

A reminder of the history associated with the diagnosis of athletic pubalgia is also helpful [1••]. For many years, general surgeons have attempted, without predictable success, various hernia repairs for this pain syndrome in high-performance athletes. There is no reason that those previous operations, or operations like them, should now suddenly produce miraculous success! The principle reason that we published our initial manuscript [5] on this subject was for that reason; that is, most attempts at surgery for this syndrome had been unsuccessful. In particular, most hernia operations did not work, so we developed an operation based on some concepts first suggested by the work of a Yugoslavian surgeon named Nesovic.

Finally, most empiric evidence points to the fact that this syndrome is not an occult hernia. The pattern of symptoms, operative findings, and reported results all suggest that the lower-abdominal/inguinal pain in these athletes is not due to occult hernia [1••]. Instead, this syndrome, as well as possibly several others, should be thought to result from injury to attachments that stabilize the complex joint of the pelvis. In other words, the best way to think of some of these injuries is that we are dealing with a subtly unstable pelvis.

Pelvic Anatomy

For the purpose of this review, we describe the pelvis as a girdle, with two pairs of innominate bones, plus the sacrum and the coccyx [6–8]. The innominate bone is composed of the ilium, the ischium, and the pubis, which also forms a portion of the acetabulum. One common concept is that there is little motion across the joints of the pelvis in the normal state. Another, perhaps more applicable, concept is that there is a lot of motion across these joints, but because there are so many tiny joints here, any one mini-joint ordinarily receives just a small fraction of this motion. Certainly, athletes may stretch these ordinarily relatively static joints and cause excess motion at various sites within the pelvis.

If this anatomy is so incredibly complex, how does one make enough sense of it to create any meaningful clinical significance? Consider simply that many athletes with chronic pain can pinpoint the precise time when their pelvic pain began, and often remember the locations of the distinct “rips,” “pops,” or “tears.” If one were to map out these described locations of initial pain, the most common locations are 1) the rectus abdominis muscle site of insertion on the pelvis, 2) a nearby location where the adductor longus inserts, and 3) various other, more hard-to-describe locations. These descriptions, as well as the known anatomy, lead one to the concept of one big joint centered on the pubic symphysis. One can surmise that several important structures insert onto the pelvis and its anterior attachment, the pubic symphysis. These structures include the rectus abdominis, external oblique, internal oblique, and transverses abdominis. Structures that insert along the inferior aspect of the symphysis or nearby

attached tissue include the adductor muscles, pectineus, gracilis, obturator internus, quadratus femoris, and gluteus muscles. A series of ligamentous arches also exist between the pelvic bones, further stabilizing the joint [8].

In addition to these various and complex insertions, there are a number of bursae of the anterior pelvis, several of which potentially communicate with each other. Although the psoas inserts principally onto the femur, its bursa is rather large and complexly shaped so that it may even touch the above-described joint. There are also potentially clinically significant bursae behind the symphysis and near the lesser and greater trochanters.

Another significant consideration is the number of potentially important projections. Two that seem associated with several of the syndromes described below include the pectineus insertion, where a relatively common magnetic resonance imaging (MRI) finding of avulsion fracture occurs [9], and an anterior projection of the inferior pubic ramus. The latter projection sits relatively close behind the adductor muscular insertions onto the pubis and may contribute to the adductor pain of athletic pubalgia. We presume that the relatively weak rectus insertion onto the pubis results in overcompensation by the relatively unopposed adductor [1••] and a kind of compartment syndrome.

Most Commonly Seen Entities

We will not describe such problems as avascular necrosis of the hip or various stress fractures, which are relatively easy to recognize on MRI. Most of the entities described here are difficult ones, from the standpoint that they have escaped MRI diagnosis. The problems listed below have also been disabling from the viewpoint of the high-performance athletes. By disabling, we mean they prevent the athlete from performing at desired levels of ability, thereby greatly diminishing his or her quality of life. In actuality, some of these diagnoses are occasionally made definitively by MRI. For example, a disruption of the rectus insertion onto the pubis can be seen in approximately 12% of patients with athletic pubalgia. One source that describes these entities in more detail is Chapter 13 of *Principles and Practice of Orthopaedic Sports Medicine* [4].

Athletic pubalgia

Certainly, this is the most common fixable problem that we see, but there are many traps in its diagnosis. The syndrome is common in high-performance athletes. Most of these athletes face an end to their career because of the lower abdominal and groin pain. The pain progresses over months to years and involves the adductor longus tendons and then the contralateral inguinal or adductor regions. Most patients remember a distinct injury during exertion. Usually, the abdominal pain involves the inguinal canal near the insertion of the rectus muscle onto the pubis. Generally, the diagnosis is empiric. In general, the pain is

minimal at rest and begins unilaterally, but becomes bilateral within months or years if the injury is untreated. Two thirds of the patients describe the pain with adduction of the hip, which can occasionally be more prominent than the abdominal findings. The pain may also be fleeting, appearing and disappearing on one or the other side, or involve both abdominal and adductor components. Fewer than 25% of patients have significant symptoms attributable to the posterior perineum. Interestingly, involvement of the posterior perineum is associated with a decreased likelihood of successful repair.

When examining a patient suspected of having athletic pubalgia, the physical examination must be directed to obtain key findings. Most patients exhibit pain with adduction of the hip against resistance and pain with resisted sit-up. Twenty-five percent of patients have pubic or peripubic tenderness. One third have some degree of subjective tenderness along the adductor tendons near the pubis. Superior inguinal or real abdominal tenderness is uncommon. By definition, no patients have hernias.

Now let us consider some of the traps; we will divide them into *positive* and *negative* traps. We define positive traps as findings that might mistakenly dissuade someone from making the diagnosis, and negative traps as findings that probably should dissuade one from making the diagnosis. Probably the most common positive trap is the MRI or bone scan finding of osteitis pubis. When we first started doing pelvic floor repairs in the late 1980s, we avoided operating on anyone with an MRI or bone scan diagnosis of osteitis. After we published our first report, a Swedish group [10] reproduced our results and told us that they had operated on similar patients but with MRI-diagnosed osteitis and obtained similar success. Therefore, we called back to the clinic a number of such patients whom we had previously turned down. Those patients also did well with pelvic floor repairs. Perhaps the second most common positive trap is the absence of MRI findings. In fact, the vast majority of patients on whom we have operated do not exhibit MRI findings of rectus muscle disruption. It was not until our 12th patient, a National Football League middle-linebacker, that we saw this finding on MRI. We were relieved, of course, in that we finally saw the finding that we suspected. But the fact remains that most patients do well with pelvic floor repair in the absence of definitive MRI findings. When we looked at the MRIs of a large number of patients with this syndrome, only 12% had MRI findings that clearly indicated a problem at the rectus insertion site. The relatively small incidence of a specific diagnosis by imaging studies suggests that the problem may be an attenuation of the muscle or tendon due to repeated microtrauma. Nonspecific MRI findings, on the other hand, occur frequently [9]. The nonspecific findings include focal osteitis and nonspecific abdominal wall, perineal, or adductor findings. They also include asymmetry, distinct inflammation, cortical irregularity, distinct fluid accumulation, irregularity of the rectus abdominis, atrophic changes, small pelvic avulsion fractures, or disruption of the

pectineus muscle. When we blinded a group of radiologists with respect to which side or sides were clinically involved, the radiologists were able to pick out the afflicted sides with approximately 90% accuracy. The latter observation reinforced our impression that we were dealing with a problem with instability of a complex joint.

The third positive trap is a history of an inguinal hernia repair, either in childhood or adulthood, without evidence of a recurrent hernia. A previously successful hernia repair does little to rule out athletic pubalgia. The cause of the syndrome is pelvic instability and not an occult hernia; the term "sports hernia" [11] is a misnomer!

The most common negative trap is pain without exertion. A certain amount of mild discomfort at rest is certainly acceptable, but severe pain in the absence of exertion is a tip-off that the patient probably does not have the diagnosis of athletic pubalgia. Most patients with the syndrome clearly have pain only with extremes of exertion. With chronicity, the pain begins to interfere with some activities of daily living. Some pain may persist after activity, but almost never is the pain particularly severe at rest. The nonathlete who complains of constant pain almost certainly does not have the diagnosis, even if the symptoms and signs are in the right locations. No doubt, this realization helps explain the poorer results from pelvic floor repairs in nonathletes.

The second most common negative trap is lateral pain in the inguinal region. If the pain is clearly lateral to the adductors, one should suspect intrinsic hip disease or a variety of other pelvic disorders. The differential diagnosis here, of course, is long.

The third negative trap is true testicular or epididymal pain. Upper scrotal pain can be in the distribution of the ilioinguinal nerve, which can easily be involved in the inflammatory process. Pain and tenderness along the lateral edge of the pubic symphysis is consistent with the problem, but true testicular or epididymal pain generally is not. Pain with sexual activity is consistent with the syndrome so long as simple exertion is causing the pain; pain with ejaculation only is not consistent with the syndrome.

The final negative trap to be mentioned here is the finding of cyclical pain in women. In this case, endometriosis should be considered.

Adductor longus tendonitis

A minority of patients have pain only at the adductor longus insertion site onto the pubis. Although our standard approach has been to wait at least several months to see if the pain resolves with conservative therapy [1••], we have seen many patients whose pain did not resolve. The choice of surgery is between an adductor release alone or in combination with a pelvic floor repair. Seven patients who underwent the release operation alone eventually developed lower abdominal pain consistent with athletic pubalgia and required pelvic floor repair. Therefore, we recommend pelvic floor repair in addition to adductor release whenever possible in these patients.

The principle advantage of the isolated adductor release operation, rather than combined with pelvic floor repair, is the relative speed of recovery. One does not have to wait for the stabilizing scarring to occur in order to let the patient return to competition. One individual male tennis player had his release operation 2 weeks before his best-ever Wimbledon performance.

A second category of these patients is those who had some degree of adductor pain at the time of pelvic floor repair, at which time an adductor release was not performed. This group was more common early in our experience, but there remains a group of patients who have seemingly minor pain at the adductor insertion site at the time of original operation, yet develop more significant adductor pain afterward, and respond to subsequent operative release.

Snapping hip syndrome and iliopsoas tendonitis

This diagnosis should be considered when the pain occurs primarily with resisted flexion or passive extension of the hip, or if the patient describes a painful "snap" or "pop" lateral to the adductor area. One of the key diagnoses in the differential here is labral tear. This problem occurs more in long distance runners, it seems, than other athletes, but we have seen the problem in a variety of sports. This problem can also occur in combination with athletic pubalgia, particularly early in the symptom complex. We speculate that the cause of this combination of problems is dissection of a hematoma or inflammatory process.

We usually begin with a course of Indocin (Merck, Whitehouse Station, NJ). If this doesn't work, the next step is a psoas bursa steroid injection, best performed under fluoroscopy. In total, we have 27 patients who have failed both nonsurgical treatments and required operative psoas releases without complication. Of the original 27 patients, 23 reported good or excellent relief after surgery. The principle complication to avoid in this operation is direct or traction injury to branches of the femoral nerve.

Hockey goalie/baseball pitcher syndrome

This is a relatively easily recognized syndrome, manifested by chronic pain several inches down from the adductor longus insertion site onto the pubis. The syndrome is manifested by chronic, intermittent pain. We have seen several dozen baseball pitchers with this problem, along with seven professional hockey goalies, hence the name we have given this entity. The pain pattern is similar; often, the player will suddenly develop severe pain in the above location that may persist long enough to put him on the disabled list, but the pain goes away with persistent stretching. Recurrence of pain is common, however. With persistence of disabling pain, surgery may be necessary. In actuality, the player can usually localize the pain with accuracy. The problem is readily seen at surgery: a localized herniation of muscle between fibers of epimesium. Debridement and relatively extensive epimysiotomy

(fasciotomy) relieves the syndrome. We believe the intermittent, chronic nature of the pain is related to entrapment of muscle, and the intermittent relief results from spontaneous release of the entrapping fibers.

Osteitis pubis and the gracilis syndrome

We believe strongly that there is a primary osteitis pubis syndrome, which can be difficult to treat. Primary osteitis is manifested by severe pain at rest and exquisite tenderness. On the other hand, most cases of osteitis pubis are secondary to another particular problem. For example, the disease may be related to a previous hernia repair in which infection occurred around sutures placed into the pubis. Traumatic osteitis pubis is a fatigue fracture involving the bony origin of the gracilis muscle at the pubic symphysis [12]. When the bony lesion is due to trauma and located at the lower margin of the symphysis, the entity may be appropriately referred to as gracilis syndrome.

Labral tears

Intra-articular hip pathology may be an important cause of groin or thigh pain. Some of the more important diagnoses to consider include synovitis, loose congenital or traumatic bodies, septic or osteoarthritis, avascular necrosis, hypertrophied ligamentum teres, or torn acetabular labrum. In our experience, torn labrum is the most likely diagnosis. We have seen these most often in hockey players. Direct or indirect MRI arthrogram has proved the most useful in making this diagnosis. Important in the differential diagnosis is iliopsoas bursitis, which produces pain in a similar location. Even with a torn labrum identified by MRI, the question still remains whether the labral tear could be incidental to another problem. When this combination of diagnoses occurs or is entertained, we recommend simultaneous hip arthroscopy and repair with pelvic floor repair, adductor and partial psoas release. We have had excellent results with three patients on whom we did these procedures simultaneously. Although we are unsure which operation cured the pain, each athlete was in the off-season and could not afford the time lost by a mistake in diagnosis.

Endometriosis

Undoubtedly, this is the most common confusing problem in women. Women get the athletic pubalgia syndrome, but endometriosis-associated lower abdominal or inguinal pain is even more common. Therefore, we routinely suggest laparoscopy and ablation or removal of endometrial implants, with pelvic floor repair and division of the round ligaments in patients with these diagnoses under suspicion. We are not sure why division of the round ligament is effective (which has been true in several patients who underwent this as an isolated procedure). The direct connection with the uterus and the frequent finding of endometriosis imbedded in the round ligament suggests that traction has something to do with the accompanying pain.

Other important problems

It is beyond the scope of this review to detail every diagnosis in the differential of these patients. Some of the important ones include simple contusions, stress fractures, sacroiliac sprain, iliotibial band syndrome, piriformis and hamstring syndromes, and other adductor syndromes.

Other important problems that we have encountered in patients initially being evaluated for the pubalgia syndrome include inflammatory bowel disease, prostatitis, aseptic necrosis of the hip, herpes, pelvic inflammatory disease, and rectal and testicular carcinoma [1••]. These other diagnoses emphasize the importance of a detailed careful history and physical examination, and the importance of obtaining appropriate imaging tests.

Results of Repairs and Releases

A success rate of 95% can be expected from surgical treatment in well-selected patients. There has been a 3% incidence of contralateral pubalgia after unilateral repair and a 2% incidence of recurrence. All the recurrences have occurred more than 3 years after repair. Our data clearly indicate that many standard hernia repairs are inadequate in treating athletic pubalgia. In particular, laparoscopic hernia repair does not appear to be the correct solution for this problem. The laparoscopic repair emphasizes a tension-free mesh insertion that does not stabilize the anterior pelvis. We have seen many patients now who have had unsuccessful laparoscopic repairs and required reoperation. The next most frequently encountered unsuccessful hernia repairs were, in order, Lichtenstein, Shouldice, and Kugel.

The generally poor results of the laparoscopic repair and other hernia operations provide additional evidence that the mechanism of athletic pubalgia is not due to an occult hernia. However, a few patients have done well after hernia operations. The small, or at best inconsistent, success rates seem likely due to general fibrosis, which accompanies all operations and inadvertently stabilizes the anterior pelvis [1••]. The Cooper's ligament or McVay repair for inguinal hernia seems more likely to treat the problem, but also may unnecessarily stretch the anterior abdominal musculature down to the more posterior attachments of the pelvis. Therefore, this operation may not provide optimal anterior stabilization. We have seen inconsistent results with the McVay approach; thus, we recommend performing a rectus reattachment and adductor release to treat athletic pubalgia [1••]. We had one patient, a National Hockey League player, who developed an incarcerated direct inguinal hernia on the same side as a previously successful pelvic floor repair. The symptom complex for the incarceration was entirely different than for the pubalgia. However, this isolated case brings up the possibility of the pelvic floor repair predisposing to the development of a direct hernia.

Conclusions

In this article, we offer some opinions based on a large experience in the care of athletes with abdominal and inguinal pain. This experience accumulated almost by chance [5]. After the successful treatment of several patients, word of mouth brought more patients seeking help. We then realized the wide prevalence of these problems. The initial problem that was successfully treated was one we called *athletic pubalgia* [5], a relatively vague term that describes the general location of pain, but does not imply a hernia. As is probably evident, the initial success also brought a large number of patients who sought help for problems that were slightly different from those of patients with athletic pubalgia. Therefore, we have had the opportunity to make some additional observations. We hope that via the publication of this article, we are providing some additional insight into a wide variety of problems that continue to be seen by team physicians and trainers.

References and Recommended Reading

Papers of particular interest, published recently, have been highlighted as:

- Of importance
- Of major importance

- 1.•• Meyers WC, Foley DP, Garrett WE Jr, et al.: **Management of severe lower abdominal or inguinal pain in high-performance athletes.** *Am J Sports Med* 2000, 28:2–8.

This article summarizes the findings in our initial long-term assessment of operations for athletic pubalgia.

- 2.•• Irshad K, Feldman LS, Lavoie C, et al.: **Operative management of "hockey groin syndrome": 12 years of experience in National Hockey League players.** *Surgery* 2002, in press.

This chapter provides the best summary to date of the differential diagnosis of lower abdominal and groin pain in the athlete.

- 3.• Gilmore OJA: **Gilmore's groin: ten years of experience of groin disruption—a previously unsolved problem in sportsmen.** *Sports Med Soft Tiss Traum* 1991, 3:12–14.

Dr. Gilmore has contributed a great deal to the understanding of this entity in the United Kingdom.

4. Meyers WC, Ricciardi R, Busconi BD, et al.: **Athletic pubalgia and groin pain.** In *Principles and Practice of Orthopaedic Sports Medicine*. Philadelphia: Lippincott, Williams & Wilkins; 2000:223–230.
5. Taylor DC, Meyers WC, Moylan JA, et al.: **Abdominal musculature abnormalities as a cause of groin pain in athletes.** *Am J Sports Med* 1991, 19:239–242.
6. Gross ML, Nasser S, Finerman GAM: **Hip and pelvis.** In *Orthopaedic Sports Medicine*. Edited by DeLee JC, Drez DJ, et al. Philadelphia: WB Saunders; 1994.
7. Anson BJ, Morgan EH, McVay CB: **Surgical anatomy of the inguinal region.** *Surg Gynecol Obstet* 1960, 707:111–117.
8. Moore KL: **The abdomen and pelvis.** In *Clinically Oriented Anatomy* edn 3. Baltimore: Williams & Wilkins; 1985.
9. Albers SL, Spritzer CE, Garrett WE Jr, Meyers WC: **MR findings in athletes with pubalgia.** *Skeletal Radiol* 2001, 30:270–277.
10. Renstrom AFH: **Tendon and muscle injuries in the groin area.** *Clin Sports Med* 1992, 11:815–831.
11. Kemp S, Batt ME: **The 'sports hernia': a common cause of groin pain.** *Physician Sports Med* 1998, 26:36–44.
12. Wiley JJ: **Traumatic osteitis pubis: the gracilis syndrome.** *Am J Sports Med* 1983, 11:360–363.