

Analysis of the influence of various types and positions of pelvic belts on gait parameters in pregnant women with pelvic pain

Jeanne Bertuit^{a,b,*} and Véronique Feipel^{b,c}

^a*School of Health Sciences (HESAV), University of Applied Sciences and Arts Western Switzerland (HES-SO), Lausanne, Switzerland*

^b*Laboratory of Functional Anatomy, Faculty of Motor Sciences, Université Libre de Bruxelles (ULB), Brussels, Belgium*

^c*Laboratory of Anatomy, Biomechanics and Organogenesis – Faculty of Medicine, Université Libre de Bruxelles (ULB), Brussels, Belgium*

Abstract.

BACKGROUND: Many pregnant women develop pelvic pain during their pregnancy. Pregnancy can modify pelvic geometry while causing micro-mobility, leading to some instability, which will manifest itself through pain and an increase of tiredness when walking. Pelvic belts could restore stability and help reduce pain, thus facilitating motor activities such as walking. However, there are no guidelines on the use of pelvic belts.

PURPOSE: The objective of this study was to compare the effects of two types of belts and several belt positions on gait parameters in pregnant women.

METHODS: Forty-six pregnant women with pelvic girdle pain and 23 non-pregnant women were recruited. The motor task consisted in several gait trials at three different speeds, with and without pelvic belt. Temporal and spatial parameters were analysed. Two pelvic belts (narrow and flexible or broad and rigid) and several positions (high or low) were used. An analysis of variance for repeated measures (ANOVA) assessed the effects of group (pregnant/not pregnant), gait speed and belt.

RESULTS: Gait parameters did not show any significant difference according to belt type or position. For pregnant women, gait velocity was reduced. Gait cycle phases were modified by an increase of stance phase and double support. Gait pattern displayed alterations during pregnancy. These changes favour a more stable and safe gait.

Conclusion: There was no difference between belt positions (high and low) or between belt types (narrow and flexible or broad and rigid) on gait parameters. This suggests that all belt types and positions could be advised to pregnant women.

Keywords: Pregnant women, gait, pelvic girdle pain, pelvic belt

1. Introduction

About 50% of pregnant women suffer from pelvic girdle pain, which is reported as the most common

cause of sick leave [1–3]. Pain is localized in the posterior region of the pelvis, between the posterior iliac crest and the gluteal fold, particularly in the vicinity of the sacroiliac joint. It may also affect the pubic symphysis [3]. Aetiologies of PGP are multifactorial and affect the joint stability of SIJ. The ‘self-locking’ mechanism explains how shear in the SIJ is prevented by the combination of the structure of the anatomical features (form closure) and

*Corresponding author: Professor Jeanne Bertuit, School of Health Sciences (HESAV), Avenue de Beaumont 21, 1011 Lausanne, Switzerland. Tel.: +41 21316 81 33; E-mail: jeanne.bertuit@hesav.ch.

the compression generated by muscles and ligaments, which can be accommodated to the specific loading situation by a self-bracing mechanism (force closure). The tension of the specific tissues passing over the SIJ leads to higher friction and hence stiffness [4]. PGP seems to be related to hormonal and mechanical factors which have an impact on force closure leading to instability, owing to a slightly larger range of movement in the pelvic joints [5–7]. This instability could lead to pelvic or low back pain and hinder daily activities such as walking [8, 9].

To restore pelvic stability, the use of pelvic belts could be advised. According to the biomechanical model – although certain authors disagree [10–12] – a pelvic belt could press sacroiliac joint surfaces together and generate a ‘self-locking’ mechanism to improve pelvic girdle stability. One possible explanation could be linked to decreased muscle activity [13, 14] and a release of the tension in the ligaments (the sacrospinous, sacrotuberous and the interosseous sacroiliac ligaments) during the use of a belt [15]. In a previous study, a pelvic belt was shown to be efficient for altering muscle activation patterns [16]. It is also likely that the belt has an effect on motor activities such as walking. Wearing a belt would provide postural support, which could significantly improve gait stability [17].

In a randomised control study involving forty-six pregnant women, Bertuit et al. (2017) analysed the effect of belts worn during nine weeks on pain and disability. The results showed that the use of pelvic belts during several weeks reduced pelvic girdle pain, particularly in the sacroiliac joint. Pain intensity decreased by 20 mm ($p: 0.004$) on a visual analogic scale, and daily activities such as standing, walking and sitting were made easier ($p < 0.001$). These conclusions were drawn after testing the regular use of belts for short periods (4 days/week and ± 2 h30/day) over two months. In this study, two types of belts were distributed to the pregnant women. A difference between the two types was noted: the narrow flexible belt lead to a significant decrease in SIJ and global pain, while the broader and more rigid belt lead to a decrease in back pain, suggesting the possibility of a differential benefit of both types of belts. Further research is needed to confirm if the different types of belts (flexible or rigid belt) could have different effect during pregnancy [9]. Also, the flexible belt seemed to be better tolerated by the subjects compared to the rigid belt [9, 18].

Two belt positions have been evaluated in previous studies: a high position where the belt acts at the level

of the anterior superior iliac spine and a low position, where the belt acts at the height of the greater trochanter and pubic joint [19]. Pelvic belt positions are considered to have an impact on musculoskeletal structures and on stability: Wearing a belt in the high position would imitate the action of multifidus and transverse abdominal muscles. It would improve the stability of the sacroiliac joint by increasing compression forces by 52% [11, 19, 20]. Another study suggests that the low position leads to an increased muscular activity in the pelvic floor [11]. This position would relieve ligaments by 50% and improve compression forces by 40% [19].

Despite the multitude of products currently available, their clinical assessment remains weak, unclear and controversial. Currently, there are no guidelines on the use of pelvic belts. In order to improve the follow-up of pregnant women, it is necessary to be able to give advice grounded in evidence-based practice. Belts are easy to use, of limited cost and without side effects, which suggests that belts could be a promising device for pregnant women with pelvic pain [21]. As different belt positions and types were shown to influence the effect on stability, pain, disability and musculoskeletal structure, it is likely that the belts will have an impact on gait parameters facilitating motor function. It is important to further explore this field in order to know if there is one type of belt which facilitates activities the most.

The objective of this study was to compare the effects of two types of belts (narrow and flexible and broad and rigid) and different positions (high or low) on gait parameters (at three speeds) in pregnant women with pelvic girdle pain.

2. Methods

2.1. Participants

The characteristics of the three groups are presented in Table 1.

Recruitment was carried out at the Erasme University Hospital (Brussels, Belgium) in the gynaecology-obstetrics and maternal care departments and during pre- and post-natal gymnastics sessions.

For the first and the second groups, forty-six pregnant women with pelvic girdle pain aged between 25 and 35 years were recruited. The inclusion criteria were: women between the 5th and 7th month of their pregnancy, with pain in the sacroiliac joints

Table 1
Characteristics of the study samples

Groups	Number of subjects	Age (years)	Height (cm)	Week of pregnancy	Mass (kg)	VAS (mm)
A	21	29 (5)	162 (7)	28 (6)	66 (10)	60 (20)
B	25	30 (6)	163 (4)	26 (5)	72 (8)	50 (30)
A+B	46	30 (5)	162 (5)	27 (5)	71 (11)	
CG	23	27 (5)	168 (6)	/	/	/

CG: Control Group. VAS: Visual. Analogue Scale.

and/or pubic region - as verified by a set of tests during clinical examination by the principal physiotherapist investigator: the tests used were the posterior pelvic pain provocation test, Patrick Faber's test, Trendelenburg modified test, and active straight leg raise test, as well as a pain palpation test of the long dorsal ligament /SI joint. These tests have a high sensitivity and specificity. A minimum of 4 to 6 tests should be validated to confirm the presence of pelvic girdle pain [8, 22]. The exclusion criteria were: the presence of lumbopelvic pain before pregnancy, as well as other pathologies involving gait problems, surgery of the lumbar spine, pelvis, hips or knees, fractures, pain radiating below the knee, tumours or active inflammation in the lumbopelvic region, presence of known anomalies of the spine, and rheumatic diseases. Twin pregnancies and pregnancies with complications were also exclusion criteria. These women were randomized, by dice throwing, into two groups (A/B): Group A included twenty-one women who wore belt 1 (see description below) in position high or low in order to analyse the effect of the position of the belt. Group B included twenty-five women who wore belt 1 and belt 2 (see description below) in order to analyse the effect of the type of belt.

The third group, corresponding to the control group, included twenty-three non-pregnant women of the same age range, free from pelvic pain, and without any previous surgery.

All subjects gave written informed consent prior to participation in the study, which was approved by the Ethics Committee of University and Hospital Erasme (Be) (number P2011/017).

2.2. Equipment used

The spatial and temporal parameters of gait were measured using the GAITRite electronic walkway (GAITRite Gold, CIR Systems, PA, USA, length: 6.1 m, width: 61 cm). Embedded pressure sensors form a horizontal grid. As the subject walks over

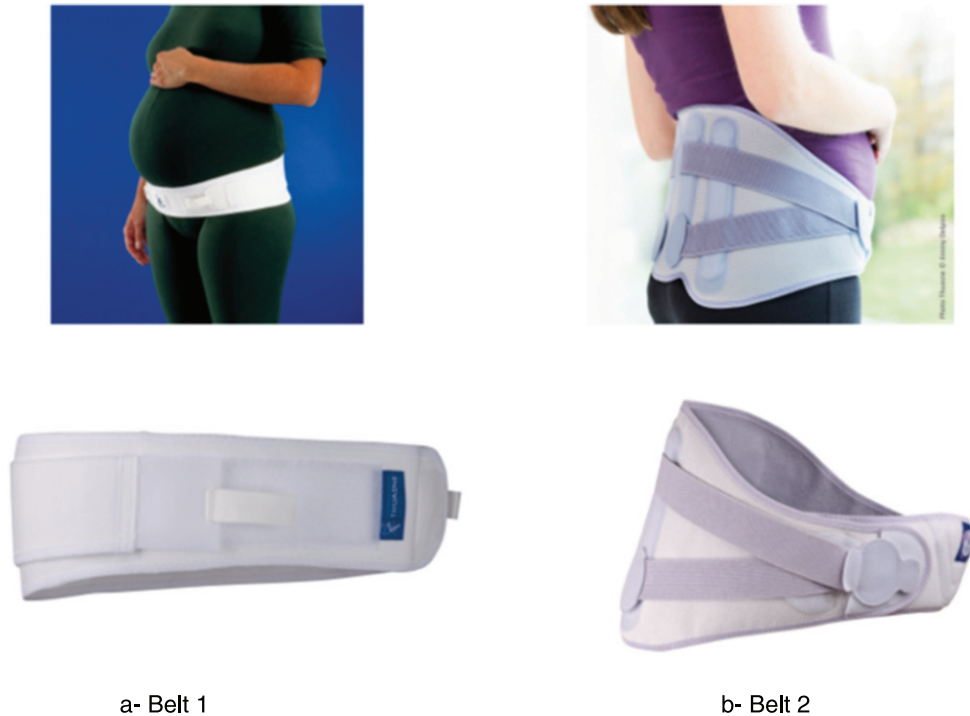
the walkway, activation of the sensors enables collection of spatial and temporal gait parameters. Data are sampled at a frequency of 100 Hz. The walkway is connected to a PC by a serial interface cable. The spatial and temporal characteristics of gait are processed and stored using GAITRite GOLD, version 3.2b software.

Two pelvic belts were used:

- Belt 1 (Ortel-P, Thuasne, FR) (Fig. 1a). This belt is narrow and flexible. The belt can be placed in two positions: high position (at the level of the anterior superior iliac spine) or low position (at the level of the pubis). Women had the belt first adjusted on their body and then modified the belt pressure themselves with Velcro systems on each side.
- Belt 2 (LombaMum, Thuasne, FR) (Fig. 1b). This belt is broad and rigid with metal reinforcements in the lumbar area. It allows only one position but a sophisticated Velcro system makes it possible to adjust tension to a number of different levels.

2.3. Data collection

Because it is known that pregnant women use different adaptive strategies depending on their gait speed [23], the motor task consisted of nine gait trials, at different speeds, with three trials at each speed. Each participant was invited to walk barefoot on the GAITRite walkway for 6.1 m (length of the walkway). A rest period was allowed if the participant felt tired. Its duration was not fixed (the maximum time used was two minutes). Gait speeds were self-selected, but standardized instructions were used. First, the subjects were invited to walk at their preferred speed. Then, the subjects walked at fast and slow speeds. The order was randomized. The instructions for fast speed were: 'walk as fast as possible. As if you were catching a bus' and the instructions for slow speed were 'walk slowly. As if you were window-shopping'. To counter the methodolog-



a- Belt 1

b- Belt 2

Fig. 1. Belts used (www.thuasne.com).

ical bias of acceleration and deceleration in gait, the participants started walking 2 m ahead of the walkway and finished the trial 2 m after the end of the walkway.

Pregnant women walked at first without a belt and then with a belt: group A walked with belt 1 in both high and low positions, group B walked with belt 1 (high position) and belt 2. The order of these conditions was randomized as well. Instructions on the use of belts were provided to patients during an information session. Women were left to freely choose the tension [19] but the principal physiotherapist investigator positioned the belts on participants. Participants of the control group walked without a belt.

2.4. Data processing

During data collection, following information was collected: age, height, weeks of pregnancy and body mass. The level of pain was evaluated with a visual analogue scale (VAS) (Table 1). The following dependent variables were analysed: step length (m), step width (m), and toe in/out angle (degrees) for spatial parameters and gait velocity (m/s), gait cycle time (s), stance (% of gait cycle), single and double support (% of gait cycle) for temporal parameters. The average values over all three trials were calculated.

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2.5. Statistical analysis

All statistical procedures were conducted using Statistica 5.0 software for Windows. To investigate the normal distribution of the data we used the Kolmogorov-Smirnov test. All scores were found to be normally distributed. A Student's *t*-test for paired samples was not significantly different between sides: data for the left and right foot were, thus, averaged. An analysis of variance for repeated measures (ANOVA) was performed for the comparison of all dependent variables between different speeds, belt types, and belt positions (within group factors) and groups (between groups factor) evaluated. When a significant effect was found, the LSD *post hoc* test was applied. The statistical level of significance was set at $p < 0.05$.

3. Results

The 3 groups' characteristics were homogenous and comparable. No statistical differences were

observed regarding the participants' age, height, weeks of pregnancy, mass, and level of pain.

Table 2 shows the results. When compared to the control group, for each speed, pregnant women with pelvic girdle pain walked at a slower pace (-10% at slow speed, -19% at preferred speed and -20% at fast speed - $p < 0.001$). There was an increase in the stance phase by 2% ($p = 0.001$) and double support (+18% - $p < 0.001$).

Pregnant women with pelvic girdle pain walked with smaller steps when compared to the control group. The difference ranged from 0.05 to 0.11 m, depending on the speed ($p < 0.001$) representing a decrease of 9% at slow speed, 13% at preferred speed and 14% at fast speed.

Table 2 shows the results of spatial and temporal gait parameters as a function of belt position and type. One parameter showed a significant difference according to belt position: with a high belt position, step length was reduced by 3% at preferred speed (LSD: $p = 0.003$) and also 3% at fast speed (LSD: $p = 0.009$). The other parameters did not show any significant difference according to belt type or position.

4. Discussion

In this study, the objective was to compare two types of pelvic belts and several belt positions during gait in pregnant women with pelvic girdle pain.

During pregnancy the pattern of gait is significantly modified [24]. Bertuit et al. (2015) observed that the gait speed of healthy pregnant women (0.99 ± 1.06 m/s) was lower by 22% compared to that of non-pregnant women (1.26 ± 1.13 m/s). Pregnant women walked at a slower pace, and gait cycle phases were modified with a decrease of swing and single support and an increased double support. Step width was also increased. This study shows that pregnant women with pelvic girdle pain displayed the same gait adaptations as those found in healthy pregnant women compared to a control group. These adaptations are aimed at obtaining a more stable gait in order to avoid falls or to decrease pelvic pain. These results illustrate the difficulty this motor activity represents for pregnant women [24].

For all gait parameters, we did not observe any difference between the types of belts. However, according to Bertuit et al. (2017), the type of belt

Table 2
Effect of belt – Mean (SD) temporal and spatial parameters of according to speed and groups

	Speed	No belt	Belt		P-values Groups ¹	Positions		P-values Groups ²
			Belt 1	Belt 2		Upper	Lower	
Gait velocity (m/sec)	S	0.73 (0.18)	0.73 (0.13)	0.80 (0.34)	0.710	0.79 (0.25)	0.77 (0.17)	0.734
	P	1.02 (0.21)	0.96 (0.19)	0.95 (0.16)		0.99 (0.23)	1.02 (0.20)	
	F	1.40 (0.47)	1.45 (0.33)	1.36 (0.32)		1.36 (0.30)	1.39 (0.24)	
Gait cycle time (sec)	S	1.41 (0.24)	1.39 (0.18)	1.37 (0.25)	0.196	1.36 (0.25)	1.36 (0.20)	0.389
	P	1.16 (0.11)	1.15 (0.09)	1.19 (0.09)		1.16 (0.12)	1.14 (0.11)	
	F	0.93 (0.11)	0.92 (0.10)	0.96 (0.15)		0.96 (0.12)	0.96 (0.07)	
Stance (%)	S	62 (2)	63 (2)	62 (3)	0.102	62 (3)	61 (3)	0.712
	P	60 (2)	61 (2)	61 (3)		60 (2)	60 (2)	
	F	58 (2)	58 (2)	58 (2)		58 (2)	58 (1)	
Single support (%)	S	40 (15)	37 (2)	39 (5)	0.177	38 (3)	39 (4)	0.982
	P	41 (8)	39 (2)	41 (9)		41 (4)	40 (4)	
	F	43 (5)	42 (2)	43 (7)		42 (2)	42 (1)	
Double support (%)	S	26 (4)	26 (3)	25 (6)	0.608	24 (5)	27 (11)	0.340
	P	23 (14)	22 (3)	22 (2)		21 (4)	21 (3)	
	F	18 (10)	17 (4)	17 (3)		17 (4)	16 (3)	
Step length (m)	S	0.50 (0.07)	0.50 (0.05)	0.51 (0.07)	0.103	0.51 (0.08)	0.50 (0.06)	0.013
	P	0.58 (0.08)	0.55 (0.09)	0.55 (0.07)		0.56 (0.10)	0.57 (0.07)	
	F	0.67 (0.09)	0.65 (0.10)	0.63 (0.10)		0.64 (0.09)	0.65 (0.09)	
Step width (m)	S	0.10 (0.03)	0.11 (0.03)	0.10 (0.03)	0.850	0.09 (0.03)	0.09 (0.02)	0.372
	P	0.10 (0.03)	0.09 (0.04)	0.10 (0.03)		0.10 (0.02)	0.10 (0.03)	
	F	0.10 (0.03)	0.10 (0.04)	0.09 (0.03)		0.10 (0.02)	0.10 (0.03)	
Toe in/out (degrees)	S	7 (5)	8(5)	7 (5)	0.715	6 (5)	6 (5)	0.106
	P	5 (5)	6 (5)	6 (5)		5 (5)	4 (5)	
	F	4 (5)	5 (5)	4 (5)		3 (5)	3 (4)	

S: slow, P: preferred.
F: fast R-ANOVA.

could influence the sensation of pain. In this study, the narrow and flexible belt achieved better results on pain, which would lead us to favour this type of belt [9]. The present study shows that belts do not have a major influence on motor activities such as walking. These results do not allow us to emit a preference for one type of belt over another. Results for belt positions showed no differences between the high and the low positions, with the exception of step length which was reduced by 3% with the belt in low position. In the literature there is no consensus on the best position for pelvic belts [11, 19]. The results of the present study do not support an advantage of one of the positions compared to the other, in terms of their influence on gait parameters.

From the results of this study, the position and the type of belt does not appear to have an effect on gait. Nevertheless, taking into account the results described previously for pain, the flexible and narrow belt seems to be better tolerated [9]. With this study and a previous study [9], the following guideline points for clinical practice can be suggested:

- 1) Pelvic belts decrease pelvic girdle pain and improve functional capacity [9].
- 2) Pelvic belts are easy to use and well accepted by women [9].
- 3) The literature encourages clinicians to suggest the use of pelvic belts to pregnant women.
- 4) Women can choose the belt that suits them best.
- 5) Belt positions should be personalized to relieve the woman's pain.
- 6) In order to be effective, it is advisable to use the belt regularly (4 days/week) during a short period (2.5 hours/day).

The present study has several limitations. This study only considered the immediate effects of pelvic belt type and position on gait parameters. Conclusions on the long-term effects can thus not be drawn. However, a within-group design, as the one chosen for each of the two factors, warrants sample homogeneity. The fact that the sample did not include patients with pelvic girdle pain in early pregnancy is also a limitation of our work. This study did not analyse pain according to belt position or type.

5. Conclusion

No difference was observed between belt positions (high and low) and belt types (narrow and flexible or broad and rigid) on gait parameters. In combination

with results of previous studies, this suggests that all belt types and positions can be advised to pregnant women. Besides clinical considerations, the choice of a pelvic belt and its placement can thus be based on individual comfort criteria of the patient, as these factors will not influence their biomechanical effect on gait.

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Conflict of interest

The authors declare that there is no conflict of interests regarding the publication of this article.

References

- [1] Robinson HS, Mengshoel AM, Veierød MB, Vøllestad N. Pelvic girdle pain: potential risk factors in pregnancy in relation to disability and pain intensity three months postpartum. *Man Ther* 2010;15:522–8. doi:10.1016/j.math.2010.05.007.
- [2] Larsen EC, Wilken-Jensen C, Hansen A, Jensen DV, Johansen S, Minck H, et al. Symptom-giving pelvic girdle relaxation in pregnancy, I: prevalence and risk factors. *Acta Obstet Gynecol Scand* 1999;78:105–110.
- [3] Vleeming A, Albert HB, Östgaard HC, Sturesson B, Stuge B. European guidelines for the diagnosis and treatment of pelvic girdle pain. *Eur Spine J* 2008;17:794–819.
- [4] Vleeming A, Stoecart R, Volkens AC, Snijders CJ. Relation between form and function in the sacroiliac joint. Part I: Clinical anatomical aspects. *Spine* 1990;15:130.
- [5] Kristiansson P, Svärdsudd K, von Schoultz B. Reproductive hormones and aminoterminal propeptide of type III procollagen in serum as early markers of pelvic pain during late pregnancy. *Am J Obstet Gynecol* 1999;180:128–34.
- [6] Mens J, Pool-Goudzwaard A, Stam HJ. Mobility of the pelvic joints in pregnancy-related lumbopelvic pain: a systematic review. *Obstet Gynecol Surv* 2009;64:200.
- [7] Aldabe D, Ribeiro DC, Milosavljevic S, Dawn Bussey M. Pregnancy-related pelvic girdle pain and its relationship with relaxin levels during pregnancy: a systematic review. *Eur Spine J Off Publ Eur Spine Soc Eur Spinal Deform Soc Eur Sect Cerv Spine Res Soc* 2012;21:1769–76. doi:10.1007/s00586-012-2162-x.
- [8] Mens, J M A, Vleeming A, Stoecart R, Stam HJ, Snijders CJ. Understanding Peripartum Pelvic Pain. *Spine* 1996;21:1363–70.
- [9] Bertuit J, Van Lint CE, Rooze M, Feipel V. Pregnancy and pelvic girdle pain: analysis of pelvic belt on pain. *J Clin Nurs* 2017. doi:10.1111/jocn.13888.

- [10] Pool-Goudzwaard AL, Vleeming A, Stoeckart R, Snijders CJ, Mens JMA. Insufficient lumbopelvic stability: a clinical, anatomical and biomechanical approach to “a-specific” low back pain. *Man Ther* 1998;3:12–20.
- [11] Mens JMA, Damen L, Snijders CJ, Stam HJ. The mechanical effect of a pelvic belt in patients with pregnancy-related pelvic pain. *Clin Biomech Bristol Avon* 2006;21:122–7. doi:10.1016/j.clinbiomech.2005.08.016.
- [12] Soisson O, Lube J, Germano A, Hammer K-H, Josten C, Sichtung F, et al. Pelvic belt effects on pelvic morphology, muscle activity and body balance in patients with sacroiliac joint dysfunction. *PLoS One* 2015;10:e0116739. doi:10.1371/journal.pone.0116739.
- [13] Park K-M, Kim S-Y, Oh D-W. Effects of the pelvic compression belt on gluteus medius, quadratus lumborum, and lumbar multifidus activities during side-lying hip abduction. *J Electromyogr Kinesiol Off J Int Soc Electrophysiol Kinesiol* 2010;20:1141–5. doi:10.1016/j.jelekin.2010.05.009.
- [14] Jung H-S, Jeon H-S, Oh D-W, Kwon O-Y. Effect of the pelvic compression belt on the hip extensor activation patterns of sacroiliac joint pain patients during one-leg standing: a pilot study. *Man Ther* 2013;18:143–8. doi:10.1016/j.math.2012.09.003.
- [15] Sichtung F, Rossol J, Soisson O, Klima S, Milani T, Hammer N. Pelvic belt effects on sacroiliac joint ligaments: a computational approach to understand therapeutic effects of pelvic belts. *Pain Physician* 2014;17:43–51.
- [16] Oh J-S. Effects of Pelvic Belt on Hip Extensor Muscle EMG Activity during Prone Hip Extension in Females with Chronic Low Back Pain. *J Phys Ther Sci* 2014;26:1023–4. doi:10.1589/jpts.26.1023.
- [17] Krkeljas Z. Changes in gait and posture as factors of dynamic stability during walking in pregnancy. *Hum Mov Sci* 2017. doi:10.1016/j.humov.2017.12.011.
- [18] Flack NA, Hay-Smith EJC, Stringer MD, Gray AR, Woodley SJ. Adherence, tolerance and effectiveness of two different pelvic support belts as a treatment for pregnancy-related symphyseal pain - a pilot randomized trial. *BMC Pregnancy Childbirth* 2015;15:36. doi:10.1186/s12884-015-0468-5.
- [19] Pel, J J M, Spoor CW, Goossens, R H M, Pool-Goudzwaard. Biomechanical model study of pelvic belt influence on muscle and ligament forces. *J Biomech* 2008;41:1878–84.
- [20] Damen L, Buyruk HM, Güler-Uysal F, Lotgering FK, Snijders CJ, Stam HJ. The prognostic value of asymmetric laxity of the sacroiliac joints in pregnancy-related pelvic pain. *Spine* 2002;27:2820–4. doi:10.1097/01.BRS.0000035726.65066.57.
- [21] Carr CA. Use of a maternity support binder for relief of pregnancy-related back pain. *J Obstet Gynecol Neonatal Nurs JOGNN NAACOG* 2003;32:495–502.
- [22] Albert H, Godskesen M, Westergaard J. Evaluation of clinical tests used in classification procedures in pregnancy-related pelvic joint pain. *Eur Spine J* 2000;9:161–166.
- [23] Wu WH, Meijer OG, Bruijn SM, Hu H, Van Dieën JH, Lamoth CJC, et al. Gait in Pregnancy-related Pelvic girdle Pain: amplitudes, timing, and coordination of horizontal trunk rotations. *Eur Spine J* 2008;17:1160–1169.
- [24] Bertuit J, Feipel V, Rooze M. Temporal and spatial parameters of gait during pregnancy. *Acta Bioeng Biomech Wroc Univ Technol* 2015;17:93–101.