Documentation of outcomes for sacroiliac joint fusion: does prior spinal fusion influence the outcome?

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Abstract

Purpose The purpose of this prospective case series (level II) was to determine the clinical outcomes of anterior SIJ fusion, comparing the outcomes of patients who had prior spinal fusions at any level compared to patients who have not.

Methods This prospective study included 25 patients who underwent SIJ fusion with anterior plate fixation. All patients had failed non-operative treatment, had a positive Patrick test, and positive response to intra-articular SIJ injections with greater than 50 % pain relief. Patients had follow-up at 3, 6, 9 and 12 months where they completed Oswestry disability index (ODI) and Short Musculoskeletal Functional Assessment (SMFA) surveys. Outcome data are available for 19 patients who completed pre-operative and 12-month follow-up surveys. Their average time of the final follow-up was 1.1 years (range 10–33 months).

Results Significant improvements between pre-operative and the final follow-up in ODI ($p = 0.007$) and SMFA ($p = 0.01$) were observed; the ODI assessed outcomes in patients who had previous spinal fusion surgery were significantly worse than those that did not at the final follow-up ($p = 0.04$).

Conclusion Patients who have not undergone prior spinal fusion surgery, regardless of age, gender, and BMI have better outcomes following anterior SIJ fusion.

Keywords Sacroiliac joint · Arthrodesis · Dysfunction · Fusion

Introduction

Sacroiliac joint (SIJ) pain may be debilitating to patients, however, identifying the SI joint as the unique pain source is difficult if not impossible. The issue is differentiating SIJ pain from other sources of low back pain (LBP). The pain that patients report is usually in the low back, buttock or groin [1–3]. Patients with SIJ pain can suffer from other causes of LBP (herniated disc, facet pain, sciatica); prior to 1934 the SIJ was thought to be the main cause of LBP.

The prevalence of LBP originating from the SIJ has been reported in the recent literature ranging from 13 to 35 % [4–6] and may be due to low or high energy trauma as well as inflammatory arthritis diseases, pregnancy, osteoarthritis, and previous spinal fusions which can result in SIJ pain and dysfunction [7, 8]. Patients with prior lumbar fusion often have symptoms referable to the SIJ. Surgical fusion in this group of patients often results in a poor outcome [9]. Often the diagnosis is made by a consortium of provocation, palpation, and position tests in conjunction with diagnostic injections [10, 11]. There have been many studies conducted to confirm the reliability and validity of these tests; however, results have varied greatly and are often contradictory [1, 2, 5, 10–18]. Once the diagnosis is made, patients are generally treated non-operatively with pain control, chiropractic mobilization of the joint, physical therapy, and/or joint injections [19]. Many physicians use the intra-articular injection as a diagnostic tool [6, 16]. If patients receive 50–100 % relief of their symptoms following the injections it is generally considered pathognomonic for pain originating from the SIJ. Should these modalities fail to bring acceptable long lasting improvement in the patient's symptoms, the final option is SIJ arthrodesis [19].

Much of the clinical research that has been done on SIJ pain is focused on confirming the diagnosis. There is little

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in the literature on the treatment of SIJ pain and clinical outcomes of treatment. This study strives to provide some insight into the clinical outcomes of surgical treatment for SIJ dysfunction. We hypothesized that there would be statistically significant improvements in the ODI and SMFA in all patients. We also hypothesized that there would be greater magnitude of improvements in patients who did not had prior spinal fusions when compared to patients who had undergone a prior fusion procedure because of the increased difficulty with identifying the SI joint as the major source of pain.

Patients and methods

This study was approved by the Institutional Review Board. Patients presented as referrals from outside practitioners for the treatment of their SIJ pain. All patients were seen and examined by the senior author. If the patients' histories were congruent with SIJ dysfunction of at least 1 year and their Patrick test was positive they were sent for plain radiographic evaluation and/or CT imaging of their pelvis to assess for pathologic changes in their SIJs. Patients were prescribed physical therapy and non-steroidal medications for the treatment of their pain.

Physical therapy treatments consisting of core strengthening exercises as well as chiropractic adjustment (based on patient preference) of the SIJ were begun for patients who did not received these modalities prior to presentation. After a period of 6–12 weeks of conservative care, re-examination of the patients was completed. If there was no improvement, they were referred for radiographically controlled intra-articular injections.

Diagnostic and therapeutic intra-articular SIJ injections were administered to all patients prior to surgical intervention. Local anesthetic was placed into the SIJ under direct fluoroscopic visualization. Only patients who received greater than 50 % relief of their symptoms by self-report immediately after the injections were offered a fusion procedure. Prior to their procedure, the patients completed an Oswestry disability index Chiropractic version (ODI) [20, 21] and Short Musculoskeletal Functional Assessment (SMFA) [22] survey to determine their baseline functional status. Lower scores on the ODI and SMFA scores at the final follow-up correlated to a subjective improvement by the patient. Twenty-five patients were enrolled in this prospective cohort study; 19 patients completed the 1-year follow-up outcome measures of which 12 had a prior lumbar fusion.

Surgical technique

The patients are positioned supine on a radiolucent table and antibiotics are administered. The proximal half of the

anterior ilioinguinal approach is outlined to approximately 20 cm in length. The interval between the gluteal fascia and external oblique/conjoint tendon is identified and then divided down to the superior ilium. The Cobb elevator is used to elevate the iliacus off of the inner table of the ilium. A cobra retractor is placed along the iliopectineal line and then under direct vision with headlamp illumination the capsule is removed from the iliac side and then from the sacral side with electrocautery. Care must be taken to avoid the L5 nerve root which runs along the anterior surface of the sacral ala. Once the anterior aspect of the SIJ is exposed, a Homan retractor is inserted and then with the series of pituitary rongeurs and straight and angled curettes, the joint is eliminated down to the posterior ligamentous structures (Fig. 1a). The sacral and iliac sides of the joint are drilled with multiple 2.5 mm drill holes to enhance fusion. A series of Lambotte osteotomies are used to remove the inner table of the ilium and then harvest an appropriate amount of cancellous autograft. The autograft is then tamped into the SI joint. The 3-hole, 4.5 mm reconstruction plate is then fixed across the SI joint with a fully threaded cancellous screw on the sacral side and two cortical screws on the iliac side (Fig. 1b).

Post-operative treatment and follow-up

Post-operatively patients are kept toe-touch weight bearing for 6 weeks. Pool therapy is initiated at 6 weeks, which eventually is transitioned to land-based core body strengthening therapy. Patients at their 3, 6, 9 and 12 months appointments are given Oswestry disability index (ODI) and Short Musculoskeletal Functional Assessment (SMFA) surveys to complete or, if they are unable to present for their visit, they are mailed their surveys.

Complications

Complications are identified at the subsequent clinical follow-up visits and recorded.

Statistical analysis

A paired *t* test was used to analyze the differences between the initial pre-operative and final follow-up ODI and SMFA scores. In the sub-analysis comparison of prior spinal fusion and no spinal fusion group, the initial pre-operative and final follow-up ODI and SMFA scores were compared using group *t* tests. Individual patient change was calculated by subtracting the final score from the pre-operative score to determine the magnitude of the change in these sub-groups.

Fig. 1 **a** Surgical approach, **b** implant placement

Results

Patient data were reviewed from 10/10/2006 to 12/8/2008. One-hundred patients were referred for evaluation of the SI joint being the primary source of their low back/buttock pain; 25/100 (25 %) patients met all criteria for SIJ fusion. Six of these patients did not complete 12 months outcome surveys and did not respond to contacts from the authors. Nineteen patients completed an outcome questionnaire a minimum 300 days after the surgery (mean 1.1 years, range 10–33 months). Twelve patients had undergone prior spinal fusion while seven had not. Their basic demographic data are described in Table 1.

Oswestry disability index scores

There was a significant improvement in the ODI between pre-operative (63.1) and final follow-up (45.2) ($p = 0.007$). The average magnitude of change between pre- and post-operative dysfunction was 18 points in the improved function (Table 2). Four patients reported diminished function of between 2 and 12 points. All of the patients with

diminished function had undergone a prior fusion. There was no significant difference in pre-operative complaints on the ODI when comparing patients with (61.0) and without prior fusion (66.7) ($p = 0.76$). At the final follow-up, patients without a prior fusion had significantly better outcomes (32.0) than the patients with a fusion (52.8) ($p = 0.04$) with an average 20 point improvement in the function (Table 3).

We noted four post-operative complications in four patients. These included one wound hematoma, one non-union, one long screw which produced posterior superior iliac spine irritation and one non fatal PE related to pelvic DVT. Three surgical complications required re-operation and resolved with secondary surgery. These patients had less improvement, according to ODI, when compared to the patients who did not have post-operative complications; this was not found to be statistically significant (-6.0 vs. -20.6) ($p = 0.10$).

Table 1 Patient demographics

Patient demographics	Total (<i>n</i> = 19)	Spinal fusion (<i>n</i> = 12)	No spinal fusion (<i>n</i> = 7)
Gender (male/ female)	5/14	3/9	2/5
Average age (years)	51 (34–77)	51 (34–69)	61 (48–77)
BMI (kg/m ²)	30.1 (23.1–41.7)	29.5 (23.2–37.5)	31.1 (24.9–41.6)

Table 2 Patient subjective score results

	Δ ODI (mean/Std. Dev.)	Δ SMFA (mean/Std. Dev.)
Overall population (<i>n</i> = 19)	-17.9 ± 25.4	-11.7 ± 18.2
Spinal fusion		
With (<i>n</i> = 12)	-10.8 ± 18.3	-5.3 ± 12.0
Without (<i>n</i> = 7)	-30.0 ± 20.1	-22.9 ± 22.3
Complications		
With (<i>n</i> = 4)	-6.00 ± 7.3	0.00 ± 8.5
Without (<i>n</i> = 15)	-20.6 ± 28.8	-14.9 ± 18.9

Short musculoskeletal functional assessment scores

There was significant change between the pre-operative (47.7) and post-operative (36.0) dysfunction scores on the SMFA ($p = 0.01$). The average magnitude of change between pre- and post-operative dysfunction was 12 points (Table 2). Six patients reported diminished function (2–26 points). Four of these six patients had a prior fusion. There was no significant difference between patients who had undergone a prior fusion (46.8 baseline; 40.7 final follow-up) and those who had not (49.3 baseline; 27.9 final follow-up) at either time point on the SMFA (pre-operative; $p = 0.35$ and final follow-up; $p = 0.23$) despite the no prior fusion group demonstrating an average 17 points improvement in function (Table 3). A 7-point change in SMFA dysfunction scale is considered clinically important.

Two patients reported diminished function after surgical treatment on both the SMFA and ODI. Both of those patients had undergone prior fusion.

The patients with post-operative complications had significantly less improvement, according to their total SMFA scores, when compared to the patients who did not have post-operative complications (0.0 vs. -14.9 , $p = 0.04$). All of these complications resolved with further treatments.

Patients who have not undergone prior spinal fusion surgery, regardless of age, gender, and BMI have better outcomes following anterior SIJ fusion. The “Appendix” (Table 3) provides additional detail on outcomes.

Discussion

The results of our study confirmed the initial hypotheses: patients noted subjective improvements and there were better outcomes, on average, amongst patients with no prior spinal fusions when compared to those who had undergone prior fusions. However, the individual patient magnitude and rate of functional improvement varied substantially, especially with respect to the comparison of patients who had and had not suffered post-operative complications. This discrepancy was likely impacted by the two different sample sizes. The individual plots over time for the SMFA and ODI data with and without spinal fusion are depicted in Figs. 2, 3, 4, and 5. Clinically significant improvements in the ODI have been reported in the literature ranging from 4 to 30 points depending on the etiology of the pain [20]. The FDA states that a decrease of 15 points is considered clinical improvement in spinal fusion patients [20]. We observed an average decrease of 18 points in ODI in all patients included in the study. With regards to SMFA scores, in the description of the validity and reliability of the SMFA as a clinical outcomes tool, patients who reported that they were subjectively in better or much better health

Fig. 2 The changes in ODI over their follow-up period for the patients who had prior spinal fusions

Fig. 3 The changes in ODI over their follow-up period for the patients who did not had prior spinal fusions

Fig. 4 The changes in SMFA scores over their follow-up period for the patients who had prior spinal fusions

Fig. 5 The changes in SMFA scores over their follow-up period for the patients who did not had prior spinal fusions

had SMFA score decreases of 9.66 in the dysfunction category [22]. We noted an average decrease of 12 points in the patients' dysfunction SMFA score.

There is currently no proven diagnostic algorithm that is highly sensitive for SIJ dysfunction. There are a multitude of physical exam tests designed to aid in the diagnosis of pain originating from the SIJ [3, 12, 14, 18, 23]. Other studies have sought to test the reliability and validity of these tests, but results have not shown any one test or group of tests to be superior to another [10, 11, 13, 15, 17, 18, 23]. This is mainly because of inter-rater reliability issues. The providers administering these tests will conduct the exams differently based on their experience levels, clinical experiences, and personal preferences. This inevitably leads to different interpretations of the results as well. For this study a combination of patient history, positive Patrick test, and intra-articular injection yielding >50 % relief of symptoms were used to identify patients eligible for SIJ arthrodesis. Much of the published literature on surgical fixation of SIJ dysfunction relates to the use of posterior fixation techniques [8]. Belanger and Dall [24], in their case series of four patients showed at the 10-year follow-up that all patients had some residual SIJ pain. However, all four patients stated that they had improvements in pain, mobility and functionality. All of the patients included underwent a posterior approach with pedicle screw and bone graft arthrodesis and three of the four patients had previously undergone lumbar fusions. Buchowski et al. [25] showed significant improvements in the 20 patients according to SF-36 and AAOS Modems Instrument scores. Their procedure involved a posterior approach and posterior fixation with T- or L-plates. However, their patient cohort also involved patients with osteoarthritis, postpartum instability, and inflammatory arthropathies as well as SIJ dysfunction. Waisbrod et al. [26] in their study of 22 SIJ arthrodeses also performed a posterior approach with iliac bone graft. What they found was 50 % of the patients

had satisfactory results. They deemed a patient satisfactory if they had decreased pain by 50 %, no longer required analgesics for pain, and had returned to work. They went on to state that there were six patients in the unsatisfactory group whom should not have been operated on. Waisbrod concluded that if patients are screened correctly for surgery, that 70 % satisfactory results can be achieved.

With a posterior approach the posterior elements of the SIJ are violated to gain access to the joint space. These posterior ligamentous structures are the main stabilizers of the pelvis [27]. If these structures are divided, the structural integrity of the pelvis could be compromised [28]. This in turn could lead to increased laxity in the ligaments, increased motion in the joint, or increased stress through the joint, all of which can cause larger stresses placed on implants used for fixation. In contrast, the anterior approach allows the stabilizing posterior structures to remain intact and work in conjunction with the implants used for fixation. The anterior approach to the SIJ is safe and effective [29].

For this study, anterior plating of the SIJ was used to stabilize the arthrodesis. The published literature on anterior plating of the SIJ has shown good results. However, most of the reports involve the fixation of unstable sacroiliac joint disruptions. Rand describes in his paper a case where a 45-year-old female was treated with anterior plating of her SIJ for non-union of a prior sacral fracture [30]. He reported that at the 2.5-year follow-up, the patient had no symptoms of pain and had been fully active. Simpson et al. [31] reported on their small cohort of eight patients who were treated with anterior plating of the SIJ for unstable vertical fractures. They reported that seven of the eight patients had excellent results. They did not, however, define the parameters of what they considered excellent results.

There is very little in the literature regarding anterior plating and fusion of the SIJ for the treatment of SIJ dysfunction. In patients who have been unresponsive to non-operative treatments, the use of an anterior approach with anterior plating and bone grafting to achieve SIJ arthrodesis for the treatment of SIJ dysfunction yields statistically significant improvements in the patients subjective outcome scores. All of the patients who presented for the follow-up had improved ODI and SMFA scores. This suggests that after the surgical intervention all included patients saw improvements in their daily functional abilities and/or in their pain relief. As Waisbrod et al. [26] warned, it is important that patients be properly screened for this procedure and that they have completed conservative treatments without the resolution of their symptoms.

Patients with prior spinal fusions have significantly worse outcomes when compared to the patients who had no prior fusions. Previously, there have been studies that show patients with lower lumbar and lumbosacral fusions have increased SIJ pain following surgery. In a recent article by

Ha et al. [7] patients who had undergone lumbar and lumbosacral fusions were compared to an age-matched control group to assess the progression of SIJ degeneration; patients who had undergone prior fusions had significantly higher incidence of SIJ degeneration when compared to the control group (7 vs. 38.2 %, respectively). This evidence suggests that the poorer outcomes noted in our spinal fusion case series are likely due to the increased stresses placed on SIJ from the spinal fusion. However, even though the patients in the spinal fusion cohort had worse outcomes when compared to the patients who did not have spinal fusion, they were still noted to have improvements in their subjective outcome scores as a group. Therefore, patients with prior spinal fusions should be counseled that they are likely to see improvements in their pain, functionality, and mobility but it may not be as extensive as they hoped.

There are risks with any surgery. The most common include excessive bleeding and infection. Specific to this procedure the L5 nerve root can be stretched during retraction of the soft tissue causing a neuropraxia or worse the nerve can be permanently damaged during the procedure. All patient complications in this cohort resolved with further treatments. Despite these complications the significant improvements in both the ODI and the SMFA scores seem to justify the risks involved with this procedure.

There were limitations to our study. First, the follow-up period for patients included in this study was only 1 year. A longer follow-up period may reveal improving or worsening functional outcomes. Second, only one surgical

method was used in the treatment of these patients. We can make no inferences regarding outcomes of other techniques for sacroiliac fusion. Finally, nearly one-third of the patients were either lost to the follow-up or did not complete their ODI and SMFA surveys past the 6 month mark. Lastly, this study was a prospective surgical cohort study.

Sacroiliac joint dysfunction is a controversial topic of discussion and a difficult condition to treat. The diagnostic criteria for determining which patients actually have SIJ pain are poorly defined. This study showed that the use of surgical intervention in patients, who have previously failed non-operative treatment and meet strict diagnostic criteria, yields statistically significant improvements in those patients' subjective outcome scores and justifies the risks of the procedure. It also showed that, on average, patients who have undergone prior spinal fusions have worse outcomes when compared to the patients who had no fusions. We recommend this procedure as a safe and effective treatment for properly screened patients with SIJ pain unresponsive to conservative management. Caution is advised in recommending the procedure to patients with prior lumbar fusion.

Conflict of interest No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

Appendix

See Table 3.

Table 3 Ancillary results of the average baseline, follow-up, and total change in the ODI and SMFA scores

	Average baseline ODI	Average follow-up ODI	Δ ODI	Average baseline SMFA total	Average follow-up SMFA total	Δ SMFA total
Overall population	63.1 $\pm$ 10.2	45.2 $\pm$ 23.2	−17.9 $\pm$ 28.6	47.7 $\pm$ 11.1	36.0 $\pm$ 20.4	−11.7 $\pm$ 21.7
Gender						
Male (<i>n</i> = 5)	61.0 $\pm$ 10.3	34.0 $\pm$ 26.0	−27.0 $\pm$ 35.9	44.2 $\pm$ 10.0	32.2 $\pm$ 24.8	−12.0 $\pm$ 30.6
Female (<i>n</i> = 14)	63.9 $\pm$ 10.4	49.1 $\pm$ 21.8	−14.7 $\pm$ 26.4	48.9 $\pm$ 11.5	37.3 $\pm$ 19.5	−11.6 $\pm$ 19.1
Age						
≤53 (<i>n</i> = 7)	60.1 $\pm$ 12.0	53.4 $\pm$ 30.4	−6.70 $\pm$ 38.8	50.9 $\pm$ 11.8	41.4 $\pm$ 22.7	−9.4 $\pm$ 21.9
>53 (<i>n</i> = 12)	64.8 $\pm$ 9.1	40.3 $\pm$ 17.6	−24.5 $\pm$ 19.8	45.8 $\pm$ 10.7	32.8 $\pm$ 19.2	−13.1 $\pm$ 22.5
BMI						
<30 kg/m ² (<i>n</i> = 10)	61.9 $\pm$ 13.3	41.0 $\pm$ 21.5	−20.9 $\pm$ 32.2	46.5 $\pm$ 12.4	30.7 $\pm$ 21.6	−15.8 $\pm$ 24.3
≥30 kg/m ² (<i>n</i> = 9)	64.4 $\pm$ 5.6	49.8 $\pm$ 25.4	−14.7 $\pm$ 25.5	49.0 $\pm$ 10.0	41.8 $\pm$ 18.5	−7.2 $\pm$ 18.8
Spinal fusion						
With (<i>n</i> = 12)	61.0 $\pm$ 10.8	52.8 $\pm$ 23.5	−8.2 $\pm$ 28.2	46.8 $\pm$ 12.4	40.7 $\pm$ 18.1	−6.1 $\pm$ 13.4
Without (<i>n</i> = 7)	66.7 $\pm$ 8.70	32.0 $\pm$ 16.9	−34.7 $\pm$ 21.9	49.3 $\pm$ 8.9	27.9 $\pm$ 23.0	−21.4 $\pm$ 30.2
		<i>p</i> = 0.04*	<i>p</i> = 0.04*			
Complications						
With (<i>n</i> = 4)	62.5 $\pm$ 11.1	56.5 $\pm$ 17.6	−6.0 $\pm$ 7.3	44.8 $\pm$ 18.6	44.8 $\pm$ 20.4	0.0 $\pm$ 8.5
Without (<i>n</i> = 15)	63.3 $\pm$ 10.3	42.1 $\pm$ 24.1	−20.6 $\pm$ 28.8	48.5 $\pm$ 9.0	33.6 $\pm$ 20.5	−14.9 $\pm$ 18.9

* Bolded cells indicate significance at *p* ≤ 0.05

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