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Original article

The association between pelvic floor muscle function and pelvic girdle pain – A matched case control 3D ultrasound study

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ABSTRACT

There is uncertainty regarding the association between the function of the pelvic floor muscles (PFM) and pelvic girdle pain (PGP), and whether exercises to strengthen the PFM should be recommended for patients with PGP. This one-to-one matched case-control study examined whether there is any difference in voluntary PFM function between women with and without clinically diagnosed PGP. PFM function was assessed by manometry and three-dimensional ultrasound. Images were saved anonymously and analyses were performed offline by one investigator. A special Cox regression model was used to fit a conditional logistic regression procedure for one-to-one matched case-control studies. Forty-nine pairs of women were successfully matched according to age and parity. The study showed no difference in voluntary PFM function measured by palpation, manometry or ultrasound. The size of the levator hiatus area, together with BMI, was significantly associated with PGP. Women with PGP had statistically significantly smaller levator hiatus areas and a tendency for higher vaginal resting pressure compared to the control group. A significantly smaller levator hiatus and a tendency for higher vaginal resting pressure may indicate increased activity of the PFM. Hence, no evidence was found to recommend strengthening exercises for the PFM in patients with PGP. It is important to note that in this study we examined only voluntary contractions and not an automatic response of the PFM to a functional activity.

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1. Introduction

Pelvic girdle pain (PGP) generally arises in relation to pregnancy and pain is experienced between the posterior iliac crest and the gluteal fold, particularly in the vicinity of the sacroiliac joints (Vleeming et al., 2008). It has been estimated that 20–25% of all pregnant women suffer from PGP sufficiently severely to seek medical help (Wu et al., 2004; Vleeming et al., 2008). Most women recover spontaneously postpartum; however, in about 7% PGP persists for years after delivery (Albert et al., 2001). The etiology of PGP is unclear and probably multifactorial with a combination of both hormonal and biomechanical factors as the most common hypothesis behind the development of PGP (Vleeming et al., 2008). An alteration to the functioning of the deep stabilizing muscles may be a reason for ongoing pain and is believed to affect lumbopelvic stability (Beales et al., 2009). It has been suggested that stability of the pelvis is obtained by ridges and grooves in the articular surfaces of the sacroiliac joint (SIJ), which allow form closure, and additional compression forces, which are generated by muscles, fascia and ligaments, provide force closure (Snijders et al., 1993).

A large number of muscles play a role in lumbopelvic stability, including the pelvic floor muscles (PFM). Besides controlling continence and the position of the pelvic organs, the PFM have another function in providing stability to the lumbopelvic region (Neumann and Gill, 2002; Richardson et al., 2004; Sapsford, 2004). Due to their contribution to the modulation of intra-abdominal pressure and stiffness of the sacroiliac joints, the PFM are said to provide a way of controlling the lumbar spine and pelvis (Hodges et al., 2007). Although no studies have directly assessed the effect of PFM activity on lumbopelvic stiffness, simulated tension of the PMF increased stiffness of the pelvic ring in an experimental study (Pool-Goudzwaard et al., 2004). The PFM surround the pelvic openings and during voluntary contraction the muscles increase urethral closure pressure, lift the pelvic organs and prevent descent during rise in intra-abdominal pressure (Ashton-Miller and Delancey, 2007), as well as constricting the levator hiatus (Dietz et al., 2005).

It is hypothesized that PFM dysfunction may cause a deficit in the force closure mechanism, resulting in impaired load transfer and pain in the lumbopelvic area (Pool-Goudzwaard et al.,

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2004, 2005). Whereas the association between lumbopelvic pain and deep abdominal muscles has been studied and debated (Richardson et al., 2002; Stuge et al., 2006; Smith et al., 2008; Gubler et al., 2010), few studies have examined the PFM function in patients with low back or PGP, commonly labeled lumbopelvic pain. However, in a study by O'Sullivan and Beales (2007) subjects with SIJ pain exhibited descent of the bladder during conscious contraction and Pool-Goudzwaard et al. (2005) demonstrated increased activity and reduced endurance time of the PFM in patients with lumbopelvic pain. Accordingly, there is uncertainty regarding the association between the function of the PFM and PGP and whether strengthening exercises for the PFM should be recommended.

Despite numerous studies, general agreement on the most valid and reliable method for PFM assessment has been lacking. The use of a combination of assessment tools is, however, recommended to assess different aspects of the functioning of the PFM (Slieker-ten Hove et al., 2009). Transperineal ultrasound is considered more reliable than transabdominal ultrasound (Thompson et al., 2007), and three-dimensional (3D) ultrasound is regarded as the preferred method. 3D ultrasound allows multiplanar imaging and has been found to measure functional aspects of PFM contraction, such as squeeze and lift reliably (Braekken et al., 2009b).

To our knowledge, no previous study has investigated the association between PFM function and PGP postpartum by palpation, vaginal pressure transducer (manometry) and 3D ultrasound. Thus, the aim of this study was to examine whether there is any difference in voluntary PFM function in women with and without clinically diagnosed PGP.

2. Material and methods

2.1. Study design

The study was designed as an individual, one-to-one matched case-control study. Each woman was matched by age (±5 years), number of vaginal deliveries and the age of her children (±5 years for those more than 1 year and ±1 month for those less than 1 year). The study was approved by the Regional Committee for Medical Research Ethics in Oslo, Norway.

2.2. Participants

The participants were selected during spring 2010, were at least 6 months postpartum and were able to speak and understand norwegian. The cases included were patients recruited consecutively by physical therapists in Oslo, Norway. All patients were examined by one physical therapist (KS) and assessed against recommended criteria for PGP (Stuge et al., 2004; Vleeming et al., 2008). The inclusion criteria were: PGP located distal or lateral to the L5-S1 area in the buttocks or in the symphysis with pain onset during pregnancy or within three weeks after delivery. Fulfillment of the diagnostic criteria was based on the following tests: Posterior Pelvic Pain Provocation (P4) test; Active Straight Leg Raise (ASLR) test; pain provocation of long dorsal sacroiliac ligament; pain provocation of the symphysis by palpation and by a modified Trendelenburg test. The P4 test or the ASLR test (score of at least 3) had to be positive on the right or left side, and at least one of the other three tests had to be positive. The P4 and the ASLR are well-established tests for PGP, with acceptable reliability and validity (Ostgaard et al., 1994; Mens et al., 2001; Robinson et al., 2007; Gutke et al., 2009). The P4 test was scored as positive or negative (Ostgaard et al., 1994), whereas for the ASLR test, the patients were asked to score the difficulty of lifting their legs on a six-point scale from 0 (not difficult at all) to 5 (impossible) and the scores from both sides were added to a sum score 0–10 (Mens et al., 2001). The control subjects were women without PGP recruited from friends of the participants and by interactive announcements. The exclusion criteria for both groups were: less than 6 months since delivery, radiating back pain and previous pelvic floor surgery.

2.3. Procedure

The women included in the sample completed a questionnaire consisting of sociodemographic data (age, education, work status, height and weight), urinary incontinence, pelvic organ prolapse, pain and functional status measured by the Oswestry Disability Index (ODI) (Fairbank et al., 1980) and Pelvic Girdle Questionnaire (PGQ) (Stuge et al., 2011). Two questions concerning vaginal bulge and vaginal heaviness covered pelvic organ prolapse symptoms (Mouritsen and Larsen, 2003). The International Consultation on Incontinence Urinary Incontinence Short Form questionnaire (Avery et al., 2004) assessed urinary incontinence and its impact on the quality of life. Appointments were made for clinical examination of the PFM. The clinical and ultrasound assessments of the PFM were performed by an experienced physical therapist (IHB), blinded to group allocation and background data.

The ability to perform a PFM contraction was assessed by visual observation and vaginal palpation while the subject was supine (Bo and Sherburn, 2005). Manometry was evaluated with a vaginal balloon catheter (balloon size 6.7 × 1.7 cm) connected to a high precision pressure transducer (Camtech AS, Oslo, Norway). The pressure transducer had conventional, current electronic sensor technology. The middle of the balloon was placed 3.5 cm from the vaginal introitus in the vaginal high pressure zone (Bo et al., 1990b; Guaderrama et al., 2005).

The participants emptied their bladders before the ultrasound examination. A GE Voluson E8 ultrasound system (GE Healthcare, Oslo, Norway) with a 3D/4D ultrasound transducer (4–8 MHz, RAB 4–8 l/obstetric) was used. The probe was covered with a condom and placed on the perineum in the sagittal plane. The field of view angle was set to its maximum 90 × 85°. The depth was 6.5 cm, and the focus to 3.5 cm to optimize the clarity of the PFM. Adjustments were made to the focus and brightness to obtain the best possible pictures. The ultrasound procedure followed the recommendations of Dietz (2004). The participants performed three PFM contractions while supine and the images were saved anonymously. For test-retest analyses the ultrasound examination was repeated immediately after the first examination of 18 of the participants. The ultrasound images were analyzed offline (4D View v 10.0; GE Healthcare, Oslo, Norway) by one investigator (X) 6 to 12 months after the final examination. The investigator was blinded to group allocation and background data.

2.4. Outcome measures

2.4.1. Ultrasound measurements

Axial plane analyses included measurements of the levator hiatus area and pubovisceral muscle length, additionally measurements of the anterio-posterior and transverse distance of the levator hiatus and levator urethra gap (Fig. 1). All analyses in the axial plane were performed using rendered volume with the centre placed in the plane of minimal hiatal dimensions (Kruger et al., 2010). The one volume out of the three contractions captured with the most narrowing of the levator hiatus antero-posterior distance was used in further analyses. The levator hiatus area was defined as the area bordered by the pubovisceral muscle (inner part of the PFM), symphysis and inferior pubic ramus in the axial plane. Pubovisceral muscle length was defined as the inner border of the muscle sling, calculated as the circumference of the levator hiatus

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