

ORIGINAL

Clinical Features Requiring Sacroiliac Joint Arthrodesis in Patients with Sacroiliac Joint Pain

Daisuke Kurosawa, MD¹, Eiichi Murakami, MD, PhD¹, Toshimi Aizawa, MD, PhD², and Takashi Watanabe MD, PhD³

¹Department of Orthopaedic Surgery / Japan Sacroiliac Joint and Low Back pain Center, JCHO Sendai Hospital, Sendai, Japan, ²Department of Orthopaedic Surgery, Tohoku University School of Medicine, Sendai, Japan, ³Department of Hospital Medicine, JCHO Sendai Hospital, Sendai, Japan

Abstract : Purpose : This study aimed to reveal the clinical features requiring sacroiliac joint (SIJ) arthrodesis, which was performed for patients who complain of severe SIJ pain. **Methods :** The differences in clinical features between a surgical treatment group (n = 20) and a conservative treatment group (n = 66) were investigated. All patients were definitively diagnosed with SIJ pain by the use of SIJ injections. **Results :** Six significant features were identified in the surgical treatment group, namely, sitting tolerance (<15 minutes), walking with a cane, pain in the supine position, pain while lying on the painful side, numbness in the lower limbs, and any accident that induced SIJ pain (P<0.01). Univariate logistic regression analysis revealed that sitting tolerance <15 minutes (odds ratio : 31.73), pain in the supine position (13.07), and pain while lying on the painful side (18.30) showed a high odds ratio. **Conclusions :** Sitting tolerance (<15 minutes), walking with a cane, pain in the supine position, pain while lying on the painful side, numbness in the lower limbs, and a history of any accident that induced SIJ pain may be considered as indicators for surgery after >6 months of continued substantial conservative treatment. *J. Med. Invest.* 70:123-128, February, 2023

Keywords : Sacroiliac joint, pain, arthrodesis, clinical features

INTRODUCTION

The sacroiliac joint (SIJ) works as a shock absorber between the spine and the lower limbs (1), and it is increasingly recognized as a significant cause of lower back pain and leg symptoms. SIJ pain mainly originates from functional disorders of this joint, with no specific image findings. Therefore, a definite diagnosis can only be made through the use of SIJ injections (2). Most patients with SIJ pain recover with conservative treatment, such as SIJ injections, radiofrequency neurotomy, pelvic belt, and various types of physical therapy, including mobilization and manipulation (3). However, if SIJ pain does not improve after these treatments, SIJ arthrodesis is the last resort.

Recently, SIJ surgery has been widely performed for patients with painful SIJ, owing to the development of new products (4, 5). SIJ arthrodesis is often performed for patients who complain of severe SIJ pain, despite substantial conservative treatments being continuously administered for >6 months (6, 7). With respect to the inclusion criteria for SIJ surgery, several literatures have adopted high Oswestry Disability Index (ODI) score (8, 9), in addition to severe SIJ pain; however, this evaluation tool is not specific for SIJ-related issues. It is occasionally difficult to objectively select patients for SIJ arthrodesis, since there are no specific imaging findings that may aid in selecting the surgical treatment option. Therefore, the decision for SIJ surgery is often made by the surgeon individually, on the basis of a conclusive combination of the patient's medical history, clinical test results, outcomes of SIJ injections, and X-ray and computed tomography (CT) findings (4); this indicates that important diagnostic criteria

for requirement of surgical treatment are lacking.

Symptoms, background characteristics, and imaging findings for requirement of SIJ arthrodesis have not been investigated well. This study aimed to identify detailed clinical feature differences between the surgical and conservative treatment groups to assist both surgeons and pain physicians in recommending surgery.

PATIENTS AND METHODS

Study design

This case-control study compared two groups; the surgical treatment group and the conservative treatment group, for identifying clinical features associated with the surgical cases.

This study was approved by the Institutional Review Board of JCHO Sendai Hospital. Patients provided written informed consent for the use of their data.

Patients

In this retrospective study, we attempted to review the medical records from a single hospital. A total of 30 consecutive patients required SIJ arthrodesis (Figure 1) for severe SIJ pain between March 2010 and March 2018. Indications for SIJ arthrodesis are inadequate response to conservative treatments such as SIJ injections, specific manual therapy for SIJ pain, pelvic belt, and stabilization exercises continuing for longer than 6 months. When patients had difficulty working and/or were markedly restricted in their activities of daily living due to recurrence of severe SIJ pain, even after repeated injections and substantial number of physical therapy treatment sessions as inpatients (Figure 2), SIJ arthrodesis was considered as a last resort.

Among them, 20 patients (9 men and 11 women, with a mean age of 44.2 [range 26–79] years) constituted the surgical treatment group owing to their good surgical outcomes with respect

Received for publication August 25, 2022; accepted November 14, 2022.

Address correspondence and reprint requests to Daisuke Kurosawa MD, Department of Orthopedic Surgery/Japan Sacroiliac Joint and Low Back pain Center, JCHO Sendai Hospital, 2-1-1 Murasakiyama, Izumi-ku, Sendai 981-3281, Japan and Fax : +81-22-378-9131. E-mail : d-kurorin@m3.dion.ne.jp

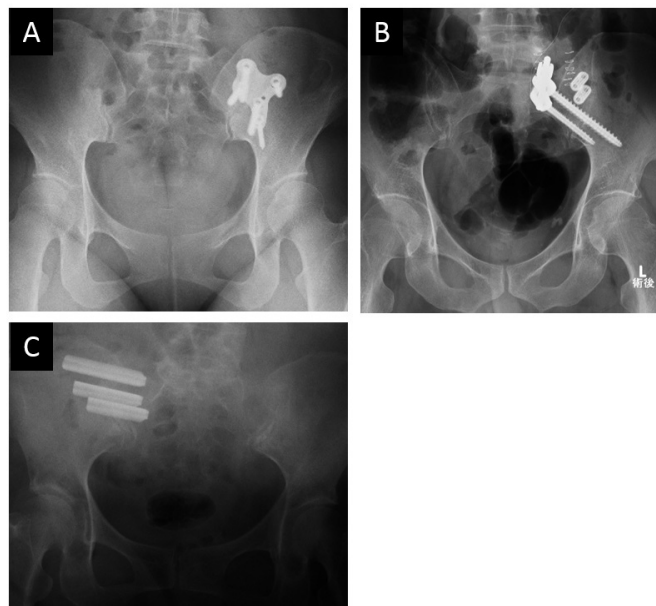


Figure 1. The types of sacroiliac joint arthrodesis we have performed.
 a. Using a plate and screws via the direct anterior approach
 b. Using an S1 pedicle screw, S2 alar-iliac screws, and cylinder cages via the posterior approach
 c. Using triangular titanium implants via the lateral approach

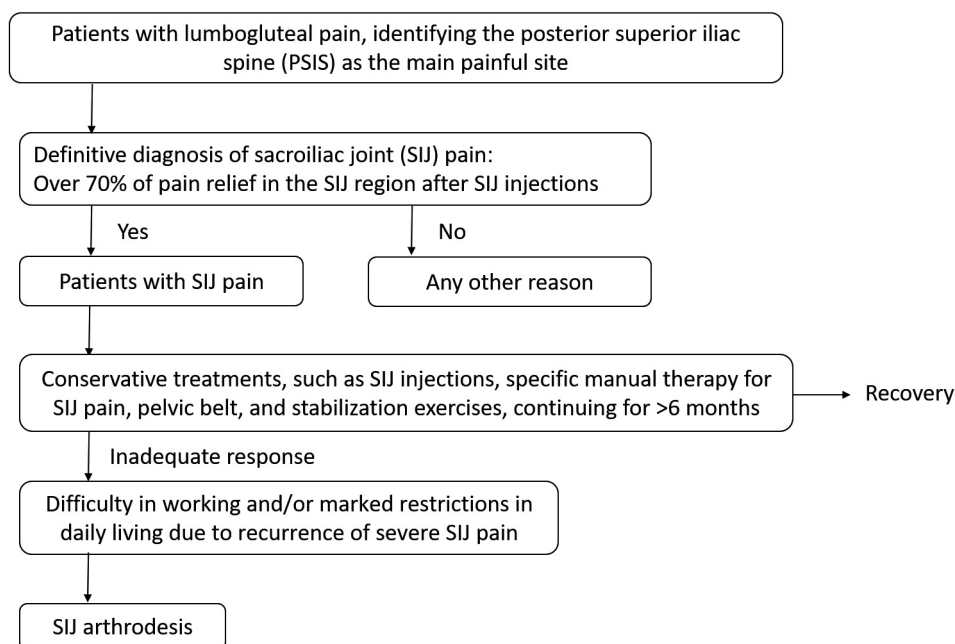


Figure 2. Flowchart for indications for surgical treatment for patients with sacroiliac joint pain.

to maintaining pain relief at >50% for >1 year postoperatively; 4 patients dropped out of follow-up in April 2019; and the remaining 6 patients were excluded because they reported <50% pain relief or did not maintain pain relief at >50% for >1 year (Table 1).

Sixty-six consecutive patients (27 men and 39 women, with a mean age of 48.7 [range 11–82] years) who were treated conservatively as inpatients, between October 2015 and April 2017,

constituted the conservative treatment group. These patients significantly recovered from their symptoms with conservative treatments within 6 months. Most of them reported that pain in the posterior superior iliac spine (PSIS) and/or leg symptoms were relieved, and they could continue sitting on the chair for a long time. (Figure 3). None of the patients were lost to follow-up while undergoing conservative therapies. As of April 2019, none had undergone surgery.

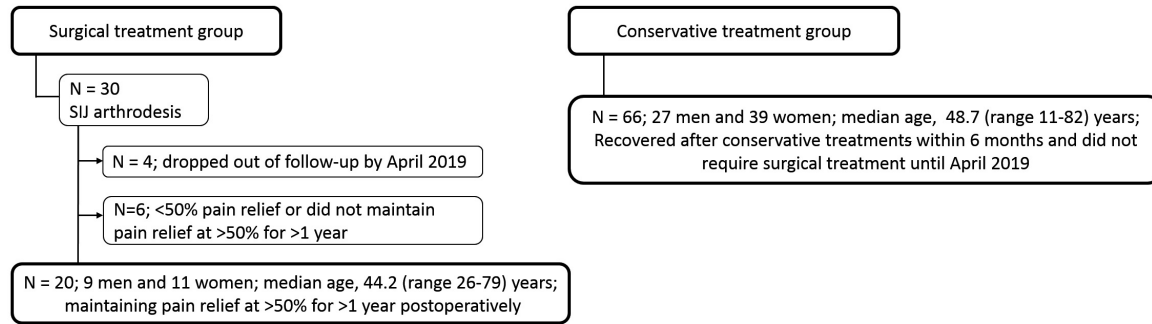


Figure 3. Flowchart for selecting the surgical treatment and conservative treatment groups, for comparison of the clinical features.

Table 1. Six patients were excluded due to less than 50% pain relief for more than 1 year after surgical treatment.

No.	Age	Sex	VAS at the PSIS	
			Pre- op	Post-op
1.	37	Man	70 mm	55 mm
2.	36	Woman	100 mm	80 mm
3.	43	Man	90 mm	72 mm
4.	73	Woman	80 mm	85 mm
5.	35	Man	98 mm	92 mm
6.	40	Woman	90 mm	80 mm

VAS : Visual analog scale, PSIS : the posterior superior iliac spine

All patients in both groups identified the PSIS as the main pain area by using their index finger (one-finger test) (10) and were considered to be experiencing SIJ pain. Definitive diagnosis of SIJ pain was confirmed by >70% pain relief in the SIJ region after SIJ injections under fluoroscopic guidance (11-13). The effectiveness of the injections was evaluated using the pain relief scale (14). We asked the patients to report the post-injection pain intensity, on the assumption that the pain score before injection was 10. The remaining pain was recorded 15 minutes post-injection. We assumed that pain improvement was >70% if the patients reported a post-injection pain intensity score of <3. We considered that a patient had an isolated SIJ pain when any other injections, except for those specific to SIJ, were not effective. All patients had a history of other injections including selective nerve root infiltration and/or lumbar disc nerve block that were negative. Patients with a history of infection, tumors in the lumbar and pelvic areas, recent lumbar spine and pelvic fractures, and obvious ankylosing spondylitis were excluded.

Data collection

The following items were investigated in both the surgical treatment and conservative treatment groups. These items were considered as SIJ-related symptoms and background according to previous studies (3, 6, 15, 16).

1. Age and sex
2. Pain intensity (visual analogue scale : VAS) before treatment
3. Sitting tolerance : time while patients can tolerate pain when sitting on a chair with no back rest (less than 15 minutes, or longer than 15 minutes). We asked patients how long they could continue sitting on the chair and patients answered orally.

4. Walking with a cane
5. Pain in the supine position
6. Pain while lying on the painful side
7. Rest pain and/or night pain
8. Pain/numbness in the lower limbs
9. Any accident which induced SIJ pain, such as a traffic accident, twisting, lifting a heavy weight, falling onto the buttocks, and so on
10. Time between onset of symptoms and diagnosis of SIJ pain
11. Past and combined illness (lumbar, cervical, hip, and mental disease)
12. CT findings of the SIJ ; osteophytes and vacuum phenomena/erosion with subchondral sclerosis (17, 18).

In the surgical group, the data just before the surgery were collected. In the conservative treatment group, the data checked at the first medical examination in our hospital were collected.

Statistical analysis

Items associated with surgery were identified by comparing the two groups using a univariate analysis. Age, pain intensity (VAS), and time between onset and diagnosis of SIJ pain were analyzed using the Kruskal-Wallis test ; the other factors were analyzed using Fisher's exact test. A result with a P value <0.05 was considered statistically significant. In addition, odds ratio and 95% confidence intervals for each item were calculated using a univariate logistic regression analysis. If any surgery-related items were identified, we determined the number of these items present in the surgical cases.

RESULTS

The univariate analysis results are shown in Table 2. There were no significant differences between the two groups regarding age and sex. The median values for pain intensity (VAS) were 90 mm in the surgical treatment group and 70 mm in the conservative treatment group. VAS was significantly higher in the surgical treatment group (P<0.01). The following six items were observed to be significantly higher in the surgical treatment group : sitting tolerance (<15 minutes), walking with a cane, pain in the supine position, pain while lying on the painful side, numbness in the lower limbs, and an any accident which induced SIJ pain (P<0.01). The differences were not significant in the past medical history and CT findings. Three items showed a high odds ratio : sitting tolerance less than 15 minutes (odds ratio : 31.73), pain in the supine position (13.07), and pain while lying on the painful side (18.30). Fifteen of twenty patients (75.0%) in the surgical treatment group had four or more of the

Table 2. Results of univariate logistic regression analysis

	Surgical treatment group (N = 20)	Conservative treatment group (N = 66)	p value	Odds ratio (95% CI)	p value
Age (years), median [25 ; 75 th percentile]	43 [37 ; 50]	47 [36 ; 64]	0.34 (KW)	0.98 (0.95–1.01)	0.3
Sex : Woman (%)	11 (55.0%)	39 (59.1%)	0.8	0.85 (0.31–2.32)	0.75
Pain intensity of the SIJ : VAS (mm), median [25 ; 75 th percentile]	90 [80 ; 95]	70 [60 ; 80]	0.002 (KW)*	1.06 (1.02–1.10)	0.005*
Sitting tolerance (time) <15 min.	17 (85.0%)	10 (15.2%)	<0.001*	31.73 (7.83–128.65)	<0.001*
Walking with a cane	11 (55.0%)	8 (12.3%)	<0.001*	8.71 (2.76–27.52)	<0.001*
Pain in the supine position	14 (70.0%)	10 (15.2%)	<0.001*	13.07 (4.06–42.07)	<0.001*
Pain while lying on the painful side	12 (60.0%)	5 (7.6%)	<0.001*	18.30 (5.10–65.64)	<0.001*
Rest pain	10 (50.0%)	24 (36.4%)	0.31	1.75 (0.64–4.80)	0.28
Night pain	10 (50.0%)	18 (27.3%)	0.1	2.67 (0.95–7.47)	0.062
Pain in the lower limbs	10 (50.0%)	25 (37.9%)	0.44	1.64 (0.60–4.49)	0.34
Numbness in the lower limbs	13 (65.0%)	19 (28.8%)	0.007*	4.59 (1.59–13.29)	0.005*
Any accident which induced SIJ pain	14 (70.0%)	21 (31.8%)	0.004*	5.00 (1.69–14.84)	0.004*
Time between onset and diagnosis of SIJ pain (month), median [25 ; 75 th percentile]	6 [1 ; 15]	11 [3 ; 24]	0.25 (KW)	0.99 (0.97–1.01)	0.34
Combined or past medical problems					
Lumbar disorder	4 (20.0%)	22 (33.3%)	0.41	0.50 (0.15–1.68)	0.26
Cervical spine disorder	1 (5.0%)	3 (4.6%)	>0.99	1.11 (0.11–11.25)	0.93
Hip disorder	1 (5.0%)	1 (1.5%)	0.41	3.42 (0.20–57.31)	0.39
Mental disease	3 (15.0%)	6 (9.1%)	0.43	1.76 (0.40–7.81)	0.45
CT findings of the SIJ					
Normal	12 (60.0%)	50 (75.8%)		Reference	
Osteophytes and vacuum phenomena	7 (35.0%)	12 (18.2%)		2.43 (0.79–7.49)	0.12
Erosion with subchondral sclerosis	1 (5.0%)	4 (6.1%)	0.25	1.04 (0.11–10.18)	0.97

SIJ : sacroiliac joint, VAS : visual analog scale, KW : Kruskal-Wallis test

* $p < 0.05$

six items, while 63 of 66 patients (95.5%) in the conservative treatment group had three or fewer items. The area under the receiver-operating characteristic (ROC) curve was 0.902 (95% confidence interval [CI] : 0.810–0.993).

DISCUSSION

The definitive criteria for SIJ arthrodesis remain poorly understood. Several previous papers have reported that one of the criteria for surgery was the ineffectiveness of conservative treatments continuing for longer than 6 months (4, 8, 9). However, the clinical features that the patients suffered from and required surgical treatment for are unknown. We compared clinical features between 20 surgical treated patients and 66 conservative treated patients. Unfortunately, 4 of the 30 patients who underwent surgery could not be followed, and 6 were excluded because they did not have a good postoperative course. It was unknown why the good results could not be achieved surgically for these 6 patients although they all were diagnosed as having SIJ pain using SIJ injections. These 6 might not have been appropriate candidates for surgery and they were excluded from this study to determine clinical features of surgical cases.

This study showed that VAS was significantly higher in the surgical treatment group, and high pain intensity was one of the

significant factors to require surgical treatments. In addition to this, six items ; including sitting tolerance (<15 minutes), walking with a cane, pain in the supine position, pain while lying on the painful side, numbness in the lower limbs, and a history of any accident which induced SIJ pain ; were significant clinical features requiring SIJ arthrodesis. Furthermore, cases with four or more of these items were more common in the surgical treatment group.

A sitting tolerance of less than 15 minutes showed the high odds ratio for SIJ arthrodesis. Patients with short sitting tolerance due to severe SIJ pain often cannot continue to work or study at a desk for too long and have very limited social life due to this, thereby requiring SIJ arthrodesis. It is, therefore, useful to focus on the duration of sitting tolerance when we evaluate the severity of SIJ problems. Furthermore, patients with lumbar disc herniation often complain of pain attributable to the sitting position. However, the areas with provoked pain while sitting that are associated with SIJ problems are the PSIS and ischial tuberosity ; these are different from areas with lumbar disc herniation—namely, the center of the gluteal region and the region with femoral neuralgia and sciatica (19). Therefore, focusing on areas with provoked pain can help in distinguishing between SIJ problems and lumbar disc herniation as the cause of short sitting tolerance.

Walking with a cane, pain in the supine position, and pain

while lying on the painful side were also significantly related with SIJ arthrodesis. There were many patients who needed a cane while walking in the surgical treatment group. Walking disability due to SIJ dysfunction limits social activities; therefore, using a cane while walking could indicate a need for surgery. Pain in the supine position, as well as pain while lying on the painful side, also indicated high odds ratios. In patients with severe SIJ problems, SIJ responded with hypersensitivity against the provocation tests (20), including SIJ shear test (3) and compression test. In the supine position, SIJ pain could be provoked by compression force between the patient's own weight and the bed mattress. Similarly, when patients lay on the affected side, the SIJ would be pushed against the bed mattress by their own weight, which would be like an applied compression test. Therefore, these positions could increase SIJ pain in patients with severe SIJ conditions. Exacerbations while lying on the painful side and/or on the supine position cause sleep disturbances, which may greatly affect everyday life.

Numbness in the lower limbs was more frequently observed in the surgical treatment group. According to a previous study (16), patients with SIJ disorders often complained of numbness/tingling mainly in the lateral to posterior thigh and back of the calf, which did not usually correspond to the dermatome. This numbness/tingling was one of the referred symptoms of SIJ dysfunction, since it could be reproduced by needle insertion in the posterior sacroiliac ligaments and reduced by periarticular SIJ injections. In severe cases, SIJ-related numbness/tingling could be intensified (19).

Any accidents that induced SIJ pain were more notably observed in the surgical treatment group. Traffic accidents, falling from a high place, or lifting a heavy weight can cause irreversible articular subluxation and/or rupture of SIJ-related ligaments. However, lack of specific imaging failed to identify these pathological changes. Conversely, differences were not significant in SIJ CT findings, time between onset and diagnosis of SIJ pain, and combined illness, including mental disease.

One of the limitations of this study was small number of the surgical treatment group, because patients with SIJ pain who underwent surgical treatment were very rare, and the results of this study came from a single hospital. Further studies in large number of patients at multiple institutes are required. Another limitation was the difference in the enrollment period between the surgical treatment and conservative treatment groups. We enrolled all patients who underwent surgery between March 2010 and March 2018, because patients with SIJ who underwent surgical treatment were rare. Conversely, we enrolled consecutive patients who were treated as inpatients between October 2015 and April 2017 as the conservative treatment group. This cohort was chosen for comparison with the surgical treatment group because we systematically recorded them to evaluate the SIJ injection effectiveness as both a diagnostic procedure and a conservative treatment. Selection bias might have occurred due to item selection to investigate, though we have listed the possible considerations SIJ-related items based on the previous literatures and our clinical experience. We should have checked the symptoms at the first medical examination of both groups. However, we did not know what the initial symptoms were, particularly in surgical treatment group, because many of them were referred from other hospitals as a difficulty case. We usually performed surgery because the patient did not show any improvement or just only temporally improvement after more than 6 months of conservative treatment, and the condition remained almost the same as it was 6 months before. And, since this was a retrospective study of cases treated over an 8-year period in our hospital, the most detailed data from the early years of the study was given in the description just before surgery. If we would

align the timing of the evaluation of the data of surgical cases, the time just before surgery was appropriate. On the other hand, cases that improve with conservative therapy were relieved within 6 months. Therefore, the evaluation period for this group could only be constant if the evaluation is made at the first time in our hospital.

Although this study had these limitations, several clinical features associated with the surgical cases were found in addition to high pain intensity.

Further multi-center prospective studies by both surgeons and pain physicians are needed to confirm whether these items are useful risk indicators for SIJ surgery. It would be important to share the key risk indicators for SIJ surgery among surgeons who perform such procedures and pain physicians/physical therapists who often provide conservative treatment options to many patients, in order to identify the best recovery options for patients with SIJ issues.

CONFLICTS OF INTEREST

All authors declare no conflicts of interest to declare.

REFERENCES

1. Vleeming A, Schuenke MD, Masi AT, Carreiro JE, Danneels L, Willard FH: The sacroiliac joint: an overview of its anatomy, function and potential clinical implications. *J Anat* 221: 537-567, 2012
2. Merskey H, Bogduk N: Classification of chronic pain: Descriptions of chronic pain syndromes and definitions of pain terms, Seattle, WA, IASP Press, 1994, pp.190-191
3. Bernard TN, Classidy JD: The sacroiliac joint syndrome. Pathophysiology, diagnosis and management. In: Frymoyer JW eds. *The Adult Spine: Principles and Practice*, 2nd edn. Lippincott-Raven Publishers, Philadelphia, 1997, pp.2343-2363
4. Fuchs V, Ruhl B: Distraction arthrodesis of the sacroiliac joint: 2-year results of a descriptive prospective multi-center cohort study in 171 patients. *Eur Spine J* 27: 194-204, 2018
5. Dengler J, Kools D, Pflugmacher R, Gasbarrini A, Prestamburgo D, Gaetani P, Cher D, Van Eeckhoven E, Annertz M, Stuessen B: Randomized trial of sacroiliac joint arthrodesis compared with conservative management for chronic low back pain attributed to the sacroiliac joint. *J Bone Joint Surg Am* 101: 400-411, 2019
6. Murakami E, Kurosawa D, Aizawa T: Sacroiliac joint arthrodesis for chronic sacroiliac joint pain: an anterior approach and clinical outcomes with a minimum 5-year follow-up. *J Neurosurg Spine* 29: 279-285, 2018
7. Nyström B, Gregebo B, Taube A, Almgren SO, Schillberg B, Zhu Y: Clinical outcome following anterior arthrodesis in patients with presumed sacroiliac joint pain. *Scand J Pain* 17: 22-29, 2017
8. Kibsgård TJ, Røise O, Stuge B: Pelvic joint fusion in patients with severe pelvic girdle pain - a prospective single-subject research design study. *BMC Musculoskelet Disord* 15: 85, 2014
9. Polly DW, Swofford J, Whang PG, Frank CJ, Glaser JA, Limoni RP, Cher DJ, Wine KD, Sembrano JN: Two-year outcomes from a randomized controlled trial of minimally invasive sacroiliac joint fusion vs. non-surgical management for sacroiliac joint dysfunction. *Int J Spine Surg* 10: 28, 2016

10. Murakami E, Aizawa T, Noguchi K, Kanno H, Okuno H, Uozumi H : Diagram specific to sacroiliac joint pain site indicated by one-finger test. *J Orthop Sci* 13 : 492-497, 2008
11. Murakami E, Kurosawa D, Aizawa T : Treatment strategy for sacroiliac joint-related pain at the posterior superior iliac spine. *Clin Neurol Neurosurg* 165 : 43-46, 2018
12. Kurosawa D, Murakami E, Aizawa T : Referred pain location depends on the affected section of the sacroiliac joint. *Eur Spine J* 24 : 521-527, 2015
13. Kurosawa D, Murakami E, Ozawa H, Koga H, Isu T, Chiba Y, Abe E, Unoki E, Musha Y, Ito K, Katoh S, Yamaguchi T : A diagnostic scoring system for sacroiliac joint pain originating from the posterior ligament. *Pain Med* 18 : 228-238, 2017
14. Lee JJ, Lee MK, Kim JE, Kim HZ, Park SH, Tae JH, Choi SS : Pain relief scale is more highly correlated with numerical rating scale than with visual analogue scale in chronic pain patients. *Pain Physician* 18 : E195-E200, 2015
15. Dall BE, Eden SV, Rahl MD : Surgery for the painful, dysfunctional sacroiliac joint. Springer, Switzerland, 2015, pp.55-59
16. Murakami E, Aizawa T, Kurosawa D, Noguchi K : Leg symptoms associated with sacroiliac joint disorder and related pain. *Clin Neurol Neurosurg* 157 : 55-58, 2017
17. Backlund J, Clewett Dahl E, Skorpil M : Is CT indicated in diagnosing sacroiliac joint degeneration? *Clin Radiol* 72 : 693, 2017
18. Sieper J, Braun J : Clinician's manual on axial spondyloarthritis. Springer healthcare, London, 2014, pp.57
19. Murakami E : Sacroiliac joint disorder. Accurately diagnosing low back pain. Springer, Singapore, 2018, pp.40-46
20. Laslett M : Evidence-based diagnosis and treatment of the painful sacroiliac joint. *J Man Manip Ther* 16 : 142-152, 2008