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Imaging Assessment of the Pubis in Soccer Players*

Avaliação por imagem do púbis em jogadores de futebol

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Abstract

Objective To compare the accuracy of ultrasound (US) with that of magnetic resonance imaging (MRI) in the detection of aponeurosis lesions of the rectus abdominis/adductor longus muscles, to study the characteristics of the athletes and imaging findings associated with pubalgia, and to demonstrate the importance of each method in evaluating this condition.

Materials and methods The present study was conducted from 2011 to 2016 with 39 professional soccer players: 15 with pubalgia and 24 without pubalgia. Age, field position, body mass index (BMI), weekly training load, career length, and history of thigh/knee injury and lower back pain were recorded. The following tests were performed: radiographs (anteroposterior view of the pelvis in standing and flamingo positions) to evaluate hip impingement, sacroiliac joint, and pubic symphysis instability; US to analyze the common aponeurosis of the rectus abdominis/adductor longus muscles and inguinal hernias; and MRI for pubic bone degenerative alterations and edema, and lesions in the adductor and rectus abdominis muscles and their aponeurosis.

Results There was an association between pubalgia, high BMI ($p = 0.032$) and muscle alterations ($p < 0.001$). Two patients with pubalgia had inguinal hernias and one patient with pubalgia and two controls had sports hernias. Pubic degenerative changes were frequent in both groups. Aponeurosis lesions were more frequent in patients with pain. The US detection had 44.4% sensitivity and 100% specificity.

Conclusion The evaluation of athletic pubalgia should be performed with radiography, US, and MRI. High BMI, muscle injuries, geodes, and osteophytes are findings associated with pubalgia; US has low sensitivity to detect injuries of the common aponeurosis of the rectus abdominis/adductor longus muscles.

Keywords
- magnetic resonance imaging/methods
- pubic symphysis/diagnostic imaging
- pubic symphysis/injuries
- groin
- radiography
- athletic injuries/pathology
- ultrasonography

Resumo

Objetivo Comparar a acurácia da ultrassonografia em relação à ressonância magnética na detecção de lesões da aponeurose do reto abdominal/adutor longo, estudar

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características dos jogadores e achados de imagem associados à pubalgia e demonstrar a importância de cada método.

Materiais e métodos Estudo realizado de 2011 a 2016 com 39 jogadores profissionais de futebol, 15 deles com e 24 sem pubalgia. Foram registrados idade, posição, índice de massa corporal (IMC), carga de treino semanal, tempo de profissão e lesão prévia na coxa/joelho e lombalgia. Os seguintes exames de imagem foram realizados: radiografias (anteroposterior da bacia e flamingo) para avaliar sinais de impacto do quadril, articulações sacroilíacas e instabilidade da sínfise púbica; ultrassonografia para analisar a aponeurose comum do reto abdominal/adutor longo e hérnias inguinais e do esporte; ressonância magnética buscando alterações degenerativas e edema no púbis, lesões musculares dos adutores e retos abdominais e na sua aponeurose.

Resultados Observou-se uma associação entre pubalgia e IMC elevado ($p = 0,032$) e alterações musculares ($p < 0,001$). Hérnia inguinal foi encontrada em dois casos e hérnia do esporte, em um caso e dois controles. Alterações degenerativas do púbis foram frequentes nos dois grupos. Lesões da aponeurose foram mais comuns nos pacientes com dor e a ultrassonografia teve sensibilidade de 44,4% e especificidade de 100% na detecção.

Conclusão A avaliação da pubalgia atlética deve ser realizada com radiografias, ultrassonografia e ressonância magnética. Índice de massa corporal elevado, lesões musculares, geodos e osteófitos são achados associados à pubalgia; a ultrassonografia tem baixa sensibilidade para detectar lesões da aponeurose comum do reto abdominal/adutor longo.

Palavras-chave
- imagem por ressonância magnética/métodos
- sínfise pubiana/diagnóstico por imagem
- sínfise pubiana/lesões
- virilha
- radiografia
- traumatismos em atletas/patologia
- ultrassonografia

Introduction

Chronic inguinal pain accounts for ~ 2 to 5% of all sports-related injuries.[1] Its prevalence in athletes varies according to the modality of the sport, being more frequent in those requiring rapid acceleration, direction changes and kicks, such as soccer.[2] In this sport, the prevalence of pubalgia ranges from 5[3] to 58%.[4]

In professional athletes, injuries lead to persistent pain that prevents proper involvement in activities and becomes a significant cause for missing training. Although many of its causes are treated with anti-inflammatory agents, pubalgia often recurs and may be responsible for premature career termination.[2]

Several studies[1–3,5–16] have described the findings of magnetic resonance imaging (MRI) in athletic pubalgia; few reports described ultrasonographic findings.[17–19] However, to our knowledge, no work to date has compared both methods in lesions of the common aponeurosis of the rectus abdominis/adductor longus muscles in this context.

We have performed a cross-sectional study with cases and controls to demonstrate the accuracy of ultrasound (US) compared with MRI in detecting lesions of the common aponeurosis of the rectus abdominis/adductor longus muscles, to study characteristics inherent to the players and imaging findings that may be associated with pubalgia, to show the importance of each method (x-rays, US, and MRI) in its evaluation and, finally, to propose an algorithm for image evaluation.

Material and Methods

From September 2011 to June 2016, 39 professional players from 7 soccer teams from 2 Brazilian states (Rio Grande do Sul and São Paulo) were invited to participate in the study, including 15 with clinical complaints of pubalgia and 24 with no complaints; all of the participants were male and > 18 years old. Individuals with contraindications to MRI were excluded. Participants signed an informed consent form. Baseline characteristics, such as age, field position (striker, midfielder, winger, defender, goalkeeper), and body mass index (BMI) were recorded, as well as the weekly training load (number of training hours per day multiplied by the number of days per week), career length in years, and previous history of thigh or knee injury or low back pain. Participants were clinically evaluated by the physician of the team. Symptomatic patients were those who, as described by Kachingwe et al,[20] had 5 signs and symptoms: (1) low inguinal or abdominal pain, (2) pain exacerbated by sports activity and alleviated with rest, (3) pain at palpation in the pubic rami, (4) pain with 0°, 45° and 90° of hip adduction against resistance, and (5) pain during abdominal resistance. Next, all of the participants (both symptomatic and asymptomatic) were submitted to the imaging tests described below.

Imaging Techniques

Radiographs were taken in anteroposterior (AP) view with pelvic orthostasis and in the flamingo position (AP radiographs of the pubic symphysis with alternating monopodal support) (►**Fig. 1**). The AP view evaluated signs related to hip impingement (rounding of the junction the femoral head and neck, coxa profunda, acetabular protrusion, acetabular retroversion, and secondary signs such as synovial inclusion cyst, labral ossification, and acetabuli, in addition to classic signs of arthrosis) and alterations in the sacroiliac joints

Fig. 1 Flamingo view with alternated monopodal support.

(subchondral sclerosis or erosions, diastasis, reduction of the joint spaces, or ankylosis). Radiographs in the flamingo position were performed to analyze the vertical instability of the pubic symphysis. The height difference between the pubic rami at the AP view was measured by tracing lines parallel to each pubic ramus, which, in turn, were perpendicular to the sacrum, and then determining the distance between them. Next, the same procedure was performed in monopodal views. The sum of the 2 heights, minus the base (already present in the AP view), was the total translation, considered abnormal if $>$ 5.0 mm, according to Garras et al[21] (►**Fig. 2**). The analysis of each change was dichotomized ("absent" or "present").

Ultrasound examinations were performed with a linear transducer of between 9 and 13 MHz. First, the pubic rami were identified in the axial plane. Next, the common aponeurosis of the rectus abdominus/adductor longus muscles was analyzed in the sagittal plane, at rest, and under dynamic maneuver (the patient was asked to stay in a semi-seated position, as if in an abdominal exercise). An injury was defined by the finding of aponeurosis thickening and a focal anechoic area (►**Fig. 3**). Then, the deep inguinal ring was located. Sports hernia or inguinal canal posterior wall deficiency was diagnosed by an increase in the sectional area of the inguinal canal during the Valsalva maneuver compared with rest, as described by Orchard et al[18] (►**Fig. 4**). An inguinal hernia was defined by the protrusion of fat and/or an intestinal loop through the deep inguinal ring or by a defect in the transverse fascia of the posterior wall of the inguinal canal.

The evaluator graded the presence of inguinal hernias, of sports hernias, and of aponeurosis lesions from 1 to 5, in which 1 was "totally absent", and 5 was "fully present". Next,

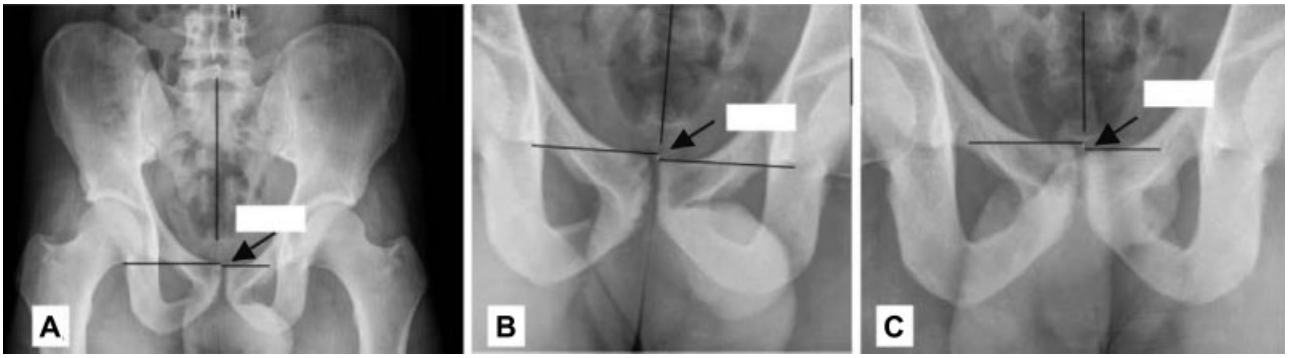

Fig. 2 Patient, 23 years-old, defender, anteroposterior (A) and flamingo radiographs raising the left leg (B) or the right leg (C). The vertical line parallel to the sacrum was reproduced. Two lines, perpendicular to the first one, were drawn in each of the upper pubic rami and the distance between them was measured. The baseline measure (at the anteroposterior view) was 0.2 cm, upper right side; raising the left leg (B), the distance was of 0.4 cm from the baseline, upper right side; raising the right leg (C), the distance was of 0.0 cm from the baseline, upper right side. Total translation was 0.4 cm.

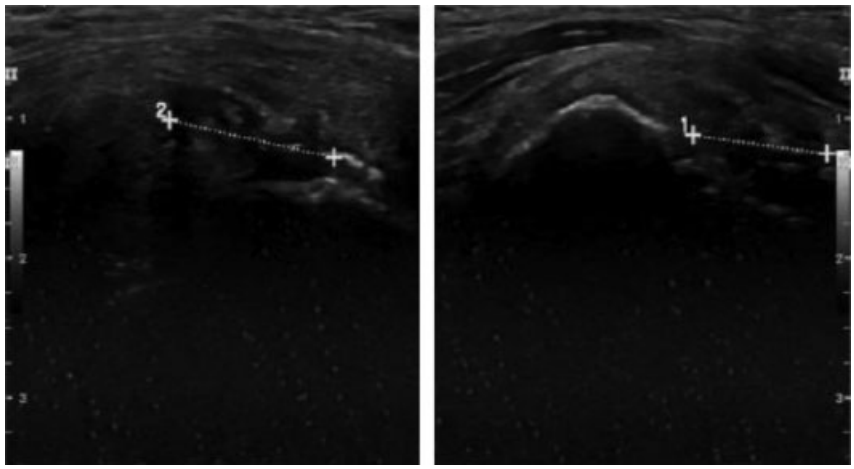

Fig. 3 Patient, 30 years old, goalkeeper. Injury of the common aponeurosis of the abdominal rectus/adductor longus muscles.

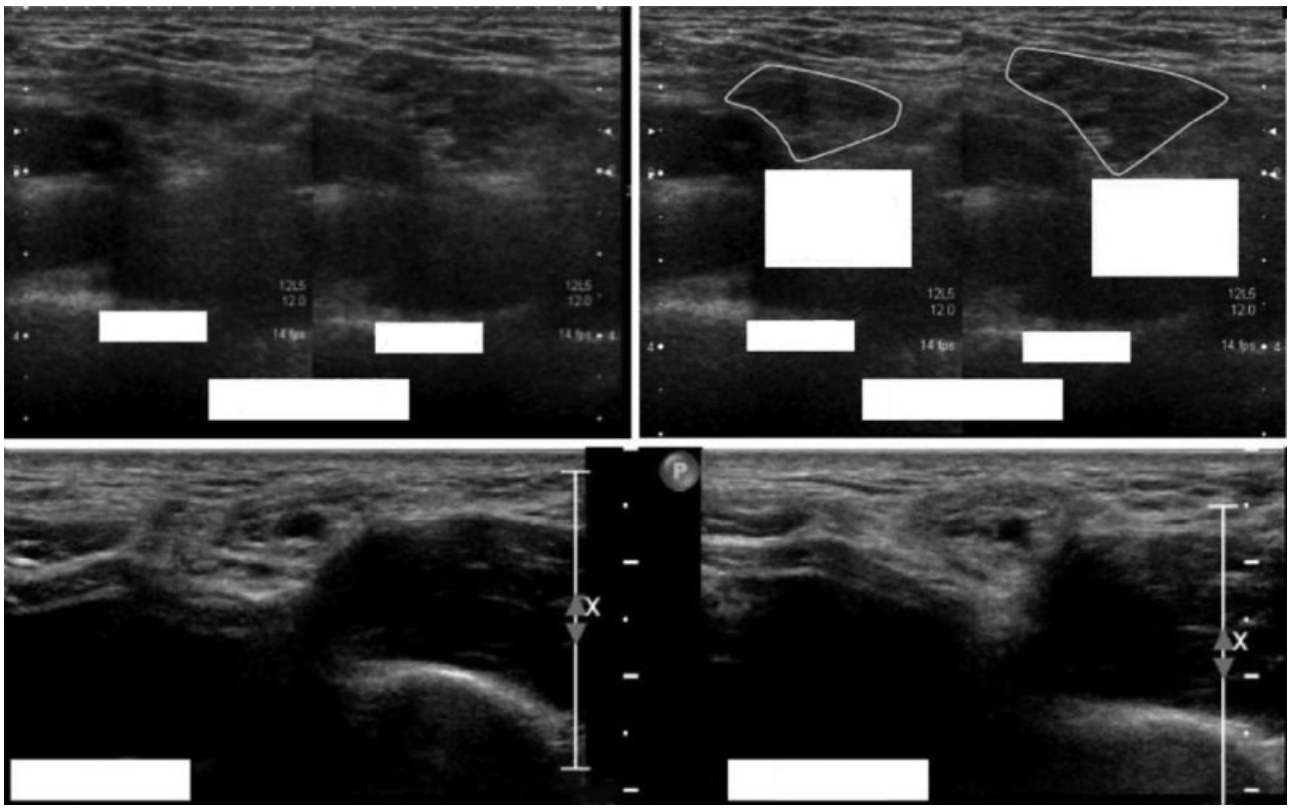

Fig. 4 Sports hernia. Patient, 27 years old, midfielder. The Valsalva maneuver increased the area of the inguinal canal. Below, normal inguinal canal for comparison.

the analysis was dichotomized (scores 1 to 3 were considered "absent", and 4 and 5 were considered "present").

Magnetic resonance imaging was performed with 2 1.5 T magnets: a Siemens Aera 1.5 scanner (Siemens Healthcare, Erlangen, Germany) and a Signa HDx 1.5T scanner (General Electric Medical Systems, Chicago, USA), and surface coils centered on the pubic symphysis. ►**Table 1** summarizes the employed protocol.

The MRI exams determined the presence or absence of:

1. degenerative changes of the pubic symphysis (subchondral sclerosis, subchondral geodesy and irregularities, osteophytes, and interpubic disc degeneration). Only osteophytes $>$ 2.0 mm were considered (►**Fig. 5**);
2. lesion of the common aponeurosis of the rectus abdominis/adductor longus muscles (secondary cleft sign) (►**Fig. 6**);
3. injuries of the adductor and rectus femoris muscles (►**Fig. 7**);
4. labral lesions; pubic rami edema (in this case, classified as absent, subtle/doubtful, moderate, or severe) (►**Fig. 8**).

Radiological, US, and MRI scans were analyzed at baseline and 5 years later, at the end of the study, by a single radiologist with 1 year of experience in musculoskeletal radiology. The radiologist was unaware of the symptoms of the patients.

Table 1 Magnetic Resonance Imaging Protocol

Sequence	Plane	FOV (cm^2)	Matrix	Slice thickness/ interval (mm)	RT (msec)	TE (ms)	BW (kHz)	ETL	NEX
SE T1	Coronal	20	256 × 192	4/1	400	Minimal	25	NA	2
FSE T2 with fat suppression	Axial	20	256 × 192	4/1	> 2,000	102	31.25	23	4
FSE T2 with fat suppression	Sagittal (includes femoral heads)	20–24	256 × 192	4/1	> 2,000	58	27.78	13	4
FSE T2 with fat suppression	Oblique axial (Fig. 4)	20	256 × 256	4/1	> 2,000	102	31.25	23	4
FSE T2 with fat suppression	Coronal	28–32	256 × 192	4/1	> 2,000	25	31.25	23	4

Abbreviations: BW, band width; ETL, echo train length; FOV, field of view; FSE T2, fast spin echo; NA, not applicable; NEX, number of excitations; RT, repetition time; SE T1, spin echo, T1-weighted image; T2-weighted image; TE, time to echo.

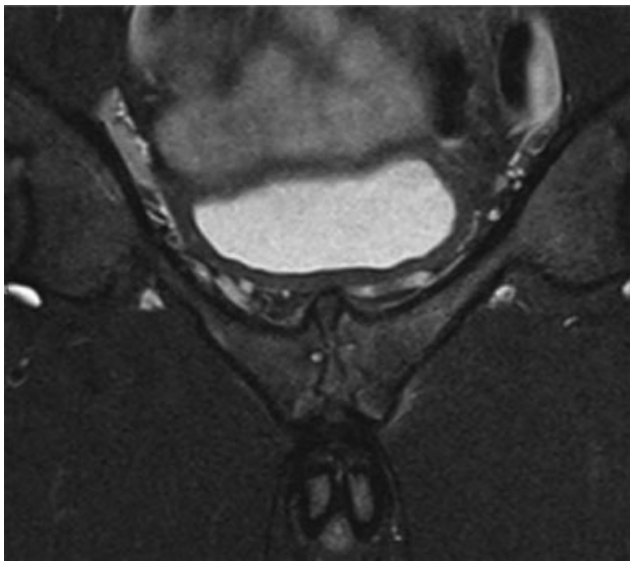

Fig. 5 Patient, 22 years old, midfielder. Degenerative pubic symphysis changes (subchondral bone irregularities, cysts, and marginal osteophytes).

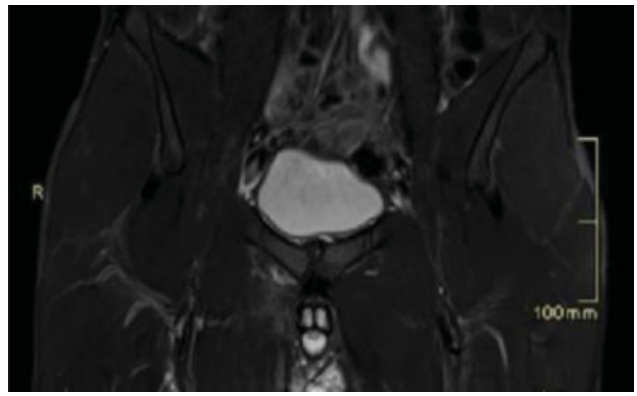

Fig. 7 Patient, 27 years old, defender. Stretching/partial lesion of the right adductor longus muscular belly. Coronal T2-weighted image of the hip with fat suppression.

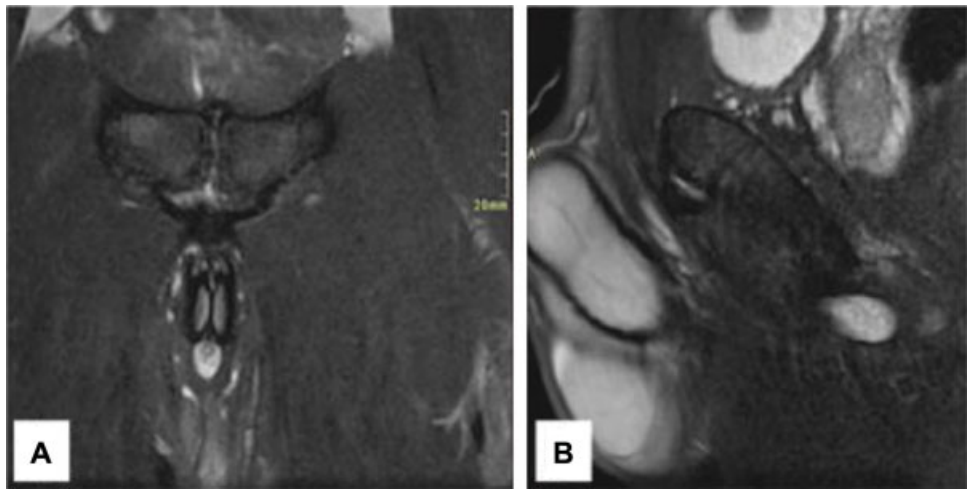

Fig. 6 Patient, 33 years old, midfielder. Injury in the common aponeurosis of the rectus abdominis/adductor longus muscles. Coronal (A) and sagittal (B) T2-weighted image with fat suppression.

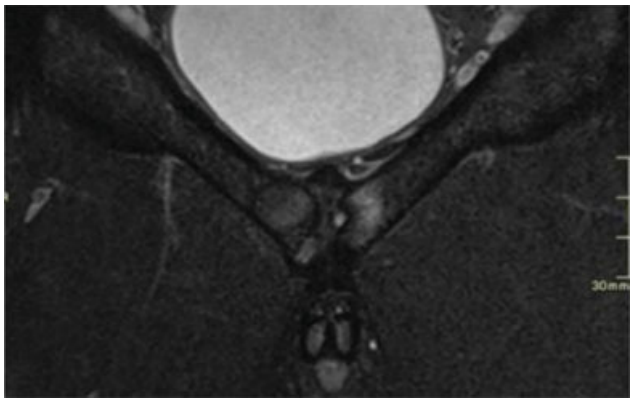

Fig. 8 Patient, 29 years old, striker. Coronal T2-weighted image with fat suppression showing accentuated bone edema in the left pubic ramus.

Statistical Analysis

Quantitative data were described as mean and standard deviation (SD). In the presence of asymmetry, the median and 25th and 75th percentiles were used. Categorical data were expressed as counts and percentages.

The Student-t test or its nonparametric equivalent (the Mann-Whitney U test) were used to compare quantitative data. The Fisher exact test compared categorical data.

The significance level was $\alpha = 0.05$, and findings were considered significant with $p < 0.05$. Data were analyzed with IBM SPSS Statistics for Windows, Version 22.0 (IBM Corp., Armonk, NY, USA).

Results

The results are summarized in ►**Table 2**.

Characteristics of the Patients

A total of 24 patients were asymptomatic, and 15 had pubalgia.

The age of the players was not statistically significant between groups, although it was higher in symptomatic individuals. The mean career length in the symptomatic group was also higher, but the difference did not reach statistical significance ($p = 0.17$).

The weekly training load was similar in both groups.

The distribution of field positions was not different among players with or without pubalgia.

A previous history of low back pain or thigh/knee injury was not associated with pubalgia.

The only feature associated with an increased risk of pubalgia was high BMI ($p = 0.032$).

Survey Radiographs

Out of the 39 patients, 7 presented with signs of femoroacetabular impingement on the survey radiographs, but this finding was not more frequent in patients with pubalgia.

No changes were observed in the sacroiliac joints of the players.

No patient presented vertical instability of the pubic symphysis in the flamingo view.

Table 2 Results

Baseline features	Without pubalgia ($n = 24$)	With pubalgia ($n = 15$)	*p*-value
Age, years old, mean (SD)	21.8 (5.5)	24.5 (4.8)	$p = 0.12$
Field positioning, n (%)			$p = 0.514$
Striker	6 (25)	2 (13.3)	
Midfielder	6 (25)	5 (33.3)	
Winger	6 (25)	2 (13.3)	
Defender	5 (20.8)	3 (20)	
Goalkeeper	1 (4.2)	3 (20)	
Body mass index, kg/cm2, mean (SD)	23.2 (1.5)	24.2 (1.5)	$p = 0.032$
Previous lumbar pain, n○ (%)	6 (25)	3 (20)	$p > 0.99$
Previous thigh or knee lesion, n○ (%)	9 (37.5)	6 (40.0)	$p > 0.99$
Career length, years, median (IQR)	5.5 (4;9.5)	8 (5;12)	$p = 0.17$
Weekly training load, hours, median (IQR)	15 (11;24)	18 (12;24)	$p = 0.66$
Radiographs			
Femoroacetabular impingement, *n* (%)	5 (20.8)	2 (13.3)	$p = 0.38$
Sacroiliac joint alterations	-	-	
Ultrasound			
Inguinal hernia, *n* (%)	-	2 (13.3)	$p = 0.14$
Sports hernia, *n* (%)	2 (8.3)	1 (6.7)	$p > 0.99$
Aponeurosis lesions of the rectus abdominis/adductor longus muscles, n (%)	-	4 (26.6)	$p = 0.017$
Magnetic resonance imaging			
Pubic symphysis degenerative Alterations, n (%)			
Subchondral bone sclerosis	6 (25)	6 (40)	$p = 0.48$
Subchondral geodes	3 (12.5)	7 (46.7)	$p = 0.027$
Subchondral irregularities	13 (54.2)	10 (66.7)	$p = 0.52$
Marginal osteophytes	4 (16.7)	9 (60)	$p = 0.013$
Interpubic disc degeneration	15 (62.5)	13 (86.7)	$p = 0.15$
Pubic rami bone edema, *n* (%)	6 (25)	7 (46.7)	$p = 0.19$
Aponeurosis lesions of the rectus abdominis/adductor longus muscles, *n* (%)	3 (12.5)	6 (40)	$p = 0.63$
Muscle belly lesions, *n* (%)	-	9 (60)	$p < 0.001$
Labral Lesions, *n* (%)	3 (12.5)	1 (6.7)	$p = 0.014$

Abbreviations: IQR, interquartile range; SD, standard deviation.

Ultrasound

Two symptomatic patients presented inguinal hernias, and one had a sports hernia. In the control group, no inguinal hernias were observed, but two patients had sports hernia.

Four players with pubalgia had alterations in the common aponeurosis of the rectus abdominis/adductor longus muscles, whereas no participant from the control group presented with these alterations ($p = 0.017$).

Magnetic Resonance Imaging

Degenerative changes of the pubic symphysis were very frequent in both groups, but only subchondral geodes and osteophytes could be associated with symptoms ($p = 0.027$ and 0.013, respectively).

Approximately half (46.7%) of the players with pubalgia had edema in the pubic rami, compared with 25% of asymptomatic individuals ($p = 0.19$). Comparing both groups, the number of symptomatic patients increased according to the degree of the edema; on the other hand, this trend was reversed in asymptomatic individuals. However, this relationship had no statistical significance. Lesions of the common aponeurosis of the rectus abdominis/adductor longus muscles demonstrated by MRI were more frequent in patients with pain (6/15 versus 3/24) ($p = 0.63$).

Out of the 15 patients with pubalgia, 9 (60%) had some alteration in the muscular bellies of the pubic region, whereas no asymptomatic patient presented with these alterations ($p < 0.001$).

Labral lesions were infrequent (4/39), and there was no statistically significant difference between the groups.

Ultrasound versus Magnetic Resonance Imaging

Regarding lesions of the common aponeurosis of the rectus abdominis/adductor longus muscles, from the 9 individuals with a positive MRI scan, 4 had a positive result at US, indicating a 44.4% sensitivity of ultrasound compared with MRI. All of the 29 individuals with negative MRI findings also had negative results at the US examination (100% specificity).

Discussion

Several studies have described patient-inherent conditions that may predispose to pubic lesions.[3,22–25] According to Engebretsen et al,[23] the main risk factor related to the player is age; however, other authors, such as Ekstrand et al[26] and Werner et al[27] found no statistically significant difference between age groups, which is in line with our study.

The field position of the players was not relevant to our study, as well as to Paajanem et al[3] and to Engebretsen et al.[23] Paajanem et al[3] also showed that only BMI and the number of hours of intense training are related to inguinal injuries.

The requirement for a range of motion superior than anatomically possible (as in femoroacetabular impingement) is believed to cause a compensatory increase of movement in other regions, such as in the lumbar spine, in the sacroiliac joints, and in the pubic symphysis.[25] Our study showed no statistically significant association between inguinal pain and femoroacetabular impingement, history of lumbar pain, or thigh/knee injury.

The AP orthostatic pelvic radiograph and the flamingo views are an important addition to the interpretation of other imaging tests and provide a preliminary analysis of pubic osteitis, limb length discrepancy, pelvic instability, hip pathology, and of other possible lesions with no clinical suspicion.[21] Flamingo views may characterize a pelvic "macroinstability" not observed in our players.

Ultrasound satisfactorily evaluates sports hernias, which, being dynamic phenomena, must be studied in real time.[24] In addition, it excludes other causes of inguinal pain not related to sports, such as true hernias, although these lesions have not been associated with pain in our study.

Sports hernia is believed to be a process of incipient herniation, a "pre-hernia" condition, or even a hidden hernia, where the major abnormality is a defect in the transversal fascia. Some authors believe that this weakness in the posterior wall of the inguinal canal precedes the development of inguinal lesions and pain,[18,28,29] while others consider it an advanced component of the same lesion spectrum beginning at the pubic symphysis.[6–8,24,30] Although sports hernias were observed in two of our asymptomatic patients, since this was not a prospective study, we could not determine a cause-effect relationship. Magnetic resonance imaging is the method of choice in the evaluation of pubalgia because it demonstrates edema (both in bone and in soft tissues) at an earlier stage, besides being multiplanar and not operator-dependent.

T1-weighted sequences exclude possible bone marrow infiltrative processes, such as metastases, myeloma, and infection. T2-weighted sequences with fat suppression evaluate muscles, tendons, bursae and bone structures. Oblique axial sections oriented to the sagittal plane parallel to the pelvic arcuate line demonstrate the rectus abdominis muscle attachments and the origin of adductor muscles.

Sagittal sections include both femoral heads for hips evaluation. Other conditions manifest as inguinal pain, warranting the inclusion of a sequence with large field of view (FOV).

►**Table 3** suggests an algorithm for imaging investigation in pubalgia patients.

Table 3 Imaging pubalgia evaluation

Survey radiographs	- Pelvis in anteroposterior view, orthostatic position: search for signs of hip impingement, discrepancies in the length of both limbs, sacroiliac alterations, and other alterations with no clinical suspicion; - Flamingo: pelvic instability.
Ultrasound	- Dynamic evaluation of true inguinal hernias, femoral hernias, and sports hernias.
Magnetic resonance imaging	- At least one T1-weighted sequence: morphological structural evaluation, bone marrow infiltrative processes (infection, tumors); - Sagittal T2-weighted sequence with fat suppression (including femoral heads): evaluation of labral lesions and aponeurosis lesions of the rectus abdominis/adductor longus muscles; - Coronal/axial T2-weighted sequence with fat suppression: bone (pubic osteitis) and soft parts edema, muscle and tendon lesions, aponeurosis lesions of the rectus abdominis/adductor longus, other pelvic alterations; - Oblique, axial, T2-weighted sequence: rectus abdominis muscle attachment and origin of all muscles from the adductor compartment; - Coronal T2-weighted sequence with fat suppression (large FOV): demonstrates other conditions manifesting as inguinal pain.

Abbreviations: FOV, field of view.

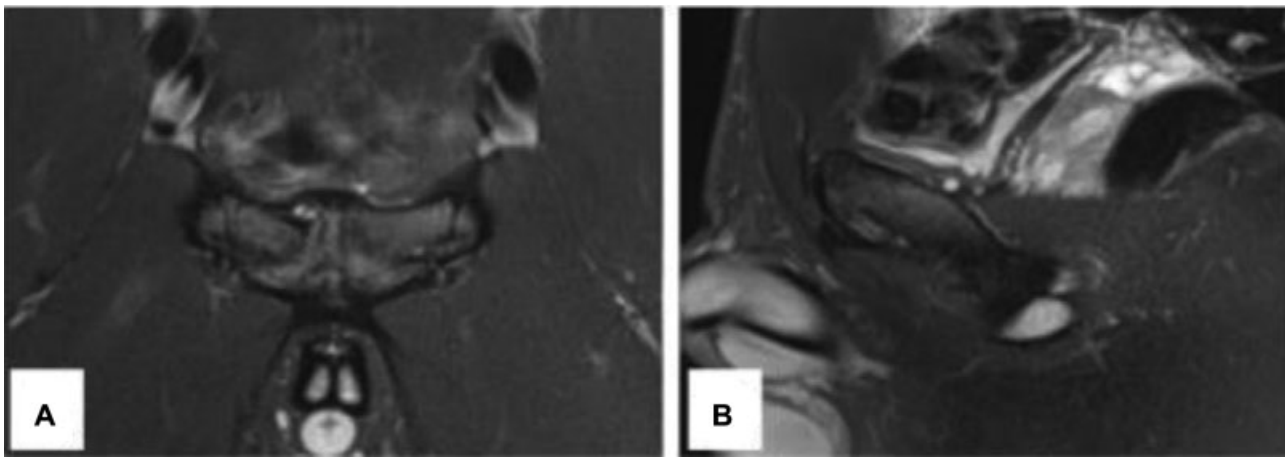

Fig. 9 Patient, 25 years old, defender. Irregularities and edema at the site of the old growth apophysis. Coronal (A) and sagittal (B) T2-weighted image with fat suppression.

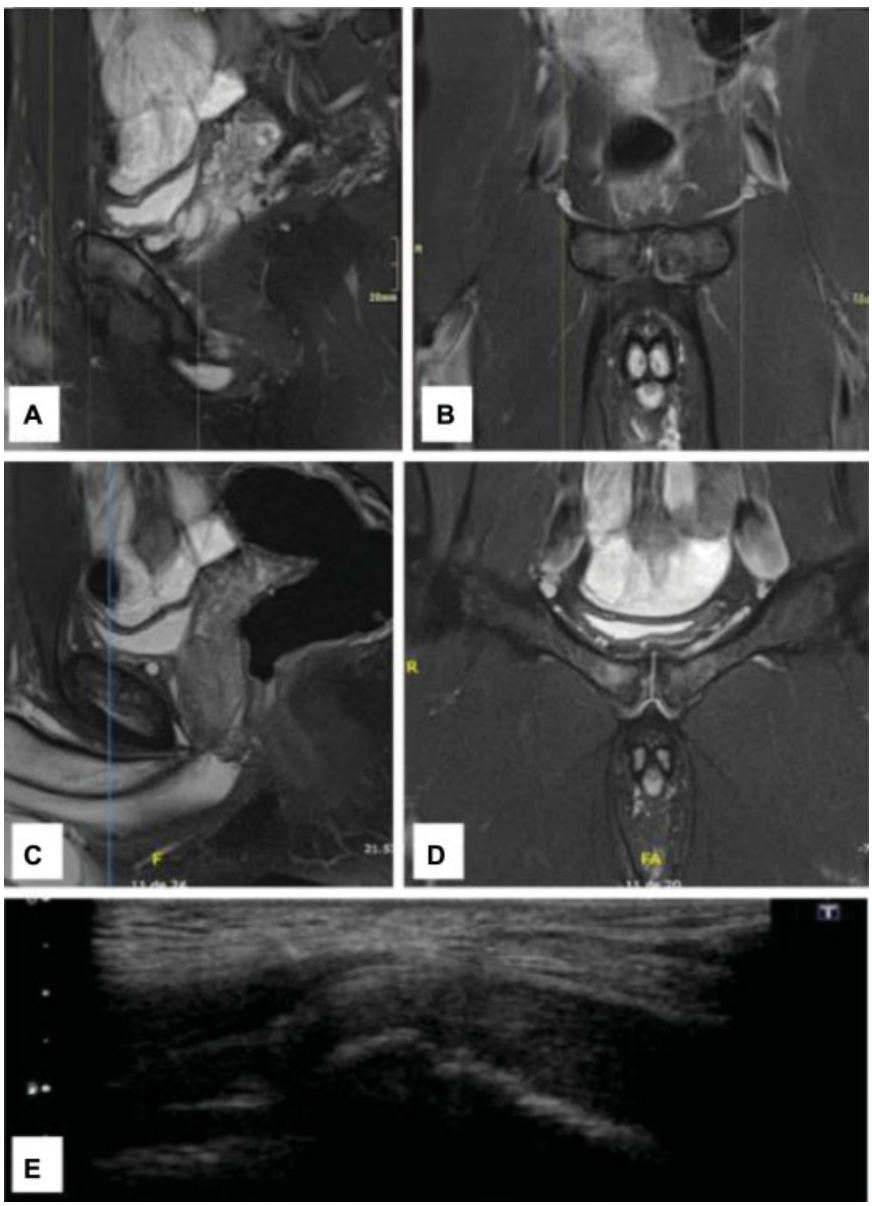

Fig. 10 Patient, 35 years old, defender. Sagittal (A) and coronal (B) T2-weighted images with fat suppression of the anterior portion of the common aponeurosis of the rectus abdominis/adductor longus muscles demonstrating mild thickening without lesions. Sagittal (C) and coronal (D) images of the posterior portion of the aponeurosis, showing a lesion, as well as the transducer position diagram. (E) Sagittal ultrasound image at the right side of the midline, with no evidence of lesions.

Excessive and repetitive loading on the pubic symphysis in soccer players leads to an accelerated degeneration of the interpubic disc. The pubic symphysis is vulnerable to microfractures and consequent degenerative changes, such as subchondral irregularities, geodes and sclerosis, in addition to marginal osteophytes.[24] It also triggers pubic osteitis, characterized by edema in the subchondral region of the pubis from anterior to posterior, especially in superior rami. Paajanen et al[11] classified the extent of pubic edema into four grades: 0 (absent), 1 (edema < 2 cm), 2 (> 2 cm), and 3 (affecting both pubic rami). It should also be considered that high-performance athletes can have subchondral bone edema even if asymptomatic, as the author demonstrated when comparing professional contact sports athletes with non-athletic controls, both without pubalgia complaints.

Degeneration may then evolve to an increase in soft tissue loading, predisposing to tendinopathies and ruptures. The secondary cleft signal is a line extending inferolaterally from the first cleft up to the coronal plane[8] (►**Fig. 6**). The first cleft refers to the degeneration of the interpubic disc, presenting as a vertical line hyperintense in T2-weighted images (►**Fig. 6**).[6] Ultrasound shows these lesions as anechoic focal defects occurring both in the rectus abdominal muscle contribution to the aponeurosis and in the adductor longus muscle.[19] The pubis apophyses close relatively late (at 20 years old) and may mimic an injury to the aponeurosis, as well as irregularities and edema in the subcortical anteromedial portion of the pubis (site of the old apophysis), which are common in athletes[13] (►**Fig. 9**).

Although the specificity of US in relation to MRI was high in our study (100%), the sensitivity was surprisingly low (44.4%), with an accuracy of 87%. Our small sample could explain this finding; in addition, lesions in the posterior portion of the aponeurosis may not be accessible to transducer (►**Fig. 10**). Moreover, small lesions may go unnoticed (►**Fig. 11**).

Our study had some limitations, such as sample size and non-randomness (since the participants were volunteers). Thus, many players with pubalgia may not have participated in the study for fear of the outcome; in addition, some individuals who said they were asymptomatic could be participating because they felt a little pain (although not incapacitating). A probable confounding factor was that the impossibility of analyzing each associated factor excluding the remaining ones because pubalgia causes overlap themselves. The use of a single, less experienced observer may have caused a measurement bias.

Conclusion

We conclude that elevated BMI, adductor muscles lesions, and degenerative changes of the pubic symphysis (especially marginal osteophytes and subchondral geodes) are associated with pubalgia, and that US has a low sensitivity in detecting lesions of the common aponeurosis of the rectus abdominis/adductor longus muscles.

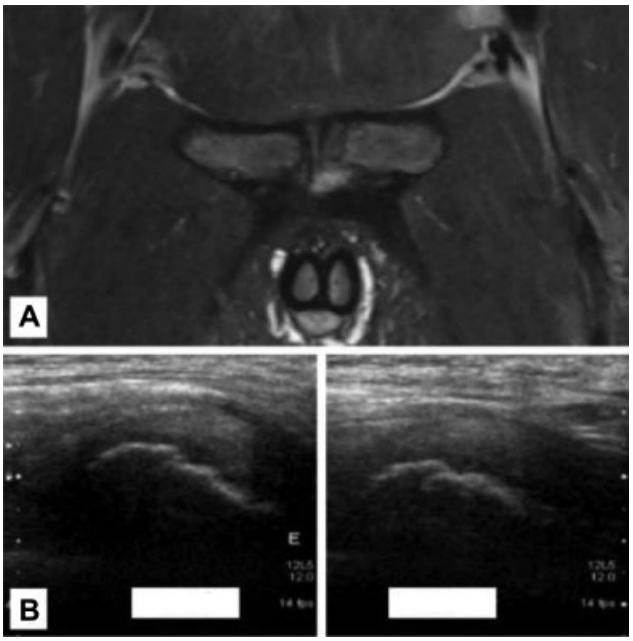

Fig. 11 Patient, 22 years old, midfielder. (A) Coronal T2-weighted image with fat suppression demonstrating a small lesion in the aponeurosis at the left side of the midline. (B) Sagittal ultrasound image of the aponeurosis at rest and in semi-seated position, without evident lesions.

Conflicts of Interest
The authors have no conflicts of interest to declare.

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