INGUINAL-RELATED GROIN PAIN IN ATHLETES

NOCICEPTIVE OR NEUROPATHIC?

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INTRODUCTION

Groin pain in athletes is one of the most puzzling medical problems for decades, confusing medical professionals involved in the diagnosis and treatment of the active population. It has been extensively researched during the last decades, but some questions are still far from answered. Groin pain usually affects athletes in sports involving kicking, twisting/turning, and explosive movements[1]. In a study analysing groin pain prevalence in football across different levels of play, the authors reported that 59% of male players and 45% of female players experienced at least one episode of groin pain during a 6 week period[2]. In addition to creating a significant burden on athlete performance, groin pain is also a challenging field for sports medicine physicians, surgeons, and physiotherapists, due to a lack of understanding of the underlying pathology, as well as inconsistency in terminology and definitions. A consensus on terminology and definitions was reached during the first World Conference on Groin Pain in Athletes in Doha, Qatar in 2014, with a paper published the year after with proposed main clinical entities in groin pain. The authors proposed adductor-related, iliopsoas-related, inguinal-related, and pubic-related groin pain as the main entities, with hip-related groin pain in athletes as a separate category, as well as some medical conditions not to be missed that might mimic activity-related groin pain. Inguinal-related groin pain is defined as pain located in the inguinal canal region and tenderness of the inguinal canal; no palpable inguinal hernia is present and is more likely if the pain is aggravated with resistance testing of the abdominal muscles or on Valsalva/cough/sneeze[3]. In this article we will focus on inguinal-groin pain since it seems to create the most debate between professionals regarding the underlying cause of pain, and it also appears to be the most difficult to examine eliciting the original pain.

ANATOMY

The inguinal region is the lateral inferior part of the anterior abdominal wall, with the inguinal canal being the center of the field. This is the area where the lateral abdominal muscles connect with the pelvis, rectus abdominis muscle, and hip adductors, with iliopsoas located in proximity, just below the inguinal ligament. The inguinal canal is created by the external oblique aponeurosis anteriorly, the inguinal ligament inferiorly, the internal oblique and transversus abdominis superiorly, and the fascia transversalis posteriorly. The spermatic duct in men, and the round ligament in women, transverse the inguinal canal with accompanying blood vessels and nerves. This is also the area where a lot of forces from the abdominal wall and lower limbs intersect during sports activities, while the inguinal canal is one of the weak points in the abdominal wall.

The inguinal canal is crossed by three sensory nerves: ilioinguinal nerve, iliohypogastric nerve, and genital branch of genitofemoral nerve. Ilioinguinal and iliohypogastric nerves arise from the 12th thoracic and 1st lumbar spinal nerves, with a trajectory posterior to the psoas muscle, and enter the groin through transversus abdominis muscle medially to the anterior superior iliac spine where their pathway continues between external and internal oblique muscles and aponeurosis. The ilioinguinal nerve is usually located over the cremaster muscle, and exits the canal through the external inguinal ring. The iliohypogastric nerve is found more cranially and along the internal oblique muscle, reaching the junction with the rectus abdominis fascia. The genital branch

Figure 1: Bilateral triple neurectomy, same patient, variability in nerve branching left vs right.

of the genitofemoral nerve originates from 1st and 2nd lumbar spinal nerves, and enters the groin through the deep inguinal ring, covered by cremasteric fascia underneath the spermatic cord, and exits through the external ring. All 3 nerves are not always present, as it was reported in a study that the ilioinguinal, iliohypogastric, and the genital branch of the genitofemoral nerve were present in 96, 94 and 90% respectively[4]. There are multiple variations in the trajectory of these nerves, as well as sensory overlapping between them. In a study on the emergence and distribution of the ilioinguinal nerve, the authors reported 16 modes of division and 8 types of distribution, with predominantly anterior scrotal topographic distribution, meaning that the genital branch of the genitofemoral nerve is not solely responsible for scrotal pain[5] (Figure 1).

In another study, authors reported that in addition to the cutaneous branches from the ilioinguinal nerve in 90.7%, cutaneous branches originating from the genital branches of the genitofemoral nerve were found in the inguinal region in 35.2%, and in 13.0% the genital branch and the ilioinguinal nerve united in the inguinal canal[6]. This is probably the reason that patient-reported pain is not well defined, and it seems that there is not one single structure responsible for pain (Figure 2).

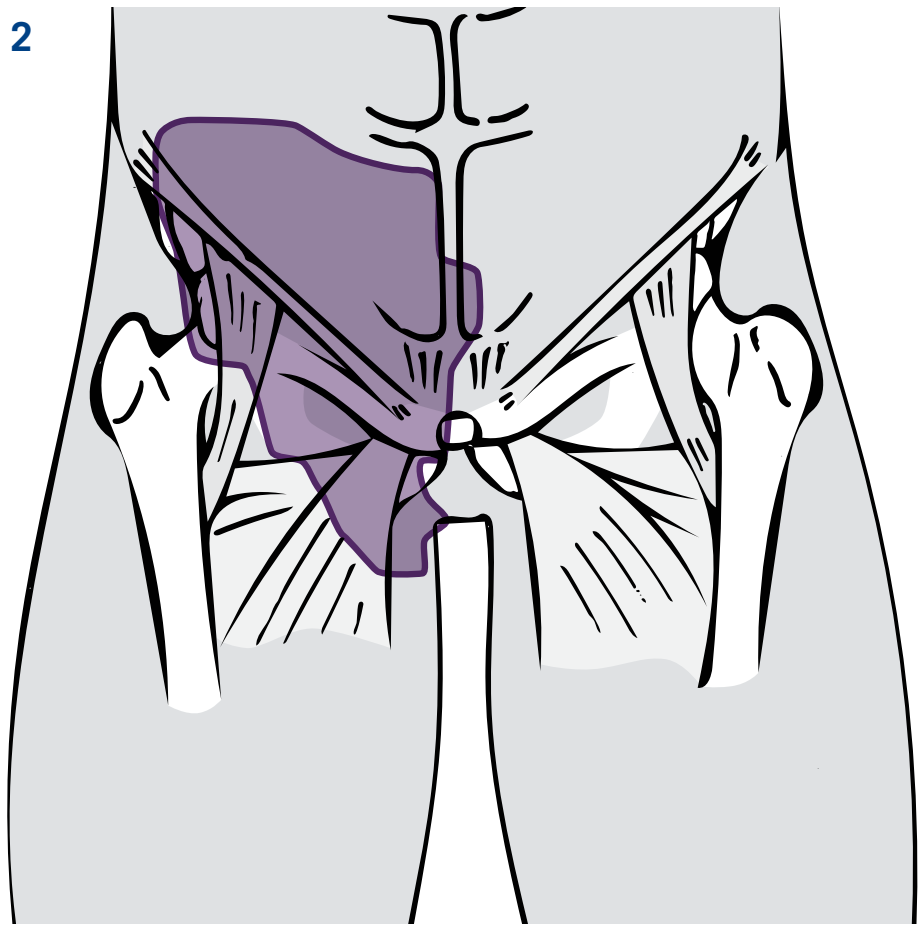


Figure 2: Purple area shows reported inguinal-related groin pain as reported by patients in a study[7].

AETIOLOGY

Multiple causes have been proposed as underlying pathologies for inguinal-related groin pain, and they can be grouped into neuropathic (nerve entrapment by overlying aponeurosis or compression by bulging of posterior wall of the inguinal canal), or nociceptive (musculoskeletal causes including aponeurotic tears and inguinal ligament enthesopathy). These different causes can generate different pain qualities, with neuropathic pain generally associated with electric, burning, and tingling sensations, and nociceptive pain with stabbing, and dull/aching pain[7,8]. We know that an inguinal hernia can be asymptomatic, but in cases where it is painful the pain is caused by direct nerve compression, with histopathological evidence of nerve fat degeneration distal to the point of compression[9]. It has been shown in inguinal hernia postoperative pain research that direct nerve injury

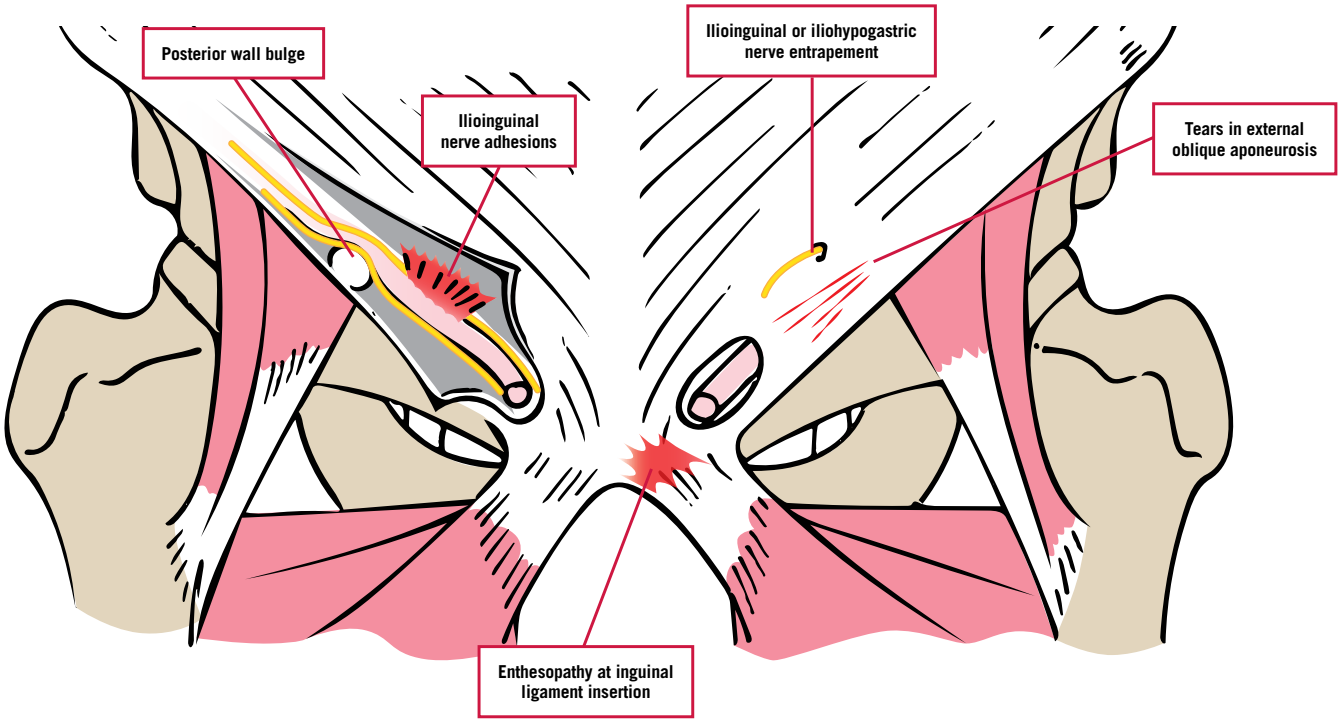


Figure 3: Proposed causes for inguinal-related groin pain[8].

(transection, suture, etc.) causes neuropathic pain, while postoperative inflammatory response (scar tissue, foreign body reaction, etc.) causes nociceptive pain. Postoperative hematoma can also cause an inflammatory response leading to nociceptive pain, and there might be an analogy with longstanding inguinal pain following an acute groin injury in athletes.

A proposed sequential model for pain considers multiple factors that influence neuroplasticity following neuropathic or nociceptive nerve injury, including genetics, age, memory, and mental state, among others. These factors might explain the differences in pain onset and pain levels between individuals following similar injuries[11]. The main cause of pain seems to be in the inguinal canal itself (with the ilioinguinal nerve crossing through the center, and the genital branch of the genitofemoral nerve positioned behind the funiculus), and not in the preperitoneal plane (between fascia transversalis and peritoneum), which might have implications in choosing the right treatment modality (Figure 3).

EXAMINATION

Clinical examination is the cornerstone in reaching the correct diagnosis in groin pain, with inguinal-related groin pain being the most difficult to reproduce with clinical tests. In our daily practice, we see patients with varying medical histories and symptom presentations. Some patients report pain whenever they engage in sports activity, with pain continuing sometimes for a few days after the activity is completed; the reported area of pain in these athletes involves the whole area from the inguinal ligament (and sometimes below) up to the lower part of oblique muscles and distal rectus abdominis. This corresponds with the ilioinguinal and iliohypogastric nerve dermatomes and is usually described as dull/stabbing pain, mimicking nociceptive pain. Other patients report having a completely normal life, and even being able to perform some activities pain-free, but experience sharp short-lasting pain like electricity or burning referred towards the suprapubic/inner-thigh area, or towards the testicles in male athletes. This presentation seems to be neuropathic pain, caused by direct nerve compression/entrapment. The ilioinguinal nerve or iliohypogastric nerve occasionally have a trajectory that pierces through the external oblique aponeurosis, causing nerve kinking and entrapment. The genital branch of the genitofemoral nerve is usually compressed by inguinal posterior wall bulging[11].

The first part of clinical examination is palpation of all inguinal canal structures, including invagination of the scrotal skin and entering the canal with the finger of the examiner, while asking the patient to perform the Valsalva manoeuvre. The second part of the examination consists of muscle resistance tests, where the strength of the lateral abdominal wall is examined possibly provoking the recognizable pain. A recent inter-examiner reliability study on inguinal examination showed that the Valsalva manoeuvre is the most prevalent positive palpation test, and that there is no single perfect test for classifying athletes with inguinal-related groin pain[12]. Another retrospective study demonstrated that athletes with groin pain have multiple entities involved in 44% of the cases, which highlights the importance of examining other structures (adductors, iliopsoas, pubic bones, and hips) when encountering a patient with inguinal-related groin pain[13].

IMAGING

Imaging modalities including X-ray, ultrasound, and MRI scans can be helpful for ruling out other underlying causes for groin pain, but currently, there is no consensus for a gold standard when it comes to inguinal-related groin pain. Frequent findings are pubic bone marrow edema on MRI, symphyseal changes on X-rays, and inguinal posterior wall bulging on ultrasound, but it has been shown that these findings are common in asymptomatic athletes as well[14]. Pubic bone stress findings in asymptomatic

athletes are also found in 48% of the cases in a study, compared to 50% in non-active control cases, showing that these findings are frequently not pathological[15]. Another study on hip and groin MRI shows positive findings in 77% of asymptomatic athletes, illustrating that we must interpret imaging scans with caution[16].

TREATMENT

The consensus on first-line treatment in inguinal-related groin pain is conservative, which consists of stopping sports activities, and undergoing supervised active exercise-based rehabilitation aimed at strengthening the lateral abdominal wall, along with correcting muscular imbalance between the abdominal wall, hip abductors, and hip adductors[17,18]. In patients with ongoing pain despite rehabilitation, the next option should be ilioinguinal/iliohypogastric nerve block (ultrasound-guided or landmark-based), using local anaesthetics and corticosteroids. The rationale for this therapy is that steroids prolong the duration of analgesia by stabilizing neuronal membranes, and inhibiting the synthesis and release of proinflammatory mediators. It has been shown that nerve blocks can provide complete resolution of symptoms, or at least temporary relief for 1-3 months. In cases of pain recurrence nerve blocks can be repeated[19,20,21].

Surgical treatment should be reserved for patients who continue to experience pain despite conservative treatment modalities. There are currently different surgical procedures performed for athletes with inguinal-related groin pain, based on surgeons' approach to underlying aetiology. Inguinal surgery can be open (mesh or non-mesh procedures) or endoscopic. Endoscopic procedures that are commonly utilized in treating inguinal hernias are trans-abdominal pre-peritoneal (TAPP), and totally extra-peritoneal (TEP) approaches, which aim to reinforce the inguinal canal by placing a mesh into the pre-peritoneal plane. A study on TEP surgery in treating inguinal-related groin pain in athletes showed a 95% return to sports at 4 weeks following surgery[22]. Another randomized controlled trial by the same author compared TEP surgery with conservative treatment, where 90% of surgically treated athletes achieved pain-free return to sports at 3 months, compared with 27% in the conservative treatment group, pointing out that surgical treatment is more effective in treating this pathology.

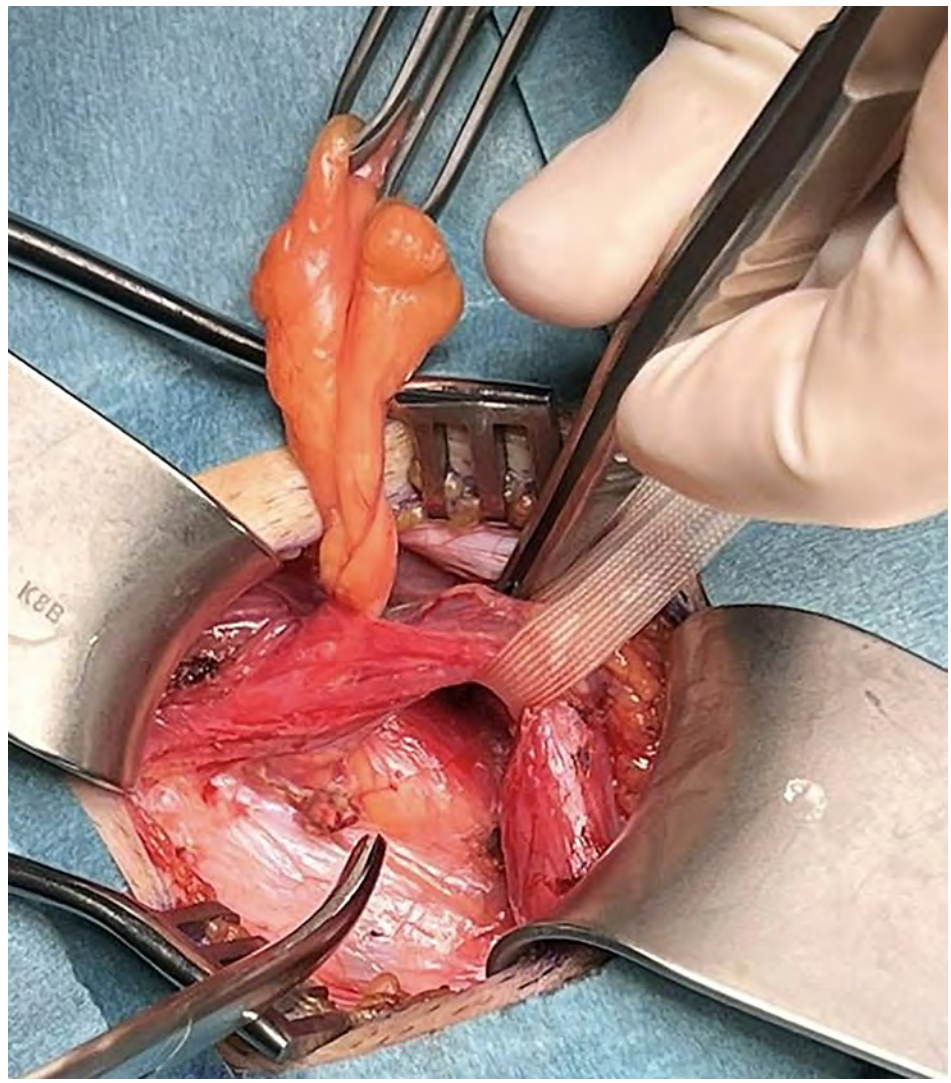
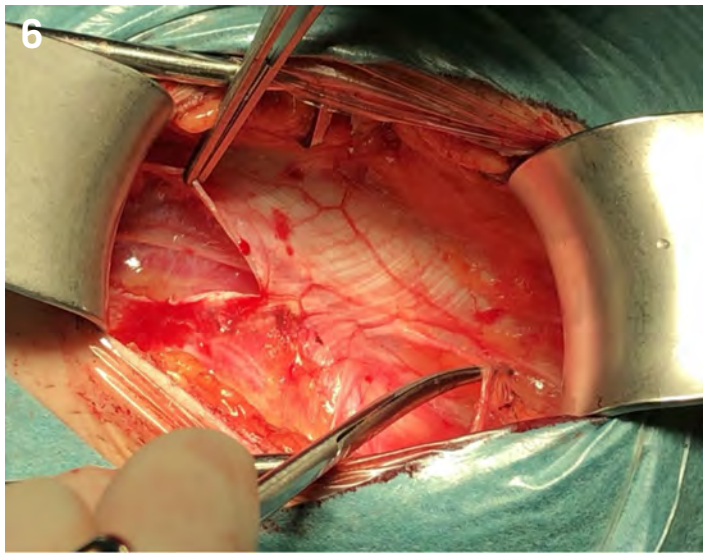


Figure 4: Posterior wall bulge with retroperitoneal lipoma in indirect (lateral) hernia position.

Other experts support an open approach in surgery, and the technique used is based on surgeons' experience. A study on open surgery using mesh compared the Lichtenstein technique (where mesh is placed in the inguinal canal in front of fascia transversalis), with an open pre-peritoneal approach (where mesh is placed in the pre-peritoneal plane), and the results showed no difference between the groups, and return to sport was achieved in all cases at an average of 53 days postoperatively[24]. Open non-mesh surgery that is commonly used is a modification of Shouldice repair by Muschaweck (open minimal repair), with different surgeons achieving excellent results with this technique. This technique involves a 4-layer inguinal posterior wall repair with 2 continuous sutures. Muschaweck reported that the main pathology found intraoperatively was inguinal canal posterior wall weakness, with the bulge compressing the genital branch of the genitofemoral nerve, so neurectomy was part of the procedure. In her series 75% of patients returned to preinjury sports activities at an average of 18.5 days, and histology verified perineural fibrosis in 100% of the cases[25]. A recent RCT compared TEP repair with open minimal (Muschaweck) repair, showing similar results regarding postoperative pain and return to sports[26] (Figure 4).

Considering the anatomy, proposed aetiology, and published surgical results for inguinal-related groin pain, it seems that using a mesh to reinforce the inguinal canal might be overshooting. Mesh inguinal repairs are valid surgical techniques for treating inguinal hernias, where a defect



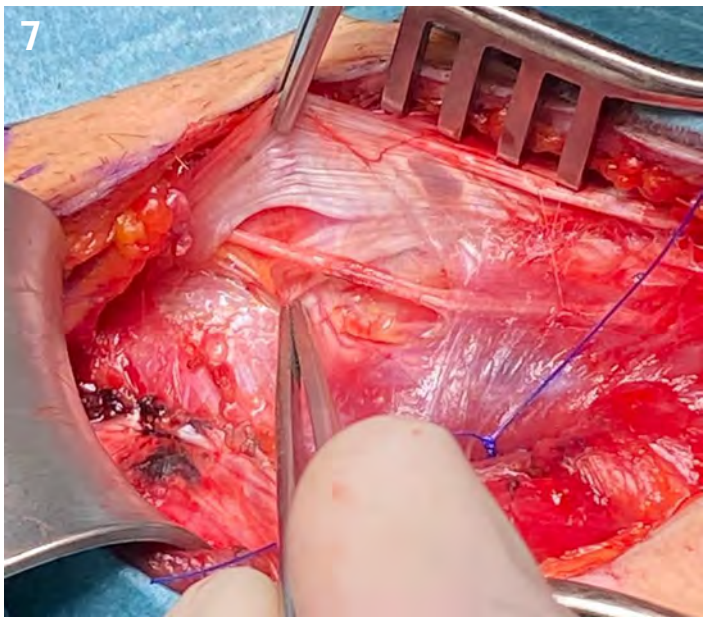


Figure 5: Iliohypogastric nerve entrapment (Right side).

Figure 6: Iliohypogastric nerve entrapment (Left side)

Figure 7: Ilioinguinal nerve entrapment (Right side).

Figure 8: Genital branch of genitofemoral nerve is sometimes difficult to identify.

in the abdominal wall needs to be repaired, especially in large hernias and attenuation of musculoaponeurotic complex, with possible collagen deficiency[27]. However, in inguinal-related groin pain in athletes there is no hernia, and implanting prosthetic material that creates more fibrosis and scar tissue increases the risk of nerve entrapment, with no viable justification if similar results can be achieved by suture repairs without mesh.

Furthermore, the need to address nerve entrapment in the inguinal canal advocates in favour of open approach. Different cadaver studies pointed out that there is significant variability in nerve trajectories, explaining different clinical presentations. A study presenting intraoperative results reported evidence of nerve entrapment, with ilioinguinal, iliohypogastric nerve, and genital branch of genitofemoral nerve involvement in 96.2%, 92.5%, and 30.8% respectively[11]. Given that research in the field of surgical treatment has shown evidence of nerve compression and entrapment, possibly requiring neurectomy, the logical choice for surgery appears to be open repair with nerve identification and neurectomy, if needed, along with inguinal posterior wall suture reinforcement (Figures 5, 6, and 7).

It has been reported that identification of all 3 nerves during hernia surgery has implications in reducing the risk of chronic

59% of male football players and 45% of female football players experienced groin pain during a 6-week period of study.

postoperative pain in hernia surgery and is thus important to consider when performing surgeries for inguinal-related groin pain. Studies show that surgeons operating on hernia patients generally identify all 3 nerves in only 40% of cases, compared to surgeons with expert level of experience identifying all 3 nerves in 70-90% of the cases[4]. This highlights the importance of having an experienced surgeon operating on athletes with inguinal-related groin pain when surgery is deemed necessary (Figure 8.)

FUTURE

Further studies are needed to understand the pathologies related to groin pain in athletes, such as research on collagen deficiency in athletes with inguinal-related groin pain, nerve histopathology after neurectomy, as well as randomized controlled trials comparing surgical repairs with and without concomitant neurectomies. There is also a need for studies comparing surgical and conservative treatment, where a structured supervised exercise-based rehabilitation is described in detail, which has not been the case in the past. Additionally, long-term follow-up is needed to have a realistic overview of different treatment methods' success rates. The number of athletes who recover with conservative treatment, but end up having surgery later in their careers, is still unknown. Future research should also focus on athletes returning to play after surgery, and having another surgery for the same pathology (recurrence) a few years later. Inguinal-related groin pain still has an unclear pathology, but all available research points to the involvement of nerves, with patients demonstrating neuropathic and nociceptive pain presentations.

References
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