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ORIGINAL ARTICLE / ARAŞTIRMA YAZISI

Sports Medicine / Spor Hekimliği

Is Groin Hernia Associated with Pubic Edema Severity in Footballers?

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ABSTRACT

Objective: The groin area, with its complex anatomical structure, can have different athletic problems simultaneously. In this study, it was aimed to investigate whether groin hernia had a relationship with pubic bone marrow edema (BME) severity in footballers.

Method: Among the athletes with painful groin from different sports, only male footballers who had pubic BME in pelvic MRI report were included in the study. The included athletes underwent a second archive scan for groin hernia (hernia symptoms, previous hernia surgery, sonography report). Then, the MRI sections of hernia-related cases were re-evaluated. For this purpose, right and left pubic BME signal intensities (SI) were quantitatively measured using the "region of interest (ROI)" program module on T2 fat-suppressed images.

Results: A total of 93 footballers with pubic BME were found. Eleven of them (11.8%) had a concurrent hernia, while five (5.4%) had a repaired hernia before the study. ROI measurements of these sixteen athletes revealed that the pubic bones on the side of concurrent / repaired hernias had a significantly greater mean BME intensity than opposite pubic bones (1049 SI versus 796 SI, $p<0.001$).

Conclusion: A groin hernia can be seen concurrently in one-tenth of footballers with pubic BME. Whether the hernia is concurrent or repaired, its side overlaps with the side of serious pubic BME. There is a significant association between hernia and pubic BME severity in terms of groin selection. Strength / flexibility imbalance between the groin sides or dominant (kicking) leg effect can be a research subject in this context.

Keywords: Football, Athlete, Groin Hernia, Bone Marrow Edema

Kasık Fıtığı Futbolcularda Pubik Ödemin Şiddeti ile İlişkili midir?

ÖZET

Amaç: Karmaşık anatomik yapısı ile kasık bölgesi aynı anda farklı atletik problemleri barındırabilir. Bu çalışmada, kasık fıtığının futbolcularda pubik kemik iliği ödem (KİÖ) şiddeti ile ilişkisi olup olmadığını araştırmak amaçlandı.

Yöntem: Ağrılı kasığı olan farklı dallardan sporcular arasından, pelvik MR raporunda pubik KİÖ bulunan sadece erkek futbolcular çalışmaya dahil edildi. Dahil edilen sporculara kasık fıtığı için ikinci bir arşiv taraması yapıldı (fıtık semptomları, önceki fıtık ameliyatı, sonografi raporu). Ardından fıtık ile ilişkili olguların MR kesitleri yeniden değerlendirildi. Bu amaçla, T2 yağ-baskılı görüntüler üzerinde "ilgi bölgesi (ROI)" program modülü kullanılarak sağ ve sol pubik KİÖ sinyal yoğunlukları (SI) sayısal olarak ölçüldü.

Bulgular: Pubik KİÖ'ye sahip toplam 93 futbolcu bulundu. Bunlardan onbirinde (%11.8) eşzamanlı fıtık, beşinde (%5.4) çalışma öncesi onarılmış fıtık vardı. Bu on altı sporcunun ROI ölçümleri, eşzamanlı / onarılmış fıtık tarafındaki pubik kemiklerin, karşı pubik kemiklerden önemli ölçüde daha yüksek bir ortalama KİÖ yoğunluğuna sahip olduğunu ortaya koydu (1049 SI'ye karşı 796 SI, $p<0.001$).

Sonuç: Pubik KİÖ'ye sahip futbolcuların onda birinde eşzamanlı kasık fıtığı görülebilir. Fıtık ister eşzamanlı ister onarılmış olsun, pubik KİÖ'nün şiddetli olduğu taraf ile örtüşmektedir. Kasık seçimi açısından fıtık ile pubik KİÖ şiddeti arasında anlamlı bir ilişki vardır. Kasık tarafları arasındaki kuvvet / esneklik dengesizliği veya dominant bacak etkisi bu bağlamda araştırma konusu olabilir.

Anahtar Kelimeler: Futbol, Sporcu, Kasık Fıtığı, Kemik İliği Ödemi

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Groin pain is a serious problem forcing athletes to career limiting/ending, and has a negative impact on the worldwide sports economy (1). Athletic groin pain may arise from pelvic osseous, muscular, tendinous, bursal, articular (hip), neural or urogenital structures (1,2). Football is a risky sport for groin pain conditions. The percentage of groin injuries to all injuries was 11.1% in amateur football players (3), while it was reported as 14% in professional players (4).

Pubic region pain is frequently seen in sports that require kicking, rotation, sudden acceleration and deceleration movements (1,2). Painful and tender pubic bones do not allow the athlete to train or compete on high levels (2,5). Increased pubic bone marrow edema (BME) signal on magnetic resonance imaging (MRI) is a common manifestation in the painful athletic groin (5-12). BME reflects a stress reaction of the pubic bone to excessive athletic loading. In a histologic study conducted on athletes with chronic groin pain, pubic bone biopsies taken from the high MRI signal intensity areas showed the existence of increased osteoblastic activity, new bone formation and neovascularization. The findings were found to be compatible with pubic bone stress injury (13).

It is unlikely to observe a frank hernial swelling in the groin area of athletes, however, a pain provoked by valsalva maneuver often exists (2,14). During the sportive activity, adductor and abdominal actions generate tractional and shearing forces on the posterior inguinal wall. The wall is composed by the fascia transversalis and lies within the Hesselbach's triangle. Factors such as groin weakness, muscle imbalance, poor coordination and groin overuse may lead to a fascial defect in this region and pave the way for hernia formation in athletes (2,14-16). Although a groin hernia is not easily detected by physical examination in athletes, it can be diagnosed by dynamic inguinal sonography (14,15,17,18).

The groin area, which has a complex anatomical structure, can host multiple athletic problems at the same time. Some of these may be linked to each other (2,6,16,19,20). Based on the above informations, this study aimed to research whether there is an association between groin hernia and pubic BME severity in football players with the painful groin.

MATERIAL AND METHOD

Study Design and Population

This retrospectively designed study was approved by the Ethics Committee of Antalya Training and Research Hospital and carried out by the principles of the Declaration of Helsinki.

The hospital's online information system (SARUS) and patient medical charts were used for data searching. Athletes who were consecutively admitted to the Sports Medicine department for painful groin were scanned. Age, gender, sports branch, clinical history (symptoms, pain duration, pain localization), physical examination findings and radiological analyses were examined. Only male footballers aged between 18 and 45 years were included in the study, while females and non-football athletes were not included. Another inclusion criterion was that "pubic BME" had been documented in the magnetic resonance imaging (MRI) report.

Then, a second archive search was performed to find which ones of these footballers were associated with groin hernia. History of hernia symptoms (increasing groin pain with sneezing, coughing or straining), history of a previous hernia operation, sonography reports and surgery referrals were checked. Sonographic reports in favor of a bulging that contains peritoneal fat or intestinal structure within the Hesselbach's triangle were considered as hernia.

Measurement of Bone Marrow Edema

Previous MRI pictures of the athletes who were found related to hernia were re-evaluated. Pubic BME signal intensity (SI) values were quantitatively measured on fat-suppressed T2 sequences. For this purpose, the "region of interest (ROI)" module of a software program was used (Sectra Workstation IDS7, Sectra AB, Sweden). SI values were measured by determining ROI areas about of 50 mm^2 within the highest signal zone of the right and left pubic bones of each athlete.

Statistical Analysis

Statistical analyses were performed using the SPSS package for Windows 18.0 (SPSS Inc, Chicago, Illinois, USA). Categorical variables were defined as percentage distribution (%). Continuous variables were defined as mean (± standard deviation), minimum (min) and maximum (max) values. Independent Samples T-test was used to compare the means of age and Mann Whitney U test was used to compare the means of symptom duration. The mean pubic BME signal intensity values of hernia-related groins and opposite groins were compared using the Wilcoxon Signed Ranks test. P values less than 0.05 were considered

as significant. Post hoc power analysis of the study was calculated with the G.Power program (version 3.0.10).

RESULTS

As a result of data searching, 93 male footballers with pubic BME on MRI reports were found. All athletes had pubic bone tenderness with digital palpation. Also, resisted "sit-ups" and "adductor squeeze" tests were painful in all. Two-thirds (61/93) of the footballers were professional athletes. Twenty eight were amateur players and 4 were football referees. The mean age was 25.1±7.3 years (min 18 years, max 45 years), and the mean duration of groin pain was 3.2±3.3 months (min 1 week, max 18 months).

The second archive scan revealed that 16 athletes were related to hernia (Figure 1). In the history of 5 athletes (5.4%), it was found that they had undergone hernia surgery before applying to the clinic. Three had been operated from the right and two from the left groin. The remaining 11 athletes (11.8%) who complained of hernia symptoms had a concurrent hernia in their sonography reports. On physical examination, only one (patient 9) had a bulge by valsalva maneuver. The side of the hernia was right in five athletes and left in six athletes (Table 1).

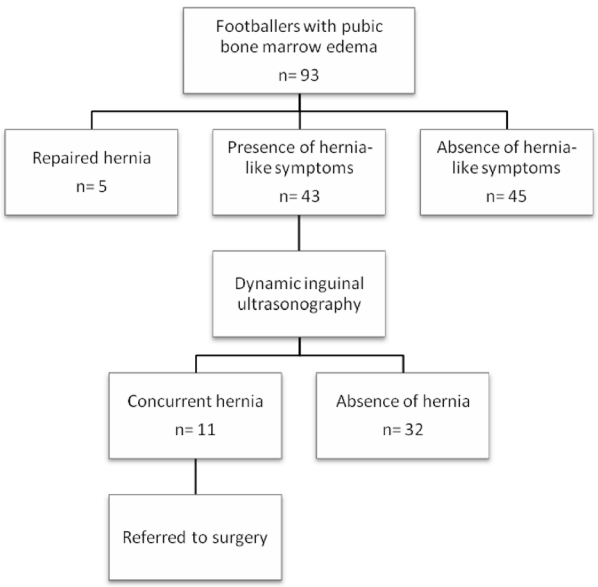

Figure 1. *The diagram shows the distribution of the footballers related to hernia.*

ROI measurement of these sixteen athletes revealed that the pubic BME signals on the side of concurrent or repaired hernia were more intense than those of opposite pubic bones. The mean pubic BME intensity value of the hernia-related groins was significantly higher (1049±380 SI, min 503 SI, max 1613 SI) than those of the opposite groins (796±280 SI, min 392 SI, max 1376 SI) (p<0.001). Figure 2 shows the ROI measurement on an athlete's MRI (patient 10). Figure 3 shows the pubic BME signal intensities of sixteen athletes and intensity means according to the groin sides.

The mean age of isolated BME cases (24.1±6.7 years) was lower than those with concurrent hernia (28.5±7.7 years, p=0.053) and repaired hernia (32±10.6 years, p=0.018). Also, the mean symptom duration was lower in isolated BME cases (2.8±2.8 months) than those with concurrent hernia (6.1±5.7 months, p=0.003) and repaired hernia (3.5±2.3 months, p=0.600).

Power Calculation

Post hoc power analysis of the study revealed that a sample size of 93 subjects had a power of 100% (1- β) based on an effect size of 0.74 and a two-sided α level of 0.05.

DISCUSSION

Groin problems reduce the athletic performance and lead to significant time and economic losses in football, which is the most popular and financial sport worldwide. Clinicians should not ignore that more than one condition can exist concurrently, especially when evaluating a footballer with prolonged groin pain (6,10,19,20). The present study showed that 11.8% of the footballers with pubic BME had a concurrent hernia as a second groin problem. This concurrency became more visible with the increasing age and pain duration, while the age and pain duration of isolated BME cases were remarkably lower. On the other hand, 5.4% of the athletes had a repaired hernia before inclusion in the study. They were the oldest group, but had shorter pain duration possibly due to a previously repaired hernia.

Pubic BME is a frequently encountered condition in footballers with a painful groin. Despite many MRI studies describing pubic BME (5-12), only three of them reported the concurrency of groin hernia and pubic BME (6,10,11). Different from the previous studies, this study tried to question the relationship between groin hernia and pubic BME. For this purpose, it was focused on the quantitative value of pubic BME by using the bilateral ROI method. The edema intensity value was directly measured in this study, instead of defining it as *"absence / presence of BME"* (6,8-10) or grading it as *"0=normal / 1=minimal / 2=moderate / 3=severe BME"* (5,7,11,12). The measurements revealed that the pubic BME on the side of concurrent hernia had a higher intensity than opposite side. Even if the hernia had been previously repaired, pubic BME severity was higher on the operated side. There is no study reporting such an outcome in the literature.

Table 1. Footballers with repaired or concurrent hernia

Patient	Age	Football level	Symptom duration	Side of hernia	Sonography report
1	38	amateur	2 months	right (repaired 8 years ago)	non-available
2	34	amateur	3 weeks	right (repaired 5 years ago)	non-available
3	25	amateur	6 months	left (repaired 4 years ago)	non-available
4	45	amateur	3 months	right (repaired 2 years ago)	non-available
5	18	professional	6 months	left (repaired 1 year ago)	non-available
6	29	professional	3.5 months	left	18 x 4 mm focal adipose tissue herniation
7	20	professional	12 months	right	bulging of the omental fat tissue with valsalva
8	22	professional	3 months	right	fat structures displacing with valsalva
9	41	amateur	18 months	left	3.5 x 2.5 cm heterogeneous echo structured adipose tissue herniation in the axial plane
10	18	professional	2 months	left	convex hernial bulging of fat tissue with valsalva maneuver
11	29	amateur	4 months	left	fat tissue volume becoming prominent in the proximal of the canal with valsalva
12	30	referee	2 weeks	right	anterior bulging of peritoneal fat tissue
13	38	professional	1.5 months	left	herniation extending to the mid-canal level with valsalva maneuver
14	34	amateur	2 months	left	bulging adipose tissue volume in adjacent to the rectus muscle
15	20	professional	9 months	right	fat tissue volume becoming prominent with valsalva
16	33	amateur	12 months	right	displacing omentum anteriorly with forced valsalva maneuver

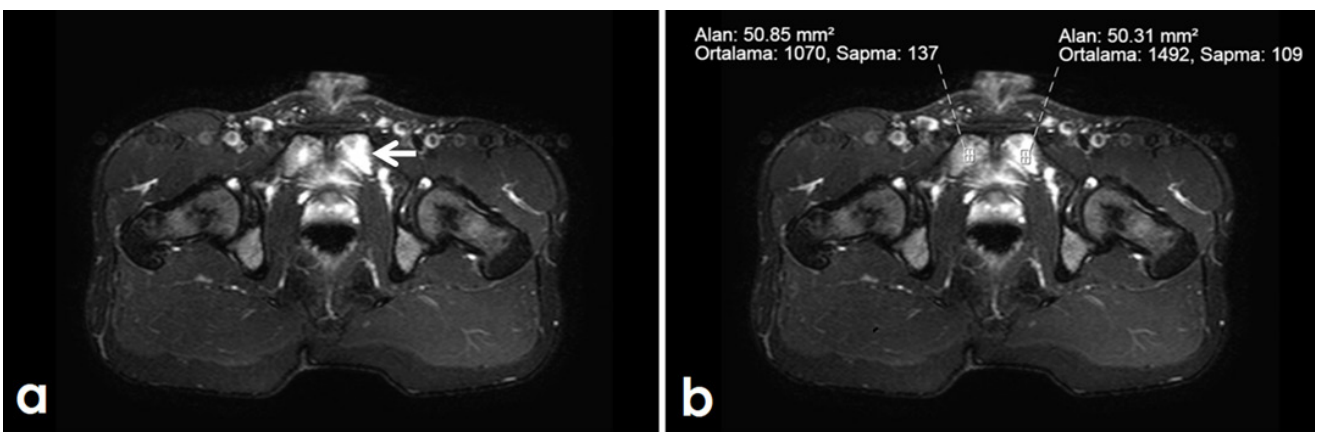

Figure 2. (a) *Coronal MRI section of an 18-year-old professional footballer (patient 10) shows the left pubic bone having more hyperintense BME (arrow) compared to the right.*
(b) *ROI measurement on axial image revealed the BME intensity difference between the pubic bones. (BME: bone marrow edema, ROI: region of interest).*

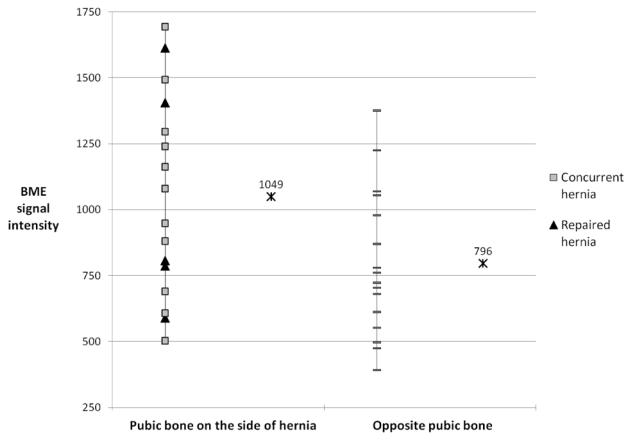

Figure 3. *The graph shows the pubic bone marrow edema (BME) signal intensities of footballers with concurrent hernia (n=11) and repaired hernia (n=5). Significantly different means (1049 SI versus 796 SI, p<0.001) between the groin sides are seen.*

Besides the selection of the same groin, both conditions (hernia and pubic BME) are anatomically in near adjacency. They probable originate from the similar injury pathways. The younger age of isolated BME cases in this study may indicate that pubic BME is the first developing condition and hernia is added to the clinical picture later. Excessive tractional and shearing forces on the weak groin side may cause both pubic bone stress and inguinal wall deterioration (2,10,16). Strength/flexibility imbalance between the groin sides, leg dominancy or asymmetric loading may play a predisposing role in the etiology. In studies conducted on footballers, hip adductor strength in the dominant (kicking) leg was found to be higher than in the non-dominant leg, but no difference was found between abductors (21,22). Asymmetric strengthening of the dominant adductors may lead to compensatory abdominal muscles hypertrophy through the pubic bone where they attach (23).

The present study has some strengths. First, to the best of current knowledge, this is the first study reporting as a significant association that the more severe pubic edema is seen in the same groin side with the hernia. Second, different from the previous studies evaluating the severity of pubic BME subjectively (5-12), this study objectively measured its quantitative value by bilateral ROI evaluation. Third, the high number of subjects is another strong aspect of this study. The athletic cohort had sufficient power and was larger than similar studies' cohorts (5,6,9-11). Fourth, subjects from the same-sex and from the same-sport provided the homogeneity of this study.

Although groin hernia was detected by sonography in one-tenth of footballers, the possible undetectable ones could be considered as a study limitation. Sonography is a safe, fast, cost-effective and non-invasive method providing bilateral groin evaluation. Many authors emphasize its importance in the diagnosis of occult groin hernias (14,15,17,24). However, sonographic results are user-dependent and hernia diagnoses may be missed sometimes. Therefore, surgical exploration has evolved into a diagnostic method in many institutions worldwide. This issue should be taken into account for future prospective studies.

CONCLUSION

One should be aware of the athletic problems that cause pain at different anatomical points of the groin region. At least one-tenth of footballers with pubic BME can have a sonography-detectable concurrent hernia. This concurrency appears to be proportional to the athlete's age and symptom duration. Pubic bones on the side of concurrent or repaired hernia have a more intense edema signal than opposite pubic bones. The signs indicate that groin hernia and serious pubic BME tend to occur in the same groin side of footballers, perhaps via similar injury pathways. To investigate this association, strength / flexibility imbalance between the groin sides and leg dominancy can be subject of the next research.

DECLARATIONS

Conflicts of Interest / Competing Interests

None.

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Ethics Approval

Institutional Ethics Committee approval number: 15 - 54/8.

Authors' Contributions

AE: Design, data collection, analysis and writing.

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