Case study

Application of posterior pelvic tilt taping for the treatment of chronic low back pain with sacroiliac joint dysfunction and increased sacral horizontal angle

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ABSTRACT

Objective: Kinesio Taping (KT) is a therapeutic method used by physical therapists and athletic trainers in combination with other treatment techniques for various musculoskeletal and neuromuscular problems. However, no research has evaluated the effect of KT in patients with low back pain (LBP). The purpose of this case was to describe the application of posterior pelvic tilt taping (PPTT) with Kinesio tape as a treatment for chronic LBP and to reduce the anterior pelvic tilt angle.

Design: Case report.

Case description: The patient was a 20-year-old female amateur swimmer with a Cobb’s angle (L1–S1) of 68°, a sacral horizontal angle of 45°, and pain in both medial buttock areas and sacroiliac joints. We performed PPTT with Kinesio tape for 2 weeks (six times per week for an average of 9 h each time).

Results: The patient’s radiographs showed that the Cobb’s angle (L1–S1) had decreased from 68° to 47° and the sacral horizontal angle had decreased from 45° to 31°. Reductions in hypomobility or motion asymmetry, as assessed by the motion palpation test, and in pain, as measured by the pain-provocation tests, were observed. On palpation for both medial buttock areas in the prone position, the patient felt no asymmetry, as assessed by the motion palpation test, and in pain, as measured by the pain-provocation tests, were observed. On palpation for both medial buttock areas in the prone position, the patient felt no

Conclusions: The case study demonstrated that PPTT intervention favourably affected the pelvic inclination and sacral horizontal angle, leading to beneficial effects on sacroiliac joint dysfunction (SIJD) and medial buttock pain. Additional research on the clinical effects of this taping procedure requires greater numbers of athletes with SIJD or LBP who have inappropriate anterior pelvic tilt angles and hyperlordosis.

1. Introduction

Low back pain (LBP) is an important health problem that affects adults in general, and postural change is one of the risk factors for LBP (Evcik & Yücel, 2003). Clinical observations have suggested that maintenance of normal lumbar lordosis is important in the treatment of spinal disorders; therefore, measurement of the lumbar curve is important for making clinical decisions (Chen, 1999; Chernukha, Daffner, & Reigel, 1998). Various studies have examined the relationship between back pain and changes in the angle of the lumbar spine (Lin, Jou, & Yu, 1992). Increased lordosis has been advocated as the major cause of postural pain, radiculopathy, and facet pain (Cailliet, 1995). The possible negative consequences of this excessive lordosis include increased compression of the apophyseal joint and increased anterior shear force at the lumbo-sacral junction, which may progress to spondylolisthesis (Neumann, 2009). L5–S1 segmental lordosis reportedly increases in patients with chronic low back pain (Korovessis, Stamatakis, & Baikousis, 1999). The degree of lumbar lordosis increases when the anterior pelvic tilt increases in the standing position (Levine & Whittle, 1996), and increases in lumbar lordosis lead to increases in sacral inclination and sacral horizontal and lumbosacral angles (Evcik & Yücel, 2003; Sarikaya, Ozdolap, Gümüştaşçı, & Koç, 2007).

The sacroiliac joint (SIJ) is a known source of LBP, conferring pain to the lower limbs (Maigne, Aivaliklis, & Pfefer, 1996; Schwarzer, Aprill, & Bogduk, 1995) and buttock region (Hansen & Helm 2003). Previous studies have established the clinical reality that the SIJ may be a source of LBP by demonstrating symptomatic relief after intra-articular injection of the SIJ (Ilaslan, Arslan, Koç, Dalkılıç, & Naderi, 2010; Rupert, Lee, & Manchikanti, 2009). SIJ-mediated
pain can result from inflammatory arthritis, ankylosis (Berthelot, Gouin, Glamarec, Maugars, & Prost, 2001; Braun, Sieper, & Bollow, 2000), osteoarthritis, post-traumatic arthritis (Bernard & Cassidy, 1991), and infection (Grace, Sim, Shives, & Coventry, 1989). Although controversial, sacroiliac joint dysfunction (SIJD) is thought to be the primary source of SIJ pain (Dreyfuss, Michaelsen, Pauza, McLarty, & Bogduk, 1996; Elgafy, Semaan, Ebraheim, & Coombs, 2001). Levangie (1999) proposed two hypotheses with respect to the pain associated with SIJD. The first proposed that the pain is caused by nociceptive mechanical stress on the structures attached to the innomates or within the SIJ due to asymmetry of the pelvic ring. The second suggested painful mechanical stress on the surrounding and intervening tissues due to SIJ hypomobility, with or without positional abnormalities, within one or both SIJs. On the other hand, DonTigny (2005) defined SIJD as a pathological release of the self-bracing position with anterior pelvic rotation. In addition to bilateral SIJD, this patient showed increased lumbar lordosis, and the pelvis was tilted anteriorly (DonTigny, 2005).

The use of Kinesio Taping (KT) is gradually increasing in orthopedic, sports medicine, and neuromuscular rehabilitation (Yasukawa, Patel, & Sisung, 2006). Both lymph and blood circulation may be enhanced (Kase, Wallis, & Kase, 2003) and the muscular and affected myofascial functions may improve at the sites where KT is applied (Yoshida & Kahanov, 2007). The application of KT to the skin stimulates cutaneous mechanoreceptors (Chang, Chou, Lin, & Wang, 2010), increasing the isokinetic eccentric peak torque (Vithoulka, Beneka, Malliou, Aggelousis, Karatsolis, & Diamantopoulos, 2010) and relieving the pain of shoulder impingement syndrome (Kaya, Zinnuroglu, & Tugcu, 2011). According to previous studies, the application of KT in hemiplegia patients promoted the functional use of the upper extremities by supporting the weakened muscles, reducing pain (Jaraczewska & Long, 2006), and increasing the bioelectric activity of the low trapezius (Hsu, Chen, Lin, & Shih, 2009), vastus medialis (Sulik, Dwornik, Bialoszewski, & Zych, 2007), and scapular muscles (Lin, Hung, & Yang, 2011).

No studies to date have evaluated the effect of KT in patients with LBP. The purpose of this case report was to describe the application of posterior pelvic tilt taping (PPTT) with Kinesio tape as a treatment for chronic LBP and to reduce the anterior pelvic tilt angle.

2. Case description

A 20-year-old female amateur swimmer who complained of severe pain in both the medial buttock areas (e.g., approximately 5 cm lateral from both posterior superior iliac spines (PSIS)) and SIJs was assessed over a 1-month period. She complained of continuous LBP for 2 years, and an examination revealed that her pelvis was tilted anteriorly. She had not undergone any specific treatment for this condition. More recently, the SIJ and medial buttock pain had become severe following repeated lumbar hyperextension whilst swimming the butterfly stroke. The patient was unable to sleep in the supine position due to the pain and always slept on her side. When she performed forward flexion in the standing position with her knees fully extended while washing dishes in the sink, she experienced pain and stiffness in her lower back.

2.1. Radiographic views

All radiographs were taken using the same X-ray machine and the same type of high-quality film plate. While taking the radiographs, the patient was in the upright position with the right side of her body facing the film, her arms folded across the chest and hands on the opposite shoulders. The distance between the film and the radiographic tube was 100 cm (Tsuji, Matsuyama, Sato, Hasegawa, Yimin, & Iwata, 2001). In this case, we measured the lumbar curve in the sagittal plane. The angle was measured between the upper end plates of L1 and S1 (Berlemann, Jeszenszky, Bühler, & Harms, 1999), and the sacral horizontal angle was defined as that between a horizontal line and a line drawn tangentially to the upper end plate of the sacrum (Evck & Yöcel, 2003; Sarikaya et al., 2007). According to a radiographic view of the sagittal plane, Cobb’s angle (L1–S1, Fig. 1A) was 68° (normal range, 50.4 ± 10.9°) (Sarikaya et al., 2007) and the sacral horizontal angle (Fig. 1B) was 45° (normal range, 31.77 ± 6.02°) (Kim et al., 2006).

2.2. Pelvic inclination

The pelvic inclination was measured with a palpation meter (PALM; Performance Attainment Associates, St. Paul, MN, USA) by one examiner. PALM consists of an inclinometer and two caliper arms. This instrument is a valid, cost-effective, and reliable clinical tool (da Costa, Armijo-Olivo, Gadotti, Warren, Reid, & Magee, 2010; Petrone, Guinn, Reddin, Sutlive, Flynn, & Garber, 2003) for calculating the height discrepancy between landmarks (Gnat, Sauticz, Biały, & Klapocz, 2009). The intratest reliability of the PALM was 0.90, and the intertest reliability was 0.85. The patient removed their shoes and spread their feet (about 10–12 cm) during the measurement and stood upright with the anterior aspect of the thighs against the stabilizing table (Gnat et al., 2009). The sagittal plane rotation of the innominate was measured with the caliper.

![Fig. 1. Cobb’s angle (A: 68°) and sacral horizontal angle (B: 45°) of the patient at the initial assessment.](image-url)
tips of the PALM in contact with the ipsilateral anterior superior iliac spine (ASIS) and posterior superior iliac spine (PSIS) (Gnat et al., 2009; Preece, Willan, Nester, Graham-Smith, Herrington, & Bowker, 2008). At the initial assessment, the anterior pelvic tilt angles were 17.5° and 19° on the right and left sides (normal range, 11 ± 4°) (Hagins et al., 1998; Levine & Whittle, 1996), respectively.

2.3. Motion palpation tests

The motion palpation tests included determination of the PSIS level in a standing or sitting position (Levangie, 1999) to detect hypomobility or motion asymmetry of the SIJs (Lindsay, Meeuwisse, Vyse, Mooney, & Summersides, 1993). The motion palpation tests used in this study were as follows: (1) The Gillet test, wherein the patient stands on 1 leg and moves the opposite knee towards the chest; the response is positive if the PSIS remains at the same level or moves superiorly (Hansen & Helm, 2003; Magee, 2007). (2) The standing trunk flexion test, wherein the patient slowly bends forward from the standing position; the response is positive if 1 PSIS moves before the other or 1 PSIS is higher at the end of the movement (Magee, 2007). (3) The supine-sitting test, wherein the patient slowly sits up from a supine position and places the foot of the affected side on the opposite knee to achieve flexion, abduction, and external rotation of the hip, and the examiner holds the opposite ASIS in a fixed position and applies pressure on the patient’s affected knee (Hansen & Helm, 2003; Kokmeyer, van der Wurff, Aufdemkampe, & Fickenscher, 2002; Zelle et al., 2005); (3) the resistive abduction (REAB) test, wherein the patient lays down in the supine position and performs a 30° abduction of the affected leg until the hip is fully extended, e.g., the patient pushes the affected leg to the side while the examiner holds the ankle of the affected leg in a fixed position (Broadhurst & Bond, 1998; Zelle et al., 2005); and (4) the posterior shear or thigh thrust test, wherein the patient lays down in the supine position and performs a 90° flexion and slight adduction of the affected knee, applying axial pressure on the femur (Kokmeyer et al., 2002; Laslett et al., 2005). For both the SIJs, the Gaenslen, Patrick, and REAB tests showed positive results, but the POSH test showed negative results (Tables 1 and 2).

Cibulka and Kolodchoff (1999) used a combination of SIJ-motion palpation tests, including standing flexion, sitting flexion, and supine-to-sit tests, to determine SIJD. Lueck (2009) found that the xmax intrarater reliability of the Gillet, standing flexion, sitting flexion, and supine-to-sit tests by an experienced examiner was 87%, 69%, 83%, 69%, respectively.

2.4. Pain-provocation tests

The pain-provocation tests reproduced pain at both SIJs through stressing (Zelle, Gruen, Brown, & George, 2005). All the provocation tests were scored as positive or as negative, and an increase in familiar pain indicates a positive response. The test result was scored as positive or as negative, and an increase in familiar pain indicates a positive response. The test result was positive if the patient experienced pain prior to the full range of motion or did not display familiar pain (Laslett, Aprill, McDonald, & Young, 2005; van der Wurff, Buijs, & Groen, 2006).

The following pain-provocation tests were used in this study: (1) The Gaenslen test, wherein the patient lays down in the supine position, the examiner draws both legs up on the chest, and then lowers the affected leg to achieve full extension of the hip (Hansen & Helm, 2003; Zelle et al., 2005); (2) the Patrick test, wherein the patient lays down in a supine position and places the foot of the affected side on the opposite knee to achieve flexion, abduction, and external rotation of the hip, and the examiner holds the opposite ASIS in a fixed position and applies pressure on the patient’s affected knee (Hansen & Helm, 2003; Kokmeyer, van der Wurff, Aufdemkampe, & Fickenscher, 2002; Zelle et al., 2005); and (3) the resistive abduction (REAB) test, wherein the patient lays down in the supine position and performs a 30° abduction of the affected leg until the hip is fully extended, e.g., the patient pushes the affected leg to the side while the examiner holds the ankle of the affected leg in a fixed position (Broadhurst & Bond, 1998; Zelle et al., 2005); and (4) the posterior shear or thigh thrust test, wherein the patient lays down in the supine position and performs a 90° flexion and slight adduction of the affected knee, applying axial pressure on the femur (Kokmeyer et al., 2002; Laslett et al., 2005). For both the SIJs, the Gaenslen, Patrick, and REAB tests showed positive results, but the POSH test showed negative results (Tables 1 and 2).

As the reliability and validity of the clinical pain-provocation tests are variable, various composites of these tests have been used to identify pain arising from the SIJ (Broadhurst & Bond, 1998). Broadhurst and Bond (1998) reported that the sensitivity of the combination of the Patrick, POSH, and REAB tests ranged from 77% to 87%, with a specificity of 100%. Dreyfuss et al. (1996) and Laslett and Williams (1994) reported that the Gaenslen, Patrick, and POSH tests displayed clinical reliability >80%.

2.5. Palpation for tenderness

The patient described her responses to a visual analog scale (VAS), with 0 representing no pain and 10 representing the worst imaginable pain. A VAS score of 8/10 was obtained for the palpation state of both medial buttock areas in the prone position (Tables 1 and 2). Slipman et al. (2000) demonstrated that 94% of patients with SIJ pain described referred buttock pain.

2.6. Intervention: posterior pelvic tilt taping

We performed PPTT with Kinesio tape for 2 weeks (six times per week for an average of 9 h each time) to provide continuous mechanical correction to the posterior tilt of the innominates. For PPTT, the Kinesio tape was stretched by approximately 30–40% over the original length and applied by a physical therapist fully trained in KT. The methods used to place the tissue into the desired position were as follows; first, the tissue was placed in the correct or desired position using manual techniques including joint positioning. Second, the elastic qualities of the KT were used to maintain the desired position (Kase et al., 2003). For the external oblique (EO) muscle, KT was applied when the patient was in the side-lying

<table>
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<tr>
<th>Table 1</th>
<th>The patient physical assessment results (right).</th>
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<td>1st — PPTT 2nd — PPTT 8th — PPTT Final</td>
<td>Pre</td>
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<tr>
<td>VAS (Tenderness at palpation)</td>
<td>8</td>
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<tr>
<td>Gillet test</td>
<td>+</td>
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<td>Standing Trunk Flexion test</td>
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<td>Supine-Sitting test</td>
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<td>Sitting Forward Flexion test</td>
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<td>Gaenslen test</td>
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<td>Patrick test</td>
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<td>Posterior shear or thigh thrust test</td>
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<td>REAB test</td>
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<td>REAB test</td>
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position, tilting the pelvis posteriorly, from the inguinal region to the T12 spinous process (Fig. 2). Mechanical correction of the posterior pelvic tilt was exerted by applying the I-Type strip from the ASIS to the PSIS when the patient was in the side-lying position, tilting the pelvis posteriorly (Fig. 3). For the rectus abdominis (RA) muscle, the KT was applied when the patient was in the hook-lying position, from the part near the pubic symphysis to the xiphoid process and the 5th to 7th costal cartilages (Fig. 4). In addition, to prevent termination of the treatment due to adverse reactions to the Kinesio tape, the Kinesio Tape was immediately removed if the patient experienced itching of the skin underneath it. In this study, other therapy or home exercise was not attempted to treat either the chronic LBP or the increased anterior pelvic tilt angles.

3. Results

Further assessments were carried out before and after the PPTT. After the initial application of the PPTT, the anterior pelvic tilt angles were reduced to 11° and 12° on the right and left sides (Figs. 5 and 6), respectively. On palpation of both medial buttock areas, the VAS scores decreased to 7/10 in the prone position. The positive motion palpation test results of the right SIJ all reversed, becoming negative, as did the supine-sitting test result of the left SIJ. In the pain-provocation tests for the right SIJ, the Gaenslen test yielded a positive result, but the Patrick, POSH, and REAB tests yielded negative results. Negative results were yielded in the pain-provocation tests for the left SIJ (Tables 1 and 2).

After removal of the PPTT, the anterior pelvic tilt angles were 13° and 17° on the right and left sides (Figs. 5 and 6), respectively, being higher than those measured at the initial PPTT application (11° and 12°, respectively) but lower than those measured at the initial assessment (17.5° and 19°, respectively). On palpation of both medial buttock areas in the prone position, the VAS score remained at 7/10. The results from the motion palpation tests of both SIJs remained negative, even after the removal of the PPTT. No pain was experienced in the Gaenslen, Patrick, POSH, or REAB tests for the right SIJ. Although no pain was experienced in the Gaenslen, Patrick, or POSH tests for the left SIJ, the REAB test yielded a positive result (Tables 1 and 2).

After the second PPTT application, the anterior pelvic tilt angles were reduced to 10° and 14° on the right and left sides (Figs. 5 and 6), respectively. On palpation of both medial buttock areas in the prone position, the VAS score decreased to 6/10 on the right side and 5/10 on the left side. In the motion palpation tests for both SIJs, the negative results persisted. Similarly, no pain was experienced in the Gaenslen, Patrick, POSH, or REAB tests for the right and left SIJs (Tables 1 and 2).

After removal of the second PPTT, all of the motion palpation test results had become negative, and the pain experienced in the pain-provocation tests was resolved. On palpation of both medial buttock areas in the prone position, no pain was experienced after the 8th PPTT application on either the right or left side (Tables 1 and 2).

In the final assessment performed after the removal of the PPTT on the day after the 11th PPTT application, the anterior pelvic tilt angles had decreased to 10° on the right side (Fig. 5) and 10.5° on the left side (Fig. 6). All findings remained negative for the motion palpation test of both SIJs. No pain was experienced in the pain-provocation tests of either SIJ (Tables 1 and 2). The radiographic view showed that the Cobb’s angle (L1–S1, Fig. 7A) had decreased to 47° and that the sacral horizontal angle (Fig. 7B) had decreased to 31°. The patient no longer complained of LBP. The subject was able to sleep in the supine position without pain and experienced no pain or stiffness of the lower back while performing forward flexion.
in the standing position with knees fully extended when washing dishes in the sink.

4. Discussion

Application of PPTT was performed for 2 weeks to provide continuous mechanical correction to the posterior tilt of the innominates. After two applications of PPTT, all of the previously positive motion palpation test results had become negative, and the pain initially experienced in the pain-provocation tests was resolved; this status was maintained in the subsequent taping treatment period. Although subjective VAS scores were used as a method of measurement, the pain-relieving effect on both medial buttock areas persisted not only during the period of taping, but also after removal of the tape (e.g., assessment to look at maintenance of this change).

The RA muscle, to which KT was applied in this case, reduced lumbar lordosis by causing a posterior pelvic tilt (Lin et al., 1992) because the RA originates from the crest and symphysis of the pubis and inserts on the xyphoid process and cartilages of 5th to 7th ribs. Furthermore, acting bilaterally the lateral fibers of the EO muscle flex the vertebral column with a major influence on the lumbar portion to permit a posterior tilt of the pelvis (Kendall, McCreary, Provance, Rodgers, & Romani, 2005; Neumann, 2009).

The certain physiological mechanism of the effect of the KT application is not known, but the proposed hypotheses from previous studies suggest that, unlike conventional tapes, Kinesio tape applied around the pelvis has an elasticity of 30–40% of original length (Kase et al., 2003). The elasticity of the KT allows for overall joint movement, creating a deformation of the skin (Shim, Lee, & Lee, 2003) and increasing stimulation of cutaneous mechanoreceptors (Chang et al., 2010). This stimulation activates a nerve impulse, causing local depolarisation that triggers nerve impulses to travel along the afferent fibres to the central nervous system (Kase et al., 2003). In previous studies, KT application increased the bioelectric activity of the scapular muscles (Lin et al., 2011), vastus medialis muscle (Slupik et al., 2007), and low trapezius muscle (Hsu et al., 2009). Thus, KT application might have improved the function of the RA and EO muscles and caused the anteriorly tilted innominates to be posteriorly tilted.

The mechanical correction technique with KT may be used to assist the positioning of muscle, fascia tissue, or joints in the desired position (Kase et al., 2003). The tension created by the application of PPTT with KT acts as a preload in the end-of-motion positions (Kase et al., 2003), resisting the end position of anterior tilt and assisting the posterior tilt of the innominate. In turn, the perception of increased tension in the anterior tilt position of the innominate
causes repositioning of the joint to normalise the perceived skin tension (Kase et al., 2003). The application of a continuous I-type strip from the anterior superior iliac spine (ASIS) to the PSIS may apply a mechanical correction effect, tilting the pelvis posteriorly. The results of this study demonstrate that the mechanical correction benefits of patellar taping obtained using Leukotape (a non-elastic tape) may also be obtained when Kinesio tape (an elastic tape) is applied over the muscles surrounding the pelvis.

This study has some limitations. Firstly, caution is necessary in suggesting that the patient had SIJ-mediated pain, as controversy exists with respect to the validity and reliability of the motion palpation and pain-provocation tests. Additionally, the POM test did not show a positive response on both SIJs. Secondly, this study was conducted as an intervention for 2 weeks, and no longer-term follow-up was performed. Thirdly, the natural resolution of the problems during the PPTT intervention were not compared or assessed because this study was a single case. Fourthly, the change that might have varied because it was difficult to maintain the tension for the Kinesio tape application at the same level for each PPTT application. Further investigation is required to determine the appropriate level of tension that should be applied.

5. Conclusion

We applied PPTT with Kinesio tape to an amateur swimmer with increased anterior pelvic tilt angles, sacral horizontal angles, and pain in both the medial buttck area and SIJs during a 2-week intervention. The present study demonstrated that PPTT favorably affected the pelvic inclination and sacral horizontal angles and displayed a positive effect on pain in the SIJ and the medial buttck areas. Additional research on the clinical effects of this taping procedure, investigating a greater number of athletes with SIJD or LBP who have inappropriate anterior pelvic tilt angles and hyperlordosis is now required.

Conflict of Interest Statements
None declared.

Ethical approval
The subject signed an informed consent document that was approved by the Human Ethics Committee of the Faculty of Health Sciences at Inje University.

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