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REVIEW ARTICLE

# European guidelines for the diagnosis and treatment of pelvic girdle pain

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**Abstract** A guideline on pelvic girdle pain (PGP) was developed by "Working Group 4" within the framework of the COST ACTION B13 "Low back pain: guidelines for its management", issued by the European Commission, Research Directorate-General, Department of Policy, Coordination and Strategy. To ensure an evidence-based approach, three subgroups were formed to explore: (a) basic information, (b) diagnostics and epidemiology, and (c) therapeutical interventions. The progress of the subgroups was discussed at each meeting and the final report is based on group consensus. A grading system was used to denote the strength of the evidence, based on the AHCPR Guidelines (1994) and levels of evidence recommended in the method guidelines of the Cochrane Back Review group. It is concluded that PGP is a specific form of low back pain (LBP) that can occur separately or in conjunction with LBP. PGP generally arises in relation to pregnancy, trauma, arthritis and/or osteoarthritis. Uniform definitions are proposed for PGP as well as for joint stability. The point prevalence of pregnant women suffering from PGP is about 20%. Risk factors for developing PGP during pregnancy are most probably a history of previous LBP, and previous trauma to the pelvis. There is agreement that non risk factors are: contraceptive pills, time interval since last pregnancy, height, weight, smoking, and most probably age. PGP can be diagnosed by pain provocation tests (P4/thigh thrust, Patrick's Faber, Gaenslen's test, and modified Trendelenburg's test) and pain palpation tests (long dorsal ligament test and palpation of the symphysis). As a functional test, the active straight leg raise (ASLR) test is recommended. Mobility (palpation) tests, X-rays, CT, scintigraphy, diagnostic injections and diagnostic external pelvic fixation are not recommended. MRI may be used to exclude ankylosing spondylitis and in the case of positive red flags. The recommended treatment includes adequate information and reassurance of the patient, individualized exercises for pregnant women and an individualized multifactorial treatment program for other patients. We recommend medication (excluding pregnant women), if necessary, for pain relief. Recommendations are made for future research on PGP.

**Keywords** Pelvic girdle pain · Pelvic pain · Ankylosing spondylitis · Sacroiliac joint · Symphysis

A guideline on pelvic girdle pain was developed by "Working Group 4" within the framework of the COST ACTION B13 "Low back pain: guidelines for its management", issued by the European Commission, Research Directorate-General, Department of Policy, Coordination and Strategy.

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## General introduction (Maurits van Tulder)

Chairman European COST ACTION B13 "Low Back pain": guidelines for its management

Low back pain (LBP) is a major health and socioeconomic problem in European countries. LBP typically affects the working population and is associated with high costs of health care utilization, work absenteeism and disablement. LBP is usually defined by pain between the 12th rib and the gluteal fold. Pelvic girdle pain (PGP) is defined by pain experienced between the posterior iliac crest and the gluteal fold, particularly in the vicinity of the sacroiliac joints (SIJ). The pain may radiate in the posterior thigh and can also occur in conjunction with/or separately in the symphysis. The endurance capacity for standing, walking, and sitting is diminished. PGP generally arises in relation to pregnancy, trauma or reactive arthritis. The diagnosis of PGP can be reached after exclusion of lumbar causes. The pain or functional disturbances in relation to PGP must be reproducible by specific clinical tests.

The European guidelines for the management of PGP were developed within the Framework of COST B13, a program for the development of European guidelines for the management of back pain issued by the European Commission. The objective of this COST B13 project was to increase consistency in the management of non-specific low back pain across countries in Europe. European guidelines for the prevention of low back pain and for the diagnosis and treatment of acute and chronic non-specific low back pain have been published previously [1]. The fourth guideline, the European guideline on PGP, is published in this issue of ESJ.

To ensure an evidence-based approach within COST B13, recommendations were based on Cochrane and other systematic reviews and on existing evidence-based national guidelines. However, relatively few systematic reviews and randomised controlled trials on PGP are available, and no national guideline on PGP exists. Consequently, it was more difficult to develop an evidence-based guideline on PGP. The authors have searched for all relevant studies published in the international literature and have used the existing evidence to develop these European guidelines. This fits well into the current approach of developing guidelines. Recommendations have been developed and published on how to adequately develop and report clinical guidelines [2]. Hopefully this will lead to a further improvement of guideline development, a better uptake of these guidelines by health care providers working in primary care, and ultimately to optimal primary care for PGP.

The members of the working group within COST B13 who developed the European guidelines on PGP have worked hard for 5 years producing these guidelines. I think they did a great job and were courageous in their ambitions to tackle this difficult topic. Readers of these guidelines may not necessarily agree with all recommendations in this new guideline. I would challenge these readers to develop their own local or national guidelines on PGP. Hopefully the European guidelines will be a useful basis for future local or national guidelines. Also, these European guidelines have identified gaps in the existing scientific evidence on PGP; these could be used for prioritising future research. If additional evidence becomes available in the near future, the European guidelines should be updated.

References

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## Introduction

### Objectives

The primary objective of this guideline is to provide a set of recommendations that can support future national and international guidelines on PGP. Ultimately, this should lead to the prevention of long-term complications, reduction of pain, and improvement of disability.

PGP generally arises in relation to pregnancy, trauma, arthritis and/or osteoarthritis.

A definition is proposed for pelvic musculoskeletal pain under the title "pelvic girdle pain (PGP)" in order to exclude gynaecological and/or urological disorders, and to promote a consistent use of terminology.

The aim of this particular guideline is to promote a realistic approach to improve the diagnosis and treatment of PGP by:

1. Providing recommendations on the diagnosis and clinical management of PGP.
2. Ensuring an evidence-based approach through the use of systematic reviews and existing clinical guidelines.
3. Providing recommendations that are generally acceptable by all health professions in all participating countries.

4. Enabling a multidisciplinary approach; stimulating collaboration and a consistent approach between health care providers.

*Clinical question*

The clinical questions that are covered by these guidelines are:

What is the most optimal diagnostic process for patients with PGP?
What is the most effective treatment for reducing pain and improving disability in patients with PGP?

Target population

The target population of this guideline consists of individuals or groups that are going to develop new guidelines or update existing guidelines, and their professional associations that will disseminate and implement these guidelines. Indirectly, these guidelines also aim to inform the general public, patients with PGP, health care providers, health promotion agencies, industry/employers, educationalists, and policy makers throughout Europe. Ultimately, however, these guidelines aim to improve the condition of patients with PGP, which generally arises in relation to pregnancy, trauma, arthritis and osteoarthritis.

When using this guideline as a basis, it is recommended that guideline development and implementation groups should undertake certain actions and procedures, not all of which could be accommodated under The COST Action B13 [36]. These will include taking patients preferences into account; performing a pilot test among target users; undertaking external review; providing tools for application; consideration of organisational obstacles and cost implications; provision of criteria for monitoring and audit; and provision of recommendations for implementation strategies [133]. An update of this guideline should be considered if new scientific evidence becomes available; a period of 3–5 years seems realistic for updating purposes.

*Guideline for pelvic girdle pain*

This guideline was developed within the framework of the COST ACTION B13 "Low back pain: guidelines for its management", issued by the European Commission, Research Directorate-General, Department of Policy, Coordination and Strategy [36].

The guideline-working group consisted of experts in the field of PGP. None of the members believed they had any conflict of interest.

Comments from other professionals was provided by members of the Management Committee of COST B13, who were asked to critically comment on drafts of the guidelines before publication. This does not necessarily imply that all members of the management committee support all the recommendations made.

The WG 4 group was initiated during a general COST B13 meeting in Hamburg 2001. Overall 7 meetings took place before the outline draft was prepared in July 2004. The guidelines were reviewed by the members of the management committee of COST B13 in Palma de Mallorca on 23rd October 2004. Subsequent drafts were circulated among the members for their comments and approval. A final version was edited in December 2007.

*Evidence*

To ensure an evidence-based approach, a strategy broadly conducive with the other guidelines in COST ACTION B13 was adopted [36].

In the first instance systematic reviews were sought, supplemented by individual scientific studies where systematic reviews were not available.

Three subgroups were formed to explore: (a) basic information, (b) diagnostics and epidemiology and (c) therapeutical interventions.

Because it became apparent that limited evidence-based knowledge was available in the form of randomized clinical trials (RCTs), a wider search of the literature was made, including basic studies.

The literature search covered the period from the beginning of 1927 to the end of 2004, plus 4 (submitted) studies that were published in 2005 and 2006.

Each subgroup decided on its specific search terms and sources. Initially, the major electronic databases were searched including the Cochrane Controlled Trials Register, Pubmed/Medline, Embase, Cinahl, followed by citation tracking, personal databases and expert knowledge.

No language restrictions were imposed, but non-English articles were only included if their language was understood by a member of the working group (i.e. Danish, Dutch, French, German, Norwegian and Swedish). All subgroups used (derivatives of) pelvic and pelvic girdle pain as a primary keyword.

In addition, the reference lists of retrieved reports and earlier reviews were also scrutinized as were any available dissertations on this subject. No national guidelines for PGP were identified. The following search terms were used:

1. (Pelvic pain OR (pelvic AND pain) OR pelvic instability OR pelvic insufficiency OR (joint instability AND (pelvis OR pelvic OR sacroiliac)) OR (pelvic

AND girdle) OR back pain OR (back AND pain) OR (sacral AND torsion) OR (nutation AND (pelvic OR pelvis OR sacroiliac OR sacral))) AND controlled clinical trials. Pubmed 821 results. Cochrane CRCT 3,058 results. Cinahl 94 results.

2. (Labor OR pregnancy OR birth OR childbirth OR postpartum OR perinatal) AND controlled clinical trials. Pubmed 5,008 results. Cochrane CRCT 18656 results. Cinahl 132 results.
3. (Physiotherapy OR physical therapy OR exercise movement techniques OR exercise OR exercise therapy OR physical fitness OR ((training OR rehabilitation OR massage OR stretch OR relaxation OR mobilization OR manipulation) AND (physical OR exercise) OR electrotherapy OR electric stimulation therapy) AND controlled clinical trials. Pubmed 6,774 results. Cochrane 28574 results. Cinahl 256 results.

*Final inclusion*: 1 and 2 and 3 combined. Pubmed 14 results. Cochrane CRCT 154 results. Cinahl 2 results.

Embase 1 and 2 and 3 combined. 202 results

Studies considered irrelevant were excluded. For example, case studies, non related gynaecological studies, non-specified subgroups or studies whose results were not exclusively selected or relevant for PGP.

In total 155 articles were admitted for this guideline.

To reduce both individual and subgroup bias, the evidence was reviewed and discussed by the entire working group, as were the final recommendations.

The progress of the subgroups was discussed at each working group meeting and this final report was based on group consensus taking into account the strength of the evidence (see below) as well as other aspects such as costs, side effects, feasibility and applicability.

A grading system was used to denote the strength of the evidence (see Appendix 1). This grading system is simple and easy to apply, and shows a large degree of consistency between the grading of therapeutic and preventive, prognostic and diagnostic studies. The system is based on the original ratings of the AHCPR Guidelines [12] and levels of evidence recommended in the method guidelines of the Cochrane Back Review group [19].

A checklist for the methodological quality of therapy/prevention studies was used to assess internal validity [49]. The studies were ranked as high methodological quality studies (low risk of bias) and moderate to low methodological quality (high risk of bias). The studies were considered to be of high methodological quality when there was: adequate method of randomisation, concealment of treatment allocation, drop-out rate described and acceptable, intention-to-treat analysis, blinding of observer/outcome assessor, and no co-interventions [19].

Quality assessment should ideally be done by at least two reviewers, independently, and blinded with regard to the authors, institution and journal. However, as experts are usually involved in quality assessment it may often not be feasible to blind the studies. Criteria should be scored as positive, negative or unclear, and it should be clearly defined when criteria are scored positive or negative. Quality assessment should be pilot tested on two or more similar trials that are not included in the systematic review. A consensus method should be used to resolve disagreements and a third reviewer should be consulted if disagreements persist. If the article does not contain information on the methodological criteria (score "unclear"), the authors should be contacted for additional information. This also gives authors the opportunity to respond to negative or positive scores. (See Appendix 1 for the recommended checklists).

### *Definition of pelvic girdle pain*

The last decade saw increasing efforts among clinicians and researchers to study pain and the etiology of pelvic girdle pain. The WG4 proposes a definition for pelvic musculoskeletal pain under the title PGP to exclude gynaecological and/or urological disorders.

> "Pelvic girdle pain generally arises in relation to pregnancy, trauma, arthritis and osteoarthritis. Pain is experienced between the posterior iliac crest and the gluteal fold, particularly in the vicinity of the SIJ. The pain may radiate in the posterior thigh and can also occur in conjunction with/or separately in the symphysis.
> The endurance capacity for standing, walking, and sitting is diminished.
> The diagnosis of PGP can be reached after exclusion of lumbar causes. The pain or functional disturbances in relation to PGP must be reproducible by specific clinical tests."

### *Definition of joint stability*

Static and dynamic stability throughout the body is achieved when the active, passive and neuromotor control systems work together to transfer load [99, 116, 117]. Adequate compression of the joint surfaces must be the result of reaction forces acting across the joint, if stability is to be insured [140, 141]. Adequate means ideally tailored to the existing situation, using the least amount of compression to guarantee stability: in fact, efficient neuromuscular control.

The joint reaction force is modified by gravity, the shape of the articular surfaces, the actual joint position, proprioceptive muscle reflexes, the level of muscle (co)contractions and increased ligament tension, which will determine the level of stiffness of the joint [99, 140].

Consequently, the ability to effectively transfer load through joints is a dynamic process and depends on many factors.

Stability is not merely about how much a joint is moving (quantity of motion) or how resistant structures are, but more about motion control which allows load to be transferred and movement to be smooth and effortless.

This guideline proposes a *functional* definition of *joint stability*:

> "The effective accommodation of the joints to each specific load demand through an adequately tailored joint compression, as a function of gravity, coordinated muscle and ligament forces, to produce effective joint reaction forces under changing conditions".
> Optimal stability is achieved when the balance between performance (the level of stability) and effort is optimized.

Non-optimal joint stability implicates altered laxity/stiffness values leading to increased joint translations resulting in a new joint position and/or exaggerated/reduced joint compression, with a disturbed performance/effort ratio [144].

(For a full report on the anatomical and biomechanical background of this guideline, please look at http://www.backpaineurope.org, WG 4 on pelvic girdle pain/anatomical background information).

## Etiology of PGP

The cause of PGP is multifactorial and PGP may be related to different conditions. Only a few factors are proven to have an impact on the development of the condition. Most studies have included women in relation to pregnancy, because the vast majority of patients with PGP are women. A large number of patients have been collected during routine pregnancy controls. In these latter cases there is no disease or trauma to initiate the condition, as there is in, for example, ankylosing spondylitis or after trauma. Consequently, there is no obvious explanation for the onset of most cases of PGP. However, during pregnancy the female body is exposed to certain factors that have an impact on the dynamic stability of the pelvis.

One such factor is the effect of the hormone relaxin, which in combination with other hormones, affects the laxity of ligaments of the pelvic girdle as well as ligaments in the rest of the body. The effect of increased ligament laxity is a slightly larger range of movement in the pelvic joints. If this is not compensated for by altered neuromotor control, pain may result. The exact role of each specific hormone and the reasons for its variations in serum levels is not known, but the primary aim is to maintain pregnancy and to initiate delivery.

Any artificial change in hormone levels during pregnancy would probably jeopardize any ongoing pregnancy and is thus not relevant for treating PGP; therefore, this is not further discussed here. However, more knowledge of hormonal effects on ligaments could provide a better understanding of PGP.

### Discussion

Several studies have shown that there is no linear relationship between pain and increased range of motion in the pelvic joints [22, 124, 147]; thus, apparently, some women can handle increased range of motion caused by ligament laxity while other women cannot. This indicates that decreased joint stability may be compensated for by changed muscle function [93].

Considering red flags [107], there is no difference between LBP and PGP, except that PGP patients are normally younger than 30 years old [13] and therefore are less likely to have malignant diseases as the cause of pain. The role of yellow flags [58] has not been investigated among PGP patients but, based on the present limited knowledge, the impression is that yellow flags are less common among PGP patients than among LBP patients.

## Epidemiology

Considering the different characteristics of patients with PGP, it is necessary to divide the patients into subgroups of non-pregnant patients and those with pregnancy-related pain, before describing the epidemiology.

### Pelvic girdle pain in non-pregnant patients

Schwarzer et al. [110] studied 100 patients with LBP of whom 43 complained of pain over the SIJ. After intra-articular anaesthetic block of the SIJ, 13 of these patients had pain relief. In this study the intra-articular injections were used as the diagnostic criteria to determine whether the patients suffered from SIJ pain. The results showed that 13% of patients in a population referred to hospital for general LBP suffered from intra-articular SIJ pain.

Petersen et al. [100] investigated a population of 90 patients who came for treatment at a specialist centre due

to LBP. On the basis of the patient history and a thorough clinical examination they concluded that in 13% of the patients the pain focus was actually located in the SIJ.

### *Conclusion*

Until now no proper epidemiological studies have been performed. The patient groups examined so far are specially selected and therefore not representative of the general population. The diagnostic tests used in the studies do not fulfil the criteria of reliability and validity, and most tests do not examine the pelvic girdle as a functional unit [152].

### *Pregnancy-related pelvic girdle pain*

Many studies have attempted to describe the incidence and point prevalence of PGP in pregnancy. However, obtaining a clear picture is difficult because the reported incidence and point prevalence of pelvic pain and LBP in pregnancy ranges from 4 to 76.4% [6, 10, 28, 35, 38, 46, 61, 65, 69, 75, 83, 85]. There are several reasons for this large variation. For example, some of the studies are prospective and others are retrospective. Another problem is the diagnostic procedure: in some studies the women diagnose their own condition, in others a history of pelvic pain is declared sufficient to propose a diagnosis, and in others both a pain history and a clinical examination is required before a woman is diagnosed with PGP. Another complicating factor is the lack of definition of the location of pain: some studies specify LBP, some PGP, some do not specify the area, and some describe both. Furthermore, many of the tests used in the studies have not been scientifically tested, or have been found to have low inter-tester reliability and validity.

Due to these basic methodological problems, in this report only those studies are included in which the area of the pain presentation is within the boundaries of the pelvic area; moreover, the studies must be prospective and the diagnosis has to be confirmed by a pain history and, preferably by a clinical examination.

Four studies with these qualifications have been identified:

Albert et al. [4] performed the largest prospective study, which over a 1-year period included 2,269 pregnant women who were examined and had their pain history taken in week 33 of gestation. The women, reporting daily pain in the pelvic joints which could be confirmed by positive pain provocation tests, were divided according to symptoms into five subgroups; pelvic girdle syndrome (pain in both SIJ and the symphysis, symphysiolysis, one-sided SIJ syndrome, double-sided SIJ syndrome and miscellaneous). The point prevalence (the number of pregnant women at week 33 with PGP) was 20.1%. In the diagnostic subgroups the point prevalence was: pelvic girdle syndrome 6%, symphysiolysis 2.3%, one-sided SIJ syndrome 5.5% and double-sided SIJ syndrome 6.3%.

Östgaard et al. [95] undertook a prospective study of back pain in 855 pregnant women at their regular visits to a maternity care unit. The authors relied on history information only (women identified the location of pain on a pain drawing). Based on their pain drawings, three groups of pain were distinguished; high back pain, low back pain and SIJ pain. In week 30 of gestation the point prevalence of low back pain and sacroiliac pain was about 32% and SIJ pain alone was about 19%. No physical examination was performed to confirm the pain presentation.

In the prospective study by Larsen et al. [68], 1,600 pregnant women filled out a questionnaire six times during pregnancy. In total, 238 women reported to have PGP and that two or more activities of daily living (ADL) induced pain, whereas 227 fulfilled the criteria of pelvic pain, giving a point prevalence of 16%. However, because Larsen et al. only examined 14.8% of the pregnant women included in the study, some of the milder cases of PGP may not have been included in the point prevalence calculations. Only a part of the population was examined, namely the 227 women who fulfilled the criteria of having a minimum of two reduced ADL.

Berg et al. [10] performed a prospective study in which 862 pregnant women completed a questionnaire in weeks 20, 30, and 35 of gestation. Of these women, 49% reported that they experienced SIJ pain at some time during the pregnancy, i.e. the *cumulative* incidence (defined as how many women reported by questionnaire at 3 different times during their pregnancy that they felt pain in their pelvic area). However, only women entitled to sick leave from work (9%) underwent clinical examination.

### *Discussion*

Of these four studies, the three which report on the numbers of women with pelvic girdle pain are: (a) prospective, (b) have a strictly epidemiological design by studying an unselected group of pregnant women reporting for a maternity check, (c) have a very large number of participants (4,724 in total), (d) the applied tests to confirm the diagnosis were tested for inter-tester reliability sensitivity and specificity, and (e) only patients with PGP were included. The results of these studies yield almost the same number of patients with PGP in their pregnancy with a point prevalence of: 20.1%, Albert et al. [4]; 19%, Östgaard et al. [95]; and 16%, Larsen et al. [68]. The slightly lower number in the Larsen study is probably due to the stricter minimum criteria used.

In the Berg et al. [10] study less than 10% of the women were examined, therefore it is not possible to report the point prevalence of PGP since this diagnosis of PGP needs confirmation by a physical examination.

*Conclusion*

Based on the above-described studies the point prevalence of women suffering from PGP during pregnancy is close to 20%. The evidence for this result is strong.

*Prognosis*

It is difficult to compare different studies in the literature because PGP is often included in LBP. However, in studies where PGP is defined and studied separately, the findings are similar and acceptable.

After pregnancy the prevalence of PGP rapidly declines to 7% during the first 3 months [3, 100]. The percentage of women suffering from severe pain after pregnancy was 3, 3, 2, 2, 1 and 1% at, respectively, 1, 3, 6, 12, 18 and 24 months after delivery [3]. Women with persisting PGP after delivery often had serious pain during pregnancy, 21% of the women with severe pain in pregnancy still suffered from PGP and had positive pain provocation tests 2 years after delivery [3]. In the study by Ostgaard et al. [94] 5% had severe pain after pregnancy, and in their studies [97, 98] the point prevalence at follow-up in post partum weeks 11 and 23 was 16 and 7%, respectively. These figures relate to non-treated populations.

Risk factors

*Pregnancy-related pelvic girdle pain*

To determine the possible risk factors for developing PGP in pregnancy, only a few epidemiological observational studies have been performed [5, 10, 65, 68]

Berg et al. [10] followed 862 women three times during pregnancy. Of these, 72 women complained of severe pain and were referred to an orthopaedic surgeon for examination. The risk factors were previous history of low back pain, heavy work and smoking (covariance with heavy work). Contraceptive pills and number of previous pregnancies presented no risk.

Östgaard et al. [97, 98] followed 855 women 7–9 times during pregnancy. If a woman reported back pain, a pain drawing and a questionnaire was filled out. The authors noticed that the risk factors for developing low back and PGP during pregnancy were previous history of low back pain, pluripara, young age, heavy workload, and if the woman believed her back to be weak. Contraceptive pills, BMI, height and weight increase during pregnancy presented no risk.

Kristiansson et al. [64] examined 200 women three times during pregnancy and once 12 weeks after delivery, with a physical examination and a comprehensive questionnaire. They found that the risk factors for developing back pain were previous history of low back pain, pluripara, and increased weight during pregnancy, whereas smoking, age, BMI at first visit, and time since last pregnancy proved to be no risk.

In the study by Larsen et al. [68], 1,600 pregnant women filled out a questionnaire six times during pregnancy. If the woman suffered from pelvic pain, and also confirmed that two out of five selected ADL were painful (turning in bed, walking, lifting light loads, getting up from a chair, climbing stairs), examination was made by a rheumatologist to exclude low back pain".

Of the 238 women who were examined, 227 fulfilled the criteria for PGP. After logistic regression analysis of these factors the authors described the following significant risk factors; previous history of LBP (OR 1.8; CI 1.2–2.6), PGP in previous pregnancy (OR 9.2; CI 4.6–18.1), uncomfortable working conditions (OR 1.7; CI 1.1–2.5), working in draft and cold (OR 2.1; CI 1.4–3.1), previous lower abdominal pain (OR 3.1; CI 1.9–5.2), where as age, height, weight, part-time or full-time work, being a single or a married mother, smoking, heavy work, and pluripara proved to be no risk.

Albert et al. [5] examined 2,269 consecutive pregnant women (at week 33 of gestation) over a 1-year period with a structured questionnaire and a thorough physical examination. Women who reported daily PGP with corresponding objective findings were allocated, according to symptoms, to four classification groups. This study demonstrates no single dominant risk factor for developing PGP in pregnancy, but does reveal a set of physical and psychosocial factors. After, logistic regression analysis the risk factors for developing PGP were: history of previous low back pain (OR 2.2), trauma of the back or pelvis (OR 2.8), pluripara (OR 2.2), higher level of stress (OR 1.1), and job dissatisfaction (OR 0.9).

The following variables were examined but revealed no differences between the healthy and diseased groups in the univariate analysis: age, marital status, full-time work, previous stillbirth, interval between current and previous pregnancy, previous use of contraceptive pills, or hormonal-induced pregnancy, urinary tract infection in the year preceding pregnancy, and less desire to become pregnant. Further more BMI >30, was excluded in the multivariate analysis.

Van Dongen et al. [131] examined 509 women postpartum and concluded that hypermobility was not a risk factor for postpartum PGP.

Albert et al. [3] observed the following risk factors for continuing PGP after pregnancy: a high pain score in pregnancy, high number of positive pain provocation tests, low mobility index, and belonging to the lowest social group.

Previously the hormone relaxin was thought to be involved in the etiology of pregnancy-related PGP. Early studies [71] concluded that an increased concentration of serum relaxin was a risk factor; this was also reported in the study by Kristiansson et al. [66] using human relaxin assays. However, this correlation has not been confirmed by subsequent studies using human relaxin assays [1, 51]. Other studies on joint laxity of peripheral joints confirm that there is no proven correlation between the level of serum relaxin and joint laxity [109].

### *Discussion*

The epidemiological studies reported are all prospective, and follow a strictly epidemiological design by examining an unselected group of pregnant women reporting for a maternity check-up. The studies include a large numbers of participants, 5586 in total. The applied diagnostic tests were tested for inter-tester reliability sensitivity and specificity and only patients with PGP were included. Furthermore, two of the studies [5, 68] performed multivariate logistic regression analysis in order to identify possible confounders and interactions. Unfortunately, only two studies reveal the OR and not all the studies examine the same risk factors.

### *Conclusion*

Risk factors for developing PGP during pregnancy are most probably: a history of previous low back pain (OR 1.8–2.2) and previous trauma to the pelvis (OR 2.8). There is slight conflicting evidence (one study) against the following risk factors; pluripara (OR 2.2) and high-work load.

There is agreement that non risk factors are: contraceptive pills, time interval since last pregnancy, height, weight, smoking and most probably age (one study reports that young age is a risk factor).

## *Non-pregnancy related pelvic girdle pain*

No studies have been published on the risk factors for the non-pregnant population to develop PGP, or which women or men are at risk to continue having PGP.

### *Diagnosis*

(For a description of the diagnostic tests see Appendix 2).

Grading of evidence and the strength of recommendations is according to the guidelines for the diagnosis of acute low back pain (Appendix 1).

### *Clinical tests*

*Test specifically evaluated in pregnant women*: In an epidemiological study Albert et al. [2] examined 2,269 consecutive pregnant women by means of inspection of pelvic tilt, palpation of muscles, one test for a locked SIJ, nine pain provocation tests for the SIJ, and two pain provocation tests for the symphysis. The sensitivity for the 11 provocation tests ranged from 0.11 to 0.93, with a specificity ranging from 0.77 to 1.00. The kappa values for the inter-tester reliability ranged from 0.34 to 0.89, with 6 tests in the almost perfect group, 3 in the substantial, 2 in the moderate and one in the fair group (Tables 1, 2). The tests with the highest sensitivity and specificity for the SIJ were the P4, Patrick's Faber test and Menell's test (Table 1). The tests with the highest sensitivity and specificity for the symphysis were palpation of the symphysis and the modified Trendelenburg test (Table 2).

Östgaard et al. [96] examined 342 women before they underwent different treatment programs. All women performed the P4 test, and the sensitivity and specificity was reported to be 81 and 80%, respectively.

In a prospective cohort study Kristiansson et al. [65] examined 200 pregnant women with several tests for the total spine. In the pelvic area they performed palpation of two ligaments, four pain provocation tests for the SIJ, and one pain provocation test for the symphysis. The inter-tester reliability and sensitivity and specificity were tested. The sensitivity of the five provocation tests was highest ranging from 0.12 to 0.87, with a specificity ranging from 0.85 to 0.99. No kappa values were reported (Tables 1, 2).

Hansen et al. [52] examined 238 pregnant women who complained of pain in 2 out of 5 selected ADL activities with palpation of muscles and ligaments, two pain provocation tests for the SIJ, and two pain provocation tests for the symphysis. These tests had previously been scrutinized by Wormslev et al. [151]. In the study by Wormslev and colleagues the inter-tester reliability of several applied tests was thoroughly examined. The tests with the highest kappa values (ranging from 0.41 to 0.60) were chosen for use in the Hansen study [52]; these tests were Patrick's Faber test, palpation of the symphysis, the modified Trendelenburg test, palpation of the sacrotuberous ligament and the iliopsoas muscle (Tables 1, 2). The test for the joints with the highest kappa values were palpation of the symphysis, the

**Table 1** Pain provocations test of the sacroiliac joint

| Test | Sensitivity | Specificity | Kappa (Inter-tester Reliability) | Population examined | Author |
|---|---|---|---|---|---|
| Posterior pelvic pain provocation (P4) | 0.81 | 0.80 | | Consecutive pregnant ($n = 342$) | Ostgaard et al. [96] |
| | 0.84–0.93 | 0.98 | 0.70 | Consecutive pregnant ($n = 2,269$) | Albert et al. [2] |
| | 0.69 | 0.90 | | Consecutive pregnant ($n = 200$) | Kristiansson and Svardsudd [65] |
| | 0.69 | | | Post partum pelvic pain women ($n = 200$) | Mens et al. [80] |
| Patrick's Faber | 0.40–0.70 | 0.99 | 0.54 | Consecutive pregnant ($n = 2,269$) | Albert et al. [2] |
| | | | 0.42–0.62 | Pregnant ($n = 20$ with $n = 20$ without PGP) | Wormslew et al. [151] |
| | 0.41–0.44 | | | Pregnant ($n = 227$) | Hansen et al. [52] |
| Palpation of the long dorsal ligament/psis/SI joint | 0.35 | 0.98 | | Consecutive pregnant ($n = 200$) | Kristiansson and Svardsudd [65] |
| | 0.70–0.74 | | | Pregnant ($n = 227$) | Hansen et al. [51] |
| | 0.11–0.49 | 1.00 | 0.34 | Consecutive pregnant ($n = 2,269$) | Albert et al. [2] |
| | 0.21 | 0.98 | 0.76 | Mixed PGP/LBP group ($n = 61$) and controls ($n = 63$) | Njoo [87] |
| | 0.76 | 0.76/0.86 | | Postpartum women with pelvic pain ($n = 178$) | Vleeming et al. [143] |
| Compression | 0.25–0.70 | 1.00 | 0.79 | Consecutive pregnant ($n = 2,269$) | Albert et al. [2] |
| | 0.23 | 0.98 | | Consecutive pregnant (n = 200) | Kristiansson and Svardsudd [65] |
| Separation | 0.04–0.40 | 1.00 | 0.84 | Consecutive pregnant ($n = 2,269$) | Albert et al. [2] |
| | 0.12 | 0.99 | | Consecutive pregnant ($n = 200$) | Kristiansson and Svardsudd [65] |
| Menell's test | 0.54–0.70 | 1.00 | 0.87 | Consecutive pregnant ($n = 2,269$) | Albert et al. [2] |

**Table 2** Pain provocation test of the symphysis

| Test | Sensitivity | Specificity | Kappa inter-tester reliability | Population examined | Author |
|---|---|---|---|---|---|
| Modified Trendelenburg test | 0.60–0.62 | 0.99 | 0.63 | Consecutive pregnant ($n = 2,269$) | Albert et al. [2] |
| | | | 0.52 | Pregnant (n = 20 with $n = 20$ without PGP) | Wormslev et al. [151] |
| | 0.40 | | | Pregnant ($n = 227$) | Hansen et al. [52] |
| Pain at palpation of the symphysis | 0.60–0.81 | 0.99 | 0.89 | Consecutive pregnant ($n = 2,269$) | Albert et al. [2] |
| | | | 0.55 | Pregnant ($n = 20$ with $n = 20$ without PGP | Wormslev et al. [151] |
| | 0.87 | 0.85 | | Consecutive pregnant ($n = 200$) | Kristiansson and Svardsudd [65] |
| | 0.80 | | | Pregnant ($n = 227$) | Hansen et al. [52] |

modified Trendelenburg test, and Patrick's Faber test (Tables 1, 2).

*Tests specifically evaluated in postpartum women*: Kogstad [60] examined 95 women postpartum with a thorough examination consisting of 120 variables. Inspection of walking was performed, posture and pelvic tilt, palpation of muscles and ligaments, checking of presumed locking of the SIJ with two tests, and four provocation tests for the SIJ. The tests of the pelvic joints are described in detail, but the sensitivity and specificity of the used tests were not reported.

Mens et al. [80, 81] evaluated the active straight leg raise (ASLR) in postpartum women; this is a functional pelvic girdle test. The test was examined for reliability in

**Table 3** Functional test of the pelvic girdle

| Test | Sensitivity | Specificity | Kappa Inter-tester reliability | Population examined | Author |
|---|---|---|---|---|---|
| Active straight leg raise (ASLR) | 0.87 | 0.94 | | Postpartum pelvic pain women ($n = 200$) sensitivity, Healthy women ($n = 50$) specificity | Mens et al. [80] |
| | 0.58 | 0.97 | | Patients with PGP and ≥3 on 0–10 pain score | Damen [24, 25] |

50 patients with varying degrees of symptoms scored with a one-week interval. The score was unfortunately only analyzed with correlations coefficients and no kappa. Pearson's correlation coefficient was 0.82 and the ICC was 0.82. In 200 patients the test was evaluated with regard to sensitivity and specificity. The ASLR was compared with the P4 test, and a sensitivity of 0.87 and a specificity of 0.94 were reported. In the absence of a gold standard for pelvic pain [81] the validity of the ASLR was evaluated in an extensive set of aspects that is expected to correlate with disease severity, and compared with other tests for pelvic pain such as the P4, pelvic torsion, sacral thrust, lumbar pressure, and tenderness of the long dorsal ligament, and also compared with an existing pain disability scale (Table 3).

Vleeming et al. [142, 143] evaluated the sensitivity of the long dorsal sacroiliac ligament in 178 women with postpartum pelvic pain. The women were examined with the P4 test and the ASLR test, and palpation of the long dorsal sacroiliac ligament. Patients were included in the study on the basis of history only. Of the patients, 76% indicated that the palpation caused pain; sensitivity was 0.76. If a cut-off score was chosen in which both the P4 and ASLR test had to be positive, the sensitivity of the test increased to 0.86; if only women with severe pain were included the sensitivity of the test increased to 0.98 (Table 1). Njoo [87] examined the reliability and validity of this test and found a high inter-tester reliability with a kappa of 0.76 (range 0.64–88). Unfortunately no strict distinction was made between lumbar and pelvic pain (Table 1).

*Tests specifically evaluated in patients with non pregnancy related pelvic girdle pain*: Van der Wurff et al. performed a thorough systematic literature review of both the reliability and validity of SIJ tests and published two papers on this topic [135, 136].

### *Reliability of SIJ tests (non-pregnant population)*

In their reliability paper, van der Wurff et al. [135] scrutinized the methodological quality of the included studies. Of the 11 studies reviewed, 9 had an acceptable methodological quality. Even though it was not an exclusion criterion, Van de Wurff et al. did not include any studies on pregnant women. The 11 studies examined were: Van de Wurff et al. [134], Maigne et al. [72], Carmichael [16], Strender et al. [120], Potter and Rothstein [101], Laslett and Williams [69], McCombe et al. [76], Dreyfuss et al. [30], Deursen et al. [27], Herzog et al. [53], and Wiles [149]. The order of the 11 studies here begins with the highest quality first.

Concerning the palpatoric/mobility test of the SIJ, the following tests were described in the review by Van der Wurff et al.: the Overtake (Vorlauf) phenomenon, spine test, lateroflexion test, Gillet test, sitting flexion test, long sitting test, flexion–adduction test, translation SIJ, prone knee flexion test, and the Maitland test. Of the 19 evaluations of these tests in the literature, 16 were judged to be unreliable. Only three tests were judged to be reliable; however, 2 of these 3 reliable scores were in the studies with the lowest methodological quality (<50 on a 0–100 scale).

The pain provocation tests evaluated were; gapping or distraction test, compression test, Gaenslen test, sacral thrust, P4/thigh thrust, cranial shear test, Patrick's Faber sign test, and flexion–adduction hip. The reliability in these tests was higher. Of the 18 evaluations, 7 were judged to be reliable and these 7 studies also had an acceptable methodological score. Agreement exists on the reliability of the P4/thigh thrust and Gaenslen test, while there is disagreement concerning Patrick's Faber test, and the gapping and the compression test. There is agreement on the unreliability of the sacral thrust, cranial shear and flexion-adduction hip.

Following this review by van der Wurff and colleagues [135, 136] several new studies on this subject have been published.

Vincent-Smith et al. [138] selected nine experienced examiners who then underwent a training session to familiarize themselves with the protocol and methods. They then performed the standing flexion test on 9 subjects. The inter-examiner reliability was low with a kappa of 0.052. The intra-examiner reliability was reasonable with an average of 0.46.

Toussaint et al. [129], examined 480 construction workers with six tests for the SIJ. They used three palpatoric tests and three pain provocation tests and compared these tests pairwise. No individual reliability test was

performed on each test. The general agreement of the pairwise tests was a kappa of 0.30–0.68. The authors emphasise the difficulties in using palpatoric test in the diagnosis. Toussaint et al. [129] advocate that it is necessary to promote overall uniform examination procedures in the future.

Riddle et al. [104] investigated the inter-tester reliability of 4 tests in 65 patients: 34 physiotherapists performed the tests for SIJ regional joint dysfunction. These physiotherapists regularly treated patients with LBP (33% of the patients), and on average had 10.1 years experience with treating patients with LBP. The therapists were given written descriptions and photographs of the procedure. They investigated the standing flexion test, prone knee flexion test, supine long sitting test and sitting PSIS test, and found kappa values ranging from 0.19 to 0.37. They conclude that the reliability of measurements obtained with these four tests is too low for clinical use. The reasons for these low kappa values are probably due to two factors: the well-known difficulties in performing tests which rely on observation or palpation, and that the physiotherapists were given the instruction in writing with photographs and no practice sessions were organised.

Two studies [18, 61] propose that the diagnosis of pelvic pain has to be based on a cluster of tests, selected from a specific test battery.

Cibulka and Koldehoff [18] had two experienced examiners who examined 219 patients with and without LBP and with and without SIJ pain, to evaluate whether the examiners could establish the diagnosis SIJ dysfunction. The patients were classified as having SIJ dysfunction if 3 out of 4 palpatoric tests were positive. The four palpatoric tests evaluated were: the standing flexion test, sitting posterior-superior iliac spine palpation, supine long-sitting test, and prone knee flexion test. They found 13 patients without LBP and SIJ dysfunction, and 86 patients with LBP had SIJ dysfunction. They reported a sensitivity of 0.82 and a specificity of 0.88 for a cluster of SIJ tests.

Kokmeyer et al. [61] had two examiners who examined 59 patients with symptoms and 19 patients without symptoms. They used the gapping test/distraction test, compression test, thigh thrust/P4, Gaenslen's test and Patrick's Faber test. The reliability of the individual tests ranged from a kappa of 0.45 to 0.67.

They also evaluated whether the examiners could agree on a diagnosis, and report slightly higher kappa values for the diagnosis ranging from 0.63 to 0.74 if the tests were pooled. The difference in agreement depending on the number of positive tests required was low; the kappa value was 0.66 with the requirement that the examiners had to agree on all 5 tests, whereas the highest kappa value was 0.74 when the examiners agreed on a diagnosis based on only two tests. It is therefore surprising that the authors conclude that three positive tests are the threshold to propose a diagnosis, while their own results show that two tests yield the highest agreement values.

### *Validity of SIJ tests*

The validity of SIJ tests is difficult to describe due to the lack of a gold standard. Maigne et al. [72] claim that (double) anaesthetic block procedures of the SIJ are the gold standard. However, there are serious problems with this approach; they are only effective in diagnosing pathological afflictions within the SIJ. Therefore this procedure is probably valid only if the pain problem is intra-articular. These intra-articular anaesthetic block procedures neglect pain arising from the ligamentous apparatus surrounding the joint, i.e. the long dorsal ligament and the interosseous SIJ ligaments and other dorsally located ligaments of the joint, which are probably an important source of pain. This is illustrated in the study by Schwarzer et al. [110] in which 43 of their patients complained of pain over the SIJ but only 13 had relief after an anaesthetic block. Therefore, it is difficult to make clear statements regarding the validity of tests against a so-called gold standard that fails to include all the extra-articular structures.

### *Outcome measures*

The aims of treatment for PGP are to relieve pain, to improve functional ability, and to prevent recurrence and chronicity. Relevant outcomes for PGP are pain intensity, functional status, health-related quality of life, general improvement, impact on employment and physical parameters. Intervention-specific outcomes may also be relevant. Until now, no ideal set of measures specifically designed and validated for PGP has been established. Since there seem to be grounds for classifying LBP and PGP as two separate conditions, outcome measures validated for LBP are not necessarily the most sensitive for PGP. Therefore, outcome measures that are sensitive to change in clinical trials for the specific patient group studied are needed [8]. Future studies should therefore address the challenge of developing suitable outcome measures to assess the functional status for PGP. The Quebec Back Pain Disability Scale (QBPDS) [62], Oswestry Low Back Pain Disability Questionnaire [37] and Disability Rating Index [108] are used in intervention studies of PGP. Mens et al. [82] have shown that when a global impression of improvement scored by the patient was used as criterion standard, the QBPDS, hip adduction strength and ASLR test were the most useful outcome measures for PGP. In addition, the SCL-90-R, assessing psychological distress in chronic patients, may be applied to PGP patients [7].

## Discussion

A review of the literature reveals that a wide variety of examinations, procedures and tests have been used to investigate pregnant and non-pregnant patients.

In the studies where the examination procedures of pregnant women are described, a combination of methods for diagnosis has been used: inspection of walking, posture and pelvic tilt, palpation of ligaments and muscles, tests for a locked SIJ, and pain provocation tests for the SIJ and the symphysis. The early studies focused more on the inspection and palpatoric findings whereas the later studies focused more on pain provocation tests, probably due to the higher reliability and specificity of these latter tests. The pain provocation tests with the highest reliability and most frequently used for SIJ pain are the P4/thigh thrust test and Patrick's Faber test. For pain in the symphysis these tests are palpation of the symphysis, and the modified Trendelenburg test used as a pain provocation test.

## Recommendation

### *Evidence level D*

Most of the evaluated tests, and all of the chosen tests, have a very high specificity indicating that, if they are negative, it is likely that the patient does not suffer from pain in the pelvic girdle. The sensitivity is, however, lower; therefore, it is recommended to perform all of the tests, not to rule out PGP, if one test might be negative.

A gold standard test is lacking and therefore validity is hard to evaluate.

The following tests are recommended for clinical examination of PGP (for a description of the diagnostic tests see Appendix 2, and for reliability see Tables 1, 2, 3):

*SIJ Pain* Posterior pelvic pain provocation test (P4/thigh thrust), Patrick's Faber test, palpation of the long dorsal SIJ ligament, and Gaensleńs test.

*Symphysis* Palpation of the symphysis and the modified Trendelenburg test of the pelvic girdle

*Functional pelvic test* Active straight leg raise test.

## Pain history

It is strongly recommended that a pain history be taken with special attention paid to pain arising during prolonged standing, walking and/or sitting. To ensure that the pain is in the pelvic girdle area, it is important that the precise area of pain be indicated: the patient should either point out the exact location on his/her body or preferably, indicate the painful area on a pain location diagram.

## *Diagnostic imaging techniques*

Imaging of the SIJ is mainly based on the diagnosis sacroiliitis. Sacroiliitis can be differentiated into: ankylosing spondylitis, reactive arthritis, psoriatric arthritis, arthritis of chronic inflammatory bowel disease, and undifferentiated spondyloarthropathy [14].

### *Conventional radiography (level C)*

*Evidence*: There are limited indications for using conventional radiography due to the poor sensitivity in detecting the early stages of degeneration and arthritis of the SIJ [89, 119]. In a review, Braun et al. [14] stated that other modalities (such as CT and MRI) had a much higher sensitivity to detect early degenerative changes around the SIJ. It was also concluded that there was no consensus about the ideal projection angles to effectively analyse the complex anatomy of the SIJ.

Dijkstra et al. [29] showed that there is a large variation in the configuration of the SIJ. Based on plain radiography, six patients, and on frontal tomography five patients, in a total of 56 ankylosing spondylitis patients with 72 imaged joints, were diagnosed as normal. However, based on oblique tomography, tailored to the individual joints of the same patients, 31 joints were now diagnosed as normal. Obviously, individually tailored oblique tomography of the SIJ is necessary to gather trustworthy information.

Osteitis condensans ilii (OCI) is a poorly defined roentgenological abnormality, with no known clinical explanation of the origin of the roentgenological appearances [56, 105, 118, 150]. The term OCI should be regarded with suspicion when applied to young people with a history of backache and needs further evaluation.

*Recommendation*: There is no evidence for using conventional radiography in diagnosing PGP.

### *Computer tomography (CT) (level C)*

*Evidence*: One controlled clinical trial (CCT) of reasonable methodological quality showed positive findings (subchondral sclerosis, non-uniform joint width, osteophytes) in 57.5% of patients with relief of pain in the SIJ, after application of an anaesthetic block under CT guidance [34]. In this study the differentiation between lumbar and pelvic pain was made without the use of specific sensitive test of the SIJ; however, lumbar spinal disease was

excluded by MRI. In another study, on a group of patients with undefined lowest back pain (below L5-S1), Hodge and Bessette showed with CT that 75% of the patients had findings of osteoarthritis of the SIJ [55].

In another study degenerative changes were found in 60% of the SIJ among healthy persons aged 20–29 years and 94% in the SIJ in the group aged 40–49 years [111]; in women, the birth of the first child had the greatest impact on changes in the SIJ [111].

*Discussion*: Degenerative findings are sometimes found at a young age among healthy individuals. The question in these studies is whether normal development of symmetrical grooves and ridges, as demonstrated by Vleeming et al. [139] and Dijkstra et al. [29], can be regarded as osteoarthritis. The relation between roentgenological visible changes and symptoms is not sufficiently clarified to propose CT as a standard procedure for PGP patients, also because the radiation dosage of this method is high.

*Recommendation*: There is no evidence for using CT in diagnosing PGP.

### *Magnetic resonance imaging (MRI) (level B)*

*Evidence*: Several reviews report that MRI enables detection of early diagnosis of ankylosing spondylitis [14, 48, 91]. MRI shows early inflammatory changes in the bone marrow and in the SIJ joint capsule [14]. One study reveals postpartum lesions in the pelvic joints in symptomatic patients [153]. Puhakka et al. [102] showed that MRI and CT had equal efficacy, but were superior to radiography in the classifying of erosions and osseous sclerosis. Only MRI allowed visualization and grading of active inflammatory changes in the subchondral bone and surrounding ligaments of the SIJ.

*Discussion*: MRI is an important tool for excluding early ankylosing spondylitis and severe traumatic (postpartum) injuries.

*Recommendation*: We recommend to use MRI for discriminating changes in and around the SIJ; early ankylosing spondylitis as well as tumours can be easily detected. To establish the diagnosis of PGP normally imaging techniques are only needed in the case of ankylosing spondylitis, or for patients showing "red flag" signs [107] and when surgical intervention procedures are considered.

### *Scintigraphy (level C)*

*Evidence*: One study [73] shows 90% specificity for increased uptake over the SIJ with a quantitative radionuclide bone scanning, correlated to a positive intra-articular block (indicating PGP) in a group of patients with more than 7 weeks of unilateral LBP. Another study [155] concluded that scintigraphy was neither specific nor sensitive enough in the detection of sacroiliitis.

One study [114] showed very low sensitivity with only four positive scintigrams out of 31 patients with pain relief after an intra-articular SIJ anaesthetic block. In two studies [26, 54] the radionuclide uptake in patients with sacroiliitis was not above the range for controls; the authors conclude that the results are non-specific due to the high bone turnover in general in the region of the SIJ.

*Discussion*: Scintigraphy is not suitable to make distinctions between PGP and healthy controls based on the present literature.

*Recommendation*: There is no evidence for using scintigraphy in diagnosing PGP.

### *Pain referral maps (level C)*

*Evidence*: A pain referral map was generated using pain-provoking injections into the right sacroiliac joint in 10 healthy volunteers. Out of 54 patients with LBP, two independent examiners identified 16 and 17 (the same 16 + 1) patients, respectively, with a positive pain mapping according to the pain referral map. Ten out of 16 patients reported more than 50% relief on the visual analogue scale after SIJ injection [41, 42].

In a cross-sectional study Sturesson et al. [125] found that 171 out of 338 pregnant women tested positive for the P4 test. A typical pain pattern was identified. Women with a unilateral positive P4 test result had gluteal and posterior thigh pain more often than the other pregnant women, with a stabbing pain sensation. Women testing positive for a bilateral P4 test more often also had lumbar, lumbosacral, symphyseal or groin pain than women testing negative. Women with a negative P4 result rarely had pain in the gluteal area or the symphysis.

*Discussion*: Pain mapping as a tool for differentiating between lumbar and pelvic pain could be used as a diagnostic tool in assessing PGP. Although the specificity of pain referral maps and injections is low there are indications for using pain referral maps with the concentration of pain directly under the posterior superior iliac spine, in the gluteal area, or the posterior thigh and groin, as a typical pain drawing for PGP.

*Recommendation*: There is not sufficient evidence to recommend pain referral maps as a stand alone diagnostic procedure.

### *Injection techniques (level C)*

*Evidence*: One RCT by Broadhurst and Bond [15] shows 100% specificity and the sensitivity ranged from 77 to 87%

for three PGP provocation tests (Patrick's Faber test, posterior pelvic pain provocation test and resisted leg abduction test from a supine position) when using lidocaine 1% intra-articularly in the SIJ compared to injection of normal saline in the SIJ. None of the saline-injected patients showed substantial relief of pain on these tests in contrast to the lidocaine group. The authors conclude that the indicated tests are substantially reliable and they prefer clinical functional assessment of SIJ patients with these tests.

However, Dreyfuss et al. [30] used the same techniques in 85 patients to compare 12 SIJ tests with intra-articular block injections, including Patrick's Faber test, and the thigh thrust test (P4), as in the Broadhurst and Bond study [15]. The authors state that in their study none of the 12 physical examination tests proved to be diagnostically sound, which is in sharp contrast to the findings of the Broadhurst and Bond study [15]. Also, Dreyfuss et al. [30] regard intra-articular blocks as the gold standard without realizing that the procedure mainly has an effect on the intra-articular part of the SIJ.

In a study by Pulisetti and Ebraheim [103], 90% of the patients had a pain relief effect of the anaesthetic block for 2–14 days. Maigne et al. [72] studied the effect of several sacroiliac pain provocation tests with a double block anaesthetic technique and questioned the accuracy of the tests; however, these authors used a mixture of tests, some with low sensitivity and specificity.

Another study [106] shows that when SIJ injections are performed without image guidance, only in 22% of the patients is the injected fluid localized intra-articularly and in 24% of the patients the fluid is localized in the epidural space. Dussault et al. [32] however, showed that with fluoroscopy-guided SIJ injections the success rate was 97%; according to these authors fluoroscopy-guided SIJ injections are safe, rapid, and reproducible.

*Discussion*: Injection with a local anaesthetic block in the SIJ relieved the pain [15], experienced by three different PGP provocation tests. This indicates that positive tests most likely reflect intra-articular pain arising from the SIJ. However, a negative test is not able to exclude extra-articular causes of PGP, such as superficial SIJ ligament pain.

In the study by Dreyfuss et al. [30] the patients had to experience a 90–100% reduction of the pain to obtain a positive diagnosis of SIJ pain; such a high threshold for pain relief probably strongly influenced the results of their study.

The above studies also indicate that SIJ anaesthetic blocks should only be performed under fluoroscopic guidance and only performed by specifically trained physicians. However, a combination of simple manual diagnostic tests with high sensitivity and specificity (as proposed in the Diagnosis section) probably analyses a broader spectrum of PGP complaints. More studies are needed in which fluoroscopic-guided intra-articular anaesthetic block studies are combined with superficial injections of extra-articularly orientated SIJ ligaments and compared with manual diagnostic tests, as in the study of Broadhurst and Bond [15].

*Recommendation*: There is insufficient evidence to use local SIJ injections as a diagnostic tool for PGP.

### *Diagnostic external pelvic fixation*

*Evidence* (Level D): The external fixation with a trapezoid Hoffman frame was introduced by Slätis and Karaharju [113] for instable pelvic fracture treatment. In two studies on PGP patients the external fixator reduced/relieved pain and improved the walking ability [112, 145]. In a radiostereometric analysis the external fixator reduced the movements in the SIJ in 10 patients to about 50% [126].

*Discussion*: Three independent studies showed that the preoperative application of an external frame fixation before fusion surgery can be helpful for decision making concerning surgery. Application of the frame should not be used as an alternative for belts and should only be considered when all other treatment modalities applied by specialized professionals have failed. Randomized trials are needed.

*Recommendation*: There is no evidence to support the use of an external frame fixator in diagnosing PGP.

## Treatment for pelvic girdle pain (During and after pregnancy and ankylosing spondylitis)

Due to the few RCTs on the effect of treatment for PGP also CCTs were searched for and assessed. In order to be included the studies had to meet the following criteria:

prospective controlled clinical trials (randomized and non-randomized) which studied pregnant women or women in the postpartum period (within 1 year after giving birth), with or without pelvic pain or low back pain. Studies were excluded if they included women with obstetric complications, inflammatory joint diseases, rheumatoid arthritis, ankylosing spondylitis, fractures, osteoporosis, neoplasm with or without metastasis, or other severe pathology related to the spinal column. Interventions evaluated were physical therapy; such as exercise, back school, massage, mobilization/manipulation, use of sacroiliac belt, water gymnastics, electrotherapy and acupuncture; in addition, external fixation, surgery and injection therapy were evaluated.

Studies with at least one of the following outcome measures were included: pain, functional status, sick leave, or with more general outcomes, such as generic health status, well being, overall improvement and patient satisfaction.

## Physical therapy

One systematic review (searching until 2000) evaluated the effectiveness of physical therapy interventions for pregnancy-related LBP [121]. Of the 17 studies found, 9 were controlled clinical trials, 4 were randomised and 3 were considered to be of high methodological quality [59, 79]. One study investigated postpartum women [79]. Because of the heterogeneity and the varying quality of the studies included in the systematic review, there is no strong evidence concerning the effect of physical therapy interventions on the prevention and treatment of back and pelvic pain related to pregnancy. Evidence was often related to multifactor programs, which include a variety of modalities, such as information, specific exercises, ergonomic advice and mobilisation. The effectiveness of the various components of these programs remains unclear. An updated search (2000–2004) revealed 5 additional studies [17, 47, 122, 123, 127].

## Exercises

### *Exercises for PGP in pregnancy*

*Evidence* (level C): Six studies have examined the effect of exercises on PGP and low back pain in pregnancy with conflicting results [31, 59, 86, 88, 97, 127]. One RCT of high methodological quality compared water gymnastics with a control group receiving no treatment, and showed a significant positive effect of water gymnastics on sick leave and on pain intensity [59]. There were no specific inclusion criteria, apart from being pregnant. Only one study [86] used specific inclusion criteria for PGP. The patients were randomized into three different treatment groups; information, home exercises, and an in-clinic exercise group. There was no significant difference between the groups during pregnancy or at the follow-up (3, 6 and 12 months postpartum) regarding pain intensity and activity. Two trials of moderate to low methodological quality studying individualized physical therapy with exercises show significant positive effects on pain intensity and sick leave [88, 97]. Another study shows significant decrease in pain intensity after pelvic tilt exercises during pregnancy [127].

*Discussion*: The interventions were heterogeneous with regard to type and duration of exercises, whether performed individually or in groups. The group consider the current scientific evidence sufficient to recommend exercises in pregnancy. Exercises should focus on adequate advice concerning activities of daily living and to avoid maladaptive movement patterns.

*Recommendation*: We recommend exercises in pregnancy.

### *Exercises for PGP postpartum*

*Evidence* (level C): Two RCTs with high methodological quality have studied PGP postpartum [79, 122]; specific inclusion criteria for PGP were used in both studies. Mens et al. [79] compared video instructed exercises for the diagonal trunk muscle system with placebo exercises and no exercises. No significant differences were found between the groups after 8 weeks of intervention. The exercises were not individualized and not supervised. In the study of Stuge et al. [122], a treatment program focusing on specific stabilising exercises was compared with physical therapy without specific stabilizing exercises. A stabilizing exercise is meant to dynamically control the lumbar segments and the pelvic joints by activating the local muscles in coordination with the global muscles. These exercises are effective when the pelvic girdle is adequately compressed at the moment of loading, as a result of forces acting across the joint, to ensure stability.

The anatomical structures responsible for stabilization are the ligaments and mono- and polyarticular muscles and fascia [78, 92, 116, 117, 139, 140].

A treatment program focusing on specific stabilising exercises [122] had both statistically and clinically a significantly better effect on pain, functional status, health-related quality of life and physical tests than physical therapy without specific stabilizing exercises, measured after 20 weeks of intervention and 1 year postpartum. A 2-year follow-up study showed persisting low levels of pain and disability in the exercise group and significant differences between the comparison groups [123].

*Discussion*: These two studies [79, 122] differ in type of intervention, individualization, dosage, duration and guidance, and in the number of subjects studied. In the study of Mens et al. [79], 25% of the subjects terminated their exercise program due to pain, probably because the exercises were too heavy. A treatment program with specific exercises that include local and global muscle systems, individually adapted and guided by a physical therapist show best effects. Further investigation is needed to identify the most effective elements in this type of individual intervention program.

*Recommendation*: We recommend the use of an individualized treatment program focusing on specific stabilizing exercises as part of a multifactorial treatment for PGP postpartum.

### *Exercises for PGP based on ankylosing spondylitis*

*Evidence* (level C): One systematic review with sufficient quality was found [20] (higher than 60 on the quality score). On the basis of this review there are indications that

exercise therapy, (consisting of functional, mobilizing and muscle strengthening and exercises for aerobic endurance, and proprioceptive neuromuscular facilitation), is effective. This recommendation is however based on one small RCT of good methodological quality [63] and there is insufficient evidence about the effectivity in relation to other forms of therapy.

*Discussion:* Dagfinrud et al. [20] stated that a home exercise program is better than no intervention, supervised group physiotherapy is better than home exercises, and that a combined inpatient spa-exercise therapy followed by supervised outpatient weekly group physiotherapy is better than weekly group physiotherapy alone [132].

*Recommendation:* We recommend the use of an individualized exercise program for PGP based on ankylosing spondylitis.

### Individual treatment

*Evidence* (level C): Two moderate to low methodological quality studies investigated individualized physical therapy [88, 97]. The two studies had no specific inclusion criteria, apart from being pregnant. Östgaard et al. [97] compared individual physical therapy with two classes of modified back-school education with training and a control group. They found that individual physical therapy resulted in significantly higher reduction in sick leave and lower pain intensity 8 weeks postpartum compared to the control group. Noren et al. [88] compared individualized physical therapy with no specific treatment. Pain intensity and sick leave was significantly reduced. However, no comparison between the groups was performed for pain intensity.

*Discussion*: Based on these findings individually tailored programs are more effective than general group training or no treatment. In our opinion, treatment should be based on the findings from an individual examination.

*Recommendation*: We recommend the use of individualized physical therapy for PGP.

### Massage

*Evidence* (level C): One quasi-randomized controlled trial studying pregnant women, compared massage therapy with progressive muscle relaxation therapy and found significantly less back pain intensity, reduced anxiety, improved mood and better sleep in the massage group. However, no comparisons between the groups were made [40]. There were no specific inclusion criteria, apart from being pregnant.

*Discussion*: Massage might be helpful. The working group agrees that massage could be given as part of a multifactorial individualized treatment program.

*Recommendation*: There is no evidence to recommend massage as a stand-alone treatment for PGP.

### Modified back school classes

*Evidence* (level C): Two moderate to low methodological quality studies investigated back school classes [74, 97]. There were no specific inclusion criteria, apart being pregnant. No significant effect was found on pain intensity or sick leave [97]. A significantly higher proportion of the control group experienced "troublesome" or "severe" backache, compared with the treated group; however, compliance was very low [74].

*Discussion*: Both studies examined an intervention with only two classes of modified back school education with training and ergonomic back care advice. The amount of therapy may have been too small to expect a realistic change, or group treatment may not be sufficient for effective treatment.

*Recommendation*: There is no evidence to recommend back school classes as a treatment for PGP in pregnancy.

### Special pillows to reduce back pain

*Evidence* (level C): One crossover trial compared the use of a specially shaped pillow to fit under the woman's abdomen (Ozzlo pillow) with a standard pillow [128]. There were no specific inclusion criteria, apart from being pregnant. Lower scores for backache at night were recorded during the week that women used the Ozzlo pillow; there were no differences in sleeping scores.

*Discussion*: A crossover study with no separate control group is considered to be a weaker design than an RCT. Moreover, because there is no theoretical rationale behind this intervention, and because the tested pillow is not commercially available, the results of this study are of minor interest here.

*Recommendation*: We do not recommend a specific pillow as a treatment for PGP during pregnancy.

### Information

*Evidence* (level D): No RCTs or CCTs have studied the effect of information as a single treatment.

*Discussion*: Several studies have included information as part of their interventions (79, 86, 88, 97, 122). The group agree that the purpose of information is mainly to reduce fear and to encourage/help patients to take an active part in their treatment and/or rehabilitation. It is essential that the information and treatment are consistent across

professions to preclude unnecessary anxiety about the condition. General information on PGP needs to be presented (anatomy, biomechanics, motor control) and the patient reassured that their problems are not dangerous to them or their child and that they will probably improve/recover. The patient needs to be encouraged to enjoy physical activity and manage and combine this with periods of rest in order to recuperate. To provide adequate information and ergonomic advice is considered useful.

*Recommendation*: There is no evidence to recommend information as a single treatment; however, providing adequate information is considered useful.

### Manipulation and joint-mobilization

*Evidence* (level D): No RCTs or CCTs have studied the effect of manipulation or joint mobilization for PGP.

*Discussion*: However, four studies have examined manipulation [21, 28] or mobilisation for PGP in pregnancy [10, 77]. The results of the studies indicate that manipulation and mobilisation might be a possible treatment for PGP. The studies had, however, few participants and no control group. Manipulation of the SIJ has been shown to normalize clinical test results without altering the position of the SIJ [130]. The results of these studies may be based on a positive soft tissue response.

*Recommendation*: There is no evidence to recommend manipulation or mobilisation for PGP. However, manipulation or joint mobilisation may be used to test for symptomatic relief, but should only be applied for a few treatments.

### Pelvic belt

*Evidence* (level D): No RCTs or CCTs have studied the effect of a pelvic belt for PGP. *Discussion*: Several studies have included the use of a pelvic belt as part of their interventions but without investigating it as a single treatment [10, 50, 79, 86, 97, 148]. The results show that a pelvic belt may reduce mobility/laxity of the SIJ [23, 141]. Effective load transfer through the pelvis, measured by active straight leg raising (ASLR) has been improved by application of a pelvic belt [78]. One pilot study using a prospective, two-group design showed a positive effect in pain scores and on daily activities after using a maternity support binder for relief of pregnancy-related back pain [17].

*Recommendation*: There is no evidence to recommend the use of a pelvic belt as a single treatment for PGP. A pelvic belt may be fitted to test for symptomatic relief, but should only be applied for short periods.

### Electrotherapy

*Evidence* (level D): There is no evidence to recommend the use of electrotherapy, because no studies on this modality were found.

*Rest evidence* (level D): There is no specific evidence to recommend rest.

### Acupuncture

*Evidence* (level B): Three RCTs investigated acupuncture in the treatment of PGP and LBP during pregnancy [47, 67, 148]. There were no specific inclusion criteria, apart from being pregnant. One study of moderate to low methodological quality compared acupuncture with physical therapy [148]. A significant effect on pain and functional status, in favour of acupuncture, was found. The results may be biased by high drop-out rates and because the groups differed with regard to pain location (LBP and PGP). Furthermore, individual acupuncture treatment was compared to physical therapy given mainly as group treatment. The second study [67] compared acupuncture with no treatment. Acupuncture patients were significantly less bothered by pain compared with the control group. However, the study was of moderate to low methodological quality because of high drop-out and no intention-to-treat analysis. Also lack of attention given to the control group might have influenced the results. The third study showed significant decrease in pain intensity in the group receiving acupuncture compared to the control group [47]; also, the capacity to perform general activities improved significantly in the acupuncture group. Another study [33] shows that acupuncture together with stabilising exercises constitute efficient complements to standard treatment for PGP. The results show significant effect of acupuncture on pain; however, effect on function was not measured.

*Discussion*: Despite the moderate to low quality of some of the studies, there is evidence that acupuncture seems to alleviate LBP and pelvic pain during pregnancy.

*Recommendation*: There are indications that acupuncture during pregnancy may reduce pain, but high quality studies are needed.

### SIJ therapeutic injection therapy

*Evidence* (level B): In two RCTs [70, 75], local anaesthetics in combination with corticosteroids were applied to the SIJ in patients suffering predominantly from non-specific spondyloarthropathies and ankylosing spondylitis; the procedure led to pain relief after 1–6 months in 60–88% of the patients.

*Discussion*: Different guiding techniques for intra-articular injections in the SIJ were used either under fluoroscopy or with CT or MRI guidance. All studies showed immediate pain relief with decreasing effects over time. The therapeutic effect in inflammatory diseases is longer compared with osteoarthritis. Local injection appears promising in patients with inflammatory diseases. However, more studies are needed to clarify whether additional SIJ injections are required besides medication for ankylosing spondylitis.

*Recommendation*: We recommend intra-articular SIJ injections (under imaging guidance) for ankylosing spondylitis.

### Radiofrequency denervation

*Evidence* (level C): Two CCTs [39, 44] reported that after application of local anaesthetics and radiofrequency denervation of nerve endings in the posterior ligaments and the posterior capsule [39] and in the posterior capsule [44], respectively, between 36 to 65% of the patients had pain relief after 3–12 month.

*Discussion*: Radiofrequency denervation needs further research before recommendations can be made.

*Recommendation*: There is no evidence to support the use of radiofrequency denervation.

### Prolotherapy

*Evidence* (level C): One RCT ($n = 110$) [154] reported that after lumbopelvic ligament injection of 20% glucose plus 0.2% lidocaine or normal saline injection, both groups reported sustained reductions in pain and disability, irrespective of the injected substance.

*Discussion*: There is a substantial effect of injection therapy independent of the used injection. Prolotherapy showed no benefit compared with local saline injections. Further studies are needed to confirm that intra-articular injections are essential, besides general medication. There is no evidence for non-ankylosing spondylitis PGP patients to use local injections as treatment.

*Recommendation*: There is no evidence to support the use of prolotherapy

### Pharmacological teatment

*Evidence*: No studies are available on PGP and pharmacological treatment.

*Discussion*: In clinical practice the medication for PGP should not differ from the medication for acute non-specific LBP [36], and should generally be restrictive until scientific studies may demonstrate otherwise.

*Recommendation*: Pharmacological treatment should follow the guidelines of acute non-specific LBP. Prescribe medication, if necessary, for pain relief (preferably to be taken at regular intervals); first choice paracetamol, second choice NSAIDs [36].

### Surgery

*Evidence* (level D). No RCTs or CCTs were identified. Eleven cohort studies on fusion surgery of the SIJ have been found [9, 11, 43, 45, 57, 84, 90, 115, 137, 146]. In most studies intra-articular SIJ anaesthetic blocks were used as a preoperative inclusion criterion. Three studies advocate an external preoperative test, before surgery [112, 126, 145].

#### *Discussion*

Surgery could be applied for severe traumatic cases of PGP as an exception to this recommendation, but only when other non-operative treatment modalities have failed when performed by professionals with expert knowledge of the condition. In that case, preoperative assessment with an external fixator for 3 weeks to evaluate longer lasting effects of fixation, is recommended.

Both clinical and biomechanical data support the use of an external fixator prior to surgery [112, 113, 126, 145].

In all mentioned reports of fusion surgery, preoperative evaluation was thorough and an operation took place only on patients in whom non-operative treatment had been unsuccessful.

The studies included 2 up to 77 patients and the results were assessed by the authors as fair to excellent in 50–89% of the patients. In a case report by Berthelot et al. [11] two patients were operated and had total pain relief. Different techniques are described, but the transiliac technique described by Smith-Petersen and Rogers [115] with some modifications was most widely used.

Intra-articular sacroiliac injections may also be a useful preoperative tool, but will probably only be an indicator in patients with intra-articular pathology.

In two studies additional symphysiodesis is advocated [90, 137]; however, from a biomechanical viewpoint this is highly questionable. Van Zwienen et al. [137] reported that 15% of pseudarthrosis in the symphysis and 9% of nerve root injury was due to posterior instrumentation.

No evidence-based criteria exist for surgery of PGP and it is strongly recommended that physicians with extensive

knowledge of the condition perform sacroiliac fusions within a scientific protocol.

*Recommendation*: There is no evidence to recommend sacroiliac fusion.

*Prevention*

*Evidence*: Two RCTs of moderate to low quality investigated the effect of treatment aimed at preventing PGP and LBP during pregnancy [31, 97]. No effect was found on prevention of the incidence of PGP or LBP. No specific prevention study has been identified.

*Discussion*: The interventions studied aimed both at prevention and treatment of pregnant women with or without PGP or LBP.

*Recommendation*: We cannot recommend any specific preventive measure.

## Summary of recommendations

Basic studies, epidemiology and risk factors for pelvic girdle pain

(For a report on the basic studies related to this guideline, please look at http://www.backpaineurope.org: WG4, anatomical background information).

- Pelvic girdle pain is a specific form of LBP, that can occur separately or in conjunction with LBP; a new definition of PGP is recommended.
- Although it is possible to focus on and specify PGP, functionally the pelvis cannot be studied in isolation.
- PGP is related to non-optimal stability of the pelvic girdle joints.
- The typical anatomy of the SIJ (which is characterized by a coarse cartilage texture, cartilage-covered grooves and ridges, a wedge-like shape of the sacrum, and a propeller-like shape of the joint surface) leads to the highest coefficient of friction of diarthrodial human joints. This friction can be altered according to the loading situation and serves to stabilize the pelvic girdle.
- Nutation of the sacrum (flexion of the sacrum relative to the ilia), is generally the result of load bearing and a functional adaptation to stabilize the pelvic girdle.
- More research is needed in patients with PGP to verify whether counternutation of the SIJ (anterior rotation of the ilia relative to the sacrum) in load-bearing situations is a typical sign of non-optimal stability of the pelvic girdle.
- The point prevalence of pregnant women suffering from PGP is about 20%. The evidence for this result is strong.
- Risk factors for developing PGP during pregnancy are most probably: a history of previous LBP and/or previous trauma to the pelvis. There is slight conflicting evidence (one study) against the following risk factors; pluripara and high-work load. There is agreement that non risk factors are: contraceptive pills, time interval since last pregnancy, height, weight, smoking and most probably age (one study reports that young age is a risk factor).
- No studies have been published on the risk factors for the *non-pregnant* population to develop PGP, or which women or men are at risk of developing chronic PGP.

Diagnosis and imaging of PGP

- To make the diagnosis PGP the following tests are recommended for use during the clinical examination: (see Appendix 2)
- *SIJ pain*: Posterior pelvic pain provocation test (P4), Patrick's Faber test, palpation of the long dorsal SIJ ligament, and Gaensleńs test.
- *Symphysis*: Palpation of the symphysis and modified Trendelenburg's test of the pelvic girdle.
- *Functional pelvic test*: ASLR test.
- It is recommended that a pain history be taken with specific attention paid to pain arising during prolonged standing and/or sitting. To ensure that the pain is in the pelvic girdle area, it is important that the precise area of pain be indicated: the patient should either point out the exact location on his/her body or, preferably indicate the painful area on a pain location diagram.
- There are limited indications for the use of conventional radiography due to its poor sensitivity in detecting the early stages of degeneration and arthritis of the SIJ.
- In most cases of non-ankylosing spondylitis PGP, there is limited value for imaging. Computer tomography (CT) as well as conventional radiography is not recommended, as a diagnostic alternative when MRI is available, because of exposure to radiation and no further information is gained. MRI discriminates changes most effectively in and around the SIJ. Early ankylosing spondylitis and tumours can be easily detected. To establish the diagnosis of PGP, imaging techniques are generally only needed in AS, for patients showing "red flag" signs, and when surgical intervention procedures are considered.
- We do not recommend scintigraphy for PGP.
- We do not recommend local SIJ injections as a diagnostic tool for PGP. A combination of manual diagnostic tests, (with high sensitivity and specificity), will analyse a broader spectrum of PGP complaints.

Treatment of PGP

- We recommend individualized exercises in pregnancy.
- We recommend an individualized treatment program, focusing specifically on stabilizing exercises for control and stability, as part of a multifactorial treatment postpartum.
- We recommend intra-articular SIJ injections (under imaging guidance) for ankylosing spondylitis.
- Prescribe medication, if necessary, for pain relief (excluding pregnant women) preferably to be taken at regular intervals; first choice paracetamol, second choice NSAIDs.
- Give adequate information and reassure the patient as part of a multifactorial treatment

Future research

*Basic studies*

- Verify whether counternutation of the SIJ (anterior rotation of the ilium relative to the sacrum) in load-bearing situations is a typical sign of non-optimal stability of the pelvic girdle in GP patients.

*Diagnosis*

- More studies are needed on diagnostic procedures for PGP. The diagnostic tests currently proposed need re-evaluation and trials for falsifications have to be set up.
- Research is needed to verify whether patients with PGP based on ankylosing spondylitis react to the same diagnostic procedures as do non-ankylosing spondylitis PGP patients.
- Studies are needed with fluoroscopic-guided intra-articular anaesthetic SIJ blocks, together with local superficial injections of extra-articular SIJ ligaments, and compared with manual diagnostic tests.
- Randomized trials are needed, as well as a universal protocol for diagnostic/follow-up procedures after fusion surgery.
- Disease-specific outcome measures for PGP need further evaluation

*Treatment*

- Different treatment modalities and applications should be investigated to establish evidence for specific recommendations. Future studies should include PGP patients in different cohorts, such as patients with ankylosing spondylitis. The methodological quality of a study is as important as the quality of the intervention studied. High methodological quality does not necessarily guarantee that a study offers a high quality of intervention. Treatment modalities to be studied include:
  - comparison of exercise programs with and without the use of a pelvic belt
  - comparison of individualized physical therapy with group treatment
  - comparison of cognitive interventions with exercise programs.
- Study the effect of information, manipulation, mobilization, massage, relaxation and rest in PGP patients.
- Randomized trials are needed to establish the effect of fusion surgery in PGP patients not responding to non-operative treatment.

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## Appendix 1: Grading system based on the original ratings of the AHCPR Guidelines (1994)[12] and levels of evidence used in systematic (Cochrane) [19] reviews on low back pain

Level of evidence

1. Therapy and prevention

   Level A: Generally consistent findings provided by (a systematic review of) multiple high quality randomised controlled trials (RCTs).
   Level B: Generally consistent findings provided by (a systematic review of) multiple low quality RCTs or non-randomised controlled clinical trials (CCTs).
   Level C: One RCT (either high or low quality) or inconsistent findings from (a systematic review of) multiple RCTs or CCTs.
   Level D: No RCTs or CCTs.

   *Systematic review*: systematic methods of selection and inclusion of studies, methodological quality assessment, data extraction and analysis.

2. Prognosis

   Level A: Generally consistent findings provided by (a systematic review of) multiple high quality prospective cohort studies.
   Level B: Generally consistent findings provided by (a systematic review of) multiple low quality prospective cohort studies or other low quality prognostic studies.

Level C: One prognostic study (either high or low quality) or inconsistent findings from (a systematic review of) multiple prognostic studies.
Level D: No evidence: no prognostic studies.

*High quality prognostic studies*: prospective cohort studies

*Low quality prognostic studies*: retrospective cohort studies, follow-up of untreated control patients in a RCT, case series

3. Diagnosis

Level A: Generally consistent findings provided by (a systematic review of) multiple high quality diagnostic studies.
Level B: Generally consistent findings provided by (a systematic review of) multiple low quality diagnostic studies.
Level C: One diagnostic study (either high or low quality) or inconsistent findings from (a systematic review of) multiple diagnostic studies.
Level D: No evidence: no diagnostic studies.

*High quality diagnostic study*: Independent blind comparison of patients from an appropriate spectrum of patients, all of whom have undergone both the diagnostic test and the reference standard. An appropriate spectrum is a cohort of patients who would normally be tested for the target disorder. An inappropriate spectrum compares patients already known to have the target disorder with patients diagnosed with another condition.

*Low quality diagnostic study*: Study performed in a set of non-consecutive patients, or confined to a narrow spectrum of study individuals (or both) all of whom have undergone both the diagnostic test and the reference standard, or if the reference standard was unobjective, unblinded or not independent, or if positive and negative tests were verified using separate reference standards, or if the study was performed in an inappropriate spectrum of patients, or if the reference standard was not applied to all study patient.

Checklist for methodological quality of therapy/prevention studies

*Items*

1. Adequate method of randomisation
2. Concealment of treatment allocation
3. Withdrawal/dropout rate described and acceptable
4. Co-interventions avoided or equal
5. Blinding of patients
6. Blinding of observer
7. Blinding of care provider
8. Intention-to-treat analysis
9. Compliance
10. Similarity of baseline characteristics

Checklist for methodological quality of prognosis (observational) studies

*Items*

1. Adequate selection of study population
2. Description of inclusion and exclusion criteria
3. Description of potential prognostic factors
4. Prospective study design
5. Adequate study size (>100 patient-years)
6. Adequate follow-up (>12 months)
7. Adequate loss to follow-up (<20%)
8. Relevant outcome measures
9. Appropriate statistical analysis

Checklist for methodological quality of diagnostic studies

*Items*

1. Was at least one valid reference test used?
2. Was the reference test applied in a standardised manner?
3. Was each patient submitted to at least one valid reference test?
4. Were the interpretations of the index test and reference test performed independently of each other?
5. Was the choice of patients who were assessed by the reference test independent of the results of the index test?
6. When different index tests are compared in the study: were the index tests compared in a valid design?
7. Was the study design prospective?
8. Was a description included regarding missing data?
9. Were data adequately presented in enough detail to calculate test characteristics (sensitivity and specificity)?

## Appendix 2: Description of pelvic girdle pain tests

Active straight leg raise test

The patient lies supine with straight legs and the feet 20 cm apart. The test is performed after the instruction: "Try to raise your legs, one after the other, above the couch for 20 cm without bending the knee". The patient is asked to score any feeling of impairment (on both sides separately) on a 6-point scale: not difficult at all = 0; minimally difficult = 1; somewhat difficult = 2; fairly difficult = 3; very difficult = 4; unable to do = 5. The scores on both sides are added so that the sum score can range from 0 to 10 [80].

Gaenslen's test

The patient, lying supine, flexes the hip/knee and draws it towards the chest by clasping the flexed knee with both

hands. The patient is then shifted to the side of the examination table so that the opposite leg extends over the edge while the other leg remains flexed. The examiner uses this manoeuvre to gently stress both sacroiliac joints simultaneously. The test is positive if the patient experiences pain (either local or referred) on the provoked side [43].

### Long dorsal sacroiliac ligament (LDL) test

#### *The LDL test in postpartum women*

The patient lies prone and is tested for tenderness on bilateral palpation of the LDL directly under the caudal part of the posterior superior iliac spine. A skilled examiner scores the pain as positive or negative on a 4-point scale: no pain = 0; mild = 1; moderate = 2; unbearable = 3. The scores on both sides are added so that the sum score can range from 0–6. [143].

#### *The LDL test in pregnant women*

The patient lies on her side with slight flexion in both hip and knee joints. If the palpation causes pain that persists for more than 5 seconds after removal of the examiner's hand it is recorded as pain. If the pain disappears within 5 seconds it is recorded as tenderness [2].

### Pain provocation of the symphysis by Modified Trendelenburg's test

The patient stands on one leg and flexes the hip and knee at 90 degrees. If pain is experienced in the symphysis the test is considered positive [2].

### Patrick's Faber test

The patient lies supine: one leg is flexed, abducted, and externally rotated so that the heel rests on the opposite knee. The examiner presses gently on the superior aspect of the tested knee joint. If pain is felt in the sacroiliac joints or in the symphysis the test is considered positive [2, 15, 151].

### Posterior pelvic pain provocation test

The test is performed supine and the patient's hip flexed to an angle of 90 degrees on the side to be examined: light manual pressure is applied to the patient's flexed knee along the longitudinal axis of the femur while the pelvis is stabilized by the examiner's other hand resting on the patients contralateral superior anterior iliac spine. The test is positive when the patient feels a familiar well localized pain deep in the gluteal area on the provoked side [96].

A similar test is described as the posterior shear or "thigh thrust" test [69].

### Symphysis pain palpation test

The patient lies supine. The entire front side of the pubic symphysis is palpated gently. If the palpation causes pain that persists more than 5 s after removal of the examiner's hand, it is recorded as pain. If the pain disappears within 5 s it is recorded as tenderness [2].

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