+	-	+	?
Hamstra Wright et al. (2020)	+	+	+	+	+	-	+	?
Li et al. (2021)	+	?	+	+	+	+	+	+
Stickley et al. (2018)	+	+	+	+	+	-	+	?

+ = low risk of bias; - = high risk of bias; ? = uncertain risk of bias

Table 3. General characteristics of the samples included in the different studies

Study	Subjects (n)		Gender(M/F)		Average age(years)		Average weight(kg)		Average height(m)	
	EG	CG	EG	CG	EG	CG	EG	CG	EG	CG
Agridag- Ucpinar et al.(2021)	78	114	34M/44F	54M/60F	30,34(± 9,71)	29,12(± 9,22)	NR	NR	NR	NR
Baker et al.(2018)	15	15	8M/7F	8M/7F	33,09(± 1,74)	31,28(± 6,73)	70,51(± 8,15)	71,53(± 9,60)	1,73(± 0,06)	1,73(± 0,06)
Brown et al.(2016)	12	20	12F	20F	32,4(± 7,9)	28,9(± 6,1)	60,6(± 5,0)	56,8(± 5,2)	1,70(± 0,06) *	1,60(± 0,09)
Brown et al.(2019)	12	20	12F	20F	32,4(± 7,9)	28,9(± 6,1)	60,6(± 5,0)	56,8(± 5,2)	1,70(± 0,06) *	1,60(± 0,09)
Everhart et al.(2019)	75	75	32M/43F	32M/43F	39,6(± 15,4)	39,4(± 14,6)	NR	NR	1,70(± 10,1)	1,69(± 9,1)
Foch et al.(2019)	18	18	18F	18F	25,7(± 5,8)	24,7(± 5,8)	59,4(±6,9)	58,9(±5,8)	1,70(±0,04)	1,67(± 0,06)
Foch et al.(2020)	15	15	15F	15F	26,7(±9,3)	25,1(± 7,0)	61,4(± 7,1)	58,5(± 6,5)	1,68(± 0,07)	1,66(± 0,06)
Hamstra- Wright et al.(2020)	9	8	9F	8F	36,0(± 11,0)	33,1(± 12,0)	63,4(± 10,0)	61,4(± 6,8)	1,66(± 6,8)	1,67(± 5,4)
Li et al.(2021)	47	47	25M/22F	25M/22F	35(±10)	35(±10)	NR	NR	NR	NR
Stickley et al.(2018)	7	26	7M	26M	23.2(±3,4)	22.3(±3,1)	73.5(±12,3)	73.7(±14)	175(±11)	172,4(±9,7)

EG: Experimental group; CG: Control Group; M: Male; F: Female; NR: Non reported value; *: significant effect

Table 4. Diagnostic criteria used by each study to elect ITBS patients

Inclusion and exclusion criteria	Agridag Upcinar et al. (2021)	Baker et al.. (2018)	Brown et al. (2016)	Brown et al. (2019)	Everhart et al.. (2019)	Foch et al. (2019)	Foch et al. (2020)	Hamstra-Wright et al. (2020)	Li et al. (2021)	Stickley et al. (2018)
1A precise definition of pain is reported	X	X	X	X	X	X	X	X		X
2 The symptoms and history correspond to those of ITBS	X	X	X	X	X	X	X	X	X	X
3 The diagnosis Is confirmed by a medical professional	X	NS	X	X	X	X	X	X	X	X
4 A test is positive (Ober, Renne, Noble)		X						X		
5 Imaging confirms diagnostic	X				X				X	
6 No history of lesion of the spine or lower limbs	X	X		X			X	X	X	X

NS: Not Specified

Table 5. Individual parameters) analyzed according to the study

Authors	Morphology			Isometric strength	Neuromuscular	Biomechanical			Fatigue
	Size of the LFE	Diameter of the ITB	Patellofemoral measurements			Hip	Knee	Pelvis	
Agridag- Ucplnar et al. (2021)		X							
Baker et al. (2018)					X	X	X		
Brown et al. (2016)						X			X
Brown et al. 2019				X	X				X
Everhart et al. (2019)	X								
Foch et al. (2019)						X	X	X	
Foch et al. (2020)					X	X	X		X
Hamstra- Wright et al. (2020)				X		X	X		
LI et al. (2021)			X						
Stickley et al. (2018)							X		

LFE: Lateral femoral epicondyle; ITB = Iliotibial band

DISCUSSION

Morphological factors

One study (27) was able to identify that LFE is significantly more prominent (0.9mm) in the pathological group than in the control group (p<0,001). The size of the LFE therefore appears to be a factor in the ITBS. However, the retrospective nature of the study represents a limitation because it does not allow to determine prospectively the size of the LFE in patients and thus to know if this prominence is the cause, a compensation or a side effect of the pathology. Although limited, this study still supports existing knowledge about the anatomical and biomechanical causes of ITBS, and thus potentially improves treatment options for this pathology.

Another trial (26) revealed a significantly greater thickening of the ITB in patients with ITBS (p<0,0000001). These data are consistent with those of another study carried out much earlier (3). The diameter of the ITB was notably greater in a previous study (29) than in this trial. This can be explained by the difference in protocols between the two studies; one including Magnetic Resonance Imaging (MRI) with full knee extension while the other at 30° knee flexion, and by the stage of pathology (3,26). Moreover, same remark is applied as previously mentioned; since the study is not prospective, relationship between the diameter of the ITB and ITBS with respect to causation is unclear.

Other authors (28) revealed that 34% of the ITBS group had abnormal patellofemoral measurements. More precisely, 17% had patella alta, 23.4% showed a decreased lateral patellofemoral angle (LPA), 10.6% had an increased LPA indicating patellar tilt. 17% had combinations of two or three abnormalities together. This study also revealed that the ITBS group had significantly higher Insall-Salvati ratio, LPA and non-weight-bearing facet of the lateral femoral condyle angle (p=0,001, p<0,001 and p<0,001, respectively). This is, once again, a retrospective design leading to the same causality questions. The sample size is (n=47) is lower than generally reported in the literature (1,33,34).

Isometric strength

No statistical difference (p>0,05) in isometric muscular strength of hip abductors and adductors was found in the literature between ITBS patients and healthy subjects (29,30). These data therefore refute previously stated assumptions about possible muscle weakness in patients with ITBS (19,20) and support studies that have shown that no difference in isometric strength exists between affected and healthy subjects (21-23).

Neuromuscular factors

The only significant difference (p=0,02) with regard to neuromuscular factors concerns the activity of the tensor fascia lata muscle (TFL): in a single study a greater activity of TFL is reported in the ITBS group compared to the control group. These data are valid at T1 (after running three minutes) but not at T2 (after running 30 minutes), where the values between the two groups are indifferent. According to the authors, this increase results from a compensation mechanism in ITBS patients; they would increase the strain on TFL to control the excessive knee and hip adduction they could potentially present (35).

Biomechanical factors

Three studies showed atypical frontal plane hip kinematics (30-32). One study (30) concluded with a significantly (p=0,008) more adducted hip, only at touchdown, increasing the strain on ITB compared to a control group. These authors also mention a cross over effect due to the bilateral kinematic differences. On the contrary, a decrease in duration of hip adduction at stance phase (31) or a decrease in hip adduction excursion during a 30 minutes run (32) was found in ITBS participants compared to healthy subjects (respectively p=0,03 and p=0,009). The authors explained that this reduced adduction in ITBS subjects was potentially an adjustment in response to the installation of the pathology to relieve the symptoms associated with it. They pointed out that a decrease in the hip adduction angle could lead to a decrease in stress on the ITB, a decrease in the length of the ITB, and a decrease in contact with the LFE, leading to a decrease in the tension of the ITB fibres (14). It is therefore proposed that runners may attempt to limit hip adduction movement to minimize the risk of re-emerging pain (21).

Changes in frontal and transverse plane kinematics at knee joint in ITBS groups compared to control groups were also highlighted (30,35,36). In one study (35), peak kinematics values from heel strike to peak knee flexion demonstrated significantly increased knee adduction (p=0,002) at 30 minutes in ITBS subjects. Another paper (36) mentioned an increased maximum knee varus angle (p=0,02) and adduction moment (p=0,002), a higher maximum varus velocity (p=0,006) that occurred sooner (p=0,04) during stance in ITBS participants. Additionally, the authors interpreted these changes as a decrease in dynamic varus stability during loading. The difference between the two groups of subjects was explained by the fact that the subjects belonging to the control group gradually decreased the adduction moment during the 30 minutes of race, while the ITBS subjects reduced it very slightly. It is therefore possible that the adduction of the knee and the angle of varus are important variables in ITBS.

Hamstra-Wright et al (30) reported an increase in knee flexion and abduction at toe-off and internal rotation during loading. As these increases are not significant (respectively p=0,1, p=0,1 and p=0,3), it is not possible to mention the implication of any of these parameters in the development of the ITBS. Increased knee abduction and flexion have never been investigated before, while the internal rotation of the knee has already been the subject of debate without a clear and definitive answer in the scientific literature (21,37,38). This study therefore does not provide solid evidence to clarify this debate and advance knowledge about this parameter.

Furthermore, a study looked at frontal - transverse coordination patterns at pelvis, hip, knee, thigh and shank level in female runners during the braking and propulsive phases of stance, but no significant difference was highlighted between runners with ITBS and healthy runners. However, runners with one ITBS occurrence exhibited greater variability in frontal plane hip – transverse plane hip (braking p=0.031, propulsion p=0.044) and in frontal plane pelvis – frontal plane thigh (braking p=0.008, propulsion p=0,039) coordination patterns during stance compared to the recurrent ITBS group and control. Thus, the number of previous injury episodes may influence coordination variability in runners with ITBS (41).

Fatigue

Hamstra-Wright et al (30) found that fatigue affected the control and ITBS groups in the same way, as each of the groups showed a significant decrease in muscle strength after exercise. It was noted, in a single study, that while the muscular strength of the gluteus medius did not differ from one group to another, its resistance to fatigue was significantly lower in the ITBS group (p=0,01) (30). This suggests that ITBS patients need action of the gluteus medius more than healthy subjects. The authors proposed that ITBS patients used their gluteus medius to better control and limit the adduction in charge, and thus avoided the constraints on the ITB, as well as pain. They also commented that fatigue of gluteus medius muscle was more prominent (30).

There were no recent studies investigated biomechanics of the ankle and foot joint. However, it was reported that excessive pronation of the hind foot, during the support phase, led to an increase in the internal tibial rotation (37,39,40), inducing tension on the ITB (41,42). Also, no studies since 2015 have investigated the relationship between trunk biomechanics and the development of ITBS. It was suggested to conduct additional research in order to provide new information in this field (21).

Limitations

Only nine studies met the eligibility criteria. In order to allow a better appreciation of this work, it would have been valuable to select a larger number of articles. However, even by broadening the choice of selection criteria, as well as by querying a larger number of databases, the available articles were limited in quantity. Absence of a Randomized Controlled Trial since 2015 was another important issue, as well. In addition, despite the obvious methodological quality of the included articles highlighted by the use of the JBI reading grid, the use of the Cochrane collaboration tool nevertheless highlighted the risk of bias inherent in each study. As a result, of the nine studies, all have at least a high risk of bias in one of the categories.

Implication for clinical research

There is a need to evaluate the association between individual factors and the ITBS with more high-quality prospective randomized controlled studies. Subsequent studies should be more consistent and homogeneous in terms of gender and different stages of pathology, as well as measurement protocols. It also seems essential to carry out studies on sufficiently powerful samples. Moreover, although many factors have been investigated, this review of the literature does not sweep away the field of all the parameters potentially involved in the syndrome. Studies on the influence of the trunk, pelvis and the ankle and foot joint have not been found while the debate about the involvement of these factors is still pending. Certain aspects, oftenly neglected in the protocols, should be considered. For example, downhill running appears to be a common denominator for ITBS (25).

It would be interesting to set up new protocols for muscle, neuromuscular and biomechanical analyses to reflect the reality on the ground. This is in line with the suggestions of another study (30), which advocate an investigation of eccentric muscular strength, not only isometric strength.

Implication for practice

If this review does not provide tangible evidence as to a standardized consensus of the treatment of ITBS, it at least allows directing it towards new avenues. Gluteus medius muscle does not seem to be significantly weak in ITBS patients compared to a healthy subject. On the other hand, ITBS patients seem to have lack of resistance to fatigue of this muscle. This information suggests that instead of pure gluteal strengthening exercises, it may be more effective to include an endurance-training program for gluteus medius muscle in rehabilitation of ITBS patients. Although there are some contradictory evidence in the selected studies, it is clear that an individual clinical approach for each ITBS patient is desirable.

CONCLUSION

ITBS patients have a significant prominence of the external femoral epicondyle, an increased thickening of the ITB, a reduction of hip adduction in the support phase, especially in female subjects, a peak of knee adduction as well as an increased varus angle, and a lower fatigue resistance of the gluteus medius muscle. Other parameters, such as muscle strength, including the gluteus medius, the neuromuscular activity of the hip muscles, the kinematics of other hip and knee movements, were also analysed but no significant differences were found between the different groups of subjects. These parameters may therefore not be involved in the onset and presentation of the syndrome and require further investigation. Some contradictory findings lead us to suggest that an individualized clinical approach would be desirable in the management of ITBS patients.

Conflict of Interest / Çıkar Çatışması

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