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Treatment of osteitis pubis and osteomyelitis of the pubic symphysis in athletes: a systematic review

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Abstract

Objectives—The authors examined the most current evidence for treatment options in athletes with osteitis pubis and osteomyelitis pubis, attempting to determine which options provide optimal pain relief with rapid return to sport and prevention of symptom reoccurrence.

Methods—Three databases—MEDLINE, Cochrane Database of Systematic Reviews and CINAHL—were searched using the OVID interface for all years between 1985 and May 2008. References were analysed from included studies, and additional relevant articles were obtained for inclusion. Inclusion criteria included (1) humans only, (2) subjects had no apparent risk factors for development of osteitis pubis or osteomyelitis of the pubic symphysis other than athletic involvement, (3) both physical exam findings and diagnostic imaging were used to confirm either diagnosis, and (4) a definitive treatment strategy was identifiable for management of osteitis pubis or osteomyelitis of the pubic symphysis. In total, 25 articles were included in the review.

Results—There were no randomised controlled trials identified with this study's search strategy. A total of 195 athletes were diagnosed as having osteitis pubis (186 males, nine females) and treated with either conservative measures/physical therapy, local injection with corticosteroids and/or local anaesthetic, dextrose prolotherapy, surgery or antibiotic therapy. Six case reports/series described conservative treatment measures (physical therapy, rest, non-steroid anti-inflammatory drugs). Four case series explored the use of corticosteroid injections in treatment. One case series described the use of dextrose prolotherapy as a treatment modality. Six case series described various surgical techniques (pubic symphysis curettage, polypropylene mesh placement and pubic bone stabilisation) in treatment. Ten case reports/series (10 subjects) outlined antibiotic treatment of osteomyelitis of the pubic symphysis.

Conclusions—The current medical literature shows only level 4 evidence of the treatment for osteitis pubis in 24 case reports/series in athletes. Without any direct comparison of treatment modalities, it is difficult to determine which individual treatment option is the most efficacious. Further study comparing the different treatment options is necessary to determine which modality provides the fastest return to sport.

INTRODUCTION

Groin pain can be a difficult yet important condition faced in the treatment of athletes. Sports-related injury rates to the groin range from 0.5% to 6.2%.¹ In specific sports such as soccer, the incidence of groin pain has been reported to be as high as 5–13%.² Causes of groin pain in athletes include musculotendinous strain, sportsman's hernia, stress fracture,

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intra-articular hip pathology, referred low back pain, genitourinary pathology and osteitis pubis to name a few. There have been several studies that have examined different treatment options for athletes with groin pain.²³

One important disease to consider in the differential diagnosis of groin pain in athletes is osteitis pubis: a painful, inflammatory process involving the pubic symphysis and its surrounding structures such as the pubic rami, cartilage, musculotendinous and ligamentous structures of the pelvis.⁴⁻⁶ Predisposing factors that contribute to the development of this condition include urological and gynaecological procedures, pregnancy, traumatic, degenerative/rheumatological states and athletic participation.⁷ Infectious cases of osteomyelitis of the pubic symphysis have been reported in the literature, but it is unclear whether this is a separate entity or a continuum on the spectrum of osteitis pubis.⁸

Initial presentation of osteitis pubis often includes insidious onset of adductor pain and abdominal discomfort along with pain in the pubic symphysis.⁹ Aggravating athletic activities include sprinting, kicking, twisting and cutting.⁵⁹ Common sports that incorporate these activities include soccer, football, ice hockey, running and rugby.⁹¹⁰ Physical examination findings include tenderness to palpation of the pubic symphysis, and pain with resisted strength testing of the adductor and lower abdominal muscle groups.¹¹ Imaging studies in the diagnostic workup may include radiographic studies, MRI, bone scan and/or CT scan.¹

Osteomyelitis of the pubic symphysis has a similar clinical presentation to osteitis pubis, except that it is typically sudden in onset and is accompanied by a fever.¹⁰ Common organisms include *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Escherichia coli*, *Salmonella* species and anaerobic bacteria.¹² Diagnostic workup for osteomyelitis pubis may include the same imaging studies as osteitis pubis along with pubic symphysis aspirate, blood cultures and evaluating for elevated markers of inflammation (complete blood count, erythrocyte sedimentation rate (ESR), C-reactive protein (CRP)).⁸¹³

Numerous case studies in the current literature have proposed different treatment options in the management of osteitis pubis. This review examines the medical literature to analyse the various treatment options for osteitis pubis in athletes. The treatment of osteitis pubis varies depending on the type and severity of the case. We felt it important to search the literature for the most common treatment modalities because there is so clear consensus on the standard course of treatment. Since it is unclear whether osteomyelitis of the pubic symphysis is a distinct disease process or represents a variant of osteitis pubis, we included this clinical entity in the current review.

METHODS

A search of three databases—PubMed, CINAHL and Cochrane Database of Systematic Reviews—was performed in May 2008. Articles were selected for inclusion in the review based on the following criteria: (1) subjects were human, (2) subjects had no apparent risk factors for development of osteitis pubis or osteomyelitis of the pubic symphysis other than athletic involvement, (3) both physical exam findings and diagnostic imaging were used to confirm the diagnosis of osteitis pubis or osteomyelitis of the pubic symphysis, and (4) a definitive treatment strategy was identifiable for management of osteitis pubis or osteomyelitis of the pubic symphysis (table 1). The three authors scanned the reference sections of articles meeting initial criteria for inclusion to locate any additional articles of interest. Review articles were omitted from inclusion.

RESULTS

A total of 2987 references were reviewed by three unblinded authors (HC, TB, MM). Disagreement over article inclusion was resolved by consensus. Ultimately, 24 articles were determined to meet inclusion criteria. Six studies examined conservative therapies for treatment of athletically induced osteitis pubis (table 2). Four investigations described the use of injection therapies for treatment of athletes with osteitis pubis (table 3), and six studies examined surgical techniques to correct osteitis pubis (table 4). Eight articles described treatment for osteomyelitis of the pubic symphysis (table 5). No randomised control trials (RCTs) comparing different treatment strategies were identified.

Treatment of osteitis pubis in athletes using conservative therapy only

Six case reports/series were identified (table 2). In total, 53 athletes (51 males, two females) averaging 22.1 years of age were studied.

Five case reports/series of 42 athletes (42 males, 0 females) describe the use of rehabilitation and/or oral anti-inflammatory medication use in their course of treatment.^{1115–18} Out of 42 athletes, 41 (97.6%) received progressive rehabilitation exercises. Out of 42 patients, 36 (85.7%) were prescribed an anti-inflammatory medication. The mean symptom duration prior to treatment was 4.625 weeks (specified only for four out of 42 athletes). Return to play averaged 9.55 weeks, with a range from a minimum of 3.8 weeks to a maximum of 13 weeks in 41 out of 42 athletes. In the case series that included 35 males with varied grades of osteitis pubis, return to play was faster in the athletes who had a less severe case of osteitis pubis.¹¹

One case series of 11 athletes (nine males, two females) described the use of compression shorts in attempt to limit groin pain and increase athletic performance in athletes with osteitis pubis.⁵ Of note, a number of athletes were concurrently treated with physical therapy (81.8%) and anti-inflammatories (36.4%). The mean duration of symptoms prior to treatment with compression shorts was 20.6 months. Visual analogue scale (VAS) scores for pelvic and groin pain were significantly reduced while wearing compression shorts during exercise, but no improvement in athletic performance was noted. The time to return to sport was not measured in this study.

Injection therapy for treatment of osteitis pubis

Four case series reported use of injection therapies in their treatment strategy (table 3). In total, 54 athletes (50 males, four females) averaging 24.8 years of age were studied.

Three case series with a total of 30 athletes (26 males, four females) studied corticosteroid injections into the pubic symphysis with or without local anaesthetic.⁴⁹²⁰ Medications included (dexamethasone, betamethasone and methylprednisolone), and anaesthetics (bupivacaine and lidocaine). No consistent type, strength or quantity of medication for injection was reported. Mean symptom duration prior to corticosteroid injection was 12.92 weeks (specified in only 12 out of 30 subjects). One athlete returned to play with conservative measures only and did not receive any injections. The remaining athletes received a mean of 1.24 injections (range of 1–3) into the pubic symphysis prior to return to sport. Out of 29 athletes, 17 (58.6%) were able to return fully to sport following injection therapy at a mean of 8 weeks from first injection. Out of 29 athletes, two (6.9%) were able to resume sport but had provocative pain on physical exam only at 6 months' follow-up. Out of 29 athletes, three (10.3%) were able to return to sport following injection but required additional medical treatment for correction of recurrent pubic symphysis pain. Out of 29 athletes, four (13.8%) had symptom relief from resting and conservative measures that could not be attributed directly to pubic symphysis injection. Out of 29 athletes, six (20.7%) did

not respond to injection therapy and were unable to return fully to sports, two of which (6.9%) required subsequent surgical intervention. These results show that a majority (58.6%) of athletes treated with corticosteroid injections were able to return to sport; however, a significant non-responder rate (20.7%) was present.

One case series with a total of 24 athletes (24 males, 0 females) used prolotherapy in the treatment of osteitis pubis.²¹ Monthly injections of dextrose and lidocaine were given at eight injection sites across the pubic rami and into the pubis symphysis. The mean symptom duration prior to treatment with prolotherapy was 15.5 months. Athletes received a mean of 2.8 injection treatments (range 2–6) prior to return to sport. Out of 24 athletes, 22 (91.7%) were able to return to sport at a mean of 9 weeks from first injection series. Out of 24 athletes, two (8.3%) failed to respond to prolotherapy and were unable to return to sport fully.

Treatment of osteitis pubis in athletes using surgical correction

Six case series and no RCTs were identified that examined surgical techniques to correct the condition (table 4). In total, 54 athletes (51 males, three females) averaging 24.1 years of age were studied.

Two case series with a total of 25 athletes (24 males, one female) were treated by pubic symphysis curettage.^{22,23} On average, athletes noted pain for 13.3 months duration prior to surgery. Out of 25 athletes, 18 (72%) were able to return to sport following curettage of the pubic symphysis at a mean of 5.6 months. One athlete (4%) who returned to play at 3 months developed recurrent symptoms at 11 months and underwent surgical fusion of the pubic symphysis. No postoperative complications were noted.

Two case series comprising 21 athletes (19 males, two females) studied polypropylene mesh placement into the preperitoneal retropubic space for treatment of refractory osteitis pubis.^{24,25} Eight patients with a mean duration of 6 months served as a non-operative control group in one study.²⁵ Of the remaining 13 athletes, pain was noted on average for 14 months prior to surgery. Out of 13 athletes, 12 (92.3%) were able to return to sport following polypropylene mesh placement into the preperitoneal retropubic space at a mean of 7.2 weeks. One athlete (7.7%) had persistent symptoms despite mesh placement and required pubic bone drilling prior to return to sport. No postoperative complications were noted.

Two case series including eight athletes (eight males, 0 females) underwent pubic symphysis stabilisation as a treatment for refractory osteitis pubis (mean of 32.3 months of pain prior to surgery).^{6,26} One study used bone grafting supplemented by a compression plate for arthrodesis, while the second study evaluated surgical fusion without bone grafting. Return to play was only commented on for seven out of eight athletes, with a mean return to sport in 6.6 months following surgery. Out of eight athletes, two (25%) suffered postoperative complications; 6 weeks of haemospermia in one athlete and 6 months of intermittent scrotal swelling during exercise in the second athlete.

Pubic symphysis osteomyelitis

Eight case reports/series with a total of 10 athletes (10 males), averaging 28.1 years of age were located involving osteomyelitis of the pubic symphysis (table 5).

All 10 athletes presented with fever and a traumatic pain about the symphysis pubis. Out of 10 athletes, six (60%) had an elevated WBC count greater than 10 000 (range 11 000–16 000). All athletes had an elevated ESR or CRP. Out of 10 athletes, nine had an elevated ESR ranging from 19 to 109. In the one case, an ESR was not measured, a CRP was drawn, and it was markedly elevated at 170. Blood cultures were not drawn in three athletes. The majority

of positive cultures were *S aureus* (four out of seven). A pubis symphysis aspirate was obtained in five out of 10 cases and positive for *S aureus* in three athletes. One aspirate was positive for *Staphylococcus epidermidis*, and one aspirate was negative.

All 10 athletes were hospitalised and received intravenous antibiotics. Out of 10 subjects, six (60%) were treated with intravenous antibiotics for at least 6 weeks, two out of 10 athletes (20%) received intravenous antibiotic treatment for less than 2 weeks followed by oral antibiotics for at least 4 weeks, and two out of 10 athletes (20%) were treated for an indeterminate duration of antibiotic therapy. One patient suffered a reoccurrence of symptoms after 5 months with development of an abscess requiring debridement and an additional 4 weeks of intravenous antibiotics. Length of recovery was not identified in three out of 10 athletes (30%), but the mean amount of time to full recovery in the remaining seven patients was 3.21 months.

DISCUSSION

The primary intent of this systematic review was to review the literature on the treatment of osteitis pubis in athletes. No level 1 studies were identified with our search strategy (table 1). All case reports/series described initial treatment of the condition with conservative measures, typically including rest, non-steroid anti-inflammatory drugs (NSAIDs), physical therapy and, in one case series, the use of compression shorts. It is thought that osteitis pubis is caused by repetitive twisting/cutting manoeuvres with stress at the pubic symphysis from restrictive hip movement.²⁷ Imbalances between the hip adductor and abdominal muscles have been thought to contribute in the development of osteitis pubis.¹⁹ Also, it has been found that an active rehabilitation programme that improves the coordination and strength of muscles that act on the pelvis helps decrease pain in patients who experience chronic groin pain.¹⁸ Therefore, conservative therapy is typically the first step in the treatment of osteitis pubis.

The symptoms of osteitis pubis can range from self-limited to chronic, lingering for months to years.^{18,25} It does appear from one large case series examining the effects of conservative treatment that patients diagnosed earlier in their course experience fewer symptoms and return to play faster.¹⁸ This case series graded the severity of osteitis pubis based on symptom severity. Stage 1 was unilateral symptoms involving the dominant leg and inguinal pain in the adductor muscles. Stage 2 was bilateral symptoms with inguinal pain involving the adductor muscles. Stage 3 involved bilateral inguinal pain involving the adductor muscles and abdominal symptoms. Stage 4 involved pain in the adductor and abdominal muscles referred to the pelvic girdle and lumbar spine with defecation, sneezing and walking on uneven surfaces with an inability to perform activities of daily living. In this specific case series, return to play ranged from 4 to 10 weeks. The rehabilitation focused on core stability with an emphasis on adductor and gluteal strength and endurance. The stage 1 group (least severe) returned to play in 3.8 weeks, approximately half the time it took for the stage 2 group to return to play (6.7 weeks). Although a small case series, it demonstrated that a successful rehabilitation programme can expedite return to play in milder cases of osteitis pubis.

Another conservative approach incorporated compression shorts in limiting groin pain and improving athletic performance in individuals with osteitis pubis.⁵ Eleven athletes who were already receiving conservative treatment involving physical therapy and NSAIDs were fitted with compression shorts during specified agility drills. In all cases, there was no difference in performance of the drills as to whether the athletes did or did not wear the shorts. The participants did note a significant decrease in pain during exercise while wearing the shorts; however, the study did not comment on length of treatment required for return to play.

Although this approach did not improve athletic ability, a reduction in pain during exercise is an important factor that can play a role in the symptom management of osteitis pubis.

The authors purposely did not include a study analysing active physical training as treatment for adductor related groin pain in athletes.³ The study took 68 athletes with adductor related groin pain (mean symptoms 40 weeks) and assigned them randomly to either a physiotherapy treatment without active therapy or an active training programme that aimed to stabilise the hip and pelvis with special attention to the adductor muscles. This study demonstrated that the active training programme was effective in the treatment of longstanding adductor related groin pain. However, because this study analysed athletes with groin pain without a specific diagnosis of osteitis pubis, and since this systematic review only looked at studies that involved treatment of osteitis pubis, the authors did not include the results in this paper.

Three case series employed corticosteroid injections with or without local anaesthetic into the pubic symphysis.^{4,9,20} Because no consistent type, strength or quantity of medication for injection was used between the three studies, it is difficult to draw any definitive conclusions on an ideal strategy. A mean of 1.24 injections (range of 1–3) was performed. Needle placement into the pubic symphysis was confirmed with fluoroscopic guidance in only one study.²⁰ Overall success rates for return to sport following corticosteroid injections were moderate (58.6% with a mean of 8 weeks from the first injection). There was also a high number of athletes who did not respond to injection (20.7%) and were unable to return to sport at all. Timing of injection from the start of symptom onset may indeed play a role in the overall success rate. The results of one study suggest that injection of corticosteroid in athletes with chronic symptoms (>16 weeks) does not promote as rapid a recovery as injection in athletes with acute symptoms (<2 weeks).⁹ Seven of eight athletes in the chronic group were able to return to sport on average at 10 weeks and required a mean of 1.75 injections, while all three athletes in the acute group returned to sport within 2 weeks and only required one injection each. Corticosteroid injections for the treatment of osteitis pubis appear to demonstrate a high safety profile; there were no reports of postinjection complication such as haematoma or infection in the 29 athletes that received at least one injection. Further investigation is needed to determine whether pain reduction and faster return to play following injection are attributable to the corticosteroid alone, anaesthetic alone or a combination of the two, and could be answered through a properly designed RCT.

Our review of the literature identified only one case series using prolotherapy (dextrose and lidocaine) to treat osteitis pubis.²¹ Numerous injection sites were targeted across the pubic rami and into the pubis symphysis rather than one single injection into the pubic symphysis. A mean of 2.8 treatments (range 2–6) were performed which is more than the reported number of corticosteroid injections. Similar to corticosteroid therapy, prolotherapy also appears to demonstrate a high safety profile with no reports of postinjection complication in the 24 athletes that received at least one treatment course. Interestingly, prolotherapy did produce high success rates for return to sport (91.7% with a mean of 9 weeks from the first injection series) in this study, suggesting that this treatment option should be investigated further.²¹ Ideally, an RCT would be conducted to critically assess the efficacy of this approach.

Six case series reported the use of surgical options to treat osteitis pubis in athletes.^{6,22–26} It should be noted that subjects suffered from prolonged osteitis pubis (mean 17 months of symptom duration prior to surgery) that was refractory to other treatment modalities including rest, rehabilitation exercises, NSAIDs and/or injection therapy. Two case series were identified for three different surgical techniques (curettage of the pubic symphysis, polypropylene mesh placement into the preperitoneal retropubic space and pubic symphysis

stabilisation). No study compared multiple surgical techniques, and so it is impossible to make head-to-head comparisons as to the most effective surgical approach. Overall, 37 out of 46 athletes (80.4%) were able to return to sport following surgery with a mean return to play of 4.6 months. Given the severity and prolonged duration of symptoms in this treatment group, the results seem particularly satisfying. The success rates for return to sport for each individual surgical type were 72% for curettage of the pubic symphysis, 92% for polypropylene mesh placement into the preperitoneal retropubic space and 100% for pubic symphysis stabilisation (omitting one athlete where return to play was not commented on). Surgical treatment with polypropylene mesh placement into the preperitoneal retropubic space provided the quickest return to sport times, averaging 7.2 weeks. In light of the invasive nature of surgical treatment options, safety of the athlete is of particular concern. Of the 46 athletes who underwent surgery, there were only two postoperative complications reported (4.3%): one athlete noted 6 weeks of haemospermia, and a second athlete suffered from 6 months of intermittent scrotal swelling during exercise (both athletes underwent pubic symphysis stabilisation procedures).

The case reports of osteomyelitis pubis in athletes were all spontaneous and non-traumatic. The exact mechanism of how it occurs is unknown; however a bacterial infection of the symphysis pubis appears to play a role. It is thought that microtrauma of the symphysis pubis in athletic activity may predispose the pubis to bacterial seeding.⁴ Osteomyelitis pubis should be suspected in a patient with acute onset of pubic symphysis pain, fever and symptoms of systemic involvement. Nine out of the 10 cases that described osteomyelitis pubis had an organism (most commonly *S aureus*) identified. The standard treatment for all cases was hospital admission and intravenous antibiotics. In all cases, patients required a minimum of 6 weeks of treatment. Complete recovery was described in seven of the 10 cases, with mean recovery at 12.9 weeks. Return to activity was reported in only one case, in which the patient was running at 4 months' follow-up.

Of note, of the 171 athletes treated for osteitis pubis or osteomyelitis of the pubic symphysis, only nine were females (5.3%). Therefore, based on the results of this systematic review at least, osteitis pubis occurs more often in males. It is difficult to determine whether these data represent a true difference in predisposition for the condition between sexes, or it could be an under-representation of the female population in the reported literature.

In summary, the mean return to play for athletes diagnosed as having osteitis pubis was 9.55 weeks using conservative treatment (41/42 athletes), 8 weeks for corticosteroid injections (17/29 athletes), 9 weeks following prolotherapy (22/24 athletes), 22.4 weeks after pubic symphysis curettage (18/25 athletes), 7.2 weeks using preperitoneal retropubic mesh placement (12/13 athletes) and 26.4 weeks for pelvic stabilisation (7/8 athletes). Return to play was not specified in the cases of osteomyelitis pubis. Comparison of the return to play time frames provided by each of the various treatment options is limited based on several factors. Conservative therapy was the first-line treatment for both the injection and surgical case reports/series. In addition, the surgical case reports/series were populated with refractory cases of osteitis pubis that failed more conservative modalities, resulting in an overall prolonged disease state prior to treatment. Of the three surgical techniques examined, preperitoneal retropubic mesh placement appears to provide the fastest return to sport, although a head-to-head trial comparing all three techniques would provide more conclusive data.

CONCLUSIONS

The current medical literature provides treatment options for osteitis pubis and osteomyelitis pubis based on level 4 evidence, making it difficult to compare treatment arms with one

another. Based on the available case reports/series in the literature, first-line therapy in the treatment of osteitis pubis should consist of conservative therapy and/or treatment with injections, given a good safety profile and a low level of invasiveness. Level 4 evidence also suggests that surgical intervention provides a reasonable treatment option in refractory cases. Recommendations for further research efforts include RCT with various treatment arms for osteitis pubis; this may be best accomplished via a multicentre trial given the low number of reported cases in the literature.

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Table 1

Search strategy of treatment options for osteitis pubis

Step		PubMed	CINAHL	Cochrane
1	(pubic symphysis) OR (osteitis pubis) OR (pubic symphysis) OR (pubic) OR (symphysis) OR (osteitis) OR (pubis) OR (symphysis)	15532	665	49
2	(athletic injury) OR (osteomyelitis) OR (athletic) OR (injury)	773178	45476	917
3	(rehabilitation) OR (physical therapy) OR ((physical) AND (therapy)) OR (arthrocentesis) OR (aspiration) OR (joint injection) OR ((joint) AND (injection)) OR (prolotherapy) OR (curettage) OR (arthrodesis) OR (surgical fixation) OR ((surgical) AND (fixation))	106066	92192	1640
4	#1 AND (#2 OR #3)	3166	130	32
5	Limit #4 to humans	2829	126	32
6	Relevant articles	14	14	0
7	Additional articles from Reference sections	5		
8	Total relevant articles	24		

Table 2

Treatment of osteitis pubis in athletes using conservative therapy only

Article	Subjects	Age (years)	Sport	Symptom duration prior to Rx	Rest	Progressive rehabilitation	Medications	Other modalities	Return to play	Complications
McMurty	1 M	21	Ice hockey	4 days	6 weeks	None	Indomethacin 25 mg	None	Not specified	None
Rodriguez	35 M	Mean 18.9	Soccer	Not specified	None	Yes	Ibuprofen 800 tid	Cryo-massage laser, ultrasound	Mild (uni-lateral symptoms): 3.8 weeks moderate (bilateral)	None
McKim	9 M 2 F	Mean 38.9	Soccer ³ Running ¹⁹ Hockey ² Squash ⁴ Skiing ⁴	20.6 months	None	9 out of 11 athletes	4 out of 11 athletes on non-steroid anti-inflammatory drugs	Compression shorts	Not specified, compression shorts significantly improved VAS pain scores after exercise by not at rest	None
Sing	1 M	17	Soccer	3 months	1 wk	Yes	None	None	3 months	None
McCarthy	1 M	20	Football	6 weeks 2 weeks ⁴	None	Yes	None	None	5 weeks Mean	None
Wollin	4 M	Mean 16.5	Football	Not specified ²	None	Yes	None	None	13 weeks	None

VAS, visual analogue scale.

Table 3

Injection therapy for treatment of osteitis pubis

Article	Subjects	Age (years)	Sport	Type of injection	No of injections	Return to play	Failures/ complications
Holt	10 M 2 F	Mean 20	Football ⁹ Soccer ² Ice hockey ¹³ Driving ⁴	1% Lidocaine 1 ml 0.25% Bupivacaine 1 ml 4 mg Dexamethasone 1 ml	Chronic group: (16 weeks symptoms) eight athletes, mean 1.75 injections Acute group: (7–10 days symptoms) three athletes, mean one injection	Chronic group: seven out of eight athletes, mean 10 weeks Acute group: three out of three athletes, all within 2 weeks	Chronic group: One athlete remained symptomatic after two injections and inguinal herniorrhaphy Acute group: none
Batt	2 M	Mean 22	Football ¹³	Betamethasone (strength/amount not specified)	Mean 1.5 injections	Mean 10 weeks	Both athletes with/recurrent symptoms months later: Case 1: improved following prednisone taper and indomethacin Case 2: improved following prednisone taper and second corticosteroid injection
O'Connell	14 M 2 F	Mean 28.4	High-level athletes (not specified)	0.5% Bupivacaine 1 ml Methylprednisolone 20 mg	Mean one injection	Within 48 h: 14 out of 16 athletes with partial symptom improvement and resumed sport At 2 weeks: 10 out of 16 noted continued pain relief At 2 and 6 months: 5 out of 16 completely symptom free	One athlete required two additional injections of bupivacaine only over 6-month period. One athlete with/ persistent pain referred for pubic symphysis fusion
Topol	24 M	Mean 25	Rugby ¹¹ Soccer ¹³	Prolotherapy of eight injection sites across pubic ramus, ischium and pubic symphysis with monthly injections of 12.5% dextrose, 0.5% lidocaine	Mean 2.8 injection sites	11 athletes (1–2 injections): within 6 weeks 11 out of 13 athletes (>2 injections): within 3 months	Two non-responders unable to return to sport

Table 4

Treatment of osteitis pubis in athletes using surgical correction

Article	Subjects	Age (years)	Sport	Symptom duration preoperatively	Type of surgery	Return to play	Complications
Williams	7 M	Mean 24.7	Rugby	Mean 26.6 months	Arthrodesis of pubic symphysis by bone grafting supplemented by compression plate	6.6 months	One patient with/haemospermia postoperatively for 6 weeks One patient with/intermittent scrotal swelling with/exercise for 6 months
Vitanzo	1 M	39	Not specified	6 years	Fusion/stabilisation of symphysis pubis	Not specified	None
Mulhall	2 M	Mean 25.5	Soccer	Mean 1.25 years	Curettage of the pubic	6 months	None
Paajanen (2004)	5 M	Mean 27.5 (four athletes)	Soccer ² Skier ⁴ Bandy player ⁴	Mean 8.7 months (three athletes)	Polypropylene mesh placed into preperitoneal retropubic space	Mean 6 weeks	None
Radic	22 M 1 F	Mean 27.04	Australian rules football ²² Soccer ³ Touch rugby ¹³ Field hockey ⁴	Mean 13.2 months	Curettage of the pubic symphysis	16 out of 23 athletes: mean 5.6 months	One athlete who returned to play at 3 months developed recurrent symptoms at 11 months and underwent surgical fusion
Paaganen (2007)	14 M 2 F	Mean 30 (eight surgical) Mean 22 (eight non-surgical)	Soccer ¹⁶ Cross country ⁴ Running ⁴ Ice hockey ⁴	16 months (surgical) 6 months (non-surgical)	Polypropylene mesh placed into preperitoneal retropubic space	Seven out of eight athletes (surgical): within 2 months Four out of eight athletes (non-surgical): mean	One athlete in the surgical group had persistent symptoms and required pubic drilling before full return to sport

Table 5

Pubic symphysis (PS) osteomyelitis

Article	Age (years)	Gender	Sport	Temperature (°C)	Inflammatory markers	Blood culture	Aspirate	x-Ray	Bone scan	CT	MRI	Tx	Complication	Return to sport
Ukwu	21	M	Football	38.7	WBC8400; ESR61	NP	<i>Staphylococcus aureus</i>	NP	Positive	Right side PS bony irregularity	NP	Intravenous ABX 2 weeks then postoperative ABX x4 months	Re-occurrence after 5 months with/debridement of abscess, intravenous nafcillin x 2 weeks then intravenous clindamycin x2 weeks	NS
Ukwu	43	M	Running	39.4	WBC6900; ESR61	<i>S aureus</i>	NP	+ Indium WBC	Normal	Normal	NP	Intravenous ABX x 6 weeks	None	NS
Ukwu	31	M	Running	39.4	WBC 13100; ESR94	Negative	NP	Cortical bone erosion	Positive	Normal	NP	Intravenous ABX x 8 weeks	None	NS
Karpos	21	M	Football	39.2	WBC 12100; ESR19	<i>S aureus</i>	<i>S aureus</i>	Sclerosis	Normal	Normal	PS oedema	Intravenous ABX x 6 weeks	None	Running after 4 months, full recovery by 6 months
Bartl	40	M	Running	40.0	WBC 13600; CRP170	<i>S aureus</i>	NP	NP	Positive	Normal	P.S. oedema	Intravenous ABX (unknown duration)	None	Full recovery by 3 months
Combs	48	M	Weight lifting	39.3	WBC 16300; ESR81	<i>S aureus</i>	NP	Normal	Positive	NP	Right side PS oedema	Intravenous ABX x 6 weeks	None	Full recovery by 3 months
Sanchez	16	M	Soccer	38.5	WBC NS; ESR 78; CRP 111; CPK1027	<i>Fusobacterium necrophorum</i>	Negative	Normal	NP	Bony erosions and lytic lesions of PS	PS oedema	Intravenous ABX unspecified, Postoperative ABX x 6 weeks	None	NS
Pauli	23	M	Football/tennis	38.0	WBC 11200; ESR 28; CRP 269	NP	<i>S aureus</i>	Sclerosis, bony destruction of PS	Positive	NP	Left >right PS oedema	Intravenous ABX x 10 days, postoperative ABX x 4 weeks	None	Full recovery by 4 months
Meirovitz	21	M	Soldier	38.5	WBC 6300; ESR 66	Negative	<i>S epidermidis</i>	Osteolytic lesions	Positive	Left sided osteolytic area	NP	Intravenous ABX x 6 weeks	None	Full recovery by 6 weeks
Pham	17	M	Tennis/soccer	38.3	WBC 12400; ESR 109; CRP 11.6	NP	NP	Deformity of right PS	Positive	NP	Right sided PS oedema	Intravenous ABX x 6 weeks	None	Full recovery by 3 months

CPK, creatinine phosphokinase; CRP, C-reactive protein; ESR, erythrocyte sedimentation; NP, not provided; NS, not specified.