Clinical Biomechanics 17 (2002) 495–498

CLINICAL BIOMECHANICS

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Does a pelvic belt influence sacroiliac joint laxity?

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Received 9 November 2001; accepted 30 May 2002

Abstract

Objective. To evaluate the influence of different positions and tensions of a pelvic belt on sacroiliac joint laxity in healthy young women.

Background. Clinical experience has shown that positive effects can be obtained with different positions and tensions of a pelvic belt. A functional approach to the treatment of the unstable pelvic girdle requires an understanding of the effect of a pelvic belt on a normal pelvic girdle.

Methods. Sacroiliac joint laxity was assessed with Doppler imaging of vibrations. The influence of two different positions (low: at the level of the symphysis and high: just below the anterior superior iliac spines) and tensions (50 and 100 N) of a pelvic belt was measured in ten healthy subjects, in the prone position. Data were analysed using repeated measures analysis of variance.

Results. Tension does not have a significant influence on the amount by which sacroiliac joint laxity with belt differs from sacroiliac joint laxity without belt. A significant effect was found for the position of the pelvic belt. Mean sacroiliac joint laxity value was 2.2 (SD, 0.2) threshold units nearer to the without-belt values when the belt was applied in low position as compared to the case with the belt in high position.

Conclusions. A pelvic belt is most effective in a high position, while a tension of 100 N does not reduce laxity more than 50 N.

Relevance

Information about the biomechanical effects of a pelvic belt provided by this study will contribute to a better understanding of the treatment of women with pregnancy-related pelvic pain.

Keywords: Laxity; Neutral zone; Pelvic belt; Sacroiliac joint

1. Introduction

The role of the pelvic belt in the treatment of subjects with pregnancy-related pelvic pain is still controversial. Clinical experience has shown that positive effects can be obtained with different positions and tensions of the belt [1]. In an anatomical study, the mobility of the sacroiliac joint (SIJ) was significantly restricted by application of a pelvic belt with a tension of 50 N, while larger forces did not give better results [2]. The underlying theory of the use of a pelvic belt is that the articular surfaces of the SIJ will be pressed together, which raises friction to resist shearing [2–4]. However, there is no in vivo proof of this mechanical effect. Therefore, first, a rational approach to the treatment of the unstable pelvic girdle requires an understanding of normal stability of the SIJs with and without the application of a pelvic belt. The next step will be measurements with patients with pregnancy-related pelvic pain.

For a better understanding of the stability of the SIJs, a conceptual model of Panjabi [5] may be helpful. This model describes the interaction between a passive, an active and a control system that provide stability. The passive system pertains to the osteoarticuloligamentous structures, the active system pertains to the myofascia while the control system through its central and peripheral neural connections co-ordinates the actions of all. Furthermore, he defined a zone of motion, which he called the neutral zone. This is a small range of displacement near the joint's neutral position, where minimal resistance is offered by the osteoligamentous structures. It is the zone of high flexibility or laxity.

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PII: S0268-0033(02)00045-1

Several experimental studies have supported the view that the neutral zone is a more sensitive parameter than the range of motion in characterising SIJ dysfunction [6]. So, stability is not about how much movement there is or is not but rather about the laxity of the joints [7].

The SIJ is an articulatio plana with small physiological mobility: translations of approximately 1.5 mm and rotations of approximately 4° were measured by Roentgen stereophotogrammetry in vivo [8]. So, in the clinical setting laxity in the SIJ joint is difficult to assess when compared with, for example, the elbow or knee joint. Some years ago, a method using low energy vibrations has been developed to measure joint laxity in vivo. This method, Doppler imaging of vibrations (DIV), was shown to be a reproducible and reliable method to measure the laxity of the SIJ [9] as well as the first tarsometatarsal (TMT 1) joint [10].

The aim of the present study is to evaluate the influence of different positions and tensions of a pelvic belt on the laxity of the SIJ in healthy young women.

2. Methods

2.1. Subjects

Ten healthy subjects with a mean age 25.4 (SD, 2.7) years, mean height 171 (SD, 4.0) cm and mean body weight 66.0 (SD, 10.3) kg were recruited to participate in this study. The inclusion criteria were female and aged 18 to 30 years. Subjects with a history of pelvic and/or low back pain in the previous year were excluded from the study.

2.2. SIJ laxity measurement

The DIV technique was used to measure SIJ laxity [9,11]. During a measurement the subject was lying in prone position with relaxed muscles on a mattress. A colour Doppler imaging scan (Quantum Angio Dynograph 1, Philips Ultrasound, Santa Ana, California, USA) was used to produce the DIV images. Vibrations (Derritron Electronics, Hastings, England) with an amplitude not exceeding 0.05 mm and a frequency of 200 Hz were applied to the anterior superior iliac spine (Fig. 1). These vibrations with low energy have been shown to be safe and useful for this kind of measurement [9]. The vibrations propagate in the pelvis across the SIJ. In a stiff joint, there is a small or imperceptible difference in vibration amplitude between both sides. The vibrations at both sides of the joint are picked up by the colour Doppler imaging transducer. The intensity of the vibration pixels of the ilium and sacrum appears simultaneously on the monitor at high threshold values (dimension power dB). Using the threshold button on the control panel of the colour Doppler imaging apparatus allows measurements by comparing the vibration amplitude of the ilium and of the sacrum as follows. At first, a threshold level is found at which the colour of the vibrating sacrum disappears and changes to grey scale. Next, a second threshold level is found for the ilium. The difference in threshold levels is expressed in threshold units (TU). Since the threshold levels as measured by DIV are directly related to the vibration amplitude of the bone, a small or absent difference between the threshold levels of the sacrum and ilium is accepted as an indication of a stiff joint (low laxity <2 TU) [9]. A large difference between the threshold levels of the sacrum and ilium is an indication of a loose joint (high laxity >5 TU) [9]. The measurements were performed with unloaded SIJ, so laxity values found are representative for the neutral zone [10].

Fig. 1. Experimental set-up showing the vibrations propagate in the ilium up to the sacroiliac area. At the dorsal side the vibrations of the ilium and the adjacent sacrum are picked up by a colour Doppler imaging transducer which covers both sides of the sacroiliac joint.

2.3. Experimental procedure

We performed three consecutive SIJ laxity measurements without postural change and used the mean laxity value of each SIJ for further analysis. SIJ laxity was tested with and without a pelvic belt. For this purpose a belt of non-elastic material (model 3221/3300; Rafys, Hengelo, The Netherlands) was used which was 5 cm wide at the anterior and 7 cm at the posterior side. The tension was measured by means of strain gauges in the buckle of the pelvic belt.

SIJ laxity was measured at both sides at five subsequent conditions:

1. without a pelvic belt;
2. with a pelvic belt at the level of the symphysis (low position) and a tension of 50 N;
3. with a pelvic belt at the level of the symphysis (low position) and a tension of 100 N;
4. with a pelvic belt just below the anterior superior iliac spines (high position) and a tension of 50 N;
5. with a pelvic belt just below the anterior superior iliac spines (high position) and a tension of 100 N.

In all tests the belt position was adjusted in the erect posture while the tension was set at 50 or 100 N in prone position. Between measurements the pelvic belt was removed and the subjects walked around for a few minutes to minimise possible influence of an earlier measurement.

2.4. Statistical analysis

The data were analysed using 3-factor repeated measure analysis of variance (ANOVA). In this procedure, the dependent variable was the difference in SIJ laxity between the condition with a pelvic belt and the condition without a pelvic belt. The independent variables were side (left versus right), tension (50 N versus 100 N), and position (high and low). The residual covariance structure was assumed to be of the type compound symmetry. A P-value of <0.05 was taken to represent statistical significance.

3. Results

The mean SIJ laxity values in TU are presented in Table 1 for five conditions: without a pelvic belt, with a pelvic belt in low position and a tension of 50 N, with a pelvic belt in low position and a tension of 100 N, with a pelvic belt in high position and a tension of 50 N, and with a pelvic belt in high position and a tension of 100 N. SIJ laxity values were on average lower with belt than without belt. In Table 1 we present the SIJ laxity values averaged across both sides, because side does not have a significant effect on the amount by which SIJ laxity with belt differs from SIJ laxity without belt ($P = 0.15$). Also tension did not have a significant influence on this amount ($P = 0.39$). A significant effect was found for the position of the pelvic belt ($P < 0.001$). Mean SIJ laxity values were on an average 2.2 (SD, 0.2) TU nearer to the without-belt values when the belt was applied in low position as compared to the case with the belt in high position.

Table 1
Mean SIJ laxity values measured in TU at five conditions

	Mean (SD) TU
Without a pelvic belt	6.1 (1.6)
Belt in low position with 50 N tension	5.4 (1.1)
Belt in low position with 100 N tension	5.1 (1.6)
Belt in high position with 50 N tension	3.0 (1.3)
Belt in high position with 100 N tension	3.1 (1.2)

4. Discussion

In the present study, we applied DIV to assess the laxity of the SIJs. To exclude the influence of muscle tension, we performed the experiment without weight bearing, with the subjects in prone position. DIV gives an indication of the amount of laxity rather than the maximal excursions of a joint, because of the very small amplitude of the vibrations, far below the physiological range of motion of the joints. In unloaded position this laxity reflects the neutral zone, which was shown to be a more sensitive parameter in characterising SIJ dysfunction than range of motion [6].

An increase of belt tension from 50 to 100 N did not lead to a significant change of laxity, although a small decrease was seen with the belt in low position. Our data are in agreement with earlier studies [1,2]. Mens et al. found that a pelvic belt with 50 N was sufficient to influence the active straight leg raise test in patients with pregnancy-related pelvic pain, and increased tension produced results similar to those at 50 N [1]. We ascribe the effect of a pelvic belt to enlargement of intra-articular friction in the SIJs [2–4]. The tension of a pelvic belt can be compared with the muscle activity of the transversus abdominis (and the obliquus internus abdominis) muscle. Due to the anterior attachment of the transversus abdominis muscle to the iliac crest, this muscle is ideally placed to act on the ilia to produce, in combination with stiff dorsal sacroiliac ligaments, compression of the SIJs [3,4]. According to Richardson et al. [4,12], forces of only 30–40% of the maximum voluntary forces of the transversus abdominis are sufficient to achieve stability of the pelvis. Because the lever arm of the transversus abdominis is almost equal to the lever arm of the pelvic belt no higher tension is needed to achieve joint stabilisation. Higher tension is also not recommended because of skin pressure and discomfort.

With the application of a belt just below the anterior superior iliac spines (high position) the results in this study showed at both tension levels a significant decrease of SIJ laxity. Laxity decrease was also shown with the belt applied at the level of the symphysis (low position), but it was less. This may be explained by a less direct compression because, in the latter position, most of the belt is below the contact area of the SIJ and the belt compresses the symphysis rather than the SIJs.

5. Limitations of the study and directions for the future

The main limitation of this study was that SIJ laxity was only measured in prone position. At present it is not possible to quantify SIJ laxity values in loaded position. By measuring in prone position, we measured the influence of the pelvic belt on SIJ laxity and tried to exclude muscle activity and tension of ligaments that could have contributed to the decreasing SIJ laxity. Earlier studies have shown that both activation of the local stabilisers (transversely oriented abdominal muscles) as well as the global mobilisers (biceps femoris, gluteus maximus, erector spinae, latissimus dorsi) can significantly decrease SIJ laxity [4,13]. Further studies will focus on the performance of measurements in standing position with the aim to investigate how SIJ laxity will behave in the standing position with and without a pelvic belt.

6. Conclusions

The decrease of SIJ laxity values with the application of a pelvic belt is due to the position of the pelvic belt rather than the tension of the belt. Tensions of 50 and 100 N do not have a significant influence on the amount by which SIJ laxity with belt differs from SIJ laxity without belt. A pelvic belt was more effective when the application was just below the anterior superior iliac spines (high position) as compared to the application at the level of the symphysis (low position).

Acknowledgements

P.G.M. Mulder from the Department of Epidemiology and Biostatistics and J.M.A. Mens from the Department of Rehabilitation Medicine, Erasmus University Rotterdam, The Netherlands are acknowledged for their statistical and valuable contributions, and the Algesiologic Institute, Rotterdam, The Netherlands for the financially support of this study.

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