©Journal of Sports Science and Medicine (2007) **6,** 71-76
http://www.jssm.org

Research article

MRI findings do not correlate with outcome in athletes with chronic groin pain

Adrien Daigeler [1], Orlin Belyaev [1], Werner H. Pennekamp [2], Stephan Morrosch [3], Odo Köster [2], Waldemar Uhl [1] and Dirk Weyhe [1]✉

[1] Department of Surgery, [2] Department of Diagnostic and Interventional Radiology and Nuclear Medicine, [3] Department of Anaesthesiology, St. Josef Hospital, Ruhr University Bochum, Bochum, Germany

Abstract

This trial aimed to assess the value of MRI in the differential diagnosis of chronic groin pain in athletes, a condition caused by various pathologies, the most common being posterior abdominal wall deficiency, osteitis pubis and muscular imbalance. Nineteen subjects with clinically ruled-out hernia and recurrent episodes of exercise-triggered groin pain were assessed. Dynamic MRI was performed under Valsalva manoeuver and at rest within a training-free period and after training activity. Follow-up was performed after 4 years using a questionnaire and physical examination. An incipient hernia was seen in one case, Valsalva manoeuver provoked a visible bulging in 7 others (3 bilateral). Eight athletes showed symphysitis (accompanied by bulging in 3 cases). MRI visualized one hydrocele, one osteoma of the left femur, one enchondroma of the pubic bone, and one dilated left ureter without clinical symptoms or therapeutic relevance. MRI findings after training and during the training free period did not vary. Fifteen participants were available for a follow-up control examination 4 years later - one suffered from ongoing pain, eleven were free of symptoms and three had improvement. However, most of them improved only with changing or reducing training. There were four participants with a specific therapy of their MRI findings. MRI revealed a variety of pathological findings in athletes suffering from chronic groin pain, but it was not reliable enough in differentiating between diagnoses requiring conservative or operative treatment. The MRI examination within the training interval did not have an advantage to that within the training-free period. Further randomized prospective trials with a long follow-up should establish whether MRI findings could be of help in the choice between conservative and surgical treatment for chronic groin pain.

Key words: MRI, hernia, athletes, chronic groin pain, symphysitis

Introduction

Recurrent activity-related groin pain is a common problem among athletes with predominance in soccer, football, hockey players and runners. Up to 6% of these athletes will suffer at least one episode a year (Cabot, 1966; Fon and Spence., 2000; Gilmore, 1998; Renstrom and Peterson, 1980; Renstrom, 1992), leading to substantial reduction of training and competitive activities and thus threatening an athlete`s career (Slavotinek et al., 2005). As a connection between the trunk and the extremity, the groin represents an area of complex structural and functional interaction implicating a diagnostic dilemma. With an incidence of 50-75%, the so called incipient hernia or "sportsman's hernia" is reported to represent an important differential diagnosis (Smedberg et al., 1985b; Lovell, G., 1995; van Veen et al., 2007). In addition,, tendinitis of the adductor, the rectus femoris and abdominis muscles, as well as symphysitis or osteitis pubis, sacroiliac joint instability, sacral stress fractures, ilioinguinal and genitofemoral nerve entrapment and combinations of all of the above mentioned are held responsible for chronic groin pain (Akita et al., 1999; Ekberg et al., 1996; Hackney, 1993; Karlsson et al., 1994; Lacroix et al., 1998; Lovell, 1995; Major and Helms, 1997; Polglase et al., 1991; Renstrom and Peterson, 1980, Smedberg et al., 1985a; 1985b; Tuite and DeSmet, 1994). Different diagnostic tools including ultrasound, herniography, CT, MRI and even laparoscopy have been suggested to identify hernias and other pathologic conditions (Fon and Spence, 2000). The hypothesis of the study was that comparing the findings of MRI examinations performed during a training-free period and those obtained directly after training may recognise certain pathological correlates of the above described pain triggering factors.

Methods

We included 19 athletes referring to us after a press release announcing our study, who had suffered recurrent episodes of exercise-triggered groin pain for at least three months without clinical signs of hernia. Inclusion criteria were regular training at least 3 times a week. Excluded were athletes at risk of electromagnetic field exposure due to metal implants or clips in their body. All participants signed a specific informed consent. The study was approved by the Ethics Committee at Ruhr University Bochum (Reg.-Nr.1698 RUB). The participants were physically examined following a standard protocol evaluating localization and quality of pain as well as possible hernia. Patient's history was obtained by a standardized questionnaire. Senior residents were responsible for acquiring the patient's history, while the physical examination was performed by an experienced consultant surgeon specialized in hernial surgery. Two separate MRI examinations were performed then: the first one followed a training-free period of at least 24 hours. Participants restored then their training till the pain appeared again. In the next 6 to 12 hours the subjects underwent a second MRI examination. The minimal interval of 6 hours was set to make an existing periosteal/perifascial edema formation visible in the T2 STIR scans. The interval between the two MRI examinations had to be at least one day, but not more than ten days (Figure 1). MRI investigation was performed using a Magnetom Symphony (Siemens, Erlangen,

Received: 18 September 2006 / Accepted: 21 December 2006 / Published (online): 01 March 2007

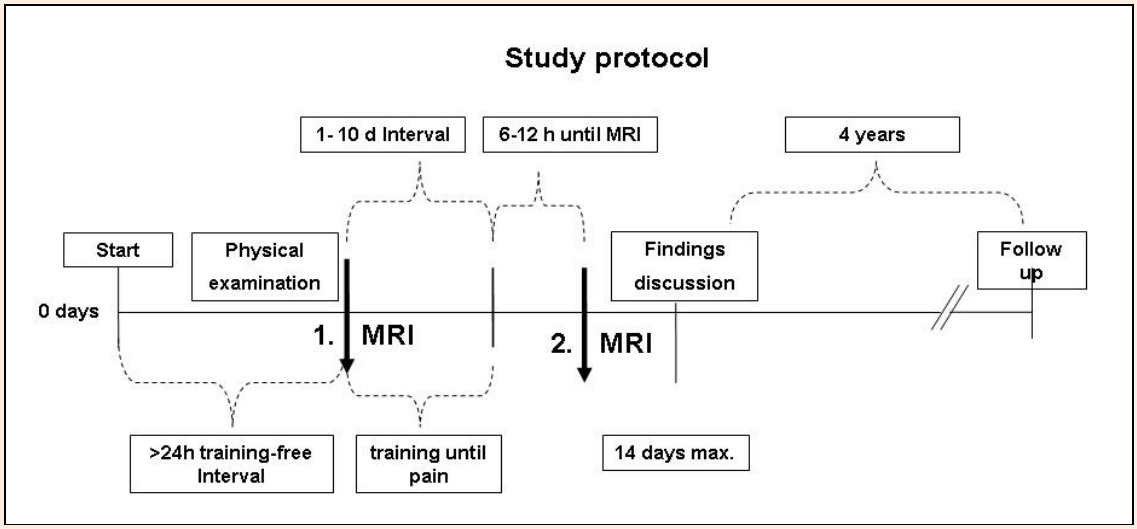

Figure1. Study protocol.

Germany) with 1.5 Tesla Phased-Array-Technique in axial, sagittal, and coronal planes, T1- and T2-weighted, in supine position including a dynamic sequence with the patient carrying out a Valsalva manoeuver to identify a peritoneal bulging compared to a sequence after exhalation. The total examination time was approximately 20 min. MRI findings were analysed by an experienced radiologist who was blinded to the findings of the physical examination, following a standardized evaluation protocol. Musculotendinous structures of the groin and the lower abdomen were assessed with special respect to edema and focal protrusion of the abdominal wall (bulging). The pubic symphysis was evaluated with attention to edema, subluxation, and degenerative changes. The inguinal region was scanned for direct or indirect hernia and edema within the inguinal canal. The osseous and joint structures were assessed for signs of fracture and changes in density and structure, arthrosis, and infection. Additionally the abdominal and pelvic organs (genito-urinary tract, bowel) were evaluated for pathologic changes. Four years after the MRI study the participants were followed up with respect to their further treatment and symptoms using a standardized questionnaire and a physical examination.

Statistical analyses

Mean values with standard deviation (±SD) were calculated. A statistically significant difference was considered for $P<0.05$ within a confidence interval of 95% (Student's T-test). MedCalc 4.16 (MedCalc, Mariakerke, Belgium) on Windows XP facilitated data processing and presentation.

Results

Participants' characteristics

The study group consisted of 19 athletes (18 male, 1 female) aged 22-44 years (mean 32.3 years, ± 6.9) with a mean body mass index of 23.4 (± 2.4) $kg \cdot m^{-2}$ complaining of groin pain without evidence of inguinal hernia on physical examination. Hip circumference averaged 92 (± 4.7) cm and pulse was 59 (± 9) beats per minute. The performed sports were triathlon (42%), soccer (26%), long distance running (16%), and others (16%) like fencing, martial arts and ski. The football players and the long distance runners had suffered significantly longer than the other athletes (30 ± 5 months vs. 14 ± 4 months, $p < 0.001$). The symptoms existed for a mean period of 18.8 (± 21.7) months.

Figure 2. Positive bulging provoked by the Valsalva manoeuver; coronal plane (dynamic MRI)

History of pain and treatment

Complaints consisted of chronic groin pain in all athletes. Pain was provoked by training, appeared during activity in all participants and improved when training was interrupted for a longer time. In 7 cases the athletes reported about accompanying pain in the adductor insertion area (both sides in two subjects). Two participants reported their main pain in the pubic area. The pain quality was described as pulling in 13, stabbing in 5 and dull in 1 case. Two athletes had previous bilateral total extraperitoneal endoscopic inguinal hernia repair. One athlete had undergone multiple cortisone injections in the adductor

insertion area, one participant had undergone ultrasound therapy, and 5 others - physical therapy. Neither conservative, nor operative treatment had brought substantial improvement of the symptoms.

Figure 3. Positive bulging provoked by the Valsalva manoeuver; axial plane (dynamic MRI).

MRI Findings

The MRI examination revealed an incipient inguinal hernia in one case. Valsalva-manoeuver provoked a visible bulging in 7 (n = 3 bilateral) athletes. In those cases a tear in the external oblique aponeurosis was shown to cause a posterior wall defect of the inguinal canal (Figure 2 and 3). This was interpreted as a posterior abdominal wall deficiency. The T2 STIR scans revealed edema in the symphysis (Figure 4) in 8 cases, while clinical examination revealed just two participants with intense pain in the symphysis. Adductor insertion site tenderness was found in three athletes on physical examination, but MRI detected edema in only one of them. Additionally, MRI visualized one hydrocele, one osteoma of the left femur, an enchondroma of the left superior ramus of the pubic bone, and one dilated left ureter. Due to the fact, that multiple findings were possible, there were overall 39 MRI findings in 19 participants (Table 1). All athletes had to describe also the type of pain they felt: pulling, stabbing or dull, where more than one type of pain was possible in a single participant - that resulted in 25 descriptions given by the 19 participants. Correlation between pain and abnormalities in the MRI showed similar results with regards to pulling pain and signal alteration in the groin and symphysis (Figure 5). Results of the MRI examinations before and after physical effort did not differ from each other. Signs of osteitis pubis or bulging were already detected by the first MRI examination before training. The second MR-imaging showed neither signal enhancement of already existent abnormalities nor appearance of new pathologic findings. Thus, a repeated examination during the training period added no information to the MRI findings detected during the training free interval.

Follow-up

During the next 4 years following our examinations, MRI-detected findings were surgically treated in four participants at other institutions. One patient died of malignant melanoma and 3 participants were lost to follow-up. Eleven of the remaining 15 participants suffered no longer from their previously described symptoms. The four surgically treated patients had undergone unilateral total extraperitoneal hernia repair (1 with bilateral bulging, 1 with incipient hernia, 2 with bilateral symphysic edema on MRI). Eleven participants reduced their training or quitted their sport completely. In the remaining subjects groin pain was alleviated significantly in 3 cases through reduction of training (two of them with left-sided bulging, and symphysitis in one of them, and another one without MRI pathology) and remained unchanged in one case with hydrocele and symphysitis (Table 2).

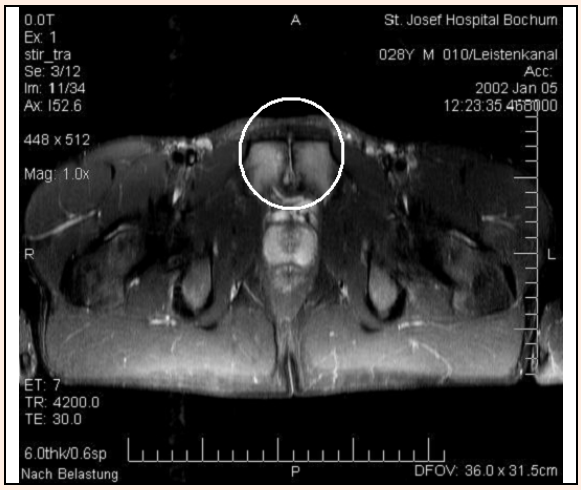

Figure 4. Pubic/symphysic edema representing symphysitis; horizontal plane, MRI at rest.

Discussion

The pathologic findings on MRI varied neither in quality nor in quantity comparing the two different time points of evaluation, suggesting that exercise-triggered pain does not have a temporary correlate, which can be visualized by MRI.

Chronic groin pain without clinical evidence of hernia can be a time consuming, costly and frustrating problem for both the athlete and the physician. Many anatomical structures are concentrated functionally within a small area. Several studies have focused on the different causes of groin pain and proposed a chronic overuse injury (Renstrom, 1992) and the so called “sports hernia” – describing a distension or bulging of the posterior inguinal channel wall musculature representing an early hernia (Edelman and Selesnick, 2006, Hackney, 1993, Polglase et al., 1991) as the most likely trigger for groin pain in the athlete. The mechanism may be stretching and tearing of the transversalis fascia and conjoint tendon implicating a reduction in internal hip rotation and a weakening of the posterior inguinal wall. Excessive adductor pull additionally leads to an increased shearing force across the symphysis (Hackney, 1993). This triangle of imbalanced forces may explain the common finding of coexisting symphysitis, sports hernia and adductor tendinitis within

Table 1. Pathological MRI findings (n=39 in 19 participants) divided into anatomic regions (multiple findings per athlete possible).

	Groin* (n = 15) 38.5%	Symphysis† (n = 15) 38.5%	Hip joint/Bones (n = 6) 15.3%	Urogenital (n = 3) 7.7%	Total (n = 39) 100%
Edema	2	15			17 (43.6)
Bulging	12				12 (30.8)
Hernia	1				1 (2.6)
Muscle insertion			4		4 (10.0)
Osteophyte			1		1 (2.6)
Osteoma			1		1 (2.6)
Bladder				1	1 (2.6)
Ureter				1	1 (2.6)
Hydrocele				1	1 (2.6)

* includes the musculofascial parts and the adductor insertion zone of the inguinal region.
† includes only the bony part of the inguinal region.

the scope of an overuse syndrome by concentrated strain forces in the inguinal region (Gullmo, 1989, Hackney, 1993). This corresponds well to our results revealing that one third of our homogeneous, well trained study group with a positive bulging (Figures 2 and 3) also presented with edema of the symphysis (Figure 4). One of those participants had a tender adductor insertion site and pathologic MRI findings there.

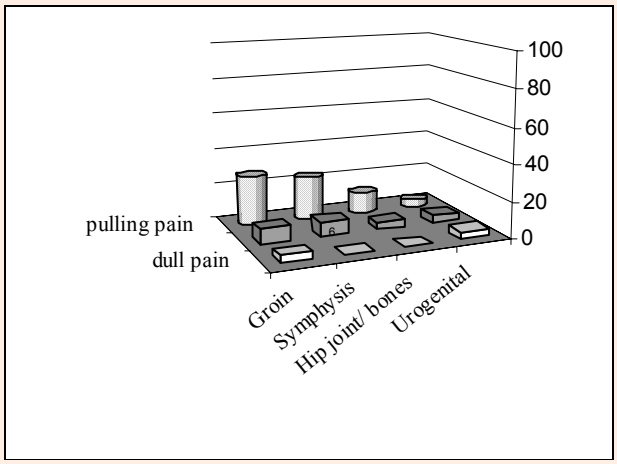

Figure 5. Athletes with pathological MRI findings in the groin or symphysis suffered frequently from pulling pain without any significant difference between both groups.

Other authors presented incipient hernia as the most likely differential diagnosis for groin pain in athletes (Lovell, G., 1995). In our series only one athlete without clinical signs of hernia was diagnosed with incipient hernia on MRI examination. This fact may be well due to the small number of cases included in our study. However, a total extraperitoneal hernia repair (TEP) relieved his symptoms completely. The TEP operation was performed successfully in three other cases, one of them with a bulging and the other two with symphysitis. Bulging was confirmed intraoperatively, proposing that the bulging may have caused the chronic groin pain. So, the surgical operation seems to be a successful treatment option in cases of correctly diagnosed posterior abdominal wall weakness. Ekstrand et al. (2001) showed in a prospective randomized study that in his group of patients who did not have osteitis pubis, surgery was better than physical therapy. However, it could be possible that the postoperative resting period and a specific physiotherapy afterwards were responsible for the improvement of the symptoms as well. We believe that a proper physical examination can exclude hernia without further diagnostics in most cases, but it is expected to fail in cases of posterior abdominal wall weakness. MRI revealed a positive bulging in 7 athletes (3 of them both sides), of whom 6 athletes achieved complete remission without operative treatment. To the authors' knowledge there is no study examining a symptom-free population for bulging, in order to better understand if bulging alone should be considered a cause for groin pain. Ten out of 15 athletes who were available for follow-up (including participants with bulging, symphysitis and those without pathologic MRI findings) achieved complete relief from their symptoms by simply reducing training. It should be noted that 67% (10/15) of the follow-up group were symptom-free after four years simply by reducing or changing their training mode. It remains of course unclear whether the symptoms would have remained if the athletes had preserved their earlier mode of training. On the other hand, the results from our small sample correlate to the results of other larger studies. However, they do not exclude the thesis of Renstrom (1992) and Hackney (1993) that the most likely differential diagnosis of groin pain in athletes is a chronic

Table 2. Results in the studied group of athletes 4 years after MRI examination (n= 15/19, 84,4% available at follow-up). Conservative or no specific treatment was successful in 67% (10/15), in 27% (4/15) operative treatment was performed and improved symptoms. The symptoms remained unchanged in one case.

	Improvement (n = 14) 93.3%		Deterioration (n = 0) 0%		No change (n = 1) 6.7%	
	Bulging	**Symphysitis**	**Bulging**	**Symphysitis**	**Bulging**	**Symphysitis**
Operation	2	2	-	-	-	-
No specific treatment	6	4	-	-	-	1

overuse injury with no indication for operative treatment (Kaplan and Arbel, 2005). This also applies to the course of the two participants who had previous hernia repair without success and got symptom-free by reducing their intensity of training in the course. In accordance with the reports of other authors our MRI findings ranged from bulging of the posterior inguinal wall and hernia in dynamic MRI (Fredberg and Kissmeyer-Nielsen, 1996; Hackney, 1993,; van den Berg et al., 1997; 1998) to adductor insertion abnormalities and symphysitis (Harris and Murray, 1974; Muckle, 1982). In contrast to previous studies we found in our small series no nerve entrapment (Kopell et al., 1962; Rischbieth, 1986), sacroiliac or lumbal abnormalities (Major and Helms, 1997) or fractures (Barry and McGuire, 1996) as possible causes for the athletes complaints. The other findings like hydrocele, enchondroma, osteoma, ischiadic tubercle edema and dilation of the ureter may be interpreted to underline the value of MRI for detection of unexpected pathology of the soft tissues and even the bones in the groin and pelvic area that may account for one aspect of the groin pain (Leander, 2000). In our opinion most of these findings do not result in a change of the therapeutic algorithm and therefore MRI should be restricted to special indications, when chronic overuse injury of the groin and posterior wall weakness seems to be unlikely as a cause for the groin pain. In almost all cases the localisation of the symptoms corresponded to the sites of pathological findings in MRI (whereas the pain quality was no valid indicator for differentiation e.g. between symphysitis and bulging) further indicating that MRI may not be superior to physical examination in the diagnosis of chronic groin pain.

Conclusion

MRI examination is useful for detection of osteitis pubis. A posterior abdominal wall weakness can also be diagnosed, but in the absence of a control group it is difficult to be exactly evaluated. No additional information could be obtained through MRI within the training-active period, compared to the training-free interval. The clinical follow-up revealed that changing or reducing training might lead to alleviation of symptoms. In our study MRI was not a helpful tool in the differential diagnosis of chronic groin pain, with respect to the choice between operative or conservative treatment. MRI findings did not appear to correlate with patient outcomes. While the relevance of pathologic MRI findings as an indication for surgical treatment is questionable, the detection of osteitis pubis requiring conservative treatment seems to be feasible.

Acknowledgements

The authors are grateful to Mrs. Morrosch for her technical assistance.

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Key points

- MRI findings after training and during the train free period did not vary.
- MRI revealed a variety of pathological findings in athletes suffering from chronic groin pain, but it was not reliable enough in differentiating between diagnoses requiring conservative or operative treatment.

✉ **Dirk Weyhe, MD**
Department of Surgery, St. Josef Hospital, Ruhr University Bochum, Gudrunstraße 56, 44791 Bochum, Germany

AUTHORS BIOGRAPHY

Adrien DAIGELER
Employment
Dr. med. Depart. of Surgery, St. Josef Hospital, Ruhr University Bochum, Gudrunstraße 56, 44791 Bochum, Germany.
Degree
MD
Research interests
Treatment of hernia, donor site morbidity of muscle flaps, apoptosis in sarcoma.
E-mail: adrien.daigeler@rub.de

Orlin BELYAEV
Employment
Dr. med., Depart. of Surgery, St. Josef Hospital, Ruhr University Bochum, Gudrunstraße 56, 44791 Bochum, Germany.
Degree
MD
Research interests
Hernia surgery, esophageal cancer, surgical diseases of the pancreas.
E-mail:
o.belyaev@klinikum-bochum.de

Werner H. PENNEKAMP
Employment
Radiologist, Department of Diagnostic and Interventional Radiology and Nucleare Medicine, University BG-Klinik-Bergmannsheil Bürckle-de-la-Camp-Platz 144789 Bochum.
Degree
MD
Research interests
Musculsceletal MRI and cardiologic MRI. There is a focus on spine deaseases. In cardiac imaging there is special interest in phase contrast flow measurement of implanted heartvalves.
E-mail: Werner.Pennekamp@rub.de

Stephan MORROSCH
Employment
Depart. of Anaesthesiology, St. Josef-Hospital, Ruhr-Univer.
Degree
MD
Research interests
Perioperative pain therapy.
E-mail: stephan.morrosch@rub.de

Odo KÖSTER
Employment
Radiologist, Depart. of Diagnostic and Interventional Radiology and Nucleare Medicine. St. Josef Hospital, Ruhr Univ.
Degree
MD
Research interests
MRI Angiography
E-mail:

Waldemar UHL
Employment
Prof. Dr., Depart. of Surgery, St. Josef Hospital, Ruhr Univ.
Degree
MD
Research interests
General and visceral surgery.

Dirk WEYHE
Employment
Dr. med., Depart. of Surgery, St. Josef Hospital, Ruhr Univ.
Degree
MD
Research interests
Biocompatibility of devices in hernia surgery, Surgical diseases of the pancreas, Postoperative metabolism.
E-mail: d.weyhe@elis-stiftung.de