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Pelvic alignment risk factors associated with sacroiliac joint pain during pregnancy

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Summary

Purpose of investigation: To investigate the influence of the change in pelvic alignment during pregnancy on sacroiliac joint pain (SIJP). *Materials and Methods:* Participants included 168 women without SIJP at recruitment and were evaluated at 12 and 36 weeks of pregnancy. SIJP intensity was assessed using the Numerical Rating Scale (NRS). Pelvic alignment measurements included the anterior and posterior width of the pelvis, anterior pelvic tilt, and pelvic asymmetry. Participants were divided into the SIJP and non-SIJP groups based on the presence of SIJP at 36 weeks of pregnancy. The influence of the change in pelvic alignment during pregnancy between the groups was investigated. *Results:* The amount of change in pelvic anteversion during pregnancy was smaller and the change in pelvic asymmetry was significantly greater in the SIJP group compared to that in the non-SIJP group. In addition, an increase in pelvic asymmetry was the most strongly associated risk factor for SIJP. *Conclusions:* A forward-bending pelvis in early pregnancy and an increase in pelvic asymmetry during pregnancy are risk factors for pregnancy-related SIJP.

Key words: Pelvic alignment; Pelvic asymmetry; Posterior pelvic pain; Pregnancy; Sacroiliac joint pain.

Introduction

Sacroiliac joint pain (SIJP), sometimes called posterior pelvic pain, is pain felt at or near the sacroiliac joints of the pelvis and can be a major discomfort during pregnancy [1, 2]. Unfortunately, pregnancy-related SIJP typically increases with advancing pregnancy and adversely impacts a woman's daily activities during and after pregnancy [3, 4]. Despite a number of research studies investigating the management of these pains [5, 6], there are several limitations to the treatments available during pregnancy. For example, pharmacotherapy and a surgical operation are often unsuitable due to adverse effects on pregnant women and developing fetuses [7, 8]. Thus, risk factors for SIJP during pregnancy must be identified in order to address and prevent the pain.

The main factors related to SIJP during pregnancy are considered to be: elasticity of the joints, such as the sacroiliac joint, due to pregnancy-related hormones; and an overload on the posterior aspect of the pelvis and lower back due to the forward shifting of woman's center of gravity caused by the gravid uterus [9, 10]. In a previous study, asymmetric of pelvis alignment and irritation of pelvic and lumbar ligaments was observed [11]. Also, asymmetric laxity of the sacroiliac joints during pregnancy has been previously reported to be significantly greater in women with moderate to severe pregnancy-related pelvic pain compared to women with no or mild pain [12]. These results suggest that changes in pelvic alignment can easily occur during pregnancy and these might be related to LPP. However, causation is not clear as this previous study used a cross-sectional design. Moreover, assessments that are easy to evaluate and factors that are easy to approach are necessary for the management of SIJP. For instance, posture and alignment are easy to evaluate visually and can be corrected by manual therapy, exercise, or by giving instructions regarding daily activities [13-15]. Therefore, this study aimed to investigate the influence of the amount of change in pelvic alignment on SIJP during pregnancy using a longitudinal design.

Materials and Methods

This longitudinal observational study was conducted from May 2014 to March 2016 in the Obstetrics and Gynecology clinics at Aichi Prefecture, Japan and pregnant women were recruited in this period and geographic area. The inclusion criteria were < 12 weeks of pregnancy and a singleton pregnancy. Women with serious orthopedic disorders or neurological diseases were excluded. Those with a high-risk pregnancy were also excluded. Two hun-

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dred and seventy-five women who met the inclusion criteria for the survey and agreed to participate in the study were initially enrolled. Participants were observed at 12 and 36 weeks of pregnancy. Among the initially enrolled participants, 58 women discontinued their participation due to hospital transfers, childbirth before 36 weeks of pregnancy, or personal feelings. The authors wanted to investigate the predictors of pregnancy-related SIJP; therefore, 49 who had already developed SIJP at 12 weeks of pregnancy were excluded from the data analysis. Therefore, the final sample used in the analyses consisted of the remaining 168 women.

Personal characteristics (age, height, weight before the pregnancy, and number of previous deliveries) were obtained at the time of recruitment. In addition, weight was recorded at 12 and 36 weeks of pregnancy. SIJP intensity was assessed at 12 and 36 weeks of pregnancy using the Numerical Rating Scale (NRS) [16]. The NRS is an 11-point pain rating scale with the endpoints representing the extremes of no pain and worst pain. The previous history of SIJP before the pregnancy was also investigated. The location of the sacroiliac joint was explained using a picture of the human body. Based on their responses at 36 weeks of pregnancy, participants were categorized into SIJP (NRS score > 0) and non-SIJP (NRS score = 0) groups.

Pelvic alignment was measured using a palpation meter. The length of the anterior and posterior pelvis, as well as the anterior pelvic tilt were measured bilaterally by placing the caliper tips of the palpation meter in contact with the ipsilateral anterior and posterior superior iliac spines (ASIS and PSIS). The lengths (in centimeters) between both ASIS and both PSIS were defined as the length of anterior pelvis and posterior pelvis, respectively (Figure 1). The mean of left and right pelvic tilt (in degrees) was defined as the anterior pelvic tilt (Figure 1). The difference between the pelvic tilt on the right and left side was defined as pelvic asymmetry. This is a valid, reliable, and cost-effective method for calculating any discrepancy in a patient's landmarks [17, 18]. During the pelvic alignment assessment, the participants took off their shoes and stood with hands crossed in front of their chest. Before the measurement, the measurers (some midwives and physical therapists) learned and used the method of the palpation meter and practiced repeatedly. In order to verify accuracy, nine measurements of pelvic alignment of a woman separately were taken by the above method. The verification procedure was repeated twice, two weeks apart. As the result, the measurement procedure showed acceptable intra and inter-rater reliability with Intraclass Correlation Coefficients (ICC 1.1) of 0.989 (95% confidence interval: 95% CI 0.971-0.996) and (ICC 2.1) of 0.992 (95% CI 0.972-0.999) for the measurements of the length of anterior and posterior pelvis, and of 0.998 (95% CI 0.995-0.999) and 0.998 (95% CI 0.992-1.000) for the anterior pelvic tilt in this study.

The present study was carried out in accordance with the guidelines of the Declaration of Helsinki, and the study protocol was reviewed and approved by the Ethics Committee of the Kyoto University Graduate School of Medicine. Written informed consent was obtained in accordance with the guidelines.

An initial independent *t*-test was used to evaluate group differences in the amount of change in pelvic alignment (anterior pelvis length, posterior pelvis length, anterior pelvic tilt, and pelvic asymmetry) from 12 to 36 weeks of pregnancy. After this initial analysis, a multivariate logistic regression analysis was used to identify risk factors for SIJP. The presence of SIJP was specified as the dependent variable, the amount of change in pelvic alignment measurements was specified as the independent variable, and other factors previously associated with SIJP (age, BMI before pregnancy, number of previous deliveries, and the presence of SIJP before pregnancy) [3] were specified as adjustment variables. Finally, a correlation analysis was performed to examine the relation between SIJP intensity (NRS score) and pelvic alignment factors identified as significantly different in the initial group analysis. Statistical analyses were performed using SPSS version 23.0 with a significance threshold set at 0.05.

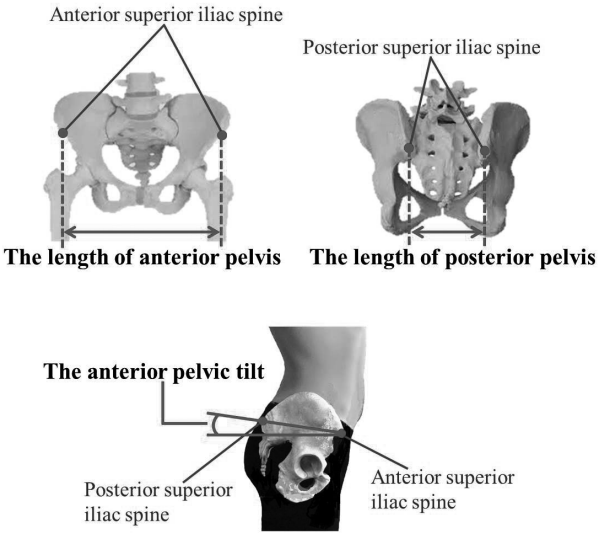

Figure 1. — The measurement points for the pelvic alignment.

Results

The demographic data for both the SIJP and non-SIJP groups are shown in Table 1. The prevalence of SIJP at 36 weeks of pregnancy was 44.6% (SIJP group; n = 75, non-SIJP group; n = 93) and the average intensity of the pain in the SIJP group was 4.8 ± 2.6. In the SIJP group compared with the non-SIJP group (Table 2), the amount of change in pelvic anteversion from 12 to 36 weeks of pregnancy was significantly smaller (0.2 ± 5.2 degrees *vs*. 2.0 ± 5.8 degrees, respectively; $p = 0.032$) (Figure 2C), and the amount of change in pelvic asymmetry was significantly greater (1.3 ± 4.2 degrees *vs*. –0.3 ± 3.3 degrees, respectively; $p = 0.007$) (Figure 2D). No significant differences were observed in the amount of change in anterior pelvis length (2.4 ± 3.2 cm *vs*. 2.4 ± 2.8 cm, respectively; $p = 0.982$) (Figure 2A) or posterior pelvis length (0.4 ± 4.1 cm *vs*. 1.0 ± 3.7 cm, respectively; $p = 0.340$) (Figure 2B). In the multivariate logistic regression analysis, the amount of change in pelvic asymmetry was shown to significantly affect SIJP (odds ratio, 1.133; 95% confidence interval, 1.028–1.249; Table 2). Given these results, the correlation between SIJP intensity and both pelvic anteversion and pelvic asymmetry was evaluated. The amount of change in pelvic asymmetry was significantly as-

Table 1. — *Demographic characteristics of SIJP and non-SIJP participants*.

		Presence of SIJP at 36 WP		
	Total (n = 168)	SIJP group (n = 75)	non-SIJP group (n = 93)	*p*-value
Age (years)	31.0 ± 4.7	31.0 ± 4.9	31.0 ± 4.5	0.997
BMI before pregnancy (kg/m^2)	20.9 ± 2.7	21.2 ± 3.0	20.7 ± 2.5	0.207
Previous deliveries (n)				
None	76	28	48	N/A
One	63	33	30	N/A
Two	25	12	13	N/A
Three	3	2	1	N/A
Four	1	0	1	N/A
Previous history of SIJP (n)	10	5	5	0.725
BMI (kg/m^2)				
12 WP	21.1 ± 2.8	21.4 ± 3.0	20.9 ± 2.6	0.201
36 WP	24.7 ± 2.7	24.9 ± 2.8	24.6 ± 2.7	0.512
Length of anterior pelvis (cm)				
12 WP	22.9 ± 2.9	22.9 ± 2.8	23.0 ± 2.9	0.804
36 WP	25.4 ± 2.6	25.3 ± 2.6	25.4 ± 2.6	0.766
Length of posterior pelvis (cm)				
12 WP	10.9 ± 3.8	11.1 ± 3.9	10.8 ± 3.8	0.687
36 WP	11.7 ± 3.5	11.5 ± 3.6	11.8 ± 3.5	0.542
Pelvic anteversion (degrees)				
12 WP	3.32 ± 5.26	4.25 ± 5.75	2.56 ± 4.72	0.038*
36 WP	4.51 ± 4.86	4.42 ± 4.18	4.59 ± 5.36	0.833
Pelvic asymmetry (degrees)				
12 WP	2.53 ± 2.49	2.45 ± 2.37	2.59 ± 2.59	0.726
36 WP	2.84 ± 3.12	3.57 ± 3.65	2.25 ± 2.48	0.008*

*Values except for previous deliveries and previous history of SIJP are shown as mean ± standard deviation p-value was calculated between the SIJP and non-SIJP groups using the independent t-test or chi-squared test SIJP: sacroiliac joints pain; BMI: body mass index; WP: weeks of pregnancy * p< 0.05*

Table 2. — *Parameters associated with sacroiliac joint pain.*

Parameter	Odds ratio	95% CI	*p*-value
Change in anterior pelvis length	1.008	0.903–1.124	0.89
Change in posterior pelvis length	0.927	0.851–1.011	0.09
Change in pelvic anteversion	0.939	0.851–1.011	0.06
Change in pelvic asymmetry	1.133	1.028–1.249	0.01*
Age	0.993	0.925–1.067	0.85
BMI before pregnancy	1.061	0.941–1.197	0.33
Number of previous deliveries	1.438	0.947–2.185	0.09
Presence of SIJP before pregnancy	1.401	0.368–5.329	0.62

*CI: confidence interval; BMI: body mass index * p< 0.05*

sociated with the intensity of SIJP (r = 0.234, $p = 0.002$). However, the change in pelvic anteversion was not so associated with the intensity of SIJP (r = -0.193, $p = 0.012$).

Discussion

Compared to patients with low back pain, pregnant patients with posterior pelvic pain are usually more disabled, exhibit considerably higher pain scores, and are more difficult to treat [3]. In the current study, the prevalence of SIJP at 36 weeks of pregnancy was about 45%; however, the authors included only women without SIJP at 12 weeks of pregnancy in the current analysis. Hence, a large portion of pregnant women experience SIJP. Thus, the elucidation of the risk factors for pregnancy-related SIJP, especially those that can be dealt with during the pregnancy period, is greatly needed. The current study investigated the influence of the amount of change in pelvic alignment on the occurrence of SIJP during pregnancy. The results suggest that an insufficient increase in pelvic anteversion and an increase in pelvic asymmetry impact the occurrence of SIJP during pregnancy. In addition, the difference between SIJP and non-SIJP groups in the amount of change in pelvic asymmetry maintained statistical significance even after adjustment for other factors previously shown to be related to SIJP. Furthermore, the amount of change in pelvic asym-

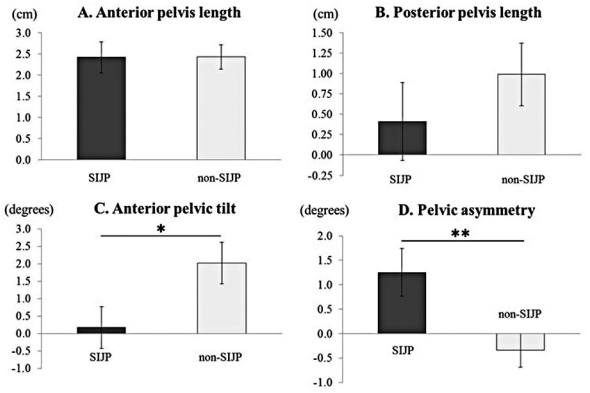

Figure 2. — Changes in pelvic alignment at 36 weeks of pregnancy are shown for SIJP and non-SIJP participants.
SIJP: sacroiliac joints pain; * $p < 0.05$; ** $p < 0.01$.

metry was associated with SIJP intensity.

There is a correlation with increased anteversion early in pregnancy and SIJP. An insufficient increase in pelvic anteversion during pregnancy may result in the joints becoming overloaded. Generally, the pelvis bends forward during pregnancy due to swelling and weight gain in the abdomen as fetal growth occurs [19, 20]. The sacroiliac joint lies below the lumbar spine and plays an important role in supporting the upper body [2]. Thus, some pelvic anteversion during pregnancy is necessary to disperse the additional loads on the axial skeleton. Given that the pelvic anteversion of women in the SIJP group was greater than that of women in the non-SIJP group at 12 weeks of pregnancy (Table 1), women in the SIJP group may not have been able to afford additional bending as the pregnancy progressed. In other words, greater forward bending of the pelvis early in pregnancy may increase risk for SIJP.

Compared with other potential pelvic alignment risk factors, an increase in pelvic asymmetry was the most strongly associated risk factor for SIJP during pregnancy. In a previous study of pregnant women, Sipko *et al.* observed asymmetry in pelvic alignment and asymmetric irritation of the pelvic and lumbar ligaments; however, a relation between these observations was not mentioned [11]. In addition, a relation between asymmetric laxity of the sacroiliac joints and posterior pelvic pain has been reported [12]. Consistent with these reports, the current results indicated that an increase of pelvic asymmetry during the pregnancy period is associated with increased occurrence of pregnancy-related SIJP. Among adults, pelvic asymmetry alters the body mechanics, placing strain on various body segments, subsequently contributing to musculoskeletal pain [21, 22]. In addition to the existence of asymmetric alignment, a difference in the amount of change on left and right sides of the body may lead to maladaptive responses, such as altered movement patterns, resulting in pain symptoms [23]. Along these lines, the development of greater pelvic asymmetry may lead to SIJP during pregnancy. Moreover, the results from the correlation analysis suggest that the intensity of the pain may be reduced by suppressing an increase in pelvic asymmetry. In regards to the result that there was not a strong correlation between pelvic asymmetry and SIJP intensity, one potential reason might be compensation, such as a change in movements patterns to offload the affected joints [24]. Although future studies are needed, the current study provides a new finding suggesting that preventing pelvic asymmetry during pregnancy may minimize worsening pain of SIJP.

There were several limitations to discuss. First, the authors investigated the presence and intensity of pain using a self-reported questionnaire, rather than via an orthopedic diagnosis. Thus, detailed pain data were not available, and the prevalence of pain in this study was higher than that reported in a previous study [10]. Second, the authors did not evaluate other factors that may affect pregnancy-related SIJP, such as the level of pregnancy-related hormones, muscular strength, or physical flexibility. However, despite these limitations, the influence of the amount of change in pelvic alignment on SIJP during pregnancy was demonstrated in this study.

Conclusion

The results suggest that the evaluation of pelvic anteversion in early pregnancy is useful for determining those with high risk for SIJP. Moreover, an increase in pelvic asymmetry strongly affected the occurrence of SIJP during pregnancy. Beyond the management of SIJP, malalignment of the pelvis can become a chronic disease after pregnancy and should thus be corrected [25]. These results suggest that it is important to evaluate and reduce pelvic asymmetry during pregnancy in order to prevent pregnancy-related SIJP.

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