

Internal obturator muscle indirect injury in groin pain syndrome: a systematic review of the literature

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Summary

Introduction: Traumatic groin pain syndrome can result from any acute trauma, but usually it is due to an indirect muscle injury (overstretching of the muscle fibers). The internal obturator muscle externally rotates the thigh and contributes to the stabilization of the hip joint. The indirect injury of this muscle may cause the onset of traumatic groin pain syndrome.

Purpose: To perform a systematic review of the literature concerning the indirect injury of internal obturator muscle in relationship to the onset of groin pain syndrome.

Conclusion: IO lesions are rare but important causes of traumatic groin pain syndrome, and despite their low incidence they must be considered during evaluation of patients with this pathology.

Study design: Systematic review.

Level of evidence: IV.

KEY WORDS: internal obturator, indirect lesion, groin pain syndrome, treatment.

Introduction

Groin Pain Syndrome (GPS) as proposed by the “Groin Pain Syndrome Italian Consensus Conference on Terminology, Clinical Evaluation and Imaging Assessment in Groin Pain in Athletics”¹ can be defined as “any clinical symptom reported by the patient, located at the inguinal-pubic-adductor area, affecting sports activities and/or interfering with Activities of Daily Living and requiring medical attention”.

GPS can also be divided into three main categories:

- I. GPS due to functional overload, characterized by insidious and progressive onset, without an acute trauma, or a situation to which the onset of pain symptoms can be attributed with certainty
- II. GPS of traumatic origin, in which the onset of pain was due to any acute trauma, and this hypothesis is supported by medical history, clinical examination and imaging
- III. Long-standing GPS or chronic GPS, in which the cohort of symptoms reported by the patient continues for a long period (over 12 weeks) and is recalcitrant to any conservative therapy.

Traumatic GPS is usually due to acute muscle-tendon problems (indirect muscle-tendon injuries), and while the most affected muscles are rectus abdominis, adductors and iliopsoas muscle¹, the internal obturator muscle (IO) lesion is very rare². IO is part of the so called “short lateral rotators” (i.e. piriformis, obturator internus, superior and inferior gemelli, obturator externus, and quadratus femoris)². These muscles give an important contribution to the hip joint stability and are considered by some Authors as the “rotator cuff” of the hip^{3,4}.

Material and methods

This systematic review was conducted in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) guidelines⁵. The protocol of this study was registered at the PROSPERO register (website: <http://www.crd.york.ac.uk/PROSPERO>) for systematic reviews.

Aim of the current systematic review

The aim of the current systematic review is to systematically underpin the role of IO direct injury in GPS of traumatic origin, according to the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines⁶, as well as to the “Muscle, Ligament and Tendon Journal” guidelines⁷.

Search strategy

Prior to this systematic review the Cochrane Database of Systematic Reviews; MEDLINE and PEDro where searched for systematic reviews on GPS caused by IO indirect injuries in order to make sure that similar systematic reviews are not already present in literature. After this verification two Authors (BGN and VP) independently searched the literature using a string of keywords such as “groin pain syndrome”, “pubalgia” “Gilmore’s groin”, “hockey groin”, “incipient hernia”, “groin disruption”, “inguinal disruption”, “inguinal related groin pain”, “adductor-related groin pain”, “iliopsoas-related groin pain”, “pubic-related groin pain”, “sportsman’s hernia”, “sportsman’s groin”, “sport hernia”, “internal obturator”, “tear”, “lesion” and “injury” properly connected by Boolean operators. If appropriate, medical subject headings (MeSH) and wild-card options were used. Target journals were hand-searched, in order to increase the possibility to obtain all the relevant articles. The research was conducted on December 2nd 2017, there were no data restriction, no language limitation was applied and the so called “grey literature” (i.e. conference, abstracts, thesis and un-

published reports) was not taken in consideration. The cross-reference from retained articles were screened to verify their possible relevance. All the double citation were removed. For each article, the relevant information was extracted and recorded on an *ad hoc* Excel spreadsheet. The details of search strategy are showed in Table I while the PRISMA flow diagram of the study search and selection procedure is showed in Figure 1.

Data extraction, synthesis and analysis

Using a standardized form two reviewers (GNB and PV) extracted the following data from the eligible studies:

- I. Study design
- II. Participants
- III. Study setting (sport type, level, gender, age)
- IV. Injury etiology
- V. Diagnosis
- VI. Type of treatment (conservative, medical or surgical)
- VII. Time loss injury
- VIII. Outcome

Data was analyzed descriptively.

Results

After screening 134 articles 6 have been included and synthesized in the current systematic review. Characteristics of included studies are shown in Table II. All studies were checked for reporting on conflict of interest⁸.

Table I. Search strategy used in the study.

Search strategy items	Details
Searched databases	PubMed/MEDLINE, Scopus, ISI, EXCERPTA MEDICA.
Searched string	(groin pain syndrome OR pubalgia OR Gilmore's groin OR hockey groin OR incipient hernia OR groin disruption OR inguinal disruption OR inguinal-related groin pain OR adductor-related groin pain OR iliopsoas-related groin pain OR pubic-related groin pain OR sportsman's hernia OR sportsman's groin OR sport hernia OR) AND (internal obturator) AND (tear OR lesion OR injury)
Inclusion criteria	P: Articles investigating GPS caused by IO muscle indirect injury at any level I: conservative, medical or surgical intervention C: None, there are no comparison parameters O: time loss injury associated by IO indirect injury causing GPS and its outcome
Exclusion criteria	P: Articles investigating IO overuse injuries or other causes not related to indirect injuries. I: Articles not related to the conservative, medical or surgical intervention of IO indirect injury. C: None, there are no comparison parameters O: Articles not focused on conservative, medical or surgical intervention for IO indirect injury
Time filter	None set
Language filter	None set
Target journals	All the peer-review and indexed journal are present in the considered data-base

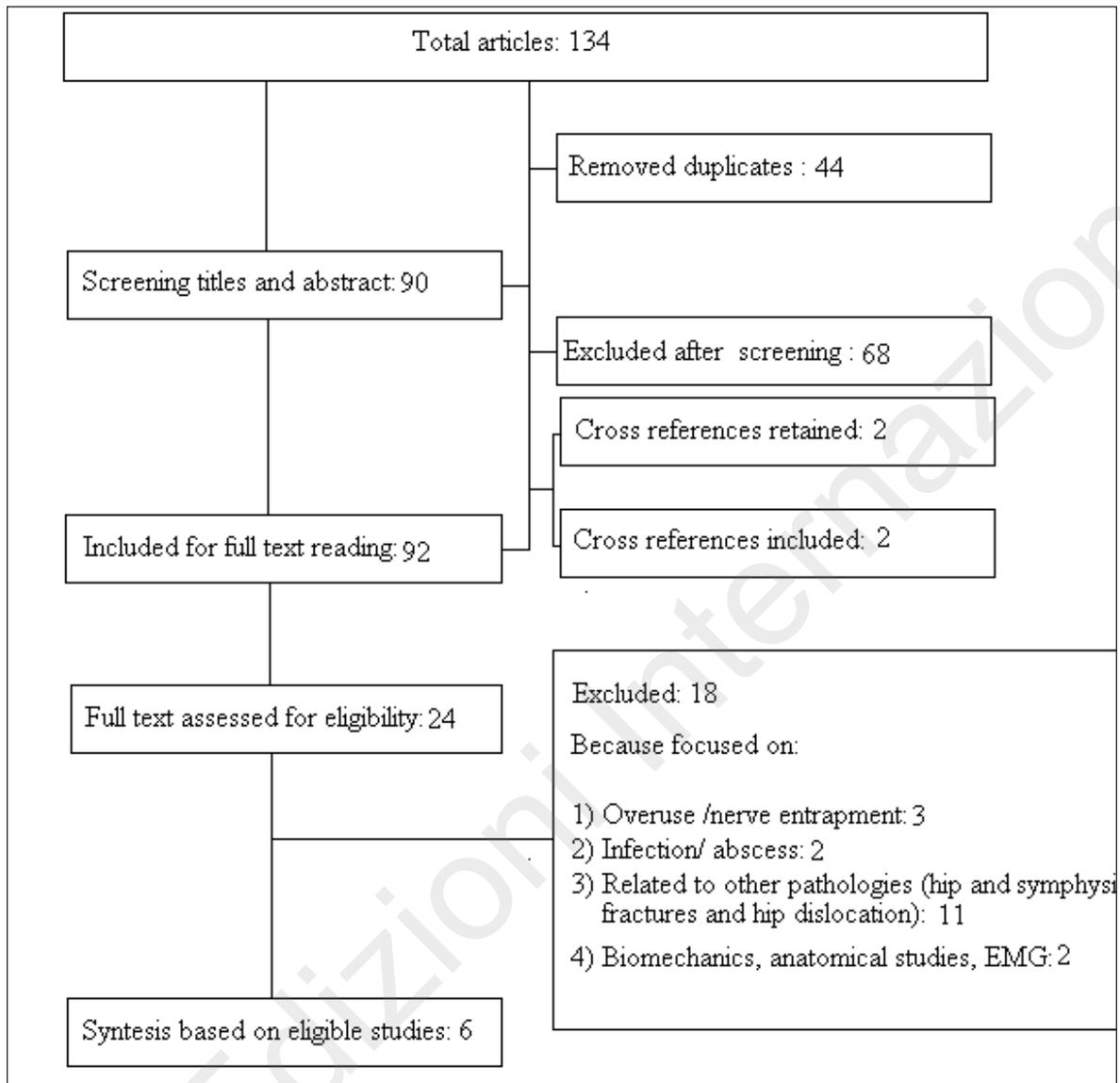


Figure 1. PRISMA flow diagram of the study search and selection procedure.

Study design

Five case reports⁹⁻¹³ (level of evidence IV) and only one retrospective observational study¹⁴ (level of evidence IV) were included in this systematic review, and the reason for such a small number of studies can be the relative rarity of IO direct injuries.

Study setting

The studies setting take in consideration a population of young subjects (range 13-28 years) composed of both professional and amateur athletes. It is interesting to underline that sport activities of the considered athletes include strong and sudden movements of torsion and flexion of the upper body. Furthermore, excluding the study of Wong-On et al.¹⁴, which makes no difference between injury at IO or external obturator level (EO), in 4 over 5 of the considered

studies the injuries at IO level occur in competition, and only one study⁹ does not specify whether the described injury occurred during training or in competition.

Injury etiology

The IO injuries are in relationship with sudden movements of torsion and flexion of the upper body, like unstable change of direction⁹, kicking the ball in an unstable position⁹, during a fall¹¹, and during twisting^{12,13} or bending¹⁰ movements performed in competition.

Diagnosis

The diagnosis of IO indirect injury was formulated in all cases by clinical and imaging assessment. The clinical assessment was based on passive hip in-

Table II. Characteristics of included studies.

Reference	Study design	Evidence level	Participants	Study setting	Injury ethiology	Diagnosis	Type of treatment	Time loss injury	Outcome
Wong-On et al., 2017	Retrospective observational study	IV	16	Professional soccer players. Average age was 25.5 ± 5.0 (ranged from 18 to 36 years). The study was focused on both internal and external obturator injury	Unstable change of direction trying to control the ball: 4 anterior or lateral hip slide in an unstable position: 2 repetitive ball kicking: 2 kicking the ball in an unstable position: 2 Not clear: 6 No differentiated between internal and external obturator	Clinical assessment and imaging (RM)	Conservative	11.5 ± 8.8 days. No differentiated between internal and external obturator	Positive. No differentiated between internal and external obturator
Byrne et al., 2016	Case report	IV	1	28-year-old male Gaelic football player (level not specified)	Twisting movement in competition	Clinical assessment and imaging (RM)	Conservative	3 weeks	Positive
Kelm et al., 2016	Case report	IV	1	28-year-old male professional soccer player	During a header in competition	Clinical assessment and imaging (RM)	Conservative	3 days	Positive
Velleman et al., 2016	Case report	IV	1	28-year-old male professional rugby player	During a fall in competition	Clinical assessment and imaging (RM)	Conservative	14 days	Positive
Khodaei et al., 2015	Case report	IV	1	14-year-old male amateur football player	During a bending movement in competition	Clinical assessment and imaging (RM)	Conservative	6 weeks	Positive
Busfield et al., 2009	Case report	IV	1	13-year-old male amateur soccer player	During a kicking ball movement. Not specified if in training or in competition	Clinical assessment and imaging (RM)	Conservative	6 weeks	Positive

ternal and external rotation test. The tests are positive for injury if they cause pain during hip flexion and internal or external rotation passively or against resistance^{13,14}. Usually the patient complains of pain at ischial tuberosity on deep pressure^{10,12}, but sometimes there can be no pain on palpation¹¹. There is usually no visible swelling, bruising, oedema or ecchymosis at inguinal, gluteal or posterior thigh area^{10,11}. The patient's history is often positive for instability of the hip joint¹⁴.

All the considered studies based the imaging assessment on MRI scan. Several Authors considered the MRI essential to the location, classification, and evaluation of the injury size^{11,14}. However, is important to underline that also the US examination shows a high sensitivity and specificity in IO assessment¹⁵. Concerning MRI assessment some Authors suggest the use of standard high-field - 1.5 or 3T¹¹. The hip MRI imaging was performed using PD, T2-weighted, FS, and/or STIR sequences¹³ in the axial, coronal, and sagittal planes¹⁴. The injury was classified in only two studies^{13,14}, and in both studies the type of used classification was accurately described. However, in the study of Wong-On et al.¹⁴ there was no differentiation between the lesions of OI and those of EO. In the others studies, there was only a description of the MRI signal changes^{9,12}, or were used very vague and non-specific terms like "acute injury", "partial injury," "no complete disruption"¹¹, "high grade strain"¹⁰.

Treatment

In all considered studies the rehabilitation program was based on both conservative and medical treatment. The conservative treatment utilized was: aquatic therapy¹⁰, cycling¹¹, electrical stimulation¹⁰, gait training⁹, hot/cold modalities¹⁰, infra-red light therapy¹⁰, iontophoresis¹⁰, manual lymphatic drainage¹², training modification and restriction¹³, on line running¹¹, rest^{11,13}, strengthening and functional movement of the hip muscles⁹⁻¹², swimming¹¹ and ultrasound therapy^{10,12}.

The medical treatment included nonsteroidal anti-inflammatories drugs^{11,13} and paracetamol¹⁰.

No study considered surgical treatment.

Time loss injury

Excluding the study of Wong-On et al.¹⁴ (in which there is no differentiation between injury at IO or EO level) the time loss injury was on average 24.40±17.30 days (range 3-42 days).

Outcome

The outcome was in all the considered studies positive and all the subjects had a complete recovery and were able to return to full sport activity.

Discussion

IO is a flat triangular muscle and is part of the hip external-rotator muscle group. It originates from the

inner surface of the obturator membrane and the surrounding bony margins of the obturator foramen. Its muscular bands pass then through the ischial foramen to become extra pelvic and to form a tendon origin that is oriented in antero-posterior direction. Finally IO inserts at the medial surface of the great trochanter, in antero-posterior to the trochanteric pit. At the level of its distal insertion, the IO blends with the tendon of the gemelli muscles (triceps coxae) forming a common tendon^{2,16,17}. This anatomical association with the gemelli tendon can explain the less frequent injuries of IO in comparison to EO¹⁴. The IO externally rotates the thigh by abducting it when the hip is flexed, and it also contributes to the stabilization of the hip joint. It is innervated by the obturator nerve (L5, S2) and its blood supply is provided by obturator artery. The maximum strength of IO depends on the flexion degree of the hip joint and is maximal at the beginning of the oscillation phase during the run stride¹⁸. In addition to the IO, the other muscles working as hip external rotators are piriformis, external obturator, gemelli and quadratus femoris. These muscles are known under the collective name of "short lateral rotators"¹⁶. This muscle group performs a major hip-joint stabilizing action, stabilizing the femoral head within the acetabulum during hip movements^{2,16}.

Despite the important work done by this muscle group, little is found in literature concerning the possible problems related to its injuries. The present study is, at our knowledge, the first systematic review present in literature focused on GPS caused by an indirect injury at IO level. Only six studies are present in literature focused on this topic, of which five are case reports⁹⁻¹³ (level of evidence IV) and one retrospective observational study¹⁴ (level of evidence IV). From the analysis of these studies we can deduct the following points.

Injury ethiology

There are essentially three main mechanisms causing traumatic IO injury.

The first is an unstable pelvis position with a sudden change in body weight distribution¹⁴. The second is a sudden change of direction in condition of pelvic instability^{13,14}. Finally, the third is represented by a sudden hip internal-rotation with hip and knee flexed at about 90°⁹. The fact that re-injuries of the IO are not described in the literature¹⁴ confirms the hypothesis that they are dependent on a well-defined biomechanical situation, such as those described above, and are independent of predisposing intrinsic factors such as excessive retraction or stiffness of the IO¹⁴.

Diagnosis

The diagnosis of IO indirect injury, like for the other muscles, is based on clinical and imaging assessment.

The most reliable clinical test for IO injury is the

passive internal rotation maneuver with and without muscle opposition by the patient^{12,14}. The clinical presentation of IO indirect muscle injury is a GPS of traumatic origin framework^{9,11,13,14}. The differential diagnosis to consider are piriformis syndrome, femoroacetabular impingement, hip joint labral tear, rectus femoris tear, iliopsoas-related GPS, adductor-related GPS, inguinal-related GPS and pubic-related GPS¹⁴. The MRI represents the imaging gold standard^{11,14}. The suggested MRI protocol is utilization of a standard high-field (1.5 or 3 T)¹¹ performing PD, T2-weighted, FS, and/or STIR sequences¹³ in the axial, coronal, and sagittal planes¹⁴. However, it is possible also to consider US scan¹⁵.

Treatment

The treatment of IO injuries is conservative and medical⁹⁻¹⁴, and does not differ from the treatment suggested for others indirect muscle injuries¹⁹.

Time loss injury

Time loss injury for a IO indirect injury (24.40±17.30 days/range 3-42 days) is in line with the time loss injury that we can find in literature concerning other muscles involved in sport activity, like the biceps femoris 20±15 days²⁰, the semitendinosus 18±11 days²⁰, the semimembranosus 23±14 days²⁰, the rectus femoris 18.00±4.24 days²¹ and GPS (24.3 days)²². From epidemiological point of view it is interesting to note that Wong-On et al.¹⁴ in their observational cross-sectional study reporting injury data recorded in four seasons in the professional Spanish football league (La Liga), showed that there were 4 indirect IO injuries during the considered period.

Outcomes

IO injuries, usually have good prognosis with optimal treatment and a recovery time substantially overlapping that of other more frequently injured muscle groups¹⁹.

Conclusions

IO lesions represent the rarest lesions among hip external rotators, muscle group which shows a very low lesion incidence^{12,14}. Etiology of IO injuries is related to well-defined biomechanical situations and seems independent from intrinsic factors¹⁴. The clinical diagnosis of IO injury presents some objective difficulties. Indeed, IO-related lesion usually causes painful symptoms at the anterior hip-joint level. For this reason IO injuries are in differential diagnosis with many other hip and groin clinical conditions^{14,23,24}. Finally, it is important to remember that even though in general hip external-rotator muscle lesions (IO in particular) represent a rare occurrence^{12,14} they must be considered in clinical evaluation of a traumatic GPS framework. In any case, IO injuries show a good prognosis and relatively short recovery times.

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