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Research article

Outcomes following surgical management of inguinal-related groin pain in athletes: a case series

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ABSTRACT

To determine the outcomes of a limited surgical intervention, consisting of neurolysis, inguinal wall repair and/or adductor debridement of adhesions based on intraoperative findings. Retrospective case series. Outpatient orthopedic/general surgery clinic. Fifty-one athletes treated surgically for inguinal-related groin pain from 2009 to 2015. Limited surgical intervention, consisting of neurolysis, inguinal wall repair and/or adductor debridement based on intra-operative findings. Ability to return to sport at the same level, time to return to play. Fifty-one athletes were included in the study with an average follow-up of 4.42 years (range 2.02–7.01). The average age was 24.2 years (range 16–49) and consisted of 94.0% males and 6.0% females. Nerve entrapment was demonstrated in 96.2% of cases with involvement of the ilioinguinal in 92.5%, the iliohypogastric in 30.8% and the genitofemoral in 13.2%. Attenuation of the posterior inguinal wall was present and repaired in 79.3% of cases. Scar tissue was present around the adductor origin and required debridement in 56.7% of cases. Forty-nine (96.1%) athletes returned to sport at the same level of play at an average of 5.9 weeks. Two athletes required a revision surgery. High rates of return to sport were achieved after surgery for inguinal-related groin pain that addresses the varying pathology and associated nerve entrapment.

INTRODUCTION

Groin pain is a common problem in elite-level athletes that can greatly impact performance [1]. The Doha agreement categorized groin pain into three major groups: defined clinical entities, hip-related and other causes of groin pain [2]. Defined clinical entities include adductor-, iliopsoas-, inguinal- and pubic-related groin pain [2]. Inguinal-related groin pain is defined as pain and tenderness in the inguinal canal [2]. Affected athletes report an insidious onset of groin pain in the inguinal area that worsens with activity and may radiate to the abdominal wall, medial thigh, pubic symphysis or genitals. Sports involving high-speed cutting and pivoting that demand trunk hyperextension and thigh hyperabduction are typically associated with inguinal-related groin pain [1]. However, the pathophysiology and biomechanics of these injuries are complex and not fully understood [3].

Traditionally, the rectus abdominus and adductor musculatures were believed to be the main causes of inguinal-related groin pain [4, 5]. However, as understanding of this condition has improved, entrapment of the ilioinguinal, genitofemoral, iliohypogastric and obturator nerves has been proposed as causes of groin pain as well [6, 7]. In this regard, we believe the mechanism of pain to be a combination of two main mechanisms. First, muscle imbalance between the adductors and abdominal musculature causes microtrauma to the transversalis fascia and weakness in the posterior wall of the inguinal canal [7]. This can lead to bulging of the abdominal structures and result in compression of the genitofemoral, ilioinguinal and iliohypogastric

nerves [7–10]. We believe that anatomic variations in the course of the nerves, most significantly the ilioinguinal nerve, can pre-dispose an athlete to nerve entrapment by reducing the ability of the nerve to stretch under stress and ultimately causing pain. A previous cadaveric study by Akita *et al.* [6], described the anatomic variations in the cutaneous nerve branching of the ilioinguinal, genitofemoral and iliohypogastric nerves and formed the basis for our hypotheses. The study examined the inguinal region of 27 cadavers (54 halves) and found cutaneous branches of the ilioinguinal nerve to be present in 90.7% of specimens [6] Cutaneous branches from the genital branch of the genitofemoral nerve and the iliohypogastric nerve were found in 35.2 and 5.6% of specimens, respectively [6]. This study also demonstrated the sensory dominance of the ilioinguinal nerve in the inguinal region, which we believe to be the key pain generator.

Currently, there is no standardized treatment for inguinal-related groin pain. The most common first-line of treatment involves a trial of physical therapy with a focus on core strengthening, activity modification, injections and anti-inflammatory medications [9, 11, 12]. Surgical management is most commonly reserved for athletes that fail conservative treatment [9, 11]. Many surgical techniques have been described mainly involving inguinal or pelvic floor repairs, adductor releases and neurolysis [11, 13]. The purpose of this study was to determine the outcomes and return to sport rates in athletes with inguinal-related groin pain undergoing surgical exploration and neurolysis of the ilioinguinal, iliohypogastric and/or genitofemoral nerves with and without posterior inguinal canal repair.

MATERIALS AND METHODS

Study design

Institutional review board approval was obtained for this study. Inclusion criteria were established as any patient that underwent surgery for inguinal-related groin pain from 2009 to 2015. Exclusion criteria included patients with a diagnosis other inguinal-related groin pain or those that did not undergo surgical intervention. Patients with <2-year follow-up were excluded. Inclusion and exclusion criteria are summarized in Table I. Demographic data [age, gender and body mass index (BMI)], physical exam findings as well as sports played, activity level, duration of symptoms, previous surgeries and laterality were collected. Pre-/post-operative care and elements of the surgical procedure were analyzed with surgical findings. The demographic data are presented in Table II. Athletes that met the inclusion criteria were contacted by phone and asked to complete a survey regarding their return to sport competition, level of activity and need for revision surgery.

Table I. Inclusion and exclusion criteria

Inclusion criteria	*Exclusion criteria*
Diagnosis of inguinal-related groin pain	<2-year follow-up
Underwent surgical treatment	Primary diagnosis not consistent with inguinal-related groin pain.

Table II. Demographic data

Average age	*24.2 years (range 16–49)*
Follow-up	4.42 years (range 2.02–7.01)
Gender	94% male; 6% female
BMI	24.4 (range 18.2–31.9)
Right-sided symptoms	49.0%
Left-sided symptoms	27.5%
Bilateral symptoms	23.5%
Duration of symptoms	8.6 months (range 0.5–60)
Previous FAI treatment	28.2%

BMI, body mass index; FAI, femoroacetabular impingement.

Diagnosis

All athletes originally presented to an outpatient orthopedic sports medicine clinic for evaluation of hip/groin pain pathology. Athletes with inguinal-related groin pain were referred to the general surgeon for evaluation and discussion of treatment options.

The diagnosis of inguinal-related groin pain was confirmed by a board-certified general surgeon based on a combination of pre-operative history and physical exam findings. History suggestive of inguinal-related groin pain included pain with kicking, running, twisting, sit-ups, coughing and sneezing that resolved at rest. A thorough physical examination was performed. The athlete was first positioned in the supine position on an examination table. Palpation was performed of the superficial and deep inguinal rings as well as the adductor origin and conjoined tendon to assess for tenderness and reproduction of pain symptoms. Examination for abdominal, inguinal and femoral hernias was performed. Athletes were then asked to

perform a sit up with manual resistance from the examiner; a positive test was indicated by a reproduction of groin pain. Once the diagnosis was made, treatment options were discussed with the athletes and they were offered conservative treatment with physical therapy, anti-inflammatory medication and activity modification. If the athlete failed conservative measures, then they were offered surgery.

Surgical procedure

Athletes were positioned supine on a standard operating room bed and induced under monitored anesthesia care with a local block of 0.25% Marcaine with Epinephrine to the inguinal area (Fig. 1A and B). A 10-cm incision was made ~3 cm above the pubic tubercle and carried obliquely along the skin cleavage lines (Fig. 1C). Bovie electrocautery was used to obtain appropriate hemostasis and blunt dissection was performed to expose the external oblique aponeurosis (Fig. 1D–F). The aponeurosis is sharply incised with a scalpel and the ilioinguinal nerve was identified exiting the inguinal canal. The ilioinguinal nerve exited the canal either through its normal course out of the superficial inguinal ring or in an aberrant course through the fascia above the external ring and into the groin (Fig. 2A and B). The inguinal canal was then opened lateral to the inguinal nerve and the entire course identified. If the ilioinguinal nerve was found to have an aberrant path or was adhered to surrounding tissue, blunt dissection was used to free the nerve and reduce tension (Fig. 3A and B) The spermatic cord (in men) or round ligament (in women) was then isolated and retracted to view the posterior wall of the inguinal canal. If the wall was attenuated, a modified Bassini repair was performed by suturing the transversus abdominus aponeurosis to the shelving edge of the inguinal ligament [14]. The genitofemoral nerve was visualized either running with the ilioinguinal nerve or on the ventral surface of the spermatic cord and followed distally. Careful inspection of the neural anatomy in this zone was performed to identify any entrapment of the genitofemoral nerve. If present, meticulous neurolysis was performed until the nerve was free from adhesions. The iliohypogastric nerve was then located as it exits the external oblique

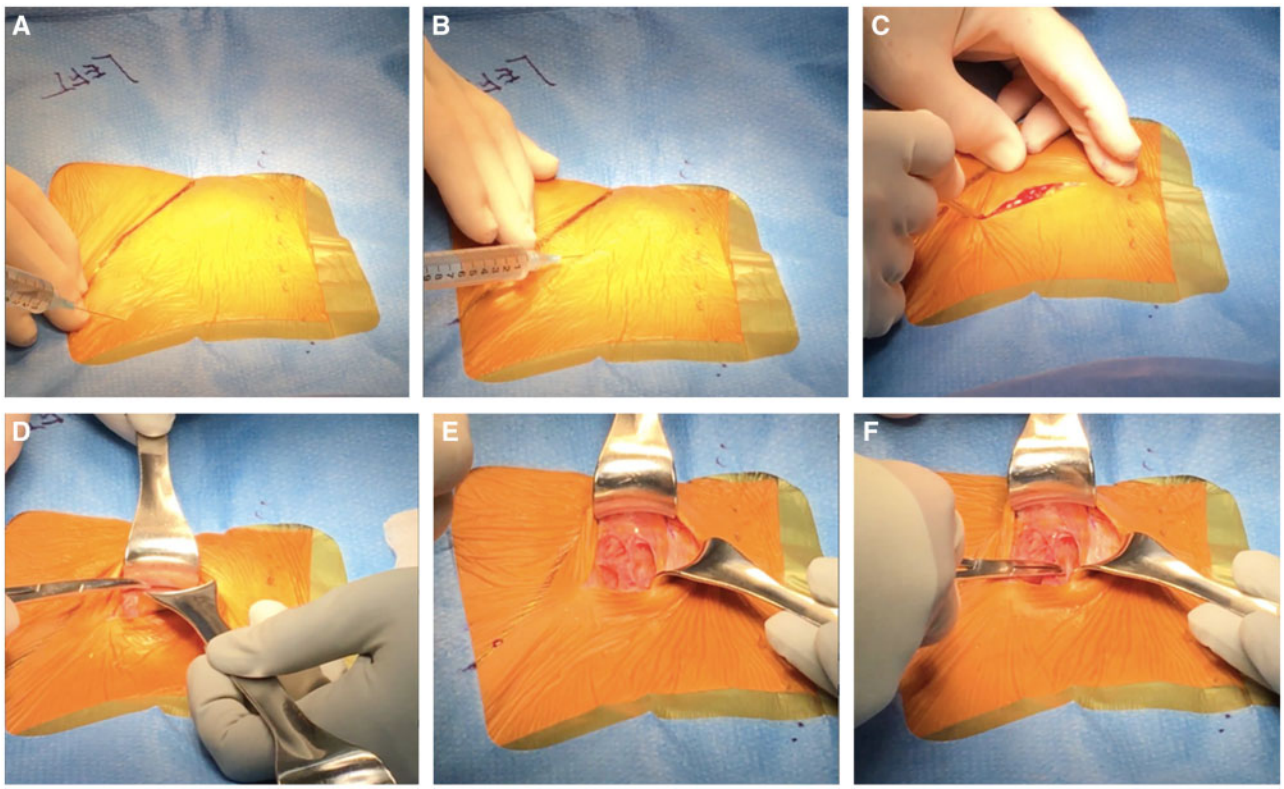

Fig. 1. Intra-operative photos of a left groin. The solid line denotes the location of the left inguinal crease and the dotted line demonstrates midline. The photo was taken from the head looking down. A local injection of 0.25% Marcaine with Epinephrine is placed into the inguinal region (**A** and **B**). A 10-cm incision is made ~3 cm above the inguinal crease and lateral to midline (**C**). Blunt dissection is used to expose the external oblique aponeurosis (**D–F**). The iliohypogastric nerve can be seen in (F) and is pointed to by the scissors.

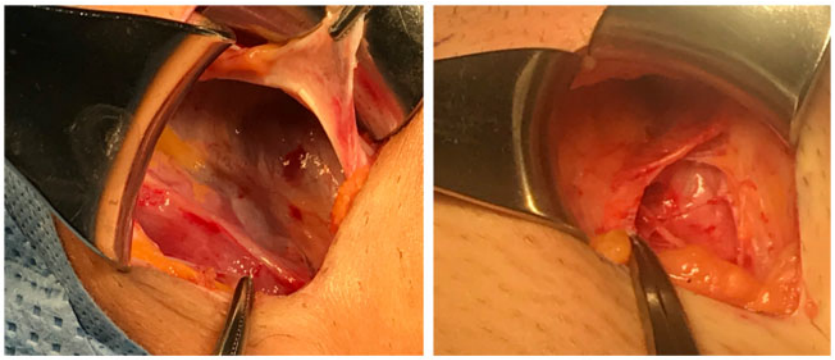

Fig. 2. The normal course of the ilioinguinal nerve as viewed of the left side (**A**). The aberrant course of the ilioinguinal nerve is seen as the nerve exits the inguinal canal early and performs a sharp turn as viewed of the right side (**B**).

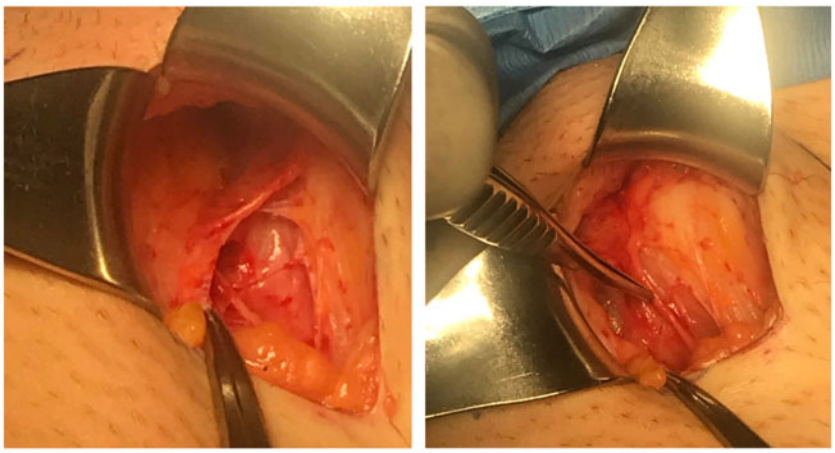

Fig. 3. Intra-operative images illustrating the aberrant course of the ilioinguinal nerve before (**A**) and after release (**B**) as viewed from of the right side.

fascia, ~2.5 cm superior to the superficial inguinal ring and followed distally. Any aberrant sensory branches underwent neurolysis.

Last, the origin of the adductor muscles was examined for adhesions using the surgical technique described by Gerhardt *et al.* [15]. We believe the adductor adhesions form from repetitive microtrauma in athletes performing frequent kicking and pivoting maneuvers. If adhesions were present over the adductor tendon origin, then the adhesions were debrided. It should be noted that release of the adductor tendon itself was not performed in any of these procedures.

After surgery, the athletes were instructed to minimize all activity for 2 weeks, especially avoiding sit-ups. All restrictions were lifted after 2 weeks and the athletes were started in physical therapy with progression of activity as tolerated until able to return to sport.

RESULTS

Demographics

A total of 51 athletes were included in the study with an average follow-up of 4.42 years (range 2.02–7.01 years). The average age of athletes was 24.2 years (range 16.0–49.0) and consisted of 48 (94.0%) males and 3 (6.0%) females with an average BMI of 24.4 (range 18.2–31.9). The distribution of sports played and level of activity are summarized in Tables III and IV. The average duration of symptoms before surgical intervention was 8.6 months (range 0.5–60). Importantly, 28.2% of athletes had a history of intra-articular hip pathology that had been treated previously with hip arthroscopy, femoroplasty and labral repair.

Surgery was performed on the right side in 49.0% of athletes, the left side in 27.5% and bilaterally in 23.5% of athletes. During surgical exploration, nerve entrapment

Table III. Distribution of sports played by the study population

Sports	*Athletes (percentage)*
Soccer	29 (56.9)
Football	4 (7.8)
Baseball	4 (7.8)
Lacrosse	2 (3.9)
Other	12(23.5)

Table IV. Distribution of activity level in the study population

Level of play	*Athletes (percentage)*
Professional	15 (29)
Collegiate	17 (33)
High School	6 (12)
Recreational	13 (25)

was demonstrated 96.2% of cases with involvement of the ilioinguinal nerve in 92.5%, followed by the iliohypogastric in 30.8% and the genitofemoral in 13.2% of cases. Attenuation of the posterior inguinal wall was present and repaired in 79.3% of cases and scar tissue was debrided around the adductor origin in 56.7% of cases.

Outcomes and return to sports

Post-operatively, 96.1% were pain-free and returned to sport/activity at their previous level at an average of 5.9 weeks (range 3.5–9). Two athletes required a revision surgery. The first was a professional athlete that had a traumatic collision during a soccer game and tore his rectus abdominus off the insertion site 4 years after the index procedure. During surgery, his rectus abdominus insertion was repaired with suture and reinforced with mesh. He returned to play at the professional level 6 weeks after the index surgery and 8 weeks after the revision surgery. The second athlete was a high school soccer player that originally returned to play 5.5 weeks after the initial surgery. He went on to play Division 1 college soccer and a year after surgery developed recurrent groin pain, which was treated surgically with adductor origin debridement, an injection of platelet-rich plasma and lysis of an aberrant cutaneous branch of the ilioinguinal nerve. The athlete returned to play 8 weeks after surgery.

DISCUSSION

One of the more notable study findings was that among the procedures performed, release of an entrapped nerve was necessary in as many as 96.2% of athletes, and often more than one branch was involved. The ilioinguinal nerve was involved in 92.5% of athletes, the iliohypogastric in 30.8% and the genitofemoral in 13.2%. The frequency of ilioinguinal nerve pathology in our series is not surprising given that the ilioinguinal nerve has the most cutaneous nerves in the inguinal area [6]. Although nerve entanglement has only briefly been implicated in classic inguinal-related groin pain [1], regional nerve entrapment was a frequent component of this clinical entity in our series.

Weakness present in the posterior inguinal wall was a common finding in our study with 79.3% of athletes requiring repair. Our data are consistent with the majority of studies that found posterior wall disruption in 80–100% of cases [7, 16, 17]. Concomitant hip pathology, specifically femoroacetabular impingement (FAI) morphology is a common associated finding in athletes with inguinal-related groin pain and can range in the literature from 12 to 94% [1, 18, 19]. We identified a prevalence of FAI morphology in 76.4% of these patients. However, only 28% of our athletes had a history of hip arthroscopy intervention.

In this series, 96.1% of athletes returned to sport after the index procedure at an average of 5.9 weeks. Prior studies similarly report a high return to sport rate of 80–100% [4, 20–22]. The largest clinical series to date performed by Meyers *et al.* [5] concluded that 95.3% of athletes returned to full play within 3 months of surgery. A recent study of athletes participating in the National Football League Combine emphasized that performance is not compromised after successful athletic pubalgia surgery [23]. This is consistent with the results of our study, which demonstrated that of the athletes that returned to play, all did so at their pre-injury level of competition.

Limitations of our study are similar to those of other studies that report on surgical outcomes for groin pain. The most significant limitation stems from discussing outcomes of surgical treatment for a clinical entity that includes varying combinations of injured abdominal wall, pelvic and proximal thigh structures. Therefore, the specific details of each procedure vary, making it difficult to present an homogeneous group of athletes. This reverberates the point that groin injuries vary widely in the constellation of pathology and therefore surgical repair involves a variety of techniques. Our belief is that the visualized pathology should dictate the surgical technique to be employed. This differs from many previous reports in which the same surgery is performed regardless of clinical presentation.

The inclusion of patients post-hip arthroscopy is a limitation to this study as the condition can overlap. However, all patients previously treated with hip arthroscopy for FAI had fully recovered and returned to competitive sports before presenting with new symptoms. Additionally, as a retrospective review, this study is inherently subject to selection bias. Last, our series mixes all levels of athletes, which allows readers to make generalizations that are applicable to everyday clinical practice, but less so to specific athletic populations.

CONCLUSIONS

High rates of return to sport are achieved after surgery for inguinal-related groin pain that addresses the varying pathology and associated nerve entrapment.

CONFLICT OF INTEREST STATEMENT

M.B.G. is a paid consultant for Arthrex. Royalties Arthrex. Research grants Arthrex. Consultant Medacta. Shareholder Kerlan Jobe Institute.

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