REVIEW ARTICLE

Athletic Pubalgia – A Review of Literature.

Qassim I. Muaidi[*1]

* For correspondence qmuaidi@uod.edu.sa

*Vice Dean for Academic Affairs & Chairman of Physical Therapy Department, College of Applied Medical Sciences, Dammam University

Submitted on: 15th September 2015, Accepted on: 11th October 2015

Abstract

Athletic pubalgia is commonly seen in sports that require athletes to perform repetitive kicking, cutting, pivoting and sharp turns such as soccer, cricket, rugby, ice hockey etc. It is caused by immoderate and disproportionate application of shear forces through the common attachments (pelvic) of the abdominal muscles and hip adductors. At present, there is no unanimity of opinion about the constituents of this diagnosis. Since it is not easy to define a clear diagnosis that is based on physical examination, methods such as ultrasonography and MRI are commonly used to rule out the existence of other conditions. Though surgeries are better than traditional treatment, laparoscopic surgery has a shorter recovery time as compared to open surgeries. This article summarises the present data regarding anatomy, biomechanics, clinical presentation, differential diagnosis, conservative treatment, preoperative and post-operative rehabilitation of athletic pubalgia. The information obtained from such a research work will help in understanding pathogenesis in a better way, build-up evidence-oriented screening and check for better surgical methods and effectively manage both post-surgical and conservative rehabilitation.

Key Words: Abdominal Muscles, athletes, laparoscopy, physical examination, running.

الملخص

فتق عظ دالي اضيين عادة ما يحص لفي ألل عاب الي اضية التي يتطلب أداء متك رر من ال حركات مثل الرك ل ت غيير الاتجا هات وال دوران الش ك ل ح ادوس ري ع مثل ال ع ة ك رة الق دم، وال ر ك بي، ول ك ي ت، لي ع ة ال ه وك ي ع ى ج لي د. ت ك ون ال ت ج ت ع رض ع ض لات ال ح وض ال ف خذ الداخلي ة وال ب طن ق وم ف رط ة و غير ب اس ب ة م ع ق وة ه ذا ف ي ع ض لات ف ي ال ق ت ال ح ض ر، لا يو ج د إج م اع ف ي ال ر أي ح ول م ك ون ات ه ذا ال ت ش خ يص. ون ظ را لأ ن ه ل ي س من س ه ل ة ال ح ت ي ت ش خ يص ق ي ق ب ن ف ي ق ط ع ل ى ال ف ح ص ال س ري ر ف ان ع دة ط رق أ خ رى مث ل ال م وج ات ف وق الص وت ي ة وال ت ص وي ر بال ر ين ان م غ ن اط يس ي ت ت خ دم لا ست ب ع اد وج ود إص اب ات أو ام راض أ خ رى. ع ل ى ال ر غ م من ان ال ع لاج ات ال ج راح ي ة ه ي أ ف ض ل من ال ع لاج ال ط بي، ال ا ن و ق ل ت ش ف اء ع ل ج راح ة ال ف ت ح ة أ ق ص ر من ال ع لاج ات ال ج راح ي ة ال م ف ت وح ة. ه ذا ال م ق ال ي ل خ ص ال ت ح ال ة ال ع ل م ي ة ال ح ال ي ة ال ت ش ر ي ح، ال ع وام ل ال ك ام ن ة ال ح ي وي ة، ال ط رق ال س ر ي ر ي ة، ال ت ش خ يص ال ف ر ق ي، ال ع لاج غ ير ال ج راح ي وال ج راح ي، وال ت أ ه يل ق ب ل وب ع د ال ج راح ة ف ت ق ع ظ دالي اضيين. ان ه ذه ال م ع ل وم ات ال ت ي ت م ال ح ص ول ع ل ي ه ا من الأبحاث ال ع ل م ي ة ت س اع ف ي ف ه م م ص در وت ط ور ه ذا ال م رض او ال ص ابة ب ش ك ل أ ف ض ل، وب ن اء ال ة م ب ي ة ع ل ى ال ت ش خ يص ال و ف ح ص ال د ق يق وال ت ح ق ق من الأ س ال ي ب ال ج راح ي ة الأ ف ض ل، ف ا ض ل ط رق ال ت أ ه يل ل ل غ ير ال ج راح ي ة وال ت أ ه يل ب ع د ال ع لاج ات ال ج راح ي ة.

Introduction

Athletic pubalgia, also known as Sports hernia or Gilmore's groin is commonly seen among the athletes who perform repetitive high speed kicking, turning or pivoting commonly seen in cricket, tennis, basket ball and most frequently soccer and hockey.[1-5] Athletic pubalgia refers to the chronic pain in the inguinal or pubic-area which is present with exertion and not explainable preoperatively by a palpable hernia or other medical diagnosis.[6] It may be unilateral or bilateral depends up on the location of pain and there may be associated medial thigh symptoms related to the adductors of the hip.[3,7] It has been reported among 5% to 28% of athletes[9] and most commonly diagnosed among

male athletes.[8] Around 2% of female athletes have been diagnosed with athletic pubalgia.[8] This variation in the incidence of pubalgia may be because of the anatomical differences between male and female rather than participation.[10] Females have a wider pelvis which makes more effective force distribution to the lower body[11] and the strength variation also makes contribution to high incidence of pubalgia among males. Literature is filled with complicated and by and large conflicting information regarding the cause, medical presentation, diagnosis, and management of sports hernia in athletes.[1,4] It is important that the clinicians should have a thorough knowledge about the condition as there is a high chance of misdiagnosis.

Applied Anatomy and Biomechanics**:** Rectus abdominus makes a conjoined tendon with transversus abdominus muscle and insert at or near the pubis. Across from these two muscles, and directly opposing their forces, is that the adductor muscle longus. Rectus abdominis muscle originates from the upper part of the symphysis pubis, with distinction often able to be made between a lateral and a medial head on both sides. Inferiorly, the medial head blends with its contralateral fellow; however, superiorly the medial heads diverge and are separated by the linea alba. The rectus abdominis has a sheet like configuration,[12] with a minimum of three intramuscular tendinous intersections, one at the level of the umbilicus, one at the xiphoid tip, and one between these two intersections. Sometimes, a fourth intersection may be present inferior to the umbilicus. The intersections extend through only to the anterior surface of the muscle, where they blend with the anterior rectus sheath. This latter structure covers the complete anterior aspect of each rectus abdominis and attaches onto the periosteum of the pubic bone anterior and adjacent to the rectus abdominis origin. The adductor muscle longus and adductor muscle brevis possess an extensive insertion on the femur. Combined with the insertion of the gracilis onto the tibia, these three tendons converge superiorly and obtain an origin close to each other on a narrow portion of the pubic body just lateral to the symphysis.

The adductor muscle tendon has its origin almost directly in line with the origin of the more superiorly placed tendon of the rectus abdominis, with the superficial fibers of these two tendons in direct continuity, coursing over the pubic crest. Farther posteriorly and slightly laterally lies the origin of the adductor muscle brevis. Some of the medial fibers of the adductor muscle longus and adductor muscle brevis tendons attach directly onto the symphyseal capsular tissues and intra articular disk.[13] When an athlete suffers a sports hernia, these opposing forces (upward pull from conjoined tendon and downward pull from adductor longus) cause disruption of the muscles at their insertion site (pubis), leading to groin pain. What happens is

that in repetitive kicking, pivoting or turning at high speeds the conjoined tendon exerts upward force and rotates the trunk, and the adductor muscle longus exert downward force and rotate the upper leg. The application of these excessive amounts of force in an imbalanced manner causes Athletic pubalgia. Often, the core muscles are less developed than the lower extremity muscles and disruption disproportionately involves the conjoined tendon leading to athletic pubalgia.

Signs and Symptoms: Athletic pubalgia is commonly seen among males than females. Most of the time the onset is insidious and in some cases an initial sudden tearing sensation may be felt. Pain is usually exercise related and felt on the lower side of the rectus abdominis muscle and it may radiate toward the testicular area, supra pubic region or adductor region. The pain may get aggravated by a sudden acceleration, cutting or even cough or sneezing. There may associate stiffness along with pain and it may persist for more than two to four days after competition. Localized tenderness at or above pubic crest of the effected side and pain will be present during resisted sit-ups. Resisted hip abduction will be painful and a painful squeeze test in supine position or 90º hip flexion position.

Diagnosis: The following criteria required for a diagnosis of athletic pubalgia includes: a clinical setting of chronic groin pain which develops during exercise, is felt over the lower lateral side of the rectus abdominis muscle with or without radiating to the testis or medial thigh muscles, and is aggravated by sudden acceleration, cutting and kicking, pivoting, sit-ups and coughing or sneezing; Subtle but consistent physical examination findings (Physical examination will not find an actual hernia, even though most of these signs and symptoms lead health care professionals to believe that one is present).[10,17-21] The Valsalva maneuver, along with muscle testing of the hip adductors, rectus abdominis, rectus femoris, and iliopsoas, will produce some discomfort.[20] Differential diagnosis has to be done to rule other causes of groin pain and appropriate imaging features. All of these criteria must be simultaneously present, because: (1) there are numerous other potential causes for groin pain in athletes; and (2) asymptomatic direct inguinal hernias are common in the general population.[22]

Differential diagnosis: Adductor Longus Tendinosis and Tenoperiostitis: It usually occurs with persistent overuse of the adductor longus muscle.[23] Adductor tendinosis is generally related to a rectus abdominis–adductor muscle longus aponeurotic injury. However, these type of injuries can be treated conservative management. The most common area of injury is proximal myotendinous junction. Pain and discomfort is in the upper medial thigh may get worsened by a resisted adduction of the hip and a tenderness can be felt on the proximal part of the tendon. The MRI shows thickening of the

adductor muscle longus tendon on the affected area, intra-tendinous tear, calcification, tendon avulsion, or a higher-grade and more distal adductor strain.

Osteitis Pubis: It is believed to result from instability of the pubic symphysis because of chronic repetitive shear and distraction injuries and unbalanced tensile stress from the muscle attachments of the pubic symphysis. The biomechanical changes leads to an inflammatory response, with osteitis and periostitis. Onset of pain over the pubis that may cause referred pain in the suprapubic region, adductor origin, and groin. Radiographs of the pubic symphysis may show subchondral sclerosis, symphyseal irregularity, and bone resorption.[24] MR images show diffuse marrow edema extending from the subchondral plate and often involving both pubic bodies.[25,26] In addition, periostitis, erosions, irregularity in articular surface, anterior and posterior osteophytes, and subchondral cysts may also be seen on MRI.[27] The myotendinous attachments are preserved unless there is coexistent tendinopathy.[28] The marrow edema in an osteitis pubis extends across the entire anteroposterior dimension of the pubic body.

Hockey Goalie–Baseball Pitcher Syndrome: Groin pain in this unusual syndrome result from an epimysial or myofascial herniation of the adductor longus muscle belly several centimetres away from the site of its pubic attachment.[29] A number of authors have suggested a link with chronic repetitive stress at sites of neurovascular penetration.[30] Acute onset of pain is usually experienced by patients in this condition, which may be persistent or may intermittently increase after stretching. Physical examination often leads to the identification of a site of pain distal to the symphysis pubis, over the herniated muscle. Imaging findings shows edema of the adductor longus muscle belly, which can possibly occupy a central position in the herniated area, and a focal muscle bulge indicative of herniation.[31]

Pubic Stress Fracture: Fatigue fractures are usually seen in athletes, especially in long-distance runners who are supposed to reflect abnormal chronic repetitive stress that surpass the bone's capability to remodel itself. Inferior pubic ramus is the most common site of pelvic stress fracture; however, stress fractures of the femoral neck are more prevalent and may cause groin pain.[32] Risk factors for stress fracture include female sex, malnutrition, and changes in the training program that place a greater amount of stress on the bone. Patients usually present with a gradual onset of pain, which, at an initial phase of injury, is aggravated by exercise and relieved by rest. If pain persists even during rest, it indicates a more advanced phase of injury. On palpation, tenderness is usually present over pubic ramus.[33] MRI finding shows areas of marrow edema obtained with fluid-sensitive sequences. There is also a possibility that periosteal edema or calluses and edema in the

adjacent muscles and soft tissues are present in some cases.

Septic Arthritis–Osteomyelitis: Infection of the pubic symphysis is commonly seen in postpartum female patients, patients with pelvic malignancies and patients subjected to direct instrumentation of the pubic symphysis, but it is also seen in athletes without such risk factors.[34] The infection is most often caused by Staphylococcus aureus and may result from a hematogenous spread rather than direct inoculation. Patients usually present with fever and an acute onset of pubic pain that can radiate up to the groin. The radiographic and MRI features of pubic septic arthritis–osteomyelitis and osteitis pubis are identical, and clinicians may depend on the duration of symptoms and the presence of risk factors to help them distinguish between these possibilities. If the diagnosis is not definite, a biopsy test is desired.

Acetabular Labral Tear: There is complete overlap between the clinical manifestations of athletic pubalgia and the pathologic conditions associated with the hip. Some of the hip disorders which may result in groin pain are osteoarthritis, synovitis, intra-articular bodies, and acetabular labral tears. The ant-superior part of the labrum is quite vulnerable to injuries, particularly during external rotation and hyperextension.[35] The labrum is comparatively poorly vascularized and its anterior-superior aspect is actually considered to be particularly weak. Labral injuries predispose the hip to paced articular cartilage loss, especially near to the tear, a condition that is considered to be the cause of alterations and instability in contact forces of the articular cartilages.[34] Abnormal morphology and signal intensity of the labrum at routine MR imaging of the hip are indicative of the diagnosis. Paralabral cysts linked with acetabular labral tears can be clearly seen on the images obtained with fluid-sensitive sequences. Additionally, MR imaging plays its role in determining whether the morphologic features of the femoral head and acetabulum predispose a patient to labral tears and femoroacetabular impingement.

Internal Snapping Hip (Coxa Saltans): Internal snapping hip is a rare cause of pain in the inguinal region and anterior part of the hip. The musculo tendentious part of the iliopsoas muscle snaps with head and anterior capsule of the femur causing an obstruction to the movement. This chronic repetitive motion may leads to tendinosis and iliopsoas bursitis. Magnetic Resonance Imaging of the hip in a patient with internal snapping may seem to be normal, but iliopsoas bursitis is frequently present.[36,37] Intermediate intra substance signal intensity and Iliopsoas tendon thickening are rare findings, but when they are observed over the spinal process or iliopectineal eminence, they are indicative of the diagnosis. Lastly, an osseous spur budding from the iliopectineal eminence may predispose the patient to growing internal snapping. Ultrasonography is often helpful for

visualizing the tendon as it passes over the iliopectineal eminence during dynamic maneuvers in addition for detecting bursitis.

Osteoid Osteoma: Osteoid osteoma is a benign bone-forming tumor generally observed in the patients between the ages of 5-30 years. It is generally occurring in the long bones, specifically the tibia and femur and in the phalanges of the toes and fingers. Lesions that include the pubic bones may repeat the symptoms of athletic pubalgia. Osteoid osteomas may appear in medullary, cortical, subcortical or periosteal sites. They typically occur as a central radiolucent nidus with a varying degree of calcification, surrounded by different zones of cortical thickening in addition to non aggressive periosteal reaction. Intramedullary lesions as well as lesions within a joint capsule are often accompanied by a small amount of or no surrounding sclerosis due to the lack of contiguity with the nearest periosteum. CT and Radiography are generally diagnostic for osteoid osteoma and may be used to give direction to biopsy and treatments like percutaneous ablation.[38]

Nerve Entrapment Syndromes: Several nerves, including the femoral, obturator, iliohypogastric, genitofemoral, lateral femoral cutaneous nerves and ilioinguinal provide motor and sensory innervation to the upper thighs and groin. Entrapment of any of these structures may result in groin pain mimicking athletic pubalgia. Patients with obturator nerve entrapment, mostly present along with aching pain near the adductor origin which may radiate to the knee and also worsen during the exercise. The nerve entrapment has been attributed to fascial thickening of the adductor compartment, specifically along the anterior aspect of the adductor brevis.[39,40] Other possible causes of obturator nerve entrapment involve a mass effect from an obturator hernia a pelvic fracture, an obturator hernia and an acetabular paralabral cyst.[41,42] Femoral nerve entrapment has been diagnosed in patients after surgical procedures such as herniorrhaphy, hip arthroplasty, abdominal hysterectomy, entrapment of the genitofemoral and ilioinguinal nerves may be seen after abdominal surgery in muscle hypertrophy or in blunt trauma.[43] Although the nerves in this area are difficult to detect at regular MRI, it may be helpful for diagnosing entrapment. MRI findings of muscle denervation-related edema or atrophy with a characteristic pattern may be suggestive of entrapment of a specific nerve.

Apophysitis: There are several pelvic apophyses which may be injured by forceful or repetitive muscle contractions during athletic activities before complete skeletal maturity is achieved i.e. between the ages of 12 and 22 years. Groin pain mimicking athletic pubalgia may be present in inflammation of the apophyses of the anterior-inferior iliac spine, where actually the rectus femoris originates and the anterior-superior iliac spine at the originating point of the

Sartorius and the tensor fascia lata. Athletes who participate in sports involving frequent kicking have a tendency to develop painful apophysitis in such locations.

Urological disease: Other commonly seen causes of obscure groin pain include prostatitis,[44] urethritis, epididymitis and hydrocele.[45]

Connective tissue disease: Various connective tissue disease, such as rheumatoid arthritis should be rules out. Diseases such as gout, ankylosing spondylitis, Reiter's syndrome and other spondarthritides may also need to be investigated.[46]

Spinal and hip abnormalities: Early assessment of the spine and hip has to be done to identify sacrolumbar abnormalities and sinister lesions such as bone tumours. Old osteochondritis of the vertebral bodies, disc lesions at L1 or L2, and crush fractures can cause radicuar pain and imitate athletic pubalgia.

Imaging: Many authors suggest that Magnetic Resonance Imaging (MRI) is having a limited ability to identify a athletic pubalgia but it can be used to rule out any the alternative diagnoses; nevertheless others have prompted that Athletic pubalgia almost always show abnormalities in MRI.[47-51] The two clearly seen patterns of injury involve lateral rectus abdominis/adductor aponeurotic injury just near to the midline rectus abdominis/adductor aponeurotic plate injury[7] and external inguinal ring. Although some degree of pubic marrow enhancement is generally reported, these findings do not foretell which patients will gain from the surgery.[7]

Management: The initial stage of treatment for any kind of muscle injury generally includes rest, ice and proper compression. Resting is obviously needed to avoid any further deterioration or aggravation of the condition. Resting period can be anywhere from few weeks to months depending upon the condition's severity and application of ice to the injured area for about 10-15 minutes every four hours all over the day help in giving some relief in the swelling and pain caused by injury in Athletic pubalgia. Compression shorts and warm pants also play their role in controlling the symptoms of athletes who still have some time for surgical intervention. However, these may not decrease the symptoms of Athletic pubalgia, but certainly help in curbing worsening of tear until the time of surgical intervention. Anti-inflammatory medications like ibuprofen may also be consumed to reduce the swelling and pain.

Physiotherapy Management: The most important aim of physical therapy management is to reduce the time lost to the player due to injury and enhance the availability of the player to the team as soon as possible. Pre-season screening of the athlete especially flexibility, posture and gait is having a major role in prevention of these type of injuries. Once the assessment is done athlete should involve a rigorous training which is specific to each

individual. Early part of functional rehabilitation should be taught to the athlete in advance to the surgery so that the athlete should have an early understanding regarding the exercises following surgery.

More emphasis should be given on the stabilising role of the transverses abdominis, which is always neglected, internal oblique, gluteal muscles and adductors of the hip. In the late preoperative/early postoperative phase, more stress should be given in maintaining the neutral position of the spine. This requires time and a detailed explanation of what is needed during what appear to be quite simple exercises for the 'ill-informed' patient. It is important that the rehabilitation program should be sports specific or occupation specific. The medical team should have an excellent understanding regarding the demands of the sport/occupation.[52] Appropriate preoperative and postoperative care must allow a full return to activity within just four to eight weeks from the date of surgery. A good coordination between the treating clinicians and the physiotherapy team for the preoperative and postoperative rehabilitation is recommended.

Preoperative rehabilitation: Preoperative rehabilitation involves; postural, range of motion and strength assessment, strengthening of gluteal muscles, transvers abdominus, erector spinae and abdominal muscles, educating the patient regarding post-operative rehabilitation, core muscle strengthening by the use Swiss ball, medicine ball, pulleys etc.

Surgery: Once the non surgical management is found ineffective , surgery is a reasonable option. Athletic pubalgia surgery can be done with all three types (local anaesthesia, general or regional anaesthesia). Athletic pubalgia surgery centres on stabilizing the insertion of the conjoined tendon at the pubic tubercle. Additionally, superficial nerve is taken away because this nerve can get caught up with post-surgical scar and mimics the symptoms of Athletic pubalgia. In order to strengthen the inguinal floor a supportive mesh will be placed over the repair and extend through the inguinal canal. The incision will be around four to five centimetre length. In order to decrease post-surgical discomfort local anaesthetics will be given before closing of the incision. The initial Athletic pubalgia surgery does not take care of the discomfort at the adductor insertion site. If the conjoined tendon is sufficiently supported by the Athletic pubalgia surgery, adductor discomfort is can be treated in postoperative rehabilitation. Rarely does the adductor needs operative release. Other surgical techniques involves an altered Bassini repair, in this technique the transversal fascia from the deep to superficial ring was released. Intra operatively, all athletes were diagnosed for thinning and a variable degree of bulging of the posterior inguinal wall. The conjoined tendon used to be attached to the inguinal ligament in a double-

layer continuous suture, as against the interrupted original Bassini repair; with a running 2/0 prolene suture.[53] A concurrent percutaneous adductor release was done by an orthopaedic surgeon in all the cases. A bilateral tenotomy was done with complete transaction of the epimysial fibres of the adductor longus tendon which is two centimetre from the pubic insertion. For those who are having persistent adductor symptoms even after post surgical rehabilitation or for those whose major complain was related to adductor muscle, non-operative options do exist. Adductor problems, that are not responsive to physical therapy can be treated with Platelet-Rich Plasma injection, which is an office-based procedure. Post-procedure rehabilitation will be continued, and it is rare that a second injection is needed. This technique has replaced operative release of the adductor insertion.

Post Surgical Rehabilitation: Postoperative rehabilitation can be started with isometric exercises of abdominal muscles and muscles around the hip joint. Early spinal mobilization program can also be initiated. Increase walking using time as limiting factor, increasing by five minutes per day can be initiated from 2nd week onwards and active assisted exercises and isokinetic program in functional standing position can be incorporated at the end of week number.[2] Functional rehabilitation program by using gymnastic ball, mobility and stability exercises and the exercise to improve cardiovascular system can be started with from 3rd week onwards. Early sports/occupational specific rehabilitation program can be incorporated with the existing rehabilitation program in the 4th and 5th weeks of surgery. The person can return to normal activities/sports by 5th or 6th week according to the functional reassessment.

Conclusion

Timely recognition is crucial in case of injury diagnosis, which can be done through thorough examination of the injury. This may include palpation of the areas of concern and manual muscle testing to exclude the other possible conditions. Mostly, the patient will complain about chronic pain in the regions such as lower abdomen, pelvic region and thighs, which all radiates to the groin region. If a clinician encounters such complaints/symptoms, then, he/she should examine the patient for Athletic pubalgia. However, one needs to be aware about the fact that these findings will not confirm the diagnosis of Athletic pubalgia, so clinicians should have a thorough knowledge of the other conditions which may mimic the symptoms. Most imaging studies are only useful to exclude other diagnoses. Patient will typically not respond to conservative/non operative treatment, so we can switch over to surgical treatment if the patient does not respond to non operative treatment even after six weeks. Usually patient returns to his pre injury level

within 6 weeks after laparoscopic repair and within 1-6 months in case of an open repair.

Acknowledgment

The author acknowledge the immense help received from the faculty members of Department of Physical therapy, University of Dammam for the completion of the review.

References

1. Kachingwe AF, Grech S. Proposed algorithm for the management of athletes with athletic pubalgia (sports hernia): a case series. The Journal of orthopaedic and sports physical therapy 2008; 38: 768-81.
2. Holmich P. Long-standing groin pain in sportspeople falls into three primary patterns, a "clinical entity" approach: a prospective study of 207 patients. British journal of sports medicine 2007; 41: 247-52; discussion 52.
3. Meyers WC, Foley DP, Garrett WE, Lohnes JH, Mandlebaum BR. Management of severe lower abdominal or inguinal pain in high-performance athletes. PAIN (Performing Athletes with Abdominal or Inguinal Neuromuscular Pain Study Group). The American journal of sports medicine 2000; 28: 2-8.
4. Swan KG, Jr., Wolcott M. The athletic hernia: a systematic review. Clinical orthopaedics and related research 2007; 455:78-87.
5. Gilmore J. Groin pain in the soccer athlete: fact, fiction, and treatment. Clinics in sports medicine 1998; 17: 787-93
6. Hackney RG. The sports hernia: a cause of chronic groin pain. British journal of sports medicine 1993; 27: 58-62.
7. Preskitt JT. Sports hernia: the experience of Baylor University Medical Center at Dallas. Proceedings (Baylor University Medical Center) 2011; 24: 89.
8. Nam A, Brody F. Management and therapy for sports hernia. Journal of the American College of surgeons 2008; 206: 154-64.
9. Larson CM, Lohnes JH. Surgical management of athleticpubalgia. Operative Techniques in Sports Medicine 2002; 10: 228-32.
10. Diesen DL, Pappas TN. Sports hernias. Advances in surgery 2007; 41: 177-87.
11. Meyers WC, Yoo E, Devon ON, Jain N, Horner M, Lauencin C, et al. Understanding "sports hernia"(athletic pubalgia): the anatomic and pathophysiologic basis for abdominal and groin pain in athletes. Operative techniques in sports medicine 2012; 20: 33-45.
12. Rizk NN. A new description of the anterior abdominal wall in man and mammals. Journal of anatomy 1980; 131: 373.
13. Robinson P, Salehi F, Grainger A, Clemence M, Schilders E, O'Connor P, et al. Cadaveric and MRI study of the musculotendinous contributions to the capsule of the symphysis pubis. American Journal of Roentgenology 2007; 188: W440-W5.
14. Anderson K, Strickland SM, Warren R. Hip and groin injuries in athletes. The American journal of sports medicine 2001; 29: 521-33.
15. Brukner P, Khan K. Clinical sports medicine. McGraw Hill; 2006.
16. Joesting DR. Diagnosis and treatment of sportsman's hernia. Current sports medicine reports 2002; 1: 121-4.
17. Geisler P, Kelly E. Groin pains. Training and Conditioning 2008; 18: 31-5.
18. Schuricht A, Haut E, Wetzler M. Surgical options in the treatmentof sports hernia. Operative Techniques in Sports Medicine 2002; 10: 224-7.
19. Ahumada LA, Ashruf S, Espinosa-de-los-Monteros A, Long JN, Jorge I, Garth WP, et al. Athletic pubalgia: definition and surgical treatment. Annals of plastic surgery 2005; 55: 393-6.
20. Farber AJ, Wilckens JH. Sports hernia: diagnosis and therapeutic approach. Journal of the American Academy of Orthopaedic Surgeons 2007; 15: 507-14.
21. Paluska SA. An overview of hip injuries in running. Sports medicine 2005; 35: 991-1014.
22. Skandalakis JE, Gray SW, Skandalakis LJ, Colborn GL, Pemberton LB. Surgical anatomy of the inguinal area. World journal of surgery 1989; 13: 490-8.
23. Akermark C, Johansson C. Tenotomy of the adductor longus tendon in the treatment of chronic groin pain in athletes. The American journal of sports medicine 1992; 20: 640-3.
24. Vix Va, Ryu Cy. The adult symphysis pubis: normal and abnormal. American Journal of Roentgenology 1971; 112: 517-25.
25. Gibbon W, Hession P. Diseases of the pubis and pubic symphysis: MR imaging appearances. AJR American journal of roentgenology 1997; 169: 849-53.
26. Verrall G, Slavotinek J, Fon G. Incidence of pubic bone marrow oedema in Australian rules football players: relation to groin pain. British journal of sports medicine 2001; 35: 28-33.

27. Kunduracioglu B, Yilmaz C, Yorubulut M, Kudas S. Magnetic resonance findings of osteitis pubis. Journal of Magnetic Resonance Imaging 2007; 25: 535-9.
28. Brennan D, O'Connell MJ, Ryan M, Cunningham P, Taylor D, Cronin C, et al. Secondary Cleft Sign as a Marker of Injury in Athletes with Groin Pain: MR Image Appearance and Interpretation 1. Radiology 2005; 235: 162-7.
29. Meyers WC, Lanfranco A, Castellanos A. Surgical management of chronic lower abdominal and groin pain in high-performance athletes. Current sports medicine reports 2002; 1: 301-5.
30. Gokhale S. Three-dimensional sonography of muscle hernias. Journal of ultrasound in medicine 2007; 26: 239-42.
31. Mellado J, del Palomar LP. Muscle hernias of the lower leg: MRI findings. Skeletal radiology 1999; 28: 465-9.
32. LeBlanc KE, LeBlanc KA. Groin pain in athletes. Hernia : the journal of hernias and abdominal wall surgery 2003; 7: 68-71.
33. Lynch SA, Renström PA. Groin injuries in sport. Sports medicine 1999; 28: 137-44.
34. Morelli V, Espinoza L. Groin injuries and groin pain in athletes: part 2. Primary Care: Clinics in Office Practice 2005; 32: 185-200.
35. Overdeck KH, Palmer WE. Imaging of hip and groin injuries in athletes. In: Seminars in musculoskeletal radiology. 2004; Copyright© 2004 by Thieme Medical Publishers, Inc., 333 Seventh Avenue, New York, NY 10001, USA.; p.41-55.
36. Brittenden J, Robinson P. Imaging of pelvic injuries in athletes. Imaging 2005; 78.
37. Blankenbaker DG, Tuite MJ. The painful hip: new concepts. Skeletal radiology 2006; 35: 352-70.
38. Cantwell CP, Obyrne J, Eustace S. Current trends in treatment of osteoid osteoma with an emphasis on radiofrequency ablation. European radiology 2004; 14: 607-17.
39. Harvey G, Bell S. Obturator neuropathy: an anatomic perspective. Clinical orthopaedics and related research 1999; 363: 203-11.
40. Bradshaw C, McCrory P, Bell S, Brukner P. Obturator Nerve Entrapment A Cause of Groin Pain in Athletes. The American journal of sports medicine 1997; 25: 402-8.
41. Modelli M, Giannini F, Guazzi G, Corbelli P. Obturator neuropathy due to obturator hernia. Muscle & nerve 2002; 26: 291-2.
42. Yukata K, Arai K, Yoshizumi Y, Tamano K, Imada K, Nakaima N. Obturator neuropathy caused by an acetabular labral cyst: MRI findings. American Journal of Roentgenology 2005; 184: S112-S4.
43. Morelli V, Weaver V. Groin injuries and groin pain in athletes: part 1. Primary Care: Clinics in Office Practice 2005; 32: 163-83.
44. Smedberg S, Broome A, Elmer O, Gullmo A. Herniography in the diagnosis of obscure groin pain. Acta chirurgica scandinavica 1984; 151: 663-7.
45. Taylor DC, Meyers WC, Moylan JA, Lohnes J, Bassett FH, Garrett WE. Abdominal musculature abnormalities as a cause of groin pain in athletes Inguinal hernias and pubalgia. The American journal of sports medicine 1991; 19: 239-42.
46. NIEPEL GA, Sitaj S. Enthesopathy. Clinics in Rheumatic Diseases 1979; 5: 857-72.
47. Lacroix VJ, Kinnear DG, Mulder DS, Brown RA. Lower abdominal pain syndrome in national hockey league players: a report of 11 cases. Clinical Journal of Sport Medicine 1998; 8: 5-9.
48. Nelson EN, Kassarjian A, Palmer WE. MR imaging of sports-related groin pain. Magnetic resonance imaging clinics of North America 2005; 13: 727-42.
49. Van Veen R, de Baat P, Heijboer M, Kazemier G, Punt B, Dwarkasing R, et al. Successful endoscopic treatment of chronic groin pain in athletes. Surgical endoscopy 2007; 21: 189-93.
50. Kluin J, den Hoed PT, van Linschoten R, IJzerman JC, van Steensel CJ. Endoscopic evaluation and treatment of groin pain in the athlete. The American journal of sports medicine 2004; 32: 944-9.
51. Shortt CP, Zoga AC, Kavanagh EC, Meyers WC. Anatomy, pathology, and MRI findings in the sports hernia. In: Seminars in musculoskeletal radiology. 2008; © Thieme Medical Publishers; p.054-61.
52. Macintyre J, Johson C, Schroeder EL. Groin pain in athletes. Current sports medicine reports 2006;5: 293-9.
53. Van Der Donckt K, Steenbrugge F, Van Den Abbeele K, Verdonk R, Verhelst M. Bassini's hernial repair and adductor longus tenotomy in the treatment of chronic groin pain in athletes. Pain 2003; 36: 38.