Korsrygg- og bekkensmerter er hovedårsaken til sykefravær blant gravide kvinner i Skandinavia, og det er et alvorlig problem at mange unge kvinner utvikler kroniske bekkensmerter også etter fødselen. I sin doktoravhandling ønsket forfatteren å bidra til økt kunnskap om bekkensmerter etter fødsel og å undersøke effekten av behandling for disse kvinnene. Denne artikkelen gir et sammendrag av den teoretiske bakgrunnen for studiene og et lite innsyn i de viktigste funnene. For mer informasjon om metode, analyse og gjennomføring anbefales originalpublikasjonene.

Dynamisk kontroll og stabilitet – effektivt mot bekkenplager?

Britt Stuge, fysioterapeut og dr. philos,
Seksjon for helsefag, Universitetet i Oslo.
E-post: britt.stuge@medisin.uio.no

Artikkelen er en forkortet versjon av Britt Stuges avhandling «Physical therapy for pregnanc-related pelvic girdle pain. Underlying principles and effect of treatment.» Britt Stuge disputerte 29.9.2005 ved Universitetet i Oslo.

Introduction

Lumbopelvic pain has been known to exist since ancient times, but there is a general impression that the occurrence has increased during the last years. It has been stated to be culturally specific and more common in the Scandinavian countries than the rest of the world (69,152). However, studies show that lumbopelvic pain is a rather common problem in many countries; Africa (22,180), America (66,73), Asia (169,229,233,234), Australia (34), and Europe (2,68,130,15 7,166,186,189,190,195,219). Postpartum lumbopelvic pain, however, has only been reported in western studies (265).

Lumbopelvic pain during pregnancy regresses spontaneously soon after delivery and disappears in most women within 6 months postpartum (53,122,189,193). Few studies have examined the long-term prevalence of postpartum lumbopelvic pain, however a few studies have shown up to 25% of those who suffered from lumbopelvic pain during pregnancy had persisting pain at several years after birth (233,178,193,265,3).

The presence of back pain before and during pregnancy, multiple pregnancies, younger age, greater weight, and physically heavy work have all been reported to correlate to persistent postpartum back pain (31,189,234). Brynhildsen et al. (33), however, reported that moderate or heavy work increased the risk for current LBP only in combination with previous LBP. In a recent study, the risk factors associated with persisting back pain were early onset of pain symptoms and severe pain at an early stage of gestation in the previous pregnancy; those who suffered were older and had greater weight gain and less ability to return to their pre-pregnancy weight level than those without persisting pain (233). High pain intensity during pregnancy indicated a bad prognosis after pregnancy (191). According to van Dongen (238), general hypermobility is not a risk factor for postpartum pelvic girdle pain (PGP). One study found no differences in the long-term prognosis between the women with previous sacroiliac joint (SIJ) dysfunction and women with other causes of LBP (33). However, the data was collected by a questionnaire 12 years after delivery. Hopefully in the future we will get more knowledge about other possible risk factors

Sammendrag

Artikkelen gjengir essensen av en doktorgradsavhandling som økte kunnskapen om behandling for graviditetsrealterte bekkenplager (PGP). Pasienter konsulterer ofte fysioterapeuter for behandling av PGP, men evidensen for effekten av ulike behandlingsmåter har vært usikker, noe som ble vist gjennom en oversikt over fysioterapiintervensjoner. Basert på nyere forskning på motorisk kontroll av lokale muskler for segmentstyring og dynamisk stabilitet i lumbopelvisområdet, ble det fremsatt et fysioterapiprogram som inkluderte spesifikke øvelser, og resultatene fra et forsøk ble rapportert.

Avhandlingen inneholder fem artikler (A): A I en systematisk oversiktartikkel med effekt av fysioterapitiltak; A II en randomisert kontrollert studie; A III en oppfølgingsstudie over to år, A IV prinsipper for stabilitetstrening; og A V en kasuskontrollstudie vurderte dyp muskelaktivering. Avhandlingen viste ingen sterk evidens for forebygging av plagene, sterk og langvarig behandlingseffekt av fysioterapi som inkluderer spesifikke stabiliseringsøvelser, og ingen statistisk signifikant forskjell i voluntær lokal muskelkontraksjon mellom responderende og ikke-responderende individer.

such as hormonal influences, heredity, and other physical and mental aspects.

Lumbopelvic pain has been looked upon as a normal discomfort of pregnancy (1,73,186), a severely disabling problem (33,84) or as a «hysterical epidemic» (205). Given he uncertainties as to terminology and prevalence, questions regarding the existence of PGP as a distinct entity have been raised. Mens et al. (161) claimed that it is questionable whether PGP is a specific syndrome or just non-specific lumbopelvic pain with its onset during pregnancy or delivery. Others, however, have asserted that differentiation between lumbopelvic pain and PGP is essential for diagnostic, therapeutic and prognostic purposes (123,129,194,228).

Characteristic symptoms and cardinal pain for PGP are located to the sacrum, posterior pelvis and/or the pubic symphysis. Mens et al. (166) found that the pubic region was indicated by 77 percent of the women, while in another study (190), more than 50 percent localized the pain to the SIJ region. Other regions frequently indicated as painful are the groin, the regions of the posterior superior iliac spine and the coccyx. One of the characteristics Cederschjöld described in 1839 was the difficulty or almost inability to move the lower limbs (84). Difficulty in walking has been confirmed by recent studies and proposed as a diagnostic sign for PGP (63,228).

To date, however, there is no consensus on internationally accepted criteria on how to diagnose or categorize PGP. Objective diagnostic criteria are lacking (187). Pain can not be related to any specific radiographic finding and no correlation has been found between the degree of symphyseal widening and pain in the pelvis (1,24). In spite of the development of imaging, including computerized tomography and magnetic resonance tomography, it is still necessary to rely on a thorough history and an examination including clinical tests when diagnosing PGP (187).

The stabilizing systems

PGP has commonly been regarded as a problem of instability. However, despite the existence of different models that describe the stability of the lumbopelvic region, a generally accepted definition of stability is lacking. In 1992, Panjabi (196) presented a model of the spinal system consisting of three subsystems: the passive, the active and the neural subsystem (Figure 1). The passive musculoskeletal system comprises the vertebrae, facet articulations, intervertebral discs, spinal ligaments, and joint capsules, as well as the passive mechanical properties of the muscles. The active system comprises the muscles and tendons surrounding the spinal column. The neural and feedback system comprises the various force and motion transducers, located in the ligaments, tendons, and muscles, and the neural control centers. These passive, active, and neural control subsystems, although conceptually separate, are functionally interdependent.

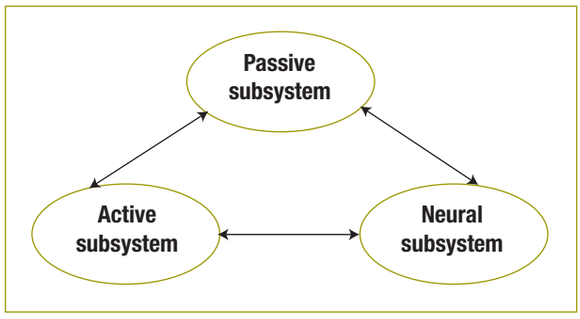

Figure 1. A model of the spinal stabilizing system, functioning as a result of the passive, active and neural subsystems from Panjabi (196).

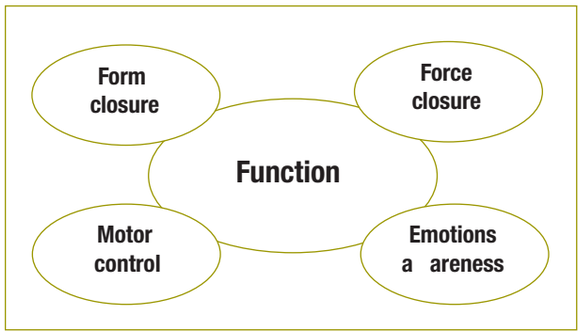

Figure 2. An integrated model of function of the lumbopelvic region by Lee and Vleeming (140,142).

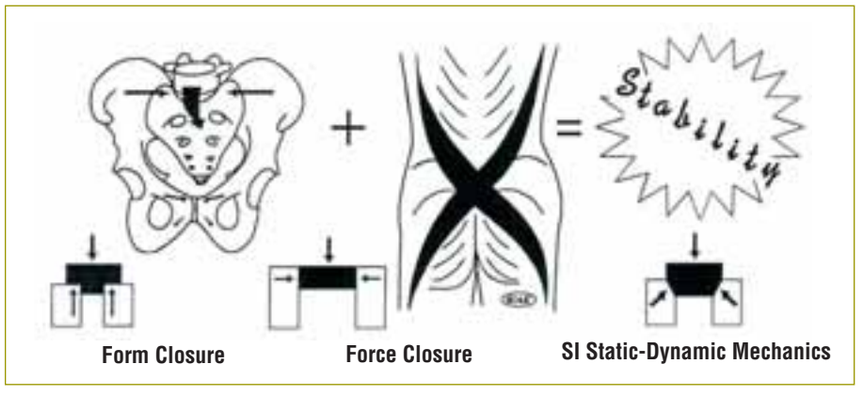

Figure 3. The self-locking mechanism by Snijders and colleagues (223).
Reprinted with permission from Vleeming A/Churchill Livingstone.

Later, Lee and Vleeming (140,142) further developed this model into a more integrated model of function of the lumbopelvic region (Figure 2). They used the terms form closure (passive subsystem), force closure (active subsystem), motor control (neural subsystem) and added emotions/awareness as a fourth component. Any one or more of the subsystems may not function appropriately, thus affecting the overall stability of the lumbopelvic system.

The self-locking mechanism

A theoretical model of the pelvic function based on anatomical and biomechanical studies has been developed (223). The model introduces the self-locking or the self-bracing mechanism of the SIJ using the principles of form and force closure related to the pelvis (Figure 3). Form closure refers to a stable situation with closely fitting joint surfaces, where no extra forces are needed to maintain the state of the system, given the actual load situation (249). The self-brace mechanism of the SIJ is nutation (flexion of

Figure 4. Illustration of local and global muscles and the intervening thoracolumbar fascia. *Reprinted with permission from De Rosa C.*

the sacrum relative to the ilium) or posterior rotation of the ilia (141,248,249). Nutation is seen as a movement to prepare the pelvis for increased loading, during which the tension of most of the SIJ ligaments increases and pulls the iliac bones together, thus enhancing the compression and the stiffness of the SIJs.

If the sacrum fit in the pelvis with perfect form closure, no lateral forces would be needed to maintain the relative positions. However, such a construction would make mobility in the SIJ practically impossible. With force closure, both friction and lateral forces are needed to withstand the impact of the vertical load on the pelvis. Because the SIJ is a relatively flat joint, loading stability cannot be achieved on the basis of skeletal orientation alone. Shear forces in the SIJ are prevented by a combination of specific anatomic SIJ features (form closure) and the compression generated by muscles and ligaments that can be adjusted to the specific loading situation (force closure) (249). The combination of form and force closure is termed «the self-locking mechanism». This mechanism is assumed to contribute to stability of the pelvis, and the muscle slings play a central role in the force closure part of it (249).

Muscles and muscle systems

Various muscles are assumed to contribute to force closure of the SIJs (Figure 4) and there has been growing interest in how the neuromuscular system supports and controls the spinal segment. Bergmark (16) described two functional muscle systems linked to spinal stabilization as the local and the global muscle systems. The muscles of the local muscle system are deep and anatomically closely related to the individual vertebrae, thus capable of increasing spinal segmental stiffness. Muscles of the global system are primarily the larger torque-producing muscles and are anatomically more distant from the joint but important for controlling spinal orientation and balancing external loads.

During recent years, there has been increased focus on the local muscle system, including musculus transversus abdominis (TrA), obliquus internus, multifidus, pelvic floor and the diaphragm. It has been shown that the TrA is recruited prior to all other abdominal muscles and that its activation is directly linked to the development of intra-abdominal pressure (100,101,208). Co-activation of the pelvic floor- and abdominal muscles is considered necessary for the development of intra-abdominal pressure, which is thought to contribute to spinal stability (216). TrA is said to play an important role in stabilising the lumbar column (105,208) and the pelvis (209). Under gravitational load, the transversely oriented muscles must act to compress the sacrum between the ilia and maintain stability of the SIJ. Richardson et al. (209) found that contraction of the TrA significantly decreased the laxity of the SIJ. These findings support the use of TrA contractions for stabilization of the lumbopelvic region. However, other muscles such as the pelvic floor muscles (PFM) also could have contributed to the decreased SIJ laxity, but were not measured in the study. Even though discussed (27), some evidence exists that specific abdominal exercises activate the PFM in healthy subjects (216) and a co-activation of the abdominal and the PFM is found (49,216). According to a biomechanical study in embalmed specimens, the pelvic floor muscles have the capability to increase stiffness of the pelvic ring and hence stabilize the pelvis in females (201).

Three global muscle slings are described by Vleeming et al. (249): longitudinal, posterior oblique and anterior oblique. The longitudinal sling consists of the combination of the multifidus muscle attached to the sacrum, the deep layer of the thoracolumbar fascia and the sacrotuberous ligament, which is connected to the long head of the biceps. The posterior oblique sling consists of the coupled function of gluteus maximus and the latissimus dorsi muscle. The gluteus maximus and the latissimus dorsi merit special attention because they can conduct forces contralaterally via the thoracolumbar fascia (249). The thoracolumbar fascia plays an important role in transferring forces between spine, pelvis and legs, especially in rotation of the trunk and stabilisation of the lower lumbar spine and SIJ (lumbopelvic stability). An increase in tension in the thoracolumbar fascia can, according to Vleeming et al. (249), lead to more compression on the SIJ, and increase force closure. The interrelationship between the latissimus dorsi on one side and the gluteus maximus on the contralateral side was confirmed in an electromyographic study (171). Furthermore, the anterior oblique sling can be activated by the external and internal abdominal muscles and also by the transversus abdominis muscle because of the connections between these muscles via the rectus sheet (249). A recent study (12) confirmed that low levels of tension are effectively transmitted between the TrA and the lumbar fascia, and thereby may influence intersegmental movement. The effects of tension on the latissimus dorsi and TrA extended only via the posterior layer of the lumbar fascia to fascial markers at S1, whereas tension on the gluteus maximus was found to displace the fascial markers to a level as low as S3, with a potential to affect the SIJ. It has further been shown that SIJ stiffness significantly increased by activation of especially the erector spinae, the biceps femoris and the gluteus maximus, even though some co-contraction of other muscles occurred (240). The finding that SIJ stiffness increased even with slight muscle activity supports the notion that load transfer from spine to legs improves when muscle activity compresses the SIJs and prevents shear forces.

Motor control

Growing evidence is emerging that the local muscles system functions differently from the global muscles system, and that the relationship between the two muscle systems changes with the loading conditions placed on the spine (43,108,181). Research reveals how the central nervous system prepares and modulates the muscle systems to support the lumbar spine and its segments for functional activity and load (41,48,105,106). An association has been found between LBP and motor control deficits in muscles of the local system, most notably in the TrA and the lumbar multifidus (97,98,107). In patients with LBP, these muscles appear to lose their normal anticipatory function, demonstrating delays in activation and thus a loss of their normal pre-programmed function for support (105,107). In contrast to subjects without LBP, the TrA in patients with LBP appears

to be unable to function independently of the other abdominal muscles and demonstrates phasic activity rather than the tonic activity required for its supporting function (109). In patients with acute episodes of LBP the lumbar multifidus has shown a decreased muscle size at a segmental level (97,98).

Over the last decade there has been an increasing emphasis on research on subtle changes in motor control caused by altered proprioceptive function. Proprioception has been defined (135) as the afferent input of joint position sense (i.e. awareness of position or movement), although others consider proprioception as a complex neuromuscular process that involves both afferent input and efferent signals that allows the body to maintain stability and orientation during both static and dynamic activities (135). The articular and muscle receptors are considered the two important groups of mechanoreceptors in joint stability (135). It has been proposed that sensory input from the ligaments' mechanoreceptors serves as a feed-forward or pre-programming mechanism that contributes to muscle coordination and joint stability (220). Changes in neuromuscular recruitment patterns may lead to increased or diminished joint compression and may seriously compromise the mechanical stability of the spine (208,224). Relaxation of the pelvic joints during pregnancy may possibly change the normal reference range for the mechanoreceptors and result in altered recruitment of stabilizing musculature; failure to adapt a functional muscle strategy may result in a dysfunction capable of generating pain (111).

Lumbopelvic stability and control in PGP subjects

Hypermobility of the pelvic joints has been suggested as a cause of PGP (89,222). However, no association between increased SIJ laxity and PGP have been found (52,226,255), and a link between instability of the symphysis and PGP has only been found when severe cases have been studied (23,121). There appears however, to be a clear relation between PGP and asymmetric laxity of the SIJs (39,52). Laxity ratio measured by Doppler imaging of vibrations has been shown to be a reliable technique for the SIJ when performed by an experienced tester (38,40,54), even though the measurement may be influenced by muscle activity (55). Asymmetric laxity measured during pregnancy has also been found to be predictive of the persistence of moderate to severe PGP into the postpartum period (53).

Other researchers have described dysfunction of the SIJ as a state of relative hypomobility within a portion of the joint's range of motion with subsequent altered structural (positional) relationship between the sacrum and the ilium (64). The location of the joints and the articular surfaces of the SIJ suggest that SIJ dysfunction may be a significant factor in PGP. The extremely rough joint surface allows the joint to be set into a slightly subluxed locked position (170). The SIJ is richly innervated by nociceptors and is capable of producing pain (137). It is suggested that a slight subluxation of the SIJ represents a potential source of ongoing discomfort due to subsequent stress of the ligaments (32). A common clinical view is that a hypomobile joint is originally a hypermobile, unstable joint that has become «locked» (compressed or dislocated).

By means of X-rays of postpartum women with asymmetric PGP problems, Mens et al. (165) showed that when the woman was standing on one leg on a bench, the pubic bone on the symptomatic side shifted caudally at the side of the leg hanging down beside the bench. The authors proposed that this shift could be caused by an anterior rotation of the ilium relative to the sacrum. In subjects with pain related to the SIJ region, Hungerford et al. (114) found that the weight bearing ilium anteriorly rotated and translated inferiorly. In contrast, posterior rotation of the ilium was found to be a normal component for stability of the pelvis (114). Anterior rotation of the ilium may be indicative of failure of the self-bracing mechanism and load transfer through the pelvis, with a resultant decrease in the ability to oppose vertical shear loads during weight bearing. This pattern may indicate abnormal articular or neuromyofascial function during increased vertical loading through the pelvis (114).

Furthermore, in subjects with pain over the SIJ compared to control subjects, a delayed onset of the oblique internus, multifidus and gluteus maximus activity of the supporting leg during hip flexion was found on the symptomatic side (113). The biceps femoris, however, demonstrated an earlier onset of electromyographic activity on the symptomatic side in subjects with pain over the SIJ than in controls. These findings suggest an alteration in the strategy for lumbopelvic stabilization that may disrupt load transfer through the pelvis. When stress was applied to the SIJ during sitting torso rotation, a significant increased electromyographic activity of the gluteus maximus on the painful side was found, possibly indicating that the gluteus maximus tries to stabilize the apparently affected SIJ (171). Identification of ilium rotation and altered patterns of muscle recruitment may thus be of significance for the management of PGP.

O'Sullivan et al. (183) identified altered motor control strategies (increased pelvic floor descent) and alterations of respiratory function (increased minute ventilation and decreased diaphragmatic excursion) in subjects with pain over the SIJ during the ASLR test. They suggest that the changes observed represent a compensatory strategy of the neuromuscular system to enhance force closure of the pelvis, and that the pelvic floor depression may be a response to increased intra-abdominal pressure from diaphragmatic bracing or splinting. The altered control strategy did not occur during manual compression of the pelvis through the iliac bones. Abnormal movement of the pelvic floor has also been found in another study of subjects with chronic SIJ syndrome (10). Dysfunction of the pelvic floor muscles may cause a deficit in the force closure mechanism in chronic SIJ pain syndrome patients (10), and should have implications for rehabilitation of PGP patients. It has also been found that certain lumbopelvic pain patients demonstrate increased activity of the pelvic floor muscles, possibly as a mechanism to compensate for compromised pelvic stability (200).

Women with postpartum PGP commonly describe difficulties in moving one or both legs forward when walking, described as a «catching» feeling of the leg (228). This «catching» feeling may reveal a problem of proprioception and motor control, where pain disturbs the function of the muscles (103,228). The tendency of one leg to «give way» has also been described by Dorman (63) and is stated to be a mechanical dysfunction of the posterior ligaments of the SIJ. Many patients also describe a feeling of being paralyzed when attempting to lift one or both legs in the supine position (161). In a sample of only nine women with postpartum PGP, walking was an obvious impairment (264). Walking speed and coordination between pelvic and thoracic rotation in the transverse plane were clearly different from healthy controls. In studying a weight-lifting task, Commissaris et al. (47) reported significantly less hip joint flexion and larger lumbar flexion in postpartum women with PGP than in healthy controls. These studies indicate altered lumbopelvic support and stability. Hence, treatment for PGP should probably aim to improve motor control and stability of the lumbopelvic region.

Treatment

Patients often consult physical therapists to seek information and treatment for their PGP. Physical therapy for PGP commonly includes advice about activities of daily living, such as walking, climbing stairs, sitting, lifting etc., in other words, activities that often provoke pain (21,202). The advice is based on a belief that being conscious of how movements affect the pelvis may lead to active adjustments of body movements, with the aim of avoiding or reducing stress on the pelvic joints and their surrounding ligaments. Together with ergonomics and body awareness, massage, mobilization and manipulation of the SIJ are common clinical practice. From experience as well as research, massage is reported to relieve pain (37,166). However, the effect is reported to be temporary in many cases. DonTigny (61) advised that each treatment of SIJ related problems must begin with assessment of the function of the SIJ. Tensed and shortened muscles might be likely to give a constant pull with resultant compressed or «sub-luxed» SIJs (141). Mobilization techniques that rotate the ilium posteriorly on the sacrum may restore normal function (62). According to Lee (139), mobilization techniques combined with stabilizing exercises will help to restore the force closure mechanism which the patient requires for a return to normal function. At that time, however, these principles were not examined in a controlled trial.

Stabilization is also searched for by orthotic devices such as a pelvic belt. Already in 1839, a corset around the pelvis was used as an aid to treat «joint loosening» (84). Since then elastic or non-elastic pelvic support has commonly been recommended to increase stability by compression of the surfaces of the pelvic joints (131,223). Wearing a pelvic belt is assumed to increase force closure (247). Studies have shown that some women experience relieved pain while using a belt, whereas others report increased pain (14,166). According to DonTigny (62), applying a belt without correcting a dysfunction may increase pain by increasing pressure on compressed pelvic joints. The SIJ is a synovial joint, subject to the same inflammatory conditions that affect other synovial joints (17), thus an inflammation or sacroiliitis may be the cause of the pain (78). In that case antiphlogistica and correction of a possible dysfunction might be a better treatment option than a pelvic belt.

The definitive stabilization of the pelvic girdle is surgical fusion of the pelvic joints. According to an experienced orthopeadist and researcher in this field, SIJ fusion should not be recommended before all other conservative possibilities have been tried, and an external frame like the Hoffmann-Slätis has been shown to relieve the pain (226). Satisfactory results of a triple pelvic ring fixation in patients with severe PGP were described in a recent study; however, complications were reported and hence the method should not be recommended before it has been further examined (241). Since surgical fixation is permanent with no recall and the outcome still unclear, conservative treatment should be preferred and further developed.

Stabilizing exercises

Due to the unique characteristics of the pelvic joints and the lack of single muscles that cross the joints, exercises for PGP have been considered a challenge. However, with the recent research that suggests that local muscles provide segmental control and dynamic stability of the lumbopelvic region, a specific exercise program has been proposed (207). The aim of this stabilizing training is to attain adequate dynamic control of lumbar spine forces, thus eliminating repetitive injury to the structures of the spinal segments and related structures.

The specific therapeutic exercise program proposed aims to reverse problems in the motor control of key muscles of the local system and restore normal synergistic function between the local and global muscle systems (208). The program is a motor learning exercise program where the initial and essential focus is on retraining the co-contraction of the transversus abdominis and lumbar multifidus, the muscles that form part of the local muscle system of the lumbopelvic region. Clinically, the motor skill is an action of gently drawing in the lower abdominal wall. When performed with a normal motor pattern, this action should activate the deep transversely oriented abdominals in co-contraction with the deep fascicles of lumbar multifidus. During the retraining process, these local muscles are cognitively activated as independently as possible from the global muscles. Facilitation of the deep local muscles with relative independence from global muscle activity requires a high level of clinical skill. Thus, the aid of technical devices, such as surface electromyography, pressure biofeedback, and ultrasound imaging may be used. The contraction is practiced repeatedly with the aim of restoring the muscle's automatic stabilization function. Sub-maximal isometric holds are recommended (208). Subsequently, training focuses on the integration of the activity of the local and global muscle systems, since both muscle systems are required for lumbopelvic stabilization and support (43,117,119).

Clinical trials have demonstrated the effectiveness of this exercise approach on pain and function in patients with lumbar segmental instability (184), and on muscle recovery in first-time acute LBP (97) with long-lasting effects (96,184). However, when the present study was planned, this exercise approach had not been examined in the treatment of PGP. According to Kogstad (123) and Östgaard et al. (194) LBP and PGP are considered two different conditions and should possibly be treated differently. It is argued that chronic functional and pain syndromes are not all the same problem with a common mechanism of pain persistence (51). According to Croft et al. (51) symptoms in specific areas of the body predict the location of pain many years later. Thus, specific influences as well as factors common to LBP and PGP need to be accounted for. From clinical experience, it is known that women with PGP can be very challenging to treat because exercises often provoke pain. There is also one factor that distinguishes women with postpartum PGP from other groups of patients: These women who are «new-born» mothers are in a special life situation. Everyday life consists of a lot of responsibility and activities they have to do, even though the activities provoke their pain. It may be difficult to act and behave according to advice and to follow a treatment plan. Thus, the patient's life situation should be taken into consideration when preparing a treatment plan.

Women with PGP often experience pain during weight bearing, which is unavoidable when caring for new-borns. To be suspended by slings reduces the weight bearing and makes it possible to exercise without pain. By using the sling exercise apparatus TerapiMaster, exercises may easily be down- and up-graded to an individual level of load. A systematic increase of lever arms together with a training diary possibly motivate to adherence to an exercise program. Also the possibility to exercise at home with an apparatus which is easy to use is probably important for this group of patients. The unstable environment of a sling also challenges the sensorimotor system to increase co-contraction of the muscles surrounding the joints (56). Furthermore, the slings allow slow controlled closed kinetic chain exercises with focus on joint position, to increase co-contraction as well as to decrease the shear forces in the joint (151).

Summary of papers

Paper I

Paper I is a systematic review including prospective controlled clinical trials (randomized and non-randomized) studying the effectiveness of physical therapy interventions for pregnant or postpartum women with or without LBP or PGP. The relevant studies were identified by specific search terms, using the following databases: The Cochrane Controlled Trials Register, MEDLINE, EMBASE, SPORT, CINAHL. In addition, the reference lists of retrieved reports and earlier reviews were scanned and personal contact was made with the authors of included articles and other experts in this field. Methodological quality was assessed in terms of internal validity and a descriptive summary was performed.

Paper II

Paper II is a randomized, single-blind, clinically controlled study with a stratified group design. The randomization procedure took place after the baseline examination was completed and eligibility was determined. An independent person unaware of subject characteristics administered pre-coded identical containers to assignment of the subjects to the intervention groups (exercise group and control group). To obtain groups as comparable as possible, a stratified design with block randomization was used. The stratification factor was pain location, based on 3 pain groups: pure symphysis pubis pain, pain from all three pelvic joints, and pain from either or both SIJ regions. The patients (n=81) were randomized in blocks of four to obtain a well-balanced trial (199). Data were collected through questionnaires and from clinical tests performed by a blinded assessor. The effect of two interventions (physical therapy focusing on specific stabilizing exercises (SSE) vs physical therapy modalities without SSE) was compared. Paper II reports short-term effects immediately after the 20-week intervention period and 1 year postpartum.

Paper III

Paper III is a follow-up study (prolongation of the study in paper II), reporting results 2 years postpartum. Data were collected by a questionnaire.

Paper IV

The results from the main study (paper II) and the follow-up results (paper III) constituted the basis of paper IV, which is a paper for exploring and discussing principles of treatment with stabilizing exercises.

Paper V

Paper V is a case-control study to examine the ability to voluntarily contract the deep abdominal muscles and the pelvic floor muscle strength in women with and without persistent PGP. Subjects were invited to participate based on their pain and disability scores on the 2-year follow-up questionnaire. Data were collected by ultrasound measurements of the deep abdominals, pelvic floor assessments, clinical tests and a questionnaire.

What did the thesis show?

- No strong evidence existed concerning the effect of physical therapy for the prevention and treatment of pregnancy-related low back and pelvic girdle pain.
- Physical therapy intervention focusing on specific stabilizing exercises demonstrated clinically and statistically significant lower pain intensity and disability, and higher health-related quality of life compared to physical therapy without specific exercises. The positive effect was observed after an intervention period of 20 weeks and was maintained after 1 year. However, the results show a large variability within both groups.
- The significant differences between the intervention groups persisted with continued low levels of pain and disability in the exercise group two years after delivery, indicating beneficial long-term effects of a treatment program focusing on specific stabilizing exercises. However, improvements in pain and significant reduction in disability were also found within the control group.
- We recommend treating postpartum PGP with stabilizing exercises. The exercise program should however, be individualized and supervised, focusing on the local muscle system with gradually addition of exercises for the global system. Further studies are needed to examine the importance of the different aspects, such as choice, order and dosage of exercises, supervision and compliance.
- No statistically significant difference in voluntary muscle contraction of the deep abdominals (TrA and obliquus internus) or PFM strength was found between the PGP group and the recovered group. Neither was any significant difference found in the ability to contract muscles voluntarily between those with positive and those with negative ASLR test. An increase in muscle thickness of the deep abdominal muscles and PFM strength were not associated to each other or to PGP.

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Available on www.fysioterapeuten.no/fag

Stuge B. Physical therapy for pregnancy-related pelvic girdle pain: underlying principles and effect of treatment. (PhD-thesis) Faculty of Medicine, University of Oslo: Oslo: Unipub; 2005.

The dissertation can be bought from the author or rented from the library at: http://ask.bibsys.no/ask/action/smpsearch?&lang=no

Abstract

This article presents the essence of a PhD-thesis which increased the knowledge about treatment of pregnancy-related pelvic girdle pain (PGP). Patients often consult physiotherapists for treatment of their PGP, but the evidence for the effect of different treatment modalities has been uncertain. This is shown in a review of physiotherapy interventions. Based on recent research of motor control of local muscles to provide segmental control and dynamic stability of the lumbopelvic region, a physiotherapy program including specific exercises was proposed, and results from the trial are reported. The thesis contains five papers (P): P I a systematic review of the effect from various physical therapy interventions; P II a randomized controlled trial; P III a follow up over two years; P IV principles for stability training; P V a case control study assessing deep muscle activation. The thesis showed no strong evidence for pain prevention, strong and long lasting treatment effect of physiotherapy including specific stabilization exercises, and no statistical significant difference in voluntary local muscle contraction between responding and non-responding individuals.