



Review Article

The effectiveness of physiotherapy interventions for sacroiliac joint dysfunction: a systematic review

MOAYAD AL-SUBAHI¹⁾, MOHAMED ALAYAT²⁾, MANSOUR ABDULLAH ALSHEHRI^{1)*}, OMAR HELAL¹⁾, HAMMAD ALHASAN¹⁾, AHMED ALALAWI¹⁾, ABDULLAH TAKROUNI¹⁾, ALI ALFAQEH³⁾

¹⁾ *Physiotherapy Department, Faculty of Applied Medical Sciences, Umm Al-Qura University: PO Box 715, Postal Code 21421, Makkah, Saudi Arabia*

²⁾ *Department of Basic Sciences, Faculty of Physical Therapy, Cairo University, Egypt*

³⁾ *Physiotherapy Department, King Faisal Hospital, Saudi Arabia*

Abstract. [Purpose] The aim of this study is to investigate the effectiveness of physical therapy interventions in the treatment of sacroiliac joint dysfunction (SIJD). [Subjects and Methods] MEDLINE, PUBMED, CINAHL, AMED, PEDro, and CIRRIE databases were searched and only relevant data from studies that matched the inclusion criteria were included. CASP tools for critical appraisal were used to assess the quality of studies included. [Results] Nine articles met the inclusion criteria, of which, three examined the effect of exercise on SIJD, three used kinesio tape and four studies examined the effect of manipulation. Various outcomes were used including the visual analogue pain scale (VAS), Oswestry disability questionnaire (ODQ), numerical pain rating scale (NPRS) and pelvic position measurement (PALM, pelvimeter and photogrammetry). The quality of included studies ranged from low to average as the CASP tools revealed several limitations that affect the validity of the studies. The results showed that physiotherapy interventions are effective in reducing pain and disability associated with SIJD, with manipulation being the most effective approach and most commonly used within physical therapy clinics. [Conclusion] Manipulation, exercise and kinesio tape are effective in the treatment of pain, disability and pelvic asymmetry in SIJD.

Key words: Sacroiliac joint dysfunction, Physiotherapy, Systematic review

(This article was submitted Mar. 29, 2017, and was accepted Jun. 10, 2017)

INTRODUCTION

Low back pain (LBP) is a major health problem having a significant impact on the quality of life and on health care costs¹⁾, with 70–85% of the population suffering from LBP at some time in their lives²⁾. Approximately 90% of all patients with acute LBP have a good prognosis, regardless of treatment. The remaining 10% are at risk of developing chronic pain and disability, accounting for more than 90% of health care costs³⁾. Each year, 5% to 10% of the workforce are absent because of their LBP, the majority for less than 7 days³⁾. In many people, the pain will arise from and be centred in one or both sacroiliac joints.

Sacroiliac joint dysfunction (SIJD) is a common cause of LBP⁴⁾, occurring in 16–30% of patients with LBP⁵⁾. The sacroiliac joint is a diarthrodial synovial joint comprising an anterior segment, which is a true synovial joint, and the posterior segment, a syndesmosis comprising the gluteus minimus and medius muscle, piriformis muscle and sacroiliac ligament. As all these muscles are shared with the hip joint, the sacroiliac joint (SIJ) cannot function independently. Furthermore, the ligamentous structures and the muscles influence the stability of the SIJ. The nerve supply for SIJ is mainly by the sacral rami dorsal⁶⁾.

*Corresponding author. Mansour Alshehri (E-mail: mamshehri@uqu.edu.sa)

©2017 The Society of Physical Therapy Science. Published by IPEC Inc.



This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial No Derivatives (by-nc-nd) License. (CC-BY-NC-ND 4.0: <https://creativecommons.org/licenses/by-nc-nd/4.0/>)

The aetiology of pain resulting from the SIJ is undetermined⁷. Extra articular causes of the dysfunction are fractures, ligamentous injuries myofascia and enthesopathy. Commonly, unidirectional pelvic shear stress, repetitive torsional forces, and inflammation can cause pain but no specific cause has been identified. Risk factors include abnormal gait pattern, leg length discrepancy, scoliosis, heavy physical exertion, trauma, pregnancy and lumbar fusion surgery with fixation of the sacrum⁸. SIJ may also be the result of direct trauma or idiopathic onset⁹. According to Schwarzer et al.¹⁰, 'Pain from the SIJs has been proven to cause not only low-back pain, but also groin and thigh pain'. The pain distribution and tenderness on palpation under the posterior superior iliac spine (PSIS) are reliable signs that the SIJ is the source of pain¹¹.

SIJD is curable with medical and physical therapy interventions. The standard physical therapy (PT) interventions include repetitive exercises, manual joint mobilisation, manipulation, bracing, massage, patient education, aerobic conditioning, general therapeutic exercise and electrotherapeutic modalities such as heat, ultrasound and TENS. In the physiotherapy context, there is a need for an effective treatment strategy for the unappreciated SIJD. Currently, there are no guidelines or an appropriate management plan for this dysfunction, physicians usually refer to it as low back pain only and physiotherapists treat the pain as LBP. However, when it is accurately diagnosed, the appropriate medical intervention or physical therapy can be implemented. Although there is no systematic review has been conducted to investigate the effectiveness of physiotherapy for the SIJD, different treatment strategies for the SIJD have been reported in the literature. For example, Barbosa et al.¹⁷, reported a pain reduction and functional improvement in patients with SIJD when combined program of manipulation and isotonic exercise was used. Another study by Castro-Sánchez et al.²⁰ used Kinesio tape and showed that treatment group was more effective than placebo group in pain reduction but both had similar effect in function. However, the definite conclusion regarding the use of physiotherapy interventions in patients with SIJD is still unclear as no systematic review has been conducted in this topic. Therefore, the aim of this study was to determine the effectiveness of physical therapy interventions for SIJD.

However, it must be noted that the study was of higher methodological quality, as they compared the KT with placebo tape and found similar results in both groups. It is possible that if Lee et al.^{19, 21} had used a control group or compared the tape with other types of tape, they might have observed similar results to the placebo suggesting that KT is not in fact an effective treatment.

SUBJECTS AND METHODS

The databases searched included MEDLINE, PUBMED, CINAHL, AMED, PEDro, and CIRRIE. Only journals were used to provide up to date information related to health care to collect information about the issue. The reference lists of the obtained articles were also searched thoroughly to find relevant studies. After determining the resources to be used in the study, the authors framed the final research question. Boolean operators (AND, OR and NOT) were used to narrow the search in the electronic databases to identify all relevant references¹². The following search terms were used:

- Condition terms: sacroiliac joint dysfunction, SIJ dysfunction, sacroiliac dysfunction, hip rotation, pelvic rotation, pelvic dysfunction
- Intervention terms: treatment, management, intervention, rehabilitation, physical therapy, physiotherapy, manipulation, mobilization, correction, tape, belt.

The inclusion criteria were experimental studies that assess the effectiveness of physiotherapy interventions published in scientific journals between 2004–2014, written in English, male and female participants, studies carried out on adults with chronic low back pain, chronic sacroiliac pain or pelvic girdle pain, having symptoms for more than 3 months without spinal surgery, studies that include pain score measures, pre and post intervention, studies that use physiotherapy interventions and follow up the progression of their participants. The current review included all types of experimental studies due to the small number of randomised control trials (RCT) available in the literature. The exclusion criteria were studies that assess other medical interventions than physiotherapy, studies with obvious bias, studies that were carried out for advertisement and funding purposes, descriptive studies, studies without follow up, studies that did not define the cause of the pain and those in which the participants had injections for the dysfunction. This study used the critical appraisal skills program (CASP) tools to assess the validity of studies included. The data were analysed and critically reviewed in a descriptive way to address the research question.

RESULTS

A total of 1114 studies were identified but only nine studies met the pre-determined inclusion criteria for this review (Fig. 1), four of which used manipulation as their intervention, three used exercise and three used Kinesio tape. Two of the manipulation studies were a repeated measures design (pre-post design), one RCT and one randomised trial. Regarding the studies that used exercise as their intervention, one study was a RCT; the others were repeated measures and case studies. In Kinesio tape studies, one was a RCT, one a case study and one a repeated measures design. Table 1 shows a summary of the research designs, objectives and main findings.

Most of the studies used pain as their outcome as measured by VAS (visual analogue scale) and NPRS (numerical pain rating scale). Some studies included disability as their outcome as measured by ODQ (Oswestry disability questionnaire).

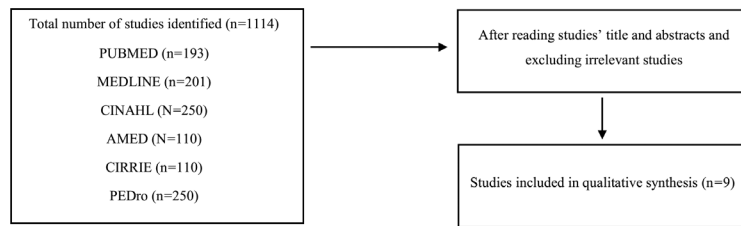


Fig. 1. Flowchart of search strategy

Table 1. Summary and main findings of included studies

Study	Design	Participants	Treatment	Outcome measures	Follow up	Main results
Childs et al. ¹³⁾	Repeated measure	Thirty LBP patients with iliac crest and weight-bearing asymmetry	Manipulation	Oswestry and NPRS	3, 4 days	All significantly improved
Shearar et al. ¹⁴⁾	Randomized control trial	60 SIJD patients	Manual vs. mechanical manipulation	NPRS, Oswestry, Orthopedic rating scale, and Algometer	After 3 weeks	Both are equally effective
Kamali & Shokri ¹⁵⁾	Randomized comparative trial	32 female with SIJ pain	Manipulation to SIJ and Lumbar Vertebrae	VAS and Oswestry	After 1 month	All improved, no difference
Boyle ¹⁶⁾	Case study	65 years female with SIJD	Exercise	NPRS and Oswestry	After 8 weeks	Significant improvement in pain and function
Barbosa et al. ¹⁷⁾	Repeated measures	Seven with abnormal pelvic tilt and LBP	Manipulation and exercise	VAS, EMG and photogrammetry	After 8 weeks	All significantly improved
Monticone et al. ¹⁸⁾	Randomized control trial	22 patients with SIJD	Group 1: Laser Group 2: Exercise	VAS at three different situations, and pain provocation tests	After 12 months	Only group 2 showed decrease in pain, the provocation tests were negative in both at the follow up
Lee et al. ¹⁹⁾	Case study	20 years female with SIJD	Kinesio tape	Palm, VAS and provocation tests	After 11 days	All significantly improved
Castro-Sánchez et al. ²⁰⁾	Randomized control trial	60 participants with SIJD	Group 1: Kinesio tape Group 2: Placebo tape	VAS and Oswestry	After 4 weeks	Oswestry: both improved VAS: group 1 is better
Lee et al. ²¹⁾	Repeated measure	40 with abnormal anterior pelvic tilt	Kinesio tape	PALM (inclination meter)	Immediately after the application	Increased anterior pelvic tilt

Furthermore, a small number of studies used other outcome measures, such as PALM inclination meter, photogrammetry, EMG and algometry to measure muscle power and pelvic inclination. Table 2 demonstrates the outcome measures used in each study.

The included studies had various methodological qualities ranging from low to medium quality according to several limitations within each study. Notably, the limitations were lack of blinding (Kamali & Shokri¹⁵⁾; Boyle¹⁶⁾; Barbosa et al.¹⁷⁾; Lee et al.¹⁹⁾; Lee et al.²¹⁾), lack of randomisation (Childs et al.¹³⁾; Barbosa et al.¹⁷⁾; Lee et al.¹⁹⁾; Lee et al.²¹⁾) and small sample size (Boyle¹⁶⁾; Barbosa et al.¹⁷⁾; Monticone et al.¹⁸⁾; Lee et al.¹⁹⁾).

In order to examine the effectiveness of each physiotherapy intervention to determine the most effective, each intervention was considered as a theme as presented in Table 3. The themes that emerged from shared interventions were: (1) effect of exercise on sacroiliac joint dysfunction, (2) effect of manipulation on sacroiliac joint dysfunction and (3) effect of Kinesio tape (KT) on sacroiliac joint dysfunction.

Three studies examined the effect of exercise on sacroiliac joint dysfunction, Boyle¹⁶⁾, Barbosa et al.¹⁷⁾ and Monticone et

Table 2. Analysis of shared outcomes

Study	VAS	Oswestry	Pelvic tilt	Pain Provocation Tests	NPRS
Childs et al. ¹³⁾		X	X		X
Shearar et al. ¹⁴⁾		X			X
Kamali & Shokri ¹⁵⁾	X	X			
Boyle ¹⁶⁾		X			X
Barbosa et al. ¹⁷⁾	X		X		
Monticone et al. ¹⁸⁾	X				
Lee et al. ¹⁹⁾	X		X	X	
Castro-Sánchez et al. ²⁰⁾	X	X			
Lee et al. ²¹⁾			X		

Table 3. Analysis of shared interventions

Study	Exercise	Manipulation	Kinesio tape
Childs et al. ¹³⁾		X	
Shearar et al. ¹⁴⁾		X	
Kamali & Shokri ¹⁵⁾		X	
Boyle ¹⁶⁾	X		
Barbosa et al. ¹⁷⁾	X	X	
Monticone et al. ¹⁸⁾	X		
Lee et al. ¹⁹⁾			X
Castro-Sánchez et al. ²⁰⁾			X
Lee et al. ²¹⁾			X

al¹⁸⁾. In the study by Barbosa et al.¹⁷⁾, they used a combined program of manipulation and isotonic exercise on seven patients. The program aimed to increase pelvic stability by performing 12% of maximum voluntary contraction with the participants in two positions. The first position involved the participant lying supine on treatment table with the hip flexed at 90° and the knee extended and performing isotonic eccentric contraction of the quadriceps. In the second position, the participant lay prone with the knee and hip extended to perform isotonic concentric contraction of the hamstring muscle. The basis of their program was to change the number of repetitions at each session to avoid accommodation; as a result of their program, the pain decreased from 5.83 to 1.29. Boyle¹⁶⁾ used a program of eight exercises for eight weeks to restore normal pelvic position and maintain it during functional movement to stabilise the lumbar-pelvic-femoral complex. The exercises were a 90–90 left hemibridge, side-lying scissor, side-lying knee-to-knee, side-lying internal rotation and abduction, long setting reverse curl-up, basic bridge and adduction, abdominal marching and pelvic floor exercises. At discharge, the patients showed no signs of disability and were free of pain. In addition, all the positive diagnostic signs were negative. Finally, Monticone et al.¹⁸⁾ used specific exercises and postural education for the treatment of SIJD. The participants were educated about how to activate and control the deep abdominal and lumbar multifidus muscle, which acts as a pelvic stabiliser. They were instructed to perform these exercises at home every day during their daily activity. Although their program lacks concentration and accuracy, the patients showed a positive improvement in pain at several positions, implying a successful intervention. However, it is unknown whether the patients performed these exercises at home, or if they performed them correctly, hence, their improvement is debatable. Despite these limitations, physical therapy exercises have been shown to be effective in treating SIJD, whether by reducing pain and disability or by restoring normal symmetry and balance of the pelvis.

Four studies included in this review used a manipulation approach; Childs et al.¹³⁾, Shearar et al.¹⁴⁾, Kamali & Shokri¹⁵⁾, Barbosa et al.¹⁷⁾. In the RCT of Kamali & Shokri¹⁵⁾, two areas (group1: SIJ, group 2: SIJ + lumbar) were manipulated in a single session. For the SIJ manipulation, ‘the patient was supine and the therapist stood contralateral to the side which was to be manipulated (e.g. right). The patient was passively moved into side bending toward the side to be manipulated. The patient interlocked the fingers behind his or her head and ‘the therapist passively rotated the patient, and then delivered a quick thrust to the anterior superior iliac spine (ASIS) in a posterior and inferior direction’¹⁵⁾. The lumbar manipulation will not be described as it is beyond the scope of this review. Their results showed that manipulation, to either SIJ alone or combined with lumbar manipulation, significantly decreased pain and disability associated with the dysfunction after 1 month follow up. Nonetheless, it is unknown if manipulation changed the abnormal position of the ilia or restored the normal symmetry of the pelvis as they did not include pelvic tilt measurement in their study. In Shearar et al.¹⁴⁾, the authors compared mechanical and manual manipulation in patients with SIJD. A certified practitioner delivered manual manipulation via high velocity low amplitude thrust (HVLA) for the symptomatic joint, with the other group receiving mechanical force-manually assisted (MFMA) manipulation using a handled instrument. Both procedures revealed positive results in patients with SIJD, with patients no longer complaining of pain and disability after 3 weeks of treatment. However, it is unknown if manipulation restored symmetry of iliac crests. Consequently, if the main cause of dysfunction was an unbalanced pelvis, then recurrent

pain is a possibility. Childs et al.¹³⁾ used the same manipulation approach as Kamali & Shokri¹⁵⁾ but with female and male participants. They also measured the pelvic symmetry before and after treatment, noting a significant improvement in pain, function and symmetry after four days follow up. However, though they avoided the limitations of Kamali & Shokri¹⁵⁾, they allowed their participants to perform home exercise independently without any records, thus, it could be considered as combined approach and the patients might differ in the intensity and duration of their exercise. Lastly, Barbosa et al.¹⁷⁾ used a combined approach of exercise and manipulation. The manipulation was achieved through 'A high-velocity, low-amplitude manipulative thrust applied to the SIJ with the contact hand on a specific area of the pelvis (posterior superior iliac spine). Short, controlled movement of the doctor's upper body, shoulder and arm, often combined with a slight falling movement to create the motion, momentum and position for the thrust, which is delivered through the contact hand'¹⁷⁾. The results showed an improvement in pain and restoration of normal pelvic position. However, as described earlier, the small sample size, lack of information regarding the duration and repetition of the intervention as well as the demographic data of the patients would make it difficult to be generalised to the public population.

The last theme to emerge from the articles was the effectiveness of KT on SIJD. Castro-Sánchez et al.²⁰⁾ carried out a RCT to examine the effect of KT in reducing pain and disability associated with SIJD and other non-specific LPB. The experimental group received standardised KT applied in sitting position (4 I-strips were placed at 25% tension overlapping to make a star shape over the point of maximum pain). They found that pain and disability decreased significantly after four weeks of treatment. However, these improvements were equal to the placebo tape, suggesting that KT is no more beneficial than placebo. Nonetheless, Lee et al.¹⁹⁾ and Lee et al.²¹⁾ reported different results. They studied the effect of KT on pain, disability and pelvic tilt in patients with signs of SIJD. In 2011²¹⁾, the tape was applied over the erector spinae and internal oblique muscles of both sides of 40 participants. In 2012¹⁹⁾, participants with a positive diagnosis of SIJD were treated by application of the KT over 1) the external oblique muscle, 2) I-strip from ASIS to PSIS in side-lying position, and 3) rectus abdominis muscle. The tape was applied for two weeks (six times per week for nine hours each time) and the participants in both studies showed a significant improvement in pelvic tilt symmetry, pain and disability. However, it must be noted that the study by Castro-Sánchez et al.²⁰⁾ was of higher methodological quality, as they compared the KT with placebo tape and found similar results in both groups. It is possible that if Lee et al.^{19, 21)} had used a control group or compared the tape with other types of tape, they might have observed similar results to the placebo suggesting that KT is not in fact an effective treatment.

DISCUSSION

This study reviewed nine studies that used three types of physiotherapy interventions to treat SIJD. Several outcomes were used to determine the effectiveness of the interventions in terms of pain, disability and pelvic tilt. It is clear that physiotherapy interventions such as exercise, manipulation and kinesio tape are beneficial in reducing pain, disability and restoring normal pelvic symmetry in patients with SIJD. The VAS and NPRS used in the studies showed that physiotherapy interventions were significantly effective in reducing pain associated with SIJD. In addition, pelvic tilt measurement through PALM, photogrammetry and pelvimeter also showed a remarkable improvement in restoring pelvic symmetry and normal pelvic position after physical therapy treatment. Furthermore, ODQ revealed a notable improvement in functional disability, in which the patient's limited mobility and function was reduced to a minimum in most studies.

Although pain, disability and pelvic symmetry were significantly improved, the mechanical dysfunction of joint was demonstrated to be the most important factor in SIJD²²⁾. This dysfunction leads to an imbalance between the two ilia, causing pain and stress of the sacroiliac joint²³⁾. Moreover, Barbosa et al.¹⁷⁾ stated that SIJD is related to torsional asymmetry, in which the positional rotation of one iliac to another can be manually corrected to restore the normal symmetry. Hence, the research question regarding the effectiveness of physical therapy intervention for SIJD has been partially answered due to the lack of sufficient studies that measure mechanical dysfunction through pelvic position measurement. This is in agreement with DonTigny²⁴⁾, that the dysfunction of sacroiliac joint is a mechanical problem that can be restored with physical therapy treatment. The studies by Cibulka et al.²⁵⁾, Cibulka²⁶⁾ and Cibulka and Delitto²⁷⁾ also support this, as they state that manipulation decreased pain, disability and pelvic asymmetry.

These results suggest that manipulation is the most effective intervention in reducing pain and improving the functional activity compared to other types of interventions. Furthermore, it is recommended that certified physiotherapists use this approach to improve the service provided to SIJD patients. Although KT was effective in restoring normal pelvic symmetry and standard pelvic position, the most effective approach to restore pelvic symmetry was not determined due to the fact that only a few studies measured pelvic position. Thus, claiming that KT is the most effective is inappropriate. Moreover, a physical therapy program ranging from one day up to four weeks can significantly reduce SIJD symptoms when it is delivered appropriately. It is also of note that the limitations of the included studies (size, time, follow up, duration, blinding and design of study) can considerably affect the final result of this systematic review, highlighting the need for further research. Finally, a diagnosis of SIJD is essential before commencing treatment, as such SIJD approaches are ineffective in the treatment of other factors of LBP.

This review has some limitations that need to be acknowledged. Only published studies written in English were included in this study. This review only searched published studies from 2004 to 2014, therefore it may have impacted on the generalisation of the results. Moreover, despite research in this topic beginning more than 20 years ago, only a small number of

relevant studies were available. The methodological quality of the selected studies and the lack of one particular research design was also an issue but due to the small number of available studies, this could not be avoided. Furthermore, the small sample sizes in Boyle¹⁶⁾, Barbosa et al.¹⁷⁾ and Lee et al.¹⁹⁾ may have affected their study results.

In conclusion, physiotherapy interventions can be effective in reducing pain, disability and restoring pelvic position in SIJD. Furthermore, manipulation appears to be more effective than therapeutic exercise, kinesio tape or non-interventional rest. Kinesio tape could effectively restore normal pelvic position according to Lee et al.^{19,21)}, but further research is required to confirm these results.

REFERENCES

- 1) van Tulder M, Koes B, Bombardier C: Low back pain. *Best Pract Res Clin Rheumatol*, 2002, 16: 761–775. [Medline] [CrossRef]
- 2) Andersson GB: Epidemiological features of chronic low-back pain. *Lancet*, 1999, 354: 581–585. [Medline] [CrossRef]
- 3) Waddell G: *The Back Pain Revolution*, 1st ed. Edinburgh: Churchill-Livingstone, 1998.
- 4) Erhard R, Bowling R: The recognition and management of the pelvic component of low back and sciatic pain. *J Am Phys Ther Assoc*, 1977, 2: 4–15.
- 5) Bernard TN Jr, Kirkaldy-Willis WH: Recognizing specific characteristics of nonspecific low back pain. *Clin Orthop Relat Res*, 1987, (217): 266–280. [Medline]
- 6) Fortin JD, Kissling RO, O'Connor BL, et al.: Sacroiliac joint innervation and pain. *Am J Orthop*, 1999, 28: 687–690. [Medline]
- 7) Frymoyer JW, Gordon SL: *New perspectives on low back pain*. Park Ridge, III: American Academy of Orthopedic Surgeons, 1989.
- 8) Schuit D, McPoil TG, Mulesa P: Incidence of sacroiliac joint malalignment in leg length discrepancies. *J Am Podiatr Med Assoc*, 1989, 79: 380–383. [Medline] [CrossRef]
- 9) Hansen HC, McKenzie-Brown AM, Cohen SP, et al.: Sacroiliac joint interventions: a systematic review. *Pain Physician*, 2007, 10: 165–184. [Medline]
- 10) Schwarzer AC, Aprill CN, Bogduk N: The sacroiliac joint in chronic low back pain. *Spine*, 1995, 20: 31–37. [Medline] [CrossRef]
- 11) Fortin J: (1998) Sacroiliac joint dysfunction: the can of worms. Update on soft tissue pain and rehabilitation. University of Manitoba and Manitoba Public Insurance, May 28–30, 1998, Winnipeg, Manitoba.
- 12) Rudestam K, Newton R: *Surviving your dissertation: a comprehensive guide to content and process*, 1st ed. Los Angeles: SAGE Publications, 2007.
- 13) Childs JD, Piva SR, Erhard RE: Immediate improvements in side-to-side weight bearing and iliac crest symmetry after manipulation in patients with low back pain. *J Manipulative Physiol Ther*, 2004, 27: 306–313. [Medline] [CrossRef]
- 14) Shearar KA, Colloca CJ, White HL: A randomized clinical trial of manual versus mechanical force manipulation in the treatment of sacroiliac joint syndrome. *J Manipulative Physiol Ther*, 2005, 28: 493–501. [Medline] [CrossRef]
- 15) Kamali F, Shokri E: The effect of two manipulative therapy techniques and their outcome in patients with sacroiliac joint syndrome. *J Bodyw Mov Ther*, 2012, 16: 29–35. [Medline] [CrossRef]
- 16) Boyle KL: Managing a female patient with left low back pain and sacroiliac joint pain with therapeutic exercise: a case report. *Physiother Can*, 2011, 63: 154–163. [Medline] [CrossRef]
- 17) Barbosa AC, Martins FL, Barbosa MC, et al.: Manipulation and selective exercises decrease pelvic anteversion and low-back pain: a pilot study. *J Back Musculoskeletal Rehabil*, 2013, 26: 33–36. [Medline] [CrossRef]
- 18) Monticone M, Barbarino A, Testi C, et al.: Symptomatic efficacy of stabilizing treatment versus laser therapy for sub-acute low back pain with positive tests for sacroiliac dysfunction: a randomised clinical controlled trial with 1 year follow-up. *Eura Medicophys*, 2004, 40: 263–268. [Medline]
- 19) Lee JH, Yoo WG: Application of posterior pelvic tilt taping for the treatment of chronic low back pain with sacroiliac joint dysfunction and increased sacral horizontal angle. *Phys Ther Sport*, 2012, 13: 279–285. [Medline] [CrossRef]
- 20) Castro-Sánchez AM, Lara-Palomo IC, Matarán-Peñarrocha GA, et al.: Kinesio Taping reduces disability and pain slightly in chronic non-specific low back pain: a randomised trial. *J Physiother*, 2012, 58: 89–95. [Medline] [CrossRef]
- 21) Lee JH, Yoo WG, Hwang-Bo G: The immediate effect of anterior pelvic tilt taping on pelvic inclination. *J Phys Ther Sci*, 2011, 23: 201–203. [CrossRef]
- 22) Szadek KM, van der Wurff P, van Tulder MW, et al.: Diagnostic validity of criteria for sacroiliac joint pain: a systematic review. *J Pain*, 2009, 10: 354–368. [Medline] [CrossRef]
- 23) Dontigny RL: Wonder why? sacroiliac 201: dysfunction and management, a biomechanical solution. *J Prolother*, 2011, 3: 644–652.
- 24) Dontigny R: The DonTigny low back pain management program. *J Manual Manip Ther*, 1994, 2: 163–168. [CrossRef]
- 25) Cibulka MT, Delitto A, Koldehoff RM: Changes in innominate tilt after manipulation of the sacroiliac joint in patients with low back pain. An experimental study. *Phys Ther*, 1988, 68: 1359–1363. [Medline] [CrossRef]
- 26) Cibulka MT: The treatment of the sacroiliac joint component to low back pain: a case report. *Phys Ther*, 1992, 72: 917–922. [Medline] [CrossRef]
- 27) Cibulka MT, Delitto A: A comparison of two different methods to treat hip pain in runners. *J Orthop Sports Phys Ther*, 1993, 17: 172–176. [Medline] [CrossRef]