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Abstract

It is never banal, before tackling a subject so controversial as the groin pain (GP), to remember that with this term—as on the other hand also as it regards all the other terms as athletic groin, groin disruption, osteitis pubis, etc. expressing the same kind of symptoms—we mean only the description of a symptom or better of a cohort of symptoms that the patient complains at the level of the pubic area. For this reason, we should be extremely careful not to identify the term GP (or any other term up to now considered as equivalent) and diagnosis. In fact, the GP has a multifactorial pathogenesis where often different clinical frameworks overlap, making sometimes the diagnosis a real diagnostic challenge. Objectively, it must be acknowledged that the anatomical complexity of the pubic region certainly does not facilitate the adoption of a clear nosological terminology. The multiple anatomical structures that may be involved are so numerous as to preclude, in fact, a comprehensive nomenclature [1], unless, as already pointed out, the term of GP is intended only as a description of a cohort of symptoms and not misunderstood with the diagnosis itself. Indeed, unfortunately, this simple and basic concept seems to be often overlooked in the specific literature. This lack of clarity uniqueness concerning terminology can be explained, but not of course justified, by the fact that since the symptoms reported by the patient can result from skeletal muscular, gastrointestinal, urogenital, neurological and gynaecological problems [2, 3], the risk for the clinician to use different terminologies is high. The fact is that the terminology is often confusing and sometimes dichotomous, a situation that creates a lot of difficulties of interpretation. Furthermore, there are objectively considerable difficulties in finding and interpreting the results reported by various studies. In this regard, a paradigmatic example is provided by Serner et al. [4] that in their systematic review emphasizes the need to standardize the terminology used in order to facilitate the comparison of results derived from the different studies present in literature. Not surprisingly, to reinforce this need, in their review, the authors included 72 studies, in which they found 33 different diagnostic terms. Recently, the “Agreement Meeting on Definitions and Terminology on Groin Pain in Athletes” held in Doha (Q) in November 2014 [5] was aimed to standardize the clinical terms used for GP.

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1 Classification and Differential Analysis of Groin Pain Syndrome

Gian Nicola Bisciotti and Piero Volpi

1.1 Introduction

It is never banal, before tackling a subject so controversial as the groin pain (GP), to remember that with this term—as on the other hand also as it regards all the other terms as athletic groin, groin disruption, osteitis pubis, etc. expressing the same kind of symptoms—we mean only the description of a symptom or better of a cohort of symptoms that the patient complains at the level of the pubic area. For this reason, we should be extremely careful not to identify the term GP (or any other term up to now considered as equivalent) and diagnosis. In fact, the GP has a multifactorial pathogenesis where often different clinical frameworks overlap, making sometimes the diagnosis a real diagnostic challenge. Objectively, it must be acknowledged that the anatomical complexity of the pubic region certainly does not facilitate the adoption of a clear nosological terminology. The multiple anatomical structures that may be involved are so numerous as to preclude, in fact, a comprehensive nomenclature [1], unless, as already pointed out, the term of GP is intended only as a description of a cohort of symptoms and not misunderstood with the diagnosis itself. Indeed, unfortunately, this simple and basic concept seems to be often overlooked in the specific literature. This lack of clarity uniqueness concerning terminology can be explained, but not of course justified, by the fact that since the symptoms reported by the patient can result from skeletal muscular, gastrointestinal, urogenital, neurological and gynaecological problems [2, 3], the risk for the clinician to use different terminologies is high. The fact is that the terminology is often confusing and sometimes dichotomous, a situation that creates a lot of difficulties of interpretation. Furthermore, there are objectively considerable difficulties in finding and interpreting the results reported by various studies. In this regard, a paradigmatic example is provided by Serner et al. [4] that in their systematic review emphasizes the need to standardize the terminology used in order to facilitate the comparison of results derived from the different studies present in literature. Not surprisingly, to reinforce this need, in their review, the authors included 72 studies, in which they found 33 different diagnostic terms. Recently, the "Agreement Meeting on Definitions and Terminology on Groin Pain in Athletes" held in Doha (Q) in November 2014 [5] was aimed to standardize the clinical terms used for GP.

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1.2 The Groin Pain Syndrome Italian Consensus Classification

The first Groin Pain Italian Consensus held in Milan February 5, 2016, was an invitation consensus conference attended by orthopaedics, sports physicians, general surgeons, radiologists, physiatrists, sport physiologists, physiotherapists and physical trainers that was aimed to approve three separate documents concerning the GP:

1. Diagnostic taxonomy document consensus
2. Clinical semeiotics document consensus
3. Imaging document consensus

Each document was first presented by a facilitator; the presentation was then followed by a plenary discussion directed by a chairman. After each discussion followed a vote. The first document has required 15 different discussions and the same number of votes, while the second and the third document required six discussions and votes. During the discussions, the document was eventually changed and was then voted only the final version. All votes are passed unanimously.

1.2.1 Summary of the First Document: Diagnostic Taxonomy Document Consensus

The first vote concerned the use of the term groin pain syndrome (GPS). The use of the term "syndrome" is justified by the frequent overlapping of different clinical frameworks and by the possible cause-effect interaction that characterize a well-defined GP clinical framework [6–8]. Obviously, the term GPS is an "umbrella term" that must necessarily be complemented by the clinical framework description. You may then, for example, have a GPS caused by adductor tendinopathy, or from inguinal hernia, or by a combination of these as of other pathologies. Therefore, it is our opinion that only adopting a comprehensive descriptive term, as GPS, and associating it with the clinical and taxonomic description of the disease, or diseases, responsible for the symptomatology reported by the patient, we can arrive to have a clear and rational identification of the problem. Then it was then proposed and approved the following definition of GPS:

> *Every clinical situation complained by the patient at the level of the inguinal-pubic area that affects the sporting activities and/or interferes negatively in activities of daily living (ADL) and requiring medical attention*

Furthermore, based on the synthesis of different studies [5, 9–17], we propose that the clinical frameworks that can be the cause of occurrence of GPS can be subdivided into 11 different categories as follows:

1. **Articular causes**
   - (a) Acetabular labrum tear
   - (b) Femoroacetabular impingement(I)
   - (c) HALTAR lesion(II)
   - (d) Hip osteoarthritis
   - (e) Intra-articular loose bodies
   - (f) Hip instability
   - (g) Adhesive capsulitis
   - (h) Legg-Calvé-Perthes disease and its outcomes
   - (i) Dysplasia and its outcomes
   - (j) Epiphysiolysis and its outcomes
   - (k) Avascular necrosis of the femoral head
   - (l) Sacroiliac joint disorders
   - (m) Lumbar column disorders
   - (n) Synovitis

   Notes:

   (I) Cam-Fai, Pincer-Fai, subspine impingement (or AIIS, anterior inferior iliac spine impingement).

   (II) Hip anterosuperior labral tear with avulsion of the rectus femoris.

2. **Visceral causes**
   (a) Inguinal hernia(I)
   (b) Other types of abdominal hernia
   (c) Intestinal diseases
   Note:
   (I) Concerning inguinal hernia, it is recommended to adopt the classification proposed by the European Hernia Society.
3. **Bone causes**
   (a) Fractures and their outcomes
   (b) Stress fractures(I)
   (c) Avulsion fractures(II)
   (d) Iliac crest contusion (hip pointers)(III)
   Notes:
   (I) Substantially concerning the pubic branch or the femoral neck.
   (II) Mainly the childhood avulsion fractures involving the anterior inferior iliac spine (AIIS), the anterior superior iliac spine (ASIS) and the apophyseal nucleus of the ischial tuberosity (ANIT).
   (III) The iliac crest contusion or hip pointers are the result of direct trauma at the level of the iliac crest which causes the formation of a periosteal haematoma. Such a haematoma can compress the lateral nerve femoro-cutaneous nerve and cause paresthesia symptoms.
4. **Muscle-tendon causes**
   (a) Rectus abdominis injuries
   (b) Rectus abdominis tendinopathy
   (c) Adductor muscles injuries
   (d) Adductor tendinopathy
   (e) Rectus abdominis—adductor longus common aponeurosis injuries
   (f) Iliopsoas injuries
   (g) Iliopsoas tendinopathy
   (h) Other indirect muscle injuries and their outcomes
   (i) Direct muscle injuries
   (j) Iliopsoas impingement(I)
   (k) Snapping internal hip
   (l) Snapping external hip
   (m) Bursitis(II)
   (n) Weakness of the inguinal canal wall(III)
   Notes:
   (I) Iliopsoas impingement with the medial portion of the acetabular rim.
   (II) Substantially concerning of the ileo-pectineal bursa and the greater trochanter sero-mucous bursa.
   (III) It's important to underline the four most important clinical signs of the inguinal canal wall weakness: tenderness to the exploration of the inguinal canal, tenderness on palpation at the level of the pubic tubercle, superficial inguinal ring dilatation and pain on palpation at the level of origin of the adductor muscles. In addition, an anamnestic index of extreme importance is a history of failure of conservative treatment.
5. **Pubic symphysis-related causes**
   (a) Osteitis pubis
   (b) Symphysis instability(I)
   (c) Symphysis degenerative arthropathy
   Note:
   (I) the radiological sign of symphysis instability is represented by an asymmetry of pubic branches greater than 3 mm visible in the Flamingo view X-ray.
6. **Neurological causes(I)**
   (a) Nerve entrapment syndrome(II)
   Notes:
   (I) The category "neurological causes" should be divided into two further subcategories. In the first category, they are the neurological damage due to overloading or overstretching (neurological causes category A). In the second category, they are the neurological damage due to an acute compression mechanism or tear of nerve structure (neurological causes category B).
   (II) Substantially concerning the femoro-cutaneous nerve, genitofemoral nerve

(genital branch), ilioinguinal nerve, iliohypogastric nerve, femoral nerve and obturator nerve.

7. **Developmental causes**
   (a) Apophysitis(I)
   (b) Growth plate at pubic level(II)
   Notes:
   (I) Substantially concerning the AIIS and the ASIS.
   (II) Below the age of 20 years is common to observe anteromedial foci of endochondral ossification centres. These findings become particularly evident in arthro-IMR [18].
8. **Genitourinary disease-related causes (inflammatory and not)**
   (a) Prostatitis
   (b) Epididymitis
   (c) Funiculitis
   (d) Orchitis
   (e) Varicocele
   (f) Hydrocele
   (g) Urethritis
   (h) Other infections of the urinary tract
   (i) Cystitis
   (j) Ovarian cysts
   (k) Endometriosis
   (l) Ectopic pregnancy
   (m) Round ligament entrapment
   (n) Testicular/ovarian torsion
   (o) Ureteral lithiasis
9. **Neoplastic causes**
   (a) Testicular carcinoma
   (b) Osteoid osteoma
   (c) Other carcinomas
10. **Infectious causes**
    (a) Osteomyelitis
    (b) Septic arthritis
11. **Systemic causes**
    (a) Inguinal lymphadenopathy
    (b) Rheumatic diseases

After a deep examination and discussion concerning the literature, we propose to subdivide the most common and probable diseases that can cause GPS in 11 different nosological categories including 63 possible different clinical frameworks (Table 1.1).

Table 1.1 The most likely causes of GPS (63) grouped into 11 different nosological categories

Categories		Number of pathology
Articular causes		14
Visceral causes		3
Bone causes		4
Muscle-tendon causes		14
Pubic symphysis-related causes		3
Neurological causes		1
Developmental causes		2
Genitourinary disease-related causes (inflammatory and not)		15
Neoplastic causes		3
Infectious causes		2
Systemic causes		2
Total	**11**	**63**

Into the last part of the first document, the consensus approved a further subdivision of the GPS in three main categories, based both on the aetiopathogenesis and the timing of onset/disappearance of the clinical framework:

1. The GPS of traumatic origin, in which the onset of pain was due to a precise traumatic event and this hypothesis is supported by the anamnestic investigation, by clinical examination and imaging.
2. The GPS due to functional overload, characterized by insidious and progressive onset, in which the patient has no memory of trauma or a situation to which is attributed with certainty the onset of pain symptoms.
3. The long-standing GPS (LSGPS) or chronic GPS, in which the cohort of symptoms complained by the patient continues for a long period and is recalcitrant to any conservative therapy. It's important to underline the fact that both the functional overload GPS and the traumatic origin GPS may hesitate in a LSGPS. Similarly, a traumatic GPS can occur in a previous framework of GPS by overuse and/or LSGPS. We can consider in this category a clinical framework that has continued for more than 12 weeks. Finally, it is interesting to underline that a situation of

LSGPS is typically most commonly encountered in an amateur athlete rather than in a professional athlete. This can be reasonably explained by the fact that an amateur athlete does not have the same access opportunities to a professional athlete to have a suitable therapeutic procedure, either conservative or surgical.

Therefore, a correct formulation of the diagnosis, corresponding to the concepts stated above, should respect the following formulation: "traumatic GPS caused by..." or "overuse GPS caused by..." or "LSGPS caused by …".

Finally, we underline the concept that, given the anatomical complexity of the pubic region, especially the GPS due to functional overload and the LSGPS can often be caused by the association of more diseases. In the case of a type of GPS caused by the association of more diseases, the diagnosis formulation will change in "traumatic or overuse GPS, or LSGPS caused by the association of …".

1.2.2 Summary of the Second Document: Clinical Semeiotics Document Consensus

Before describing the second document concerning the semiotics, we would like to recall briefly the GPS cluster of signs and symptoms.

It is estimated that a percentage between 5 and 18% of athletes ask medical attention caused by an activity-restricting GPS [10, 19–21]. Within the same sport played, males had greater GFS incidence than females with a RR equal to 2.45 [5].

In the patient affected by GPS, the symptoms are bilateral in 12% of the cases; it involves the adductor region in 40% of the cases and the perineal region in 6% of the cases: The symptom usually begins unilateral and becomes with the progress of time bilateral [20–26]. The pain onset occurs insidiously in 2/3 of patients and acutely in the remaining 1/3, a certain number of patients refers an acute event after a clinical framework of GPS or LSGPS was already present [20, 22, 26–29]. The clinical framework is characterized by subjective and objective symptoms. Subjective symptoms are mainly represented by pain and functional deficits [30, 31]. From an objective point of view, the patient may complain pain on palpation, during countered muscle contraction and during passive and active stretching. The clinical examination must therefore be based on a series of tests focused on muscle contractions (isometric, concentric and eccentric), on the active and passive stretching manoeuvres [32–36] and on the palpation of some specific anatomical areas [14, 37–40]. Thus, basing both on the examination of the literature and on expert opinion of the specialists present was approved a second document concerning the clinical examination. The clinical exams approved and recommended during the consensus were categorized in four categories as follows.

1.2.2.1 First Category: Specific Test for Abductor Muscles

1. Palpation of the pubic branch at common rectus abdominis/adductor longus common aponeurosis
2. Isometric squeeze test with proximal resistance (at knee level)
3. Isometric squeeze test with distal resistance (at ankles level)
4. Isometric squeeze test with distal resistance and apart legs
5. Isometric squeeze with flexed leg and proximal resistance
6. Isometric squeeze test in monopodalic execution with the use of a dynamometer(I)

Note:

(I) Optional test but in any case strongly recommended especially in the case of unilateral pain symptomatology.

1.2.2.2 Second Category: Specific Test for Abdominal Muscles

1. Palpation of the pubic branch at common rectus abdominis/adductor longus common aponeurosis

2. Rectus abdominis eccentric test
3. Sit-up pain test
4. Obliquus abdominis eccentric test

1.2.2.3 Third Category: Specific Test for the Hip Joint

1. Hip joint intra- and extra-rotation measurement
2. Flexion abduction external rotation (FABER) test
3. Dynamic internal rotatory impingement test (DIRIT)
4. Dynamic external rotatory impingement test (DEXRIT)
5. Posterior rim impingement test
6. Lateral rim impingement test

1.2.2.4 Fourth Category Clinical Evaluation of Inguinal Diseases

Palpation and clinical evaluation of the following anatomical structures:

1. Tuberculum pubis
2. Crista pubis
3. Linea pectinea
4. Superior ramus pubis
5. Anulus inguinalis superficialis
6. Pilastrum infero-lateralis
7. Pilastrum supero-medialis

Furthermore, as part of the second consensus document, it has approved the use, during the medical history process, of the HAGOS patient-reported outcome measures in its validated Italian form [41].

1.2.3 Summary of the Second Document: Imaging Document Consensus

The third document discussed and approved during the consensus involved the imaging exams. They were considered the protocols regarding the conventional radiology (X-ray), ultrasound examination (US) and magnetic resonance imaging (MRI). It was not made no division between first and second level exams, because it was considered that each exam has specific peculiarities. Therefore, basing both on the examination of the literature [11, 42–58] and on expert opinion of the specialists present was approved a second document concerning the imaging assessment which is composed by the following routine examinations:

1. *X-ray examination*

   The radiography routinely discussed and approved includes the following exams:

   (a) Anterior posterior view in upright position (AP1)
   (b) Anterior posterior view in upright position and alternately on one foot (Flamingo view) (AP2)
   (c) Dunn view (D)

From the radiographic assessment, it is recommended to obtain the following information:

   (a) Presence of cross sign (AP1)
   (b) Enlargement and /or erosion and/or sclerosis of the symphysis (AP1)
   (c) Symphysis asymmetry greater than 3 mm (AP2)
   (d) Calculation of alfa angle (D)

2. *US examination*

   The US examination must provide the following assessments:

   (a) Assessment of the muscle-tendon unit of the abdomen and adductor muscles
   (b) Dynamic assessment for the inguinal canal structures
   (c) Assessment of internal organs
   (d) Assessment of the urinary tract and of the external genitalia

Finally, during the execution of the US examination, the contemporary presence of the radiologist and the general surgeon is strongly suggested.

3. *MRI evaluation*

   Concerning the MRI evaluation, the use of a device of at least 1.5 T and a no-contrast protocol is recommended. The acquisition plans recommended are:

   (a) Coronal
   (b) Sagittal
   (c) Axial

(d) Axial oblique
(e) Coronal oblique
(f) Sagittal oblique

The acquisition sequences recommended are:
(a) T1
(b) T2 and T2 fat saturated (T2 FS)
(c) STIR
(d) Proton density fat saturation (PD FS)

Furthermore, into the third document, the consensus suggested the radiological findings of major interest:

The presence of bone marrow oedema (BMO) at pubis symphysis level. The presence of BMO must be identified into the sequences coronal STIR, coronal T1 and axial oblique T2 FS and PD FS. Furthermore, BMO must also be classified in I°, II° or III° in relationship of its extension measured into the PD FS or T2 FS axial oblique plan sequences.
Fatty infiltration within the BMO around the joint symphysis to verify into the coronal STIR, coronal T1 and axial oblique T2 and PD FS sequences.
Symphysis sclerosis to asses in coronal T1 and axial oblique T1 images.
High signal intensity para-symphysary line to verify in coronal STIR, axial oblique PD FS and sagittal STIR sequences.
Secondary inferior and/or superior cleft sign to assess in coronal STIR, axial oblique PD FS and sagittal STIR sequences.
Subchondral cysts/irregularities of the articular surface to verify in coronal STIR and axial oblique images.
Symphysis central disc protrusion to estimate in coronal T1 and axial oblique T1 sequences.
Adductor longus tendinopathy to assess into the axial oblique sequences PD FS, T2 FS and T1, as well as in coronal T1 sequences.
Adductor longus muscle-tendon injury to evaluate into the axial oblique sequences PD FS and T2 FS, as well as coronal STIR images.
Rectus abdominis tendinopathy to consider in sagittal STIR and axial oblique PD FS.
Rectus abdominis muscle-tendon injury to assess into the axial oblique sequences PD FS and T2 FS, as well in coronal STIR
Growth plate at pubic symphysis level to estimate in axial T1 sequences.

Furthermore, it was remembered the anatomical importance of the pre-aponeurotic fibrocartilaginous complex (PAFC). The PAFC is formed by the interconnection of the tendons of the adductor muscles and rectus femoris muscle and is included and integrated with the para-symphysarius ligaments and with the inguinal canal structures. Moreover, it is important to consider that the PAFC is in anatomical continuity with the symphysis central disc [59]. This complex anatomical structure represents a real anchoring central point and is therefore essentially formed by the interconnection of the fibres of the adductor muscles, the rectus abdominis, the external and internal oblique muscle, the inguinal ligament, the anterior pubic ligament, the arcuate ligament and the fibrocartilage symphysary disc. The acceptance of this anatomical concept presupposes two fundamental points: the first one is represented by the fact that the verification of the anatomical integrity PAFC is a central point of imaging exam and plays a crucial role in the formulation of the diagnosis, while the second point is the necessity to consider the "anatomical continuity" of the pubic symphysis, both of its superficial and deep anatomical structures and its functional continuity.

Conclusions

From the first GPS Italian consensus, some important points of discussion and reflection that we can summarize as follows emerged:

The controversy as regards the GPS diagnostic taxonomy can only be solved through the adoption of a common language, which satisfies the principles of clarity, fairness and sharability.
The adoption of a diagnostic pathway both from clinical point of view that concerning the imaging is a first step towards harmonizing and rationalizing the approach to

GPS. Obviously, such "guided" pathway does not limit the clinician professional skill, but rather it is a guide that would facilitate the formulation of definitive diagnosis, enabling this latter to be based on well-defined clinical diagnostic steps. Furthermore, the use of HAGOS questionnaire provides us the ability to objectively quantify the therapeutic effectiveness of the proposed procedures.

A standardized MRI protocol would facilitate the comparison of data from different study groups and substantially would favour the logical-deductive process that is the basis of the diagnostic path. In any case, it would require further and more detailed studies to clarify the true significance of some radiological findings that we can observe in a GPS framework.

Finally, the small number of female subjects observed in the studies present into the literature could theoretically be a limitation in the applicability of the data described above in a female population.

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Author Queries

Chapter No.: 1 0003060388

Queries	Details Required	Author's Response
AU1	Please check and confirm if the affiliations are presented correctly.	
AU2	Please check the hierarchy of the section headings and confirm if correct.	
AU3	Please check and confirm if the sentence "It's important to underline the four..." is fine as edited.	
AU4	Please check if edit to sentence starting "Into the last part…" is okay.	
AU5	Please check and confirm if "It's important to underline the fact..." is fine as edited.	
AU6	Please check if "symphysarius" should be changed to "symphysis".	