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ORIGINAL ARTICLE

Minimal Repair technique of sportsmen's groin: an innovative open-suture repair to treat chronic inguinal pain

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Abstract
Background Sportsmen's groin, also known as sportsman's hernia, sports hernia, (athletic) pubalgia or athletic hernia, especially in professional sportsmen, is a difficult clinical problem, and may place an athlete's career at risk. It presents with acute or chronic inguinal pain exacerbated with physical activity. So far, the diagnostic criteria and treatment modalities are inconsistently described and there is no evidence-based consensus available to guide decision-making.
Objectives We developed an innovative open suture repair, called the "Minimal Repair" technique. With this technique, the defect of the posterior wall of the inguinal canal is not enlarged, the suture is nearly tension-free and the patient can, therefore, return to full training and athletic activity within the shortest time.
Methods In September 2008, we started a prospective cohort study to evaluate the outcome of patients undergoing operations under the Minimal Repair technique for sportsmen's groin. Between September 2008 and May 2009, 129 patients were included in the study and were questioned at entry and 4 weeks after the operation. The primary endpoints were time to complete freedom of pain and time to resumption of exercise and sport. Here, we present the results observed 4 weeks after operation under the Minimal Repair technique.
Results At enrollment, all but three patients reported a significant restriction of physical activities due to severe groin pain (median duration of pain 142 days, interquartile range [IQR] 57–330 days). Four weeks after operation under the Minimal Repair technique, 96.1% had resumed training (median 7 days, IQR 5–14 days). At this time, there was a full return to pre-injury sports activity levels in 75.8% (median 18.5 days, IQR 11.75–28 days). Focusing on the group of professional athletes, 83.7% had returned to unrestricted sports activities (median 14 days, IQR 10–28 days). In this subgroup, the median time to complete pain relief was 14 days (IQR 6–28 days).
Discussion The surgical treatment of sportsmen's groin is common practice when non-surgical treatment has failed over a period of 6 weeks or more. However, there is no evidence-based data on the type of treatment. A wide variety of techniques with and without mesh are being performed. So far, laparoscopic repair is believed to enable a faster recovery and return to unrestricted sports activities. Our results, however, show that the outcome after operation under the Minimal Repair technique is very fast, without exposing the patient to possible risks related to mesh insertion or laparoscopic procedures.
Conclusion The Minimal Repair technique is an effective and safe way to treat sportsmen's groin.

Keywords Sportsmen's groin · Minimal Repair technique · Sports hernia · Pubalgia · Chronic groin pain · Innovative surgery

Introduction

Sportsmen's groin, also known as sportsman's hernia, athletic hernia, sports hernia, (athletic) pubalgia, incipient hernia or cryptic hernia, is a difficult clinical problem, especially in athletes who participate in sports that involve cutting, pivoting, kicking and sharp turns. It presents with acute or chronic inguinal pain exacerbated with physical

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activity. The pain can be so intense that athletes are impaired, severely constrained or even completely prevented from training and practising sport.

The literature suggests that sports hernias rarely improve without surgery [1–6]. To avoid the development of chronic groin pain, surgical repair should be considered when conservative treatment over a period of 6 to 8 weeks has failed and when careful examination has excluded other potential pain sources [7]. Both open and laparoscopic techniques produced excellent results, with most patients being able to return to their previous level of activity [3, 7–16].

In 2003, we developed a new surgical technique, named the "Minimal Repair" technique, an innovative open-suture method, for the athlete with sportsmen's groin. The aim of the surgical intervention was to achieve decompression of the genital branch of the genito-femoral nerve without enlarging the defect of the posterior wall of the inguinal canal by the preparation. The posterior wall was stabilised by a nearly tension-free suture, which allows the patient to return to full activity without pain. As a general rule, we never used prosthetic mesh for athletes because they require full elasticity and slide bearing in their abdominal muscles after surgery.

The aim of this study was to evaluate the clinical outcome after operation under the Minimal Repair technique. The primary endpoints were time to resume low-level training and full training/competing and the time to reach complete pain relief.

Methods

Diagnosis of sportsmen's groin

The diagnosis of sportsmen's groin was based on history, physical examination and dynamic ultrasonography.

Sportsmen's groin was diagnosed if the patient had suffered from pain (dull, diffuse, sharp and burning) in the groin, often with radiation down the inner thigh, the scrotum, the testicles, and the pubic bone.

The examination was carried out with the patient in upright position. When the inguinal canal was palpated, the patient usually confirmed that the pain was getting worse. A sportsmen's groin was diagnosed when no inguinal hernia was found, but there was a localised bulge in the posterior wall of the groin canal during the Valsalva manoeuvre (Fig. 1). As the canal is widened, the rectus muscle is medially and cranially retracted. This retraction causes increased tension, leading to pubalgia (Fig. 2).

Every patient had a dynamic ultrasound scan by one of two examiners, using a high-frequency transducer (5–13 MHz) with the patient supine. Care was taken not to compress the inguinal canal with excessive transducer pressure. The motion of the inguinal canal and its walls was observed during the Valsalva manoeuvre and the size of the defect was measured (about 2 cm on average). Sportsmen's groin was diagnosed if a convex anterior bulge of the posterior inguinal wall was observed during stress.

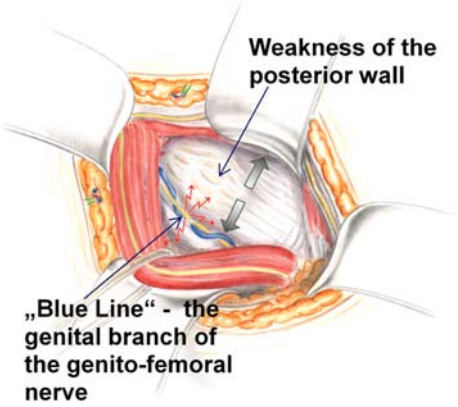

Fig. 1 Sportsmen's groin: a localised bulge in the posterior inguinal wall with compression of the genital branch of the genito-femoral nerve

The Minimal Repair technique of sportsmen's groin

All operations were performed with the Minimal Repair technique with local anaesthesia. The preparation was carried out in a common way over a small inguinal incision, dissection of subcutaneous tissue and splitting of the external oblique aponeurosis. The reparation started with testing the strength of the posterior inguinal wall by digital palpation. Typically, a circumscribed weakness was found

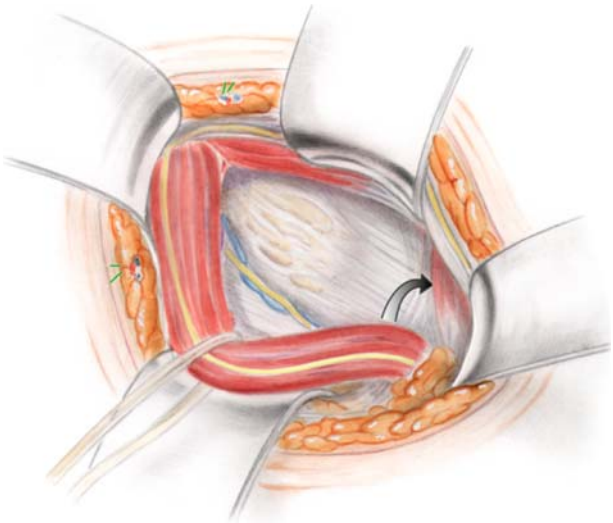

Fig. 2 Cranial and medial displacement of the rectus abdominis muscle with increasing tension at the pubic bone

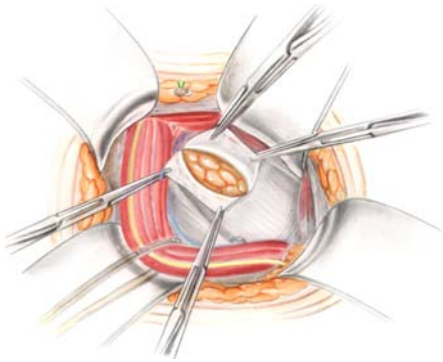

Fig. 3 Only the defect is opened and, if necessary, resection of the genital branch of the genito-femoral nerve is performed

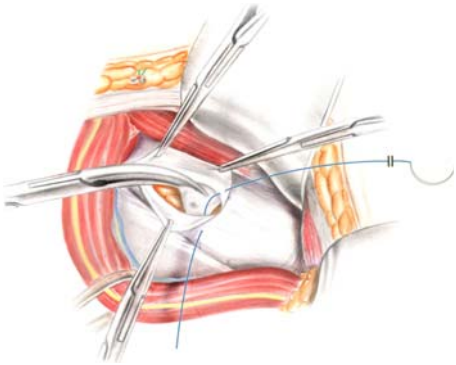

Fig. 4 Suture I: continuous suture (Prolene 2–0) from the medial towards the deep inguinal ring, creating a free lip

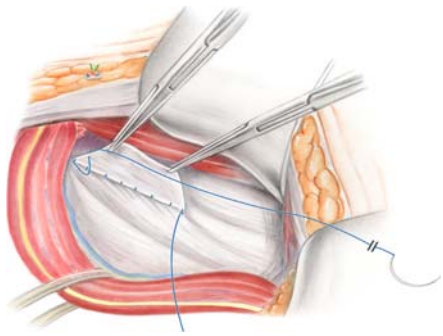

Fig. 5 The suture now reverses its course towards the pubic bone and the free border is included in the suture and brought to the inguinal ligament

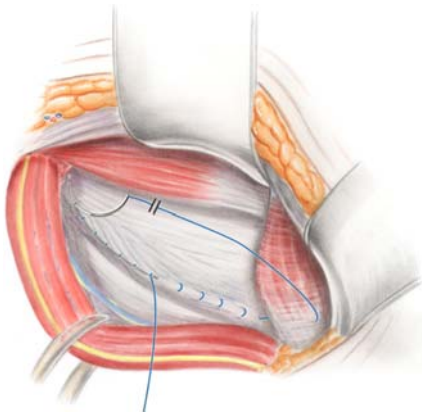

Fig. 6 Suture II: reducing the tension of the rectus abdominis muscle

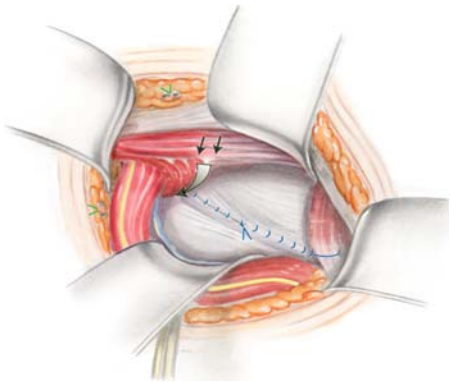

Fig. 7 The lateral section of the internal oblique muscle creates a muscular collar to protect the pampiniform plexus and nerves from mechanical irritation

in the posterior wall, with the tissue around it being firm and intact.

The fascia transversalis was split, beginning in the area of the defect towards the deep internal ring. The length of the incision enclosed only the area of fascial weakness; the surrounding tissue was kept intact (Fig. 3). The genital branch of the genito-femoral nerve was assessed and, if necessary, partly removed. Then, a continuous suture (suture I) was performed from the medial towards the deep inguinal ring, creating a free fascia lip out of the iliopubic tract (Fig. 4). There, the suture reversed towards the pubic bone. The free lip was included in the suture and brought to the inguinal ligament (Fig. 5). The rectus abdominis muscle was lateralised with suture II (Fig. 6) to counteract the increased tension at the pubic bone, caused by the retraction of the rectus muscle in the upward and medial direction. The pampiniform plexus was protected against mechanical irritation by creating a muscular collar at the deep ring with the lateral section of the internal oblique muscule (Fig. 7).

Postoperative treatment

All patients were discharged on the day of operation. Conventional non-steroidal anti-inflammatory drugs (NSAIDs) were used for postoperative pain relief. Patients were allowed to lift up to 20 kg (44 lb) immediately after surgery, to resume running/cycling on the second postoperative day (POD), to begin specific training on POD 3–4 and to complete their training on POD 5.

Study

We started a prospective cohort study to evaluate the outcome for patients undergoing operations under the Minimal Repair technique for sportsmen's groin. Subjects were operations performed with the Minimal Repair technique by a specialised hernia surgeon. During the period from September 2008 until May 2009, 129 patients were diagnosed with sportsmen's groin (three patients bilateral). In total, there were 132 operations under the Minimal Repair technique. The study was designed for questioning at entry as well as 4 weeks, 6 months, 1 year and 5 years after the operation.

All patients were contacted by telephone to assess postoperative complications, return to sport, level of pain at the time of interview (using analogue pain scores) and the overall result of their surgery. The primary endpoints were time to resuming low-level training and full training/competing and the time to reach complete relief of pain.

Currently, we received the results for the evaluation 4 weeks after operation under the Minimal Repair technique. Further analysis will follow, since the study is ongoing.

Statistics

Continuous variables are presented as median and interquartile range (IQR) and qualitative data are expressed as percentages. The comparison of continuous variables was performed with the non-parametric Mann–Whitney *U*-test. Dichotomised data were analysed with the Chi-square test. Paired variables were tested by the Wilcoxon signed ranks test. Differences were considered to be statistically significant when $P < 0.05$. SPSS statistical software was used for all statistical analyses (release 11.5; SPSS, Inc., Chicago, IL, USA).

Results

Patient characteristics

A total of 128 male patients and one female patient were included in the study. The median age was 25 years (IQR 21–29 years). Eighty-seven patients (67.4%) were professional athletes. One hundred and twenty-five patients could be contacted by telephone and gave consent to the completion of a verbal questionnaire 4 weeks after surgery. Four patients were lost to follow-up. Three patients had bilateral repairs and 19 patients (14.7%) had a second operation on the contralateral side to their first. In total, there were 132 operations under the Minimal Repair technique. Symptoms existed preoperatively for a median of 142 days (IQR 57–330) and all but three patients were not able to participate in their sports to a satisfactory level. Before surgery, patients stated a median pain score of 6 (IQR 3.75–7), where a score of 0 described no pain and 10 indicated excruciating pain (Table 1).

Athletes

In this group of 87 patients, there was one female patient. The median age was 29 years (IQR 20.25–35.75 years). Two patients had a bilateral repair and 15 patients (17.27%) had a second operation on the contralateral side to their first. Symptoms existed preoperatively for a median of 90 days (IQR 53–285 days) and all but one patient were not able to participate in their sport to a satisfactory level. Before surgery, patients stated a median pain score of 6 (IQR 3–7).

Non-athletes

In this group of 42 patients, there were no female patients. The median age was 24.5 years (IQR 21–28 years). One patient had a bilateral repair and four patients (9.5%) had a second operation on the contralateral side to their first. Symptoms existed preoperatively for a median of 225 days (IQR 112.5–427.5 days) and all but two patients were not able to participate in their sports to a satisfactory level. Before surgery, patients stated a median pain score of 5 (IQR 4–7).

Outcome at 4 weeks

Of all patients, 78.9% reported that they were completely free of pain (median 14 days, IQR 6–28 days). The pain

Table 1 Patient characteristics

	All patients	Athletes	Non-athletes	*P*-value
n (Minimal Repair)	132	89	43	
Male	128/129	86/87	42/42	0.547
Age	25 (21–29)	29 (20.25–35.75)	24.5 (21.0–28.0)	0.070
Previous contralateral groin repair (%)	19/129 (14.7%)	15/87 (17.2%)	4/42 (9.5%)	0.299
Preoperative pain scale (0–10)	6 (3.75–7)	6 (3–7)	5 (4–7)	0.454
Period of preoperative pain	180 (67.5–360)	90 (53–285)	225 (112.5–427.5)	0.036
Physical impairment preoperatively	126/129 (97.7%)	86/87 (98.8%)	40/42 (95.2%)	0.247

Table 2 Outcome 4 weeks after operation under the Minimal Repair technique

Four weeks after Minimal Repair	Athletes	Non-athletes	*P*-value
Resumption of sport within 28 days (%)	85/86 (98.8%)	39/42 (92.8%)	0.330
Time to resumption of sport (days)	7 (4–14)	8.5 (6.25–14.0)	0.002
Full return to sport within 28 days (%)	72/86 (83.7%)	25/42 (59.5%)	0.004
Time to full return to sport (days)	14 (10–28)	21 (14–28)	0.056
Complete relief of pain within 28 days (%)	68/86 (79.1%)	33/42 (78.6%)	1.00
Time to complete pain relief (days)	13 (7–28)	14 (5.25–28.0)	0.860
Perfect satisfaction of Minimal Repair	86/86 (100%)	41/42 (97.6%)	0.328
Pain scale (0–10) 4 weeks after Minimal Repair	0.5 (0–2)	1 (0–2.75)	0.064

scores indicated a marked improvement in their level of pain ($P < 0.0001$). The pain score decreased from 6 (IQR 3.75–7) to 1 (IQR 0–2) 4 weeks after operation under the Minimal Repair technique.

Comparing the groups of athletes and non-athletes, there was a significant difference ($P < 0.05$) in the "time to resumption of sport" and "return to peak performance." Athletes resumed their training earlier (median 7 days, IQR 4–14 days) than non-athletes (median 8.5 days, IQR 6.25–14 days) ($P = 0.002$). Furthermore, 83.7% of athletes had already returned to peak performance within 4 weeks after operations under the Minimal Repair technique, whereas 59.5% of non-athletes did so at this point in time ($P = 0.004$). The other parameters did not show significant differences.

All patients felt that the operation had improved their symptoms considerably. Eighty-six of 86 athletes (100%) and 41 of 42 non-athletes (97.6%) reported 4 weeks after their operations under the Minimal Repair technique that they would have elected to undergo the operation with the Minimal Repair technique again (Table 2).

Athletes

All but one athlete (98.8%) had resumed training within 28 days (median 7 days, IQR 4–14 days). This professional soccer player underwent adductor surgery shortly afterwards, which prevented him from training. A full return to pre-injury sports activity levels was reported by 83.3% (median 14 days, IQR 10–28 days) and 79.1% reported that they were completely free of pain (median 13 days, IQR 7–28 days). Pain scores indicated a marked improvement in their level of pain ($P < 0.0001$). The pain score decreased from 6 (IQR 3–7) to 0.5 (IQR 0–2) 4 weeks after operation under the Minimal Repair technique (Fig. 8).

Non-athletes

All but three patients (92.8%) had resumed training (median 8.5 days, IQR 6.25–14 days). One patient suffered from severe adductor problems, and two young patients (18 and 20 years of age) had had a long history of pain (11 months and more than 2 years), significantly prolonging the abatement of pain. These two patients had, however, after 6 months a pain score of 2 and after one year of 1.

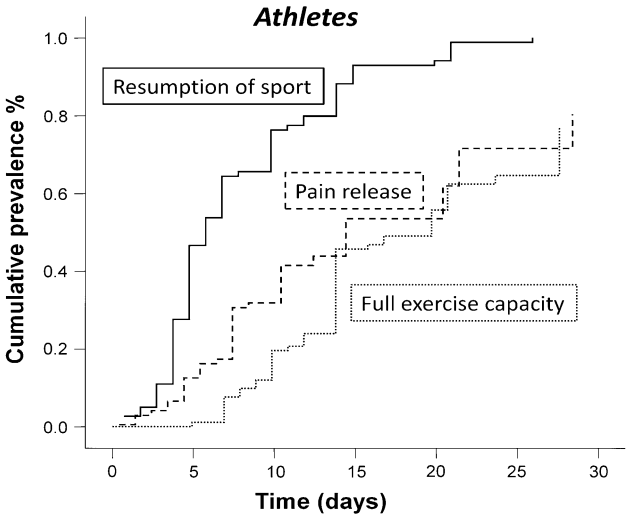

Fig. 8 Resumption of sport, pain release and full exercise capacity in athletes

A full return to pre-injury sports activity levels was reported by 59.5% (median 21 days, IQR 14–28 days) and 78.6% reported that they were completely free of pain (median 14 days, IQR 5.25–28 days). Pain scores indicated a marked improvement in their level of pain ($P < 0.0001$). The pain score decreased from 5 (IQR 4–7) to 1 (IQR 0–2.75) 4 weeks after operation under the Minimal Repair technique.

All patients were discharged on the day of operation. We observed neither minor nor major complications during a follow-up of 30 days. The histological result after nerve resection (the genital branch of the genito-femoral nerve was resected in 20%) showed a perineural fibrosis in 100% of the patients (Fig. 9).

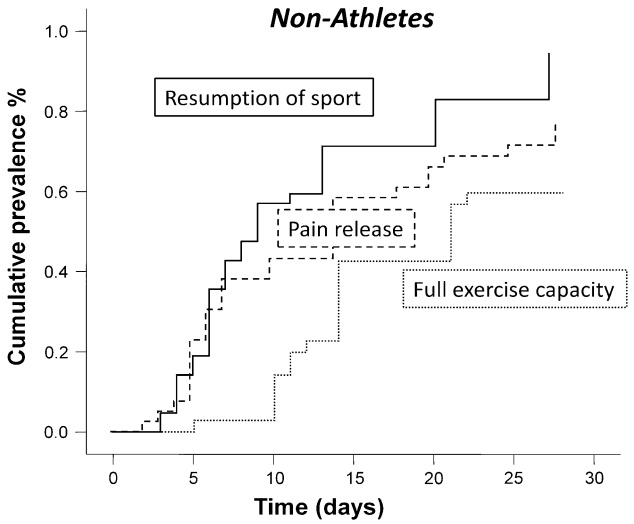

Fig. 9 Resumption of sport, pain release and full exercise capacity in non-athletes

Discussion

The Minimal Repair technique is a new open-repair technique, where the preparation and doubling of the fascia transversalis encloses only the area of fascial weakness and does not affect surrounding sound tissue like standard suture repairs (e.g. Shouldice repair). Commonly used surgical procedures include open repairs (e.g. Shouldice repair, Lichtenstein repair) as well as laparoscopic repairs (e.g. transabdominal preperitoneal [TAPP] procedure, total extraperitoneal [TEP] procedure).

In comparison with the latter methods, the new technique has the following advantages: (1) no insertion of prosthetic mesh, (2) no general anaesthesia required, (3) less traumatisation and (4) lower risk of severe complications.

Inserted meshes result in localised stiffening of the abdominal muscles and, therefore, restricted movement. Especially in athletes, who require full elasticity and movement in their abdominal muscles, meshes should be avoided. Since the Minimal Repair technique does not make use of meshes, patients are not prone to mesh-related complications, such as infections with chronic groin sepsis and fistula formation, which sometimes requires the removal of mesh [17], mesh migration and penetration into the bladder or bowel [18, 19], and foreign body reaction with decrease of arterial perfusion and testicular temperature [20] with consecutive secondary azoospermia [21]. Of note, 35% of open and 100% of laparoscopic procedures use mesh [7].

The laparoscopic approach always requires general anaesthesia. This is not the case with open procedures, including the Minimal Repair technique, so that patients are not exposed to the side effects of general anaesthesia. Existing data from large consecutive patient series and randomised studies have shown local anaesthesia to be advantageous [22].

Open repairs were shown to be less traumatic than laparoscopic approaches. Schwab et al. determined the systemic inflammatory response after endoscopic vs. Shouldice groin repair by monitoring cytokine activities (CRP, PGF1α, neopterin, IL-6). The immune trauma was significantly higher in the group of patients with laparoscopic hernia repair than in the group of patients who received a Shouldice repair. Therefore, the repair of groin hernias using a laparoscopic technique cannot be regarded as a minimally invasive procedure that is less traumatic than conventional approaches [23]. Since the Minimal Repair technique does not split the whole posterior inguinal wall, as is the case with a Shouldice repair, it can be considered as even less invasive.

Severe visceral and vascular complications were more often reported with laparoscopic techniques [24] as compared with open-repair techniques. Another common problem after laparoscopic repair is postoperative urinary retention (22.2% after laparoscopic inguinal hernia procedures) [25]. However, the number of surgeons using laparoscopic procedures has been increasing in the last few years [2, 13, 15, 16, 26, 27].

With the Minimal Repair technique, we observed neither minor nor major complications during a follow-up of 30 days. Thus, in our hands, the Minimal Repair technique is a safe procedure.

This study shows that the Minimal Repair technique allows for the excellent relief of groin pain with fast recovery to full sporting activities. On average, our patients resumed moderate training after 7 days and felt a complete relief of pain after 14 days. A return to full activity was achieved after 18.5 days. In professional athletes (67%), the time to return to pre-injury sports activity levels amounted to 14 days.

After laparoscopic repair, recovery generally took 6–8 weeks before full return to competition was permitted [4, 7, 11, 15, 28]. The recovery times in other studies varied from 2 to 3 weeks [27, 29], 4 weeks [16], 3 to 6 weeks [30] and up to 12 weeks [15, 26]. In a meta-analysis, Caudill et al. found post-surgical recovery times (based on sports activity) of 17.7 weeks for patients who underwent open approaches and 6.1 weeks for laparoscopic repairs [7]. Compared with these data, the convalescence after operation under the Minimal Repair technique seems to be faster than after the described procedures.

The limitations of our approach have to be recognised. We did not randomise patients into two different interventional treatment groups for ethical reasons. The number of patients included so far is rather low, and the follow-up period is short. Despite the limitations of our approach, this

study proves clearly that the Minimal Repair technique of sportsmen's groin is a safe and effective procedure, and is probably superior to other currently used techniques.

Conclusion

The Minimal Repair technique is an effective and safe way to treat sportsmen's groin. It is performed under local anaesthesia. Since the Minimal Repair technique ensures stabilisation of the posterior inguinal wall without the insertion of a prosthetic mesh, full elasticity and movement in the abdominal muscles are preserved. The athlete benefits from a rapid recuperation and return to normal activities, which are required during training and competition.

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