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Original Article

Investigating the Effect of a Sacroiliac Belt on the Kinematics of Trunk, Pelvis, and Hip Joints in Military Personnel Suffering from Sacroiliac Joint Pain and Healthy Military Personnel

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Keywords
Sacroiliac joint; Military personnel; Walking

Abstract

Background: Sacroiliac joint (SIJ) pain can cause frailty and pain in functional activities, especially walking. Therefore, the aim of the present study was to investigate and compare the effect of a sacroiliac belt on kinematics of the trunk, pelvis, and hip joints in military personnel with SIJ pain and healthy military personnel.

Methods: In this study, 30 military personnel, including 15 healthy individuals and 15 individuals with SIJ pain, were enrolled according to the inclusion criteria. A motion analysis device equipped with 7 cameras was used to measure the kinematic variables, which include the range of motion (ROM) of the trunk, pelvis, and hip joint in 3 planes and 3 axes. Spatial and temporal variables were also calculated. Statistical analysis was carried out using paired t-test and independent t-test.

Results: A sacroiliac belt use caused the trunk flexion/extension ROM to change on the right side of the body in both patient and healthy groups. There were also significant changes in pelvic lateral flexion on both sides of the body in the patient group and in the pelvic rotation ROM on the right side of the body in the healthy individuals. In the hip joint, sacroiliac belt use was able to make a significant change in the hip abduction/adduction and the flexion/extension ROM on the right side of the body in both healthy and patient groups.

Conclusion: The findings show that a sacroiliac belt use can increase SIJ stability in military personnel with SIJ pain. Therefore, it is a recommended treatment for these patients.

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Introduction

Low back pain is a musculoskeletal problem and the second leading cause of disability in American adults, which affects at least 80% of people during their lifetime. This complication affects the work capacity of military personnel and is one of the most common reasons for absences from work and the use of health insurance and health services. The disease is so costly that only a third of its costs are related to reduced production and wage payments. Although some of these people recover, pain and discomfort continue for more than 3 months in some of these patients, which is called chronic low back pain. Recurrence of low back pain is also common and ranges from 20-44 percent over a year and 85% over a lifetime.[1] Sacroiliac joint (SIJ) pain is a group of low back pains occurring between the posterior superior iliac spine (PSIS) and the gluteal fold. These patients make up 15-30 percent of patients with non-specific low back pain. In addition to SIJ dysfunction, factors such as inflammatory diseases, infection, tumors, metabolic problems, degenerative diseases, recurrent pain after spine surgery, and trauma can also cause problems in this joint.[2] The SIJ is located in the path of load transference from the spine to the lower extremities and vice versa from the ground to the lower extremities and spine. The primary role of the lumbar and pelvic spine is to transfer loads resulting from body weight and gravity while sitting, standing, or walking.[3]

For this purpose, very fine movements occur in the SIJ and pubic symphysis from the movements of the lower extremities and trunk.[4] According to Panjabi, pelvic stability requires interaction between the inactive, active, and motor control systems.[5] When the SIJ is in the close packed position, there is maximum joint congruity and taut ligaments.[4,6] In this position, the joint is over-compressed and it has the ability to deal with shear forces through tautening of the ligaments and increasing of the friction between the articular surfaces.[3,7]

Close packed position of SIJ consists of the 2 states of nutation or posterior innominate rotation.[4] This state occurs when the lumbar-pelvic complex is loaded during standing or walking. In this state, the long dorsal ligament becomes taut, but other ligaments such as the sacrotuberous and interosseous are relaxed, and thus the joint becomes stable, which is called self-bracing of the joint.[4,8] Individuals and military personnel with SIJ problems often complain of pain while walking. This is due to the fact that as joint stability decreases and ligament laxity increases in this area, abnormally frequent movements occur during walking and cause pain message transmission. During walking, it is necessary for the lumbar, pelvic, and hip joints to work together to achieve the desired gait. If a person starts walking with the right foot, the dorsal vertebrae will rotate to the left side and the lumbar vertebrae will bend to the right side. With this movement, the pelvic ring is rotated clockwise, the right innominate is rotated posteriorly, and the left innominate is pulled anteriorly. During heel strike, the right innominate rotates posteriorly and the sacrotuberous ligament becomes taut, which in turn increases SIJ stability. From heel strike to mid stance, right innominate rotates anteriorly in relation to the sacrum. In the right stance stage, the pelvic ring translates anteriorly. The right innominate rotates anteriorly, but the left innominate rotates posteriorly in relation to the sacrum. These movements are controlled by muscles and ligaments.[6] As mentioned, ligamentous laxity can be the cause of some SIJ pains. In fact, if a SIJ is not stable enough during walking, abnormal or normal movements occur beyond the physiological range and lead to pain in this area, so a pelvic compression belt is one of the most common treatments for such cases.[7]

Methods

Statistical population, sampling method, and sample size: The study population consisted of 2 groups of military personnel; patients with SIJ pain and healthy individuals who were homogenous with the patient group in terms of anthropometric and age criteria. According to the $N = \frac{2s^2(z_1+z_2)^2}{d^2}$ formula, the minimum sample size for each group was 15 people. In this equation, Z_1 is 95% confidence interval (CI) in the single-range test, i.e., 1.64, and Z_2 is test power of 80%, i.e., 0.84, and S_2 is an estimate of the standard deviation of each of the variables in the 2 groups. D is the minimum difference in each of the variables between the groups and shows that the difference is significant and is considered to be 0.9.

Inclusion criteria for military personnel with low back pain:

1. People aged 18 to 45 years[7]
2. Pelvic area pain between the ileum edge and the gluteal fold for more than 2 months according to sacroiliac map[9,10]
3. Positive active straight leg raising (ASLR) test result (grade II and higher)[9]
4. Positive results of at least 3 tests of the 5 tests suggesting a SIJ problem (provocation tests)[11]
5. Pain intensity of above 30 (VAS > 30)[12]

Exclusion criteria for military personnel with low back pain:

1. Pain radiating to the lower extremities[12]
2. Referral pain to the lumbar spine[12]
3. History of surgery in the lumbar region, pelvis, or lower extremities[12]
4. Congenital problems in the pelvis, lower back, or lower extremities[12]
5. Orthopedic or neurological problems in the lower extremities[14]
6. Acute inflammation of the lumbar spine, lower extremities, or pelvis[13]
7. Fracture or malignancy in the lumbar spine, lower extremities, or pelvis[14]
8. Ankylosing spondylitis (AS).[13]
9. Systemic locomotor disease[10,15]
10. Positive result on the passive straight leg raising (PSLR) test
11. The patient's reluctance to continue cooperation

Inclusion criteria for healthy military personnel:

1. Healthy military personnel with no history of low back pain in the last 12 months[16]
2. Lack of congenital problems in the lower back, pelvis, or lower extremities
3. No history of surgery on the lower back, pelvis, or lower extremities
4. Negative ASLR test result
5. Negative results on tests suggesting a SIJ problem (provocation tests)

After the ASLR training, the patient evaluation method was conducted, which consisted of the patient being asked to actively lift the painful side from the bed at a height of 20 cm for 1 second. The test is positive when the person is unable to lift the painful side from the bed or the pain increases when they do.[17] The participant was asked to rate the difficulty of the test according to the following criteria: Grade 0: without difficulty, Grade I: a little difficult, Grade II: somewhat difficult, Grade III: relatively difficult: Grade IV: quite difficult, and Grade V: unable to do it.[12] A positive test result signifies a difficulty level of higher than Grade II.[10]

SIJ provocation tests were also performed on patients. If at least 3 of the 5 tests were positive, the individual was assigned to the patient group, and the military personnel in both groups received training on the procedure and walking. Walking was carried out in each group in 2 states, i.e., without a sacroiliac belt, and with a sacroiliac belt and without shoes. The data collection tool included a motion analysis device equipped with 7 cameras (Qualys Inc., Switzerland).

In this study, the following parameters were calculated using the motion analysis device:

1. Degree of trunk rotation
2. Degree of trunk side flexion
3. Degree of trunk flexion and extension
4. Pelvic range of motion (ROM) on the sagittal plane
5. Pelvic ROM on the frontal plane
6. Pelvic ROM on the transverse plane
7. Hip flexion and extension ROM
8. Hip abduction and adduction ROM
9. Hip rotation ROM
10. Stride length
11. Gait speed
12. Stride time
13. Cadence (steps/minute)

The kinematic data were recorded according to the following steps:

1. The testing area was calibrated (static and dynamic calibration).
2. Light reflection was prevented by the participants wearing special clothing.
3. Marking mentioned landmarks in lower extremity and pelvic segments
4. Participants in both groups were asked to walk on the calibrated path of the laboratory at a desired gait speed of 60 to 80 m/minute (without shoes) 10 times without the sacroiliac belt.
5. The sacroiliac belt was used in both groups.
6. Both groups were asked to walk at above gait speed on the calibrated path of the laboratory 10 times (without shoes) with the sacroiliac belt.
7. Each test was performed 5 times for each individual at specified intervals.

Data analysis method: Data analysis was performed in SPSS software (version 25; IBM Corp., Armonk, NY, USA). Considering the normal distribution of data based on the Kolmogorov-Smirnov one-sample test in both groups of participants, the independent sample t-test was used to compare the mean changes between the healthy and patient groups. Moreover, because there was an intra-group comparison of the information before and after the intervention, paired sample t-test was used to compare the results before and after the use of the sacroiliac belt.

Results

The study participants included 15 healthy military personnel (with an average age, height, weight, and BMI of 30 years, 1.68 m, 67.67 kg, and 22.5 kg/m^2, respectively) and 15 military personnel with SIJ pain (with an average age, height, weight, and BMI of 29.87 years, 1.69 m, 69.27 kg, and 21.5 kg/m^2, respectively). These two groups were not significantly different and were homogenous with each other ($P > 0.05$).

The effect of sacroiliac belt on healthy and patient groups: The right and left sides mentioned in this research refer to the gait phase in which the person puts his/her weight on the right or left foot, respectively (stance phase of gait).

Trunk Flexion/Extension

Tables 1 and 2 show the values and changes related to the components of trunk ROM before and after sacroiliac belt use. As can be observed in these tables, there is a significant difference between patient and healthy groups in trunk flexion/extension ROM on the right side following sacroiliac belt use ($P < 0.05$). In the patient group, trunk flexion/extension ROM decreased from 7.2 to 5.9° on the right side, which is statistically significant ($P < 0.05$). On the left side, the ROM reduced from 7.57 to 6.36°, which shows an average variation of 1.21°. These variations are not statistically significant ($P > 0.09$). The average ROM decreased by about 1.29° on the right side in the healthy group, which is, as mentioned, statistically significant ($P < 0.02$). On the left side, the ROM decreased by about 1.5°, which is not statistically significant ($P > 0.05$).

As can be observed in table 2, there was no significant difference between the 2 groups in terms of changes in this movement following sacroiliac belt use on both right and left sides ($P > 0.05$).

Trunk lateral flexion: In this study, use of a sacroiliac belt led to no significant difference between the two groups in terms of changes in the trunk lateral flexion ROM ($P > 0.05$). In the patient group, trunk lateral flexion ROM decreased from 11.04 to 10.86° on the right side, which showed a change of 0.18°, while ROM of the above movement on the left side decreased by 1.72° and reached 11.06° from 12.78°.

Table 1. Average trunk kinematic parameters during gait before and after sacroiliac belt use in patients with sacroiliac joint pain

Row	Variable	Side	Before belt (mean ± SD)	After belt (mean ± SD)	P
1	Trunk flexion/ extension (degree)	Right	7.20 (2.12)	5.90 (1.72)	0.05
		Left	7.57 (2.77)	6.36 (2.21)	0.09
2	Trunk side flexion (degree)	Right	11.04 (3.35)	10.86 (2.55)	0.79
		Left	12.78 (3.91)	11.06 (2.11)	0.09
3	Trunk Rotation (degree)	Right	17.04 (4.17)	15.35 (3.61)	0.10
		Left	16.87 (2.55)	15.62 (3.76)	0.15

Table 2. Average trunk kinematic parameters during gait before and after sacroiliac belt use in healthy individuals

Row	Variable	Side	Before belt (mean ± SD)	After belt (mean ± SD)	P
1	Trunk flexion/ extension (degree)	Right	6.77 (2.18)	5.21 (1.60)	0.005
		Left	6.23 (2.18)	5.67 (1.88)	0.18
2	Trunk side flexion (degree)	Right	13.08 (1.70)	13.00 (2.00)	0.09
		Left	12.76 (1.73)	13.21 (1.55)	0.82
3	Trunk rotation (degree)	Right	18.86 (5.57)	17.33 (4.48)	0.74
		Left	18.24 (5.53)	18.38 (1.70)	0.23

In the healthy group, trunk lateral flexion ROM on the right side changed from 13.08 to 13º, which shows a reduction of only 0.01°. The ROM of the above movement on the left side increased by about 0.45°, that is, it has changed from 12.76 to 12.21º. The results showed no significant changes in trunk lateral flexion ROM between the healthy and patient groups on the right side following sacroiliac belt use, but a significant difference was observed on the left side ($P < 0.046$).

Trunk rotation: This direction of trunk movements, like trunk lateral flexion, did not change significantly in either group or on either side of the body. In people with pelvic pain, trunk rotation decreased by 1.69° and decreased from 17.04º to 15.35º on the right side of their body following sacroiliac belt use. On the left side of their body, the above rotation decreased from 16.87º to 15.62º. In the healthy group, trunk rotation decreased from 18.86º to 17.33º on the right side and showed a change of approximately 1.5°. On the left side of the trunk in this group, the trunk rotation ROM showed a slight increase of 0.27°. The results showed no significant changes in trunk rotation in the two groups following sacroiliac belt use on either of the two sides ($P > 0.05$).

Pelvic Area

Pelvic tilt: The present study showed no significant difference between the two groups and on either side of the body in terms of pelvic tilt ROM following sacroiliac belt use ($P > 0.05$). The average change in pelvic tilt ROM on the right side of the body in the patient group was 1.17°, while this value showed a decrease of about 0.91° on the left side ($P > 0.05$). On the right and left sides of the body of people without pelvic pain, the average pelvic tilt ROM was about -0.67° and -0.48º, respectively. Sacroiliac belt use reduced ROM on both sides, but this reduction was not statistically significant ($P > 0.05$). The results showed significant changes in pelvic tilt in the healthy and patient groups on both right and left sides following sacroiliac belt use ($P > 0.05$).

Pelvic lateral flexion: A very important point is that there was a significant change in the frontal plane and the pelvic lateral flexion on both the right and left sides of the body in the patient group while walking following sacroiliac belt use ($P \leq 0.05$). There was a significant change in pelvic lateral flexion on the right side of the body in the patient group; it decreased from 9.59º to 9.44º and the average variation was 0.14°. The above change was also significant on the left side of the body in the patient group, and increased from 9.59º to 9.84º, which shows an increase of 0.25° ($P \leq 0.05$). Pelvic lateral flexion ROM changed from 11º to 11.04º, which was a very slight increase (0.04°) on the right side of the body in the healthy individuals. On the left side, ROM also increased from 11.04º to 11.55º, which indicates an increase of approximately 0.5°. This increase was not significant on either side of the body ($P > 0.05$). The results showed no significant changes in pelvic lateral flexion ROM in the healthy and patient groups on either side of the body following sacroiliac belt use ($P > 0.05$).

Pelvic rotation: The average pelvic rotation ROM on the right side of the body in the patient group decreased by about 0.35° and changed from 15.52º to 15.17º. On the left side of the body of these individuals, the average ROM variation was 1.9°, which was not statistically significant on either side of the body in this group ($P > 0.05$). The average ROM of pelvic rotation on the right side of the body in the healthy group changed significantly following sacroiliac belt use and decreased from 16.6° to 14.3°, which is statistically significant ($P \leq 0.01$). On the left side of the body in the same group, ROM decreased from 15.5° to 14.35°, which is not statistically significant ($P > 0.05$). The results showed no significant changes in pelvic rotation ROM in the healthy and patient groups on either side of the body following sacroiliac belt use ($P > 0.05$).

Hip Area

Hip flexion/extension: The present study showed about 1.38° reduction in the hip flexion/extension ROM on the right side of the body in individuals with pelvic pain. On the left side of the body, hip flexion/extension ROM decreased from 41.5° to 40.98°. The changes observed on either side of the body in this group were not statistically significant ($P > 0.05$). Hip flexion/extension ROM changed from 43.9° to 41.5° on the right side of the body in the healthy group, which is statistically significant ($P < 0.05$). On the left side of the body, the average hip flexion/extension ROM change was 1.23° and decreased from 46.1° to 44.9°, which is not statistically significant ($P > 0.05$). The results showed no significant changes in hip flexion/extension ROM in the healthy and patient groups on either side of the body following sacroiliac belt use ($P > 0.05$).

Hip abduction/adduction: The remarkable thing about this plane is that significant changes were observed on the right side of the body in both groups of patients and healthy individuals. On the right side of the body in the healthy group, hip abduction/adduction ROM changed by about 3.4° and decreased from 19.1° to 15.74°, which is statistically significant, but on the left side, it decreased from 18.7° to 18.1°, which is not statistically significant ($P > 0.05$). The results showed no significant changes in hip abduction/adduction ROM in the healthy and patient groups on the right and left sides of the body following sacroiliac belt use ($P > 0.05$).

Hip rotation: On this plane, mean significant changes in hip rotation were not statistically significant on either side of the body in either group following sacroiliac belt use. The mean hip rotation ROM increased only 0.88° on the right side of the body in the patient group. On the left side of the body, the mean ROM change was -0.01°. In the group of healthy people, the mean hip rotation ROM on the right side of the body decreased by only 0.3° and reached 19.37° from 19.79°. On the left side, this change was higher, approaching 0.8°, that is, it increased from 17.18° to 17.97°. As mentioned, the average changes in hip rotation ROM in this group were not statistically significant on either side of the body ($P > 0.05$). The results showed no statistically significant changes in hip rotation on the right or left sides of the body in the healthy and patient groups following sacroiliac belt use ($P > 0.05$).

Temporal-Spatial Components

The present study revealed no significant change in any of the temporal-spatial components following sacroiliac belt use.

Stride length: The average stride length in the patient group changed from 1.15 to 1.16 m and showed an increase of < 1 cm. In the healthy group, sacroiliac belt use led to a 2 cm reduction in stride length from 1.27 m to 1.25 m. The mean changes in stride length in the two groups were not statistically significant ($P > 0.05$). The results showed no significant changes in stride length on either side of the body in either group following sacroiliac belt use ($P > 0.05$).

Stride time: In the patient group, the temporal changes were similar to spatial changes and the average stride time reduced from 1.09 to 1.07 seconds and reduced by 0.02 seconds following sacroiliac belt use. These changes are not statistically significant. In the healthy group, the changes in stride time were exactly the same as that in stride length; step time reduced by 0.02 seconds and increased from 1.09 to 1.07 seconds (P > 0.05). The results showed no significant changes in stride time on either side of the body in either group following sacroiliac belt use (P > 0.05).

Steps per minute: Sacroiliac belt use did not change the step per minute in the patient group and it remained constant at 105 steps/minute, which was similar to the results of the healthy group. This result is not statistically significant (P > 0.05). The results showed no significant changes in the steps per minute component on either side of the body in either groups following sacroiliac belt use (P > 0.05).

Gait speed: In the patient group, gait speed slightly increased by 0.73 m/second following sacroiliac belt use, that is, it increased from 57.6 to 58.3 m/second. In the healthy group, sacroiliac belt use reduced gait speed from 70.4 to 69.3 m/second (about 0.9 m/second). As mentioned above, these changes are not statistically significant, similar to the changes in other temporal-spatial components (P > 0.05), and the results showed no significant changes in this component on the right and left sides of the body between the two groups following sacroiliac belt use (P > 0.05).

Discussion

SIJ pain is one of the most important causes of chronic low back pain, which can have many causes such as capsular laxity of this joint and the supporting ligament structures.[3] When the SIJ becomes unstable due to capsular laxity and instability in other joints, changes will occur in the muscle activity pattern around the joint and the activity of some muscles increases and others decreases, which may lead to joint pain.[16] To reduce pain and increase joint stability, conservative and non-conservative methods are suggested. According to the recommendations of the International Association for the Study of Pain (IASP), SIJ pain should be treated conservatively. Various treatments have been suggested and used to reduce this pain and improve the stability of this joint. One of these methods is stabilization exercises and the use of a sacroiliac belt, which can reduce SIJ laxity and increase its stability.[2] Previous studies have investigated the effect of the sacroiliac belt on various factors and variables such as muscle activity, gait pattern, amount and severity of pain associated with capsular laxity before and after sacroiliac belt use, quality of life (QOL), gait speed, as well as tension rate during functional activities in patients with pelvic pain and healthy individuals. Conway and Herzog (1991) investigated mechanical changes during walking.[9] They carried out their study in the 3 states of without belt, with belt in its main and correct position, and with belt in an incorrect position. The study was conducted using a force plate device that examined the ground reaction force. The results showed that people's gait patterns did not significantly differ in these 3 states, but implied that sacroiliac belt use could limit the SIJ ROM. This finding was in line with that of the current study (limited SIJ ROM), but the studies differed in terms of the measured factor and the instrument used.[9]

Damen et al. investigated the effect of the sacroiliac belt on SIJ laxity in healthy individuals in the 2 modes of with and without a belt.[18] Their study population consisted of 10 individuals. The instrument used in this study was Doppler imaging of vibrations (DIV). They found that SIJ laxity indicates joint dysfunction. Therefore, by using a device to reduce SIJ laxity, we can improve the joint function and bring it closer to the normal range. They concluded that when the sacroiliac belt is worn on the pelvis of people with a tension of 50 N and below the ileum edge, joint laxity decreases; in other words, the joint becomes more stable.[18]

Hu et al. conducted a similar study. The study population included 17 healthy non-pregnant women aged 20-40 years who had no pelvic pain. Electromyography (EMG) information was examined while walking on a treadmill at different speeds, stride time, and stride length, and ASLR difficulty levels. They measured and recorded the ASLR difficulty in the 2 modes of with and without sacroiliac belt. The results showed that sacroiliac belt use had no effect on lower limb lifting during ASLR and there was no significant difference in lower limb lifting between the 2 modes of with and without the sacroiliac belt on either side of the body. However, sacroiliac belt use significantly increased the velocity of the lower limbs. In the ASLR movement, sacroiliac belt use reduced the activity of diagonal and transverse abdominal muscles, but increased the activity of the biceps femoris. This result suggests that the sacroiliac belt has been able to increase SIJ stability, which is due to a reduction in the activity of muscles that play a role in stabilizing the lumbar-pelvic region by increasing the internal abdominal pressure following sacroiliac belt use, which is somewhat consistent with the results of the current study.[19]

The comparison of the temporal-spatial data of the current study with that of the study by Hu et al. showed that in this study stride length increased with an increase in walking speed on the treadmill, but changes in speed before and after sacroiliac belt use had no significant effect on stride length.[19] This result is consistent with the results of the current study in terms of temporal-spatial changes in healthy participants, and the lack of significant effect of sacroiliac belt use on the stride length of healthy people. However, stride length was reduced by 2 cm after sacroiliac belt use, which may be due to the inherent SIJ stability in these healthy people. Moreover, stride length was reduced slightly in these individuals due to limited ROM caused by the greater compression of the articular surfaces of the ileum and sacrum in the SIJ after sacroiliac belt use, but these changes were not statistically significant. One of the features that should be considered in the design and construction of any orthosis or auxiliary device is lack of excessive limitation because the purpose of these auxiliary devices is to improve performance in the patient, and if the auxiliary device is such that it imposes excessive limitation, it is not only unable to enhance and improve the person's performance, but also somewhat reduces his/her abilities.

Furthermore, this belt has been given to patients with SIJ instability to increase stability in this joint, and to achieve this purpose, the articular surfaces are compressed by the belt. This belt causes the two ilia to move closer anteriorly; thus, the sacrum promontorium moves anteriorly and goes into nutation. This movement will move the SIJ into a locked position, improving form closure and force closure, and thereby increasing joint stability.

If we look at the results of trunk flexion/extension before and after sacroiliac belt use in both groups, we notice a decrease in ROM on both the right and left sides of the body in both healthy and patient groups, and a signification reduction in ROM on the right side of the body in both groups. This finding is consistent with the findings of Lee and Chen.[20] They observed that sacroiliac belt use can reduce lumbar lordosis in healthy young people. The results of this study are consistent with the current study in restricting lumbar flexion extension in the frontal axis and the sagittal plane. There are differences between their study and the present study, that is, Lee and Chen used a 2D motion analysis system in 1 axis, but a 3D motor evaluation system in 3 axes was used in the present study. The above study also used radiographs to examine the lumbar and pelvic ROM.

Most of these studies have been carried out on the participants in static and sitting states, but the current study was carried out on the participants in a dynamic state and during walking. In static mode, the forces usually operate on a specific axis and within a specific range, while static and dynamic forces have a greater impact on the body during walking; therefore, they differ in different axes and ranges, and their evaluation is much more complex and difficult.

Examination of trunk, pelvic, and hip ROM on the frontal plane and around the sagittal axis performed in the current study showed that sacroiliac belt use mainly reduced the ROM of the movements around this axis, including trunk lateral flexion, pelvic lateral flexion, and hip abduction/adduction. This shows the positive effect of the sacroiliac belt on joint stabilizing factors (form closure and force closure). This finding is consistent with the results of a study by Park et al.[21] on the activity of the quadratus lumborum, gluteus medius, and lumbar multifidus muscles. The differences between the current study and the above study are in the evaluation of both women and men, as well as the comparison of before and after sacroiliac belt use; Park et al.[21] only included healthy individuals in their study and the compression rate was not known, but both healthy and patient groups as well as both sexes were enrolled in the current study. They reported a reduction in the activity of supporting muscles in the lumbar-pelvic area following sacroiliac belt use. In the current study, the variable of ROM was assessed during walking, which is a more complex activity than the activities in lying or standing states; therefore, elements responsible for stability and control need to be more flexible so that they are able to perform the desired task appropriately and completely. Thus, the effect of the sacroiliac belt was better shown in this state than the static states used in previous studies.

The results of the present study show that the ROM has changed in the pelvic and hip joints and around different axes. The present study showed a decrease in pelvic tilt ROM in both groups and on both sides of the body following sacroiliac belt use, but the pelvic lateral flexion ROM increased on both sides of the body in healthy individuals and on the left side of the body in patients; however, it slightly decreased on the right side of the body in patients. These changes are somewhat consistent with the results of an article by Sichting et al.[22] They reconstructed the pelvic movements 3-dimensionally using a pressure measuring system software before and after sacroiliac belt use. The results showed that the belt was able to reduce the amount of rotation around the transverse axis and increase the rotation around the sagittal axis in the SIJ. In other words, the pelvic tilt ROM decreased and the pelvic lateral flexion ROM increased. These results can be explained by the ability of the sacroiliac belt to change the SIJ and hip ROM by changing the pressures on the supporting ligament structures. In other words, the reduction in sacral rotation around the transverse axis has been attributed to the amount of additional compression applied to the joint surfaces by the sides, followed by improved force closure, and the increase in pelvic bone inward movement has been attributed to the lever arm of the sacroiliac belt.[21] Comparison of pelvic lateral flexion shows significant changes on both sides of the body in the patient group following sacroiliac belt use, but no significant changes in this movement and the motor plate in the healthy individuals. The results showed that pain intensity significantly decreased following sacroiliac belt use, which is consistent with the results of a study by Soisson et al.[23] They showed that moderate pain tension decreased significantly following sacroiliac belt use, but before the belt was worn under high intensity, some patients experienced a decrease, increase, and no change in pain intensity.[23]

Conclusion

The results of the present study showed that trunk ROM decreased in patients and healthy people following sacroiliac belt use although these changes were significant only in flexion/extension and while the person was walking as a result of which his/her weight is placed on the right leg (stance phase of the gate cycle). In the pelvic area, the pelvic belt reduced the ROM in both pelvic tilt and pelvic rotation on both sides of the body in both healthy and patient groups, but ROM of pelvic lateral flexion increased on the right side of the body in the patient group and on both sides of the body in the healthy individuals, but it was reduced on the left side of the body in the patient group. The use of the sacroiliac belt had the greatest effect on the frontal plane and in the pelvic lateral flexion on both the right and left sides of the body in the patient group during stance phase of gait. It can be said that the sacroiliac belt could suitably control the movements on this plane in the patient group. Significant changes were observed on the right side of the body in patients, which may be justified by the fact that most participating patients complained of right-sided pelvic pain, and sacroiliac belt use may have reduced joint laxity and increased joint stability, and thus, led to significant changes in kinematic components. Stride length, gait speed, stride time, and steps per minute did not change significantly in the patient and healthy groups. Although gait speed and stride length increased slightly and stride time decreased slightly in the patient group, stride length and gait speed decreased slightly in the healthy group after sacroiliac belt use. Moreover, the steps per minute did not change in the two groups following sacroiliac belt use. Pain was also significantly reduced in patients with SIJ pain. It can be concluded that the sacroiliac belt can be effective in reducing pain in patients with SIJ pain and changing some of the kinematic variables in these patients.

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None.

Conflict of Interest

Authors have no conflict of interest.

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