Sacrotuberosus Ligament Pain in Patients who Underwent Sacroiliac Joint Arthrodesis: Incidence and Management of Post-Surgical Lower-Buttock Pain

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Abstract:

Introduction: Most sacroiliac joint (SIJ) disorders are conservatively treated; however, patients with severe pain occasionally require SIJ arthrodesis after failure of continuous conservative management for more than 6 months. We investigated the incidences of preoperative tenderness in the sacrotuberosus ligament (STL) and postoperative lower-buttock pain originating from the STL to determine the best way to manage these symptoms to achieve good outcomes.

Methods: We retrospectively investigated 33 patients (14 men and 19 women) with a mean age of 47.7 years (range: 25-79 years) who underwent SIJ arthrodesis for severe pain confirmed using diagnostic SIJ injections between April 2009 and December 2019. We investigated the pain improvement at or around the posterior superior iliac spine (PSIS) pre- and postoperatively using the visual analogue scale (VAS) values, incidence of tenderness of the STL before surgery, rate of the persisting STL tenderness, incidence of new-onset STL pain, and treatment options for STL pain postoperatively.

Results: The mean VAS value at or around the PSIS was significantly relieved postoperatively from 85.6 to 31.5 mm (P<0.001). Preoperative tenderness of the STL was identified in 21 of 33 patients (63.6%). The STL tenderness resolved after surgery in 12 of these 21 patients (57.1%); however, it persisted in nine patients (42.9%), all of whom were women. Of the 12 patients who did not have preoperative STL tenderness, 4 (33.3%) developed lower-buttock pain and had STL tenderness. In total, 9 (27.3%) of the 33 patients whose progress could be followed up after SIJ arthrodesis had pain originating from the STL; the STL pain in 8 of the 9 patients was relieved after the STL injections and physical therapy.

Conclusions: The STL pain can occur pre- and postoperatively, and management of both persisting and new-onset STL pain after SIJ arthrodesis should be considered to achieve better outcomes.

Keywords: sacroiliac joint, arthrodesis, sacrotuberosus ligament, physical therapeutic intervention

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Introduction

The sacroiliac joint (SIJ) is a synovial joint consisting of the articular surfaces of the sacral and iliac bones. It is characterized by a large ligamentous area in addition to the articular area. Bernard et al. defined the SIJ as a composite structure that comprises the joint cavity and the vast posterior ligamentous region\(^1\). It has a small range of motion at the base of the spinal column and functions as a shock absorber. SIJ dysfunction leads to loss of shock absorption, caused by repetitive or unexpected movements. This causes lumbar and buttock pain at or around the posterior superior iliac spine (PSIS), which is also referred to the groin, lower lumbar region, and lower extremities\(^2\). In addition to pain at or around the PSIS\(^3\), tenderness, particularly in the sacrotuberosus ligament (STL), is an important physical finding associated with SIJ disorder\(^4\). The STL connects the sacral lateral bulge (S3-S5) and the ischial tuberosity and restricts the nutational motion of the sacrum\(^5\). Furthermore, it has been demonstrated that sensory nerve endings similar to the Ruffini-type receptors are present in the STL near the ischial tuberosity\(^6\).
A diagnosis of SIJ disorder is confirmed by ≥70% relief of pain at and around the PSIS after an SIJ injection. Several sessions of therapeutic SIJ injections and physical therapy can relieve SIJ pain. However, some patients require surgical treatment (SIJ arthrodesis) due to difficulty in performing activities of daily living or inability to work despite conservative management for more than 6 months. There are many other studies showing the effectiveness of surgical treatment, and the long-term results of SIJ arthrodesis were good. However, several patients had poor surgical outcomes for the activities of daily living. In our clinical settings, we had some patients who complained of persisting pain in the lower buttock, including the ischial tuberosity (around the STL attachment site), which was a factor in delayed recovery to daily activities following surgery. Therefore, it is extremely important to investigate the persisting and new-onset STL pain. However, there is no report regarding remaining and new-onset symptoms after SIJ arthrodesis. This study aimed to investigate the preoperative incidence of STL tenderness and postoperative lower-buttock pain, originating from the STL, and to determine how to manage these symptoms to achieve good outcomes.

### Materials and Methods

This study was approved by the Institutional Review Board of our hospital. Written informed consent was obtained from the patients for the procedure and for the use of their data for publication. The data were retrospectively examined based on the patients’ medical records.

### Patients

There were 38 patients who had SIJ pain who underwent SIJ arthrodesis with a definitive diagnosis of SIJ disorder at our institution from April 2009 to December 2019. Of them, five were excluded due to loss to follow-up. Thus, 33 patients (14 men and 19 women; mean age, 47.7 years; range: 25-79) were finally included in the study. The mean follow-up period was 44.1±35.3 months. The patients’ demographic characteristics are presented in Table 1. The surgical procedures and post-surgical images are presented in Table 2 and Fig. 1, respectively.

The following items were retrospectively investigated: 1) improvement of pain at or around the PSIS pre- and post-SIJ arthrodesis using the visual analogue scale (VAS) value; 2) incidence of STL tenderness before surgery; 3) rate of the persisting STL tenderness; 4) incidence of new-onset STL pain; 5) degree of improvement in pre- and postoperative pain at or around the PSIS in the two groups of patients: those with postoperative STL tenderness and those without tenderness (the difference between pre- and postoperative VAS was defined as ΔVAS); and 6) treatment options for STL pain after surgery.

### Diagnosis of SIJ disorder

All patients identified the PSIS as the main location of

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**Table 1.** Demographic Characteristics of Patients who Underwent SIJ Arthrodesis.

| Characteristics (n=33) | mean (SD) * |
|-----------------------|-------------|
| Age, years            | 43.2 (12.0) |
| Height, cm            | 163.2 (9.4) |
| BW, kg                | 64.8 (15.8) |
| Women, n (%)          | 19 (57.6)   |
| BMI, mean (SD)        | 23.4 (6.2)  |

Note: SIJ, sacroiliac joint; BW, body weight; BMI, body mass index; *mean (standard division) or N (%) reported.

**Table 2.** Surgical Procedures.

| Surgical approach | Number of patients (N (% female)) |
|-------------------|----------------------------------|
| Anterior          | 14 (50.0)                        |
| Lateral           | 2 (100)                          |
| Posterior         | 17 (58.8)                        |

Total 33 (57.6)

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**Figure 1.** Techniques of sacroiliac joint (SIJ) arthrodesis.
A. Anterior SIJ arthrodesis using plate and screws.
B. Posterior SIJ arthrodesis using S1 pedicle screw and two S2 alar-iliac screws and cylinder cages.
Figure 2. Identification of the subjective pain area using the index finger (one-finger test) and identification of the sacrotuberous ligament (STL) under ultrasound scan.

A. When the patients indicates around the ischial tuberosity as the location of pain using their index finger, the painful area is confirmed using ultrasound scan.

B. The tenderness of the bone-ligament attachment site of the STL (ischial tuberosity attachment site) was confirmed under ultrasound scan guidance. a. Ultrasound scan image, ischial tuberosity (*), STL (**), tender point (white circle), b. probe position.
via ultrasound scan. The presence of tenderness was measured twice at the same site, and when the patient showed a positive response in both times, we considered that STL tenderness was present.

**Timeline of the assessment of STL tenderness**

Within 5 days prior to surgery, STL tenderness was confirmed. Persisting tenderness of the STL was confirmed within 2 weeks after surgery. With regard to new-onset STL tenderness, an assessment was performed when the patients complained of lower-buttock pain. An orthopedic surgeon or a physical therapist asked the patients to indicate the site of pain using their index finger. When the patients indicated the ischial tuberosity, the STL tenderness was evaluated.

*Physical therapy techniques*

The STL relaxation (the ischial tuberosity side) was tested by holding it with one hand while sliding the other hand back and forth in small motions to first relax and then stretch the STL (Fig. 4). The biceps femoris muscle relaxation was performed at the tender area using bilateral finger-tip movements with low-amplitude stimulation parallel and vertical to the fibrous direction under pressure.

*Assessment of treatment effectiveness for pain from the STL after the SIJ arthrodesis*

The effectiveness of physical treatment was evaluated using a pain relief scale. The patients were asked to state the intensity of the persisting STL pain after an injection into the STL and/or a STL relaxation session based on the assumption that the pain before the procedure was quantified as level 10. The treatment was considered to be effective when the patients reported a pain intensity of less than level 3, which indicated an improvement of ≥70%. Physical therapy sessions continued until the STL pain was relieved sustainably by at least 70%, i.e., the pain did not recur.

*Statistical analysis*

Pain improvement pre- and post-SIJ arthrodesis was determined using a paired t-test. The patients were categorized into two groups: one with STL tenderness after the SIJ arthrodesis and the other without. The difference in the intensity of postoperative pain at or around the PSIS between these two groups was determined using the t-test. A P-value of less than 0.05 was considered statistically significant. All statistical analyses were conducted using EZR (version 3.3.2)—a statistical software that extends the capabilities of R and R Commander.
Results

Improvement of pain at or around the PSIS pre- and post-SIJ arthrodesis using the VAS value

The mean VAS values at or around the PSIS were significantly relieved after the SIJ arthrodesis from 85.6±14.4 to 31.5±26.3 mm (P<0.001).

Incidence of the STL tenderness pre- and postoperatively

Preoperative tenderness of the STL was identified in 21 of 33 patients (63.6%). Of these 21 patients, the tenderness resolved after the SIJ arthrodesis in 12 patients (57.1%) but persisted in 9 patients (42.9%), all of whom were women. Conversely, 4 (33.3%) of the 12 patients who did not have preoperative pain developed lower-buttock pain and had STL tenderness. The new onset of post-surgical tenderness at the STL was confirmed at an average of 12.5 weeks (range: 3-19 weeks); lower-buttock pain was identified as originating from the STL in all four patients, three of whom were men (Fig. 5 and Table 3).

Improvement of the STL tenderness and postoperative PSIS pain after surgery

No difference was observed in the postoperative PSIS pain between the groups with (VAS 82.6±16.9 to 29.9±26.3 mm) and without (VAS 90.3±7.5 to 34.0±27.3 mm) STL tenderness (P=0.67). In addition, there was no difference in ΔVAS, which were 52.7±30.3 mm and 56.3±26.1 mm, respectively (P=0.52).

Incidence of postoperative STL pain and its treatment course

Of the nine women with persisting STL tenderness, five were diagnosed as having STL pain after injections (five patients were injected under fluoroscopy guidance and two under ultrasound scan) at the ischial tuberosity attachment site of the STL. Among the other four patients without definitive diagnosis, pain was relieved in two patients spontaneously at 1 and 3 months after surgery, and the other two patients complained of persisting STL tenderness and lower-buttock pain. Regarding the four patients with new-onset STL tenderness after the SIJ arthrodesis, the tenderness was confirmed to have originated from the STL using the STL injections (two patients were injected under fluoroscopy guidance and the other two under ultrasound scan). Pain in three of the four patients was relieved after the STL relaxation and biceps femoris muscle relaxation following the STL injections; one patient suffered from recurrent STL pain even after the STL injections and physical therapy sessions (Fig. 6).

Discussion

We focused on STL tenderness pre- and post-SIJ arthrodesis. Several studies have reported that lower-buttock pain can originate from the STL15,16; however, there are no studies on STL pain related to SIJ arthrodesis. STL tenderness (ischial tuberosity attachment site) is an important physical finding that is associated with SIJ disorder4. We expected the STL tenderness to resolve after SIJ arthrodesis; however, we found that preoperative STL tenderness resolved in only approximately 60% of the patients after the SIJ arthrodesis, suggesting that the persisting STL pain was not a simple symptom associated with SIJ disorders. Surprisingly, the tenderness continued in 40% of the patients even after the SIJ arthrodesis, and they required additional treatment. We statistically determined whether postoperative PSIS pain reduction was associated with postoperative STL tenderness that remained, and we found no association. This
Figure 6. Incidence of STL tenderness, definitive diagnosis of STL pain, and treatment course post-SIJ arthrodesis.

Of the 33 patients who could be followed up after SIJ arthrodesis, 9 (27.3%) had pain originating from the STL; the STL pain in 8 of the 9 patients was relieved after the STL injections and physical therapy.

indicates that the persisting STL tenderness may have occurred for reasons unrelated to SIJ disorders. According to Vleeming et al., the STL acts to resist nutation of the sacrum; therefore, when the sacrum gets stuck in a particular nutated position, tensing of the STL would continue. It is possible that STL enthesopathy had already occurred concurrently with the SIJ disorders preoperatively. In addition to the STL, the proximal hamstrings complex has a strong bony attachment on the ischial tuberosity. Injuries to the hamstring origin are another possible explanation for the ischial tuberosity region pain, which are independent of the SIJ disorders. The search for the causes of tenderness in the ischial tuberosity area should be extensive in cases with remaining lower-buttock pain even after SIJ arthrodesis.

In this study, we also observed new-onset STL pain after SIJ arthrodesis. Based on the SIJ biomechanics, SIJ arthrodesis might have been performed in specific positions of sacral nutation in these patients. However, this was not elucidated in this study, and there is no report on the ideal intraoperative position of the sacrum and ilium when an SIJ arthrodesis is performed.

For the STL pain, repeated injections of local anesthetics into the STL (ischial tuberosity attachment site) and manual relaxations were effective in most patients. However, since there were a total of five patients who did not improve even after the injections and physical therapy (fortunately, pain was spontaneously relieved in two of them), further investigation to show the origin of lower-buttock pain was necessary. Paying attention to postoperative STL pain is important as therapeutic interventions could improve the activities of daily living in some patients who underwent SIJ arthrodesis.

In this study, the risk factors of persisting and new-onset STL pain after the SIJ arthrodesis were not identified. Interestingly, only women patients complained of persisting STL tenderness; men patients (three out of four patients) were more likely to develop new-onset STL tenderness after surgery, and their lower-buttock pain were all confirmed to have originated from the STL. Previous studies demonstrated that women have a larger range of motion at the SIJ and larger strains in the STL than men and that there is a difference in the relationship between the gravitational line and location of the articular region in the SIJ among men and women. These anatomical reasons might have affected our results. Future studies focusing on gender differences in the SIJ biomechanics are required to elucidate this.

There are several limitations to this study. First, this study involved a relatively small number of patients as those with SIJ pain who undergo surgical treatment are very rare. Second, we could not evaluate the STL pain intensity for all the patients. The presence of tenderness rather than the intensity of the STL pain was examined, since pain relief at or around the PSIS alone was addressed after SIJ arthrodesis using the VAS. We should have used VAS to evaluate the intensity of the STL pain in all patients pre- and post-SIJ arthrodesis. Third, it is controversial whether 2 weeks after surgery was the optimal time to evaluate postoperative STL tenderness. We attempted to evaluate persisting STL tenderness at or approximately 2 weeks after surgery because there seemed to be less susceptibility to the effects of increasing STL load due to increases in the activity after surgery. We would have wanted to evaluate simply whether the STL tenderness, which we considered as a symptom associated with SIJ disorders, resolved as a result of SIJ arthrodesis alone. Fourth, with regard to the diagnostic method using local an-
esthetics, there are no studies investigating whether injections into the STL are truly limited to the STL and how much they leak into the surrounding tissues. In this study, we tried our best to diagnose STL pain under fluoroscopy guidance with a small amount of local anesthetic agents. Ultrasound scan-guided injections might be more reliable. More anatomical studies on the diagnostic injection method are necessary.

Despite these limitations, this is the first case series that investigated preoperative STL tenderness and the incidence of lower-buttock pain originating from the STL after SIJ arthrodesis.

**Conclusion**

The incidence of sacrotuberous ligament (STL) tenderness before the SIJ arthrodesis was 63.6%. The tenderness resolved in 57.1% of the patients after surgery. On the other hand, of the patients who did not have preoperative STL tenderness, new-onset STL tenderness was observed in 33.3% of patients. Thus, STL tenderness can remain even after SIJ arthrodesis, and it could develop for the first time postoperatively. Identification of pain originating from the STL using diagnostic injections and therapeutic management of remaining and new-onset STL tenderness after SIJ arthrodesis should be considered to achieve better surgical outcomes.

**Conflicts of Interest:** The authors declare that there are no relevant conflicts of interest.

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**Ethical Approval:** This study was approved by the Institutional Review Board of Japan Community Healthcare Organization Sendai Hospital (Approval code: 2021-5).

**Informed Consent:** Informed consent was obtained from the patients prior to the procedure and for the use of their data in publications.

**References**

1. Bernard TN, Classidy JD. The sacroiliac joint syndrome. Pathophysiology, diagnosis and management. The Adult Spine: Principles and Practice. Frymoyer JW. Philadelphia: Lippincott-Raven Publishers. 1997;2343-63.
2. Goldthwait JE, Osgood RB. A consideration of the pelvic articulations from an anatomical pathological and clinical standpoint. Boston Med Surg J. 1905;152(21):593-601.
3. Murakami E, Aizawa T, Noguchi K, et al. Diagram specific to sacroiliac joint pain site indicated by one-finger test. J Orthop Sci. 2008;13(6):492-7.
4. Kurosawa D, Murakami E, Ozawa H, et al. A diagnostic scoring system for sacroiliac joint pain originating from the posterior ligament. Pain Med. 2017;18(22):228-38.
5. Vleeming A, Stoeckart R. The role of the pelvic girdle in coupling the spine and the legs: a clinical-anatomical perspective on pelvic stability. In: Movement, Stability and Lumbopelvic Pain. Edinburgh: Churchill Livingstone, 2007; pp.113-34.
6. Varga E, Dudas B, Tile M. Putative proprioceptive function of the pelvic ligaments: biomechanical and histological studies. Injury. 2008;39(8):858-64.
7. Murakami E, Kurosawa D, Aizawa T. Treatment strategy for sacroiliac joint-related pain at or around the posterior superior iliac spine. Clin Neurol Neurosurg. 2018;165:43-6.
8. Endres S, Ludwig E. Outcome of distraction interference arthrodesis of the sacroiliac joint for sacroiliac arthritis. Indian J Orthop. 2013;47(5):437-42.
9. Rudolf L, Capobianco R. Five-year clinical and radiographic outcomes after minimally invasive sacroiliac joint fusion using triangular implants. Open Orthop J. 2014;8:375-83.
10. 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. 2018;29(3):85.
11. Kurosawa D, Murakami E, Aizawa T, et al. Surgical outcomes patients with sacroiliac joint pain: an analysis of patients with poor results regarding activities of daily living. Spine Surg Relat Res. 2021;5(3):189-95.
12. Kurosawa D, Murakami E. Pelvic girdle tenderness points to differentiate the sacroiliac joint dysfunction from lumbar diseases. Seikeigeka (ORTHOPEDIC SURGERY). 2012;63(12):1231-35. (in Japanese.)
13. Sasaki T, Kurosawa D, Murakami E, et al. Physical therapeutic options for the residual sacrotuberous ligament pain after treatment of the sacroiliac joint dysfunction. J Phys Ther Sci. 2021;33(9):646-52.
14. Lee JJ, Lee MK, Kim JE, et al. Pain relief scale is more highly correlated with numerical rating scale than with visual analogue scale in chronic pain patients. Pain Physician. 2015;18(2):E195-200.
15. Hackett GS. Treated by prolotherapy. Ligament and Tendon relaxation, 3rd ed. Springfield: Charles C Thomas Pub Ltd. 1958; p.p.26, p.45-6, p.62.
16. Leon C, Judi D. The Lower body. Clinical Application of Neuromuscular Techniques. 2nd ed. Edinburgh: Charles C Thomas Pub Ltd. 1958; p.377, p.382.
17. Vleeming A, Stoeckart R. The role of the pelvic girdle in coupling the spine and the legs: a clinical-anatomical perspective on pelvic stability. In: Movement, Stability and Lumbopelvic Pain: Integration and Research. (eds Vleeming A, Mooney V, Stoeckart R), Churchill Livingstone, Edinburgh, 2007; p.118.
18. Guanche CA: Hamstring origin avulsions and ischial tunnel syndrome. Martin HD Edt. Posterior Hip Disorders, Springer Nature Switzerland, 2019; pp.197-204.
19. Joukar A, Shah A, Kiapour A, et al. Sex specific sacroiliac joint biomechanics during standing upright: a finite element study. Spine (Phila Pa 1976). 2018;43(18):E1053-60.
20. Bellamy N, Park W, Rooney PJ. What do we know about the sacroiliac joint? Semin Arthritis Rheum. 1983;12(3):282-313.
