Case Study

Case series of ultrasound-guided platelet-rich plasma injections for sacroiliac joint dysfunction

Gordon D. Ko\textsuperscript{a,}\textsuperscript{*}, Sean Mindra\textsuperscript{b}, Gordon E. Lawson\textsuperscript{c}, Scott Whitmore\textsuperscript{d} and Leigh Arseneau\textsuperscript{d}

\textsuperscript{a}Department of Medicine, Division of Physiatry, Sunnybrook Health Sciences Centre and the Canadian Centre for Integrative Medicine, University of Toronto, Toronto, Canada

\textsuperscript{b}Faculty of Medicine, University of Ottawa, Toronto, Canada

\textsuperscript{c}Canadian Memorial Chiropractic College and the Canadian Centre for Integrative Medicine, Toronto, Canada

\textsuperscript{d}Canadian Centre for Integrative Medicine, Toronto, Canada

Abstract.

BACKGROUND: Two-thirds of adults worldwide will experience low back pain at some point in their life. In the following case series, we present four patients with sacroiliac (SI) joint instability and severe chronic low back pain, which was refractory to other treatment modalities.

OBJECTIVE: We investigated the efficacy of platelet-rich plasma (PRP) injections, a novel orthobiologic therapy, for reducing SI joint pain, improving quality of life, and maintaining a clinical effect.

METHODS: Short-form McGill Pain Questionnaire (SFM), Numeric Rating Scale (NRS), and Oswestry Low Back Pain and Disability Index were used for evaluation of treatment at pretreatment, 12-months and 48-months after treatment.

RESULTS: At follow-up 12-months post-treatment, pooled data from all patients reported a marked improvement in joint stability, a statistically significant reduction in pain, and improvement in quality of life. The clinical benefits of PRP were still significant at 4-years post-treatment.

CONCLUSIONS: Platelet-rich plasma therapy exhibits clinical usefulness in both pain reduction and for functional improvement in patients with chronic SI joint pain. The improvement in joint stability and low back pain was maintained at 1- and 4-years post-treatment.

Keywords: Musculoskeletal and joint disorders 1316 < drugs and medicines, orthopaedics 334, back pain 863 < occupational and environmental medicine 842, Ehlers-Danlos syndrome, ligament laxity 1383 < sports and exercise medicine 587, fibromyalgia, neuropathic pain, motor vehicle accident

1. Introduction

An increasing number of people suffer from chronic low back pain, a debilitating condition which not only reduces patients' quality of life, but is also a heavy socioeconomic burden worldwide [1,2]. Broadly, the differential diagnoses for low back pain include non-mechanical, and mechanical causes such as sacroiliac (SI) joint instability [3]. The SI joints are weight-bearing diarthrodial joints, normally stabilized by the strong iliosacral, iliolumbar, sacrotuberous, and sacrospinal ligaments which limit its range of motion. The correlation between increased SI joint movement and

\textsuperscript{*}Corresponding author: Gordon D. Ko, Canadian Centre for Integrative Medicine, 12 Main Street North, Markham, ON, L3P1X2, Canada. E-mail: drgordko@rog.
low back pain was first documented in pregnant women over a century ago [4]. More recent studies estimate the prevalence of SI joint dysfunction as a cause for low back pain at up to 22.5% [5].

The diagnosis of SI joint instability is made by a combination of positive patient history, provocative tests, imaging, and diagnostic injections. Characteristically, SI joint associated low back pain is exacerbated by prolonged immobility, is unilateral in distribution, and radiates down the posterior compartment of the thigh. Current treatments for SI joint instability are however inadequate, varying from conservative management, to the use of non-steroidal anti-inflammatories (NSAIDs), opioids, botulinum-toxin A, corticosteroid injections, prolotherapy, radiofrequency denervation, and surgical stabilization [6–9]. In this case series, we present four patients who were successfully treated for SI joint instability and chronic low back pain using PRP injections.

2. Case reports

2.1. Case 1

A 45-year-old woman with a past medical history significant for Ehlers-Danlos syndrome, fibromyalgia and anterior L3-S1 spinal fusion presented with new onset left-sided low back pain following a motor vehicle accident, causing her to require assistance with activities of daily living. On initial assessment, her short-form McGill Pain Questionnaire (SFMPQ score was 34/45, with a Numerical Rating Scale for pain (NRS) of 7/10, and an Oswestry Low Back Pain and Disability score of 46/50. On examination, there was marked tenderness and spasm of the adjacent piriformis muscle upon anterior-posterior and lateral stressing of the left SI joint. X-rays were negative for fractures, but a subsequent MRI identified bilateral bony sclerosis in the SI joints. Consequently, she was diagnosed with Grade 3 SI joint instability. She trialed a series of sodium morrhuate and dextrose prolotherapy injections into the right SI joint, from which no clinical improvement was noted.

2.2. Case 2

A 67-year-old woman with a past medical history significant for posterior L4-S1 spinal fusion presented with chronic right-sided low back pain following a previous tennis-related injury. The pain radiated down the lateral thigh, and interfered with her ability to walk or sit for prolonged periods. On initial assessment, her SFM score was 14/45, with an NRS of 4/10, and an Oswestry Low Back Pain and Disability score of 21/50. On examination, there was no numbness or paraesthesia, but there was marked tenderness over the right SI joint, and trigger points within iliopsoas and quadratus lumborum. Subsequent MRI scanning revealed severe degenerative changes in the right SI joint. Consequently, she was diagnosed with Grade 3 SI joint instability. She trialed a series of sodium morrhuate and dextrose prolotherapy injections into the right SI joint, from which no clinical improvement was noted.

2.3. Case 3

A 40-year-old multiparous woman presented with a 3-year history of dyspareunia progressing to severe chronic low back pain. The pain was burning in sensation, and left her nearly bedridden. On initial assessment, her SFM score was 36/45, with an NRS of 7/10, and an Oswestry Low Back Pain and Disability score of 34/50. On examination, she had full range of motion of lumbar flexion, but limited extension and lateral flexion (Table 1). The tenderness in both SI joints was further associated with neurophysiological signs including brush allodynia, and pinprick hyperalgesia over the lower back. Neurological examinations were otherwise normal. Following further investigation, she was diagnosed with Grade 2 right SI joint instability. A multi-disciplinary treatment plan including physiotherapy and spinal manipulations was employed. Pharmacological therapy with Onabotulinum Toxin A injections into the piriformis, paraspinous muscles (and intradermal into the allodynic skin), bupivacaine, Rofecoxib, and Hydromorphone also provided temporary pain relief.

2.4. Case 4

A 48-year-old woman with a past medical history significant for mild scoliosis at the T3 level presented...
with a 3-year history of chronic low back pain follow-
ing a fall. Localized to the left SI joint with rad-
iation down both groins and the left lateral thigh, 
the pain was of sufficient severity to limit sitting and 
standing tolerance to 15 minutes. On initial assess-
ment, her SFM score was 23/45, with an NRS of 7/10, 
and an Oswestry Low Back Pain and Disability score 
of 36/50. On examination, left straight leg raise was 
limited to 75°, and a positive left-sided response was 
observed to other SI joint manoeuvres including the 
Patrick’s, Gaenslen’s, Gillet’s, Yeomen’s, and shear 
test. X-rays were negative for fractures, but subsequent 
CT and MRI scanning revealed Grade 1 anterolisthe-
sis at L4-L5, spondylolysis at L5, as well as concentric 
disc bulges and facet osteoarthropathy at L3-L4, L4-
L5, and L5-S1. Consequently, she was diagnosed with 
Grade 2+ left SI joint instability. She noticed some 
clinical benefit following physiotherapy, as well as a 
trial of sodium morrhuate and dextrose prolotherapy 
injections at Hackett’s Points A, B, C, and interspinous 
ligaments. Temporary pain relief was provided with 
low dose Pregabalin (25 mg BD).

3. Methods

Signed informed consent was provided from each 
patient for involvement in this study. We diagnosed 
SI joint instability through a combination of posi-
tive patient history, a physical examination including 
profound SI joint manoeuvres [10], (Table 2), and 
imaging studies. X-rays, CT, and MRI scans were nec-
essary to exclude pathologies such as fractures or ma-
lignancy, and to identify other abnormalities suggestive 
of osteoarthritic changes, herniated nuclei pulposi, or 
ankylosing spondylitis.

In our study, all autologous PRP was prepared us-
ing the Harvest Technologies SmartPReP 2 Platelet 
Concentrate System according to manufacturer’s in-
ructions. Briefly, 60 mL of venous blood was drawn 
aspectically and mixed with 8 mL of acid citrate dext-
srose solution. This anti-coagulated blood was subse-
quenty centrifuged for 14 minutes at 3200 RPM to 
separate plasma from blood cells and the platelet con-
centrate. The platelet poor portion was removed and 
the remaining platelets with buffy coat (WBCs) and 
RBCs was remixed resulting in 10 mL of PRP (with 
a platelet concentration 5–6x above baseline). This 
was subsequently injected (3 inch 22 g needles) with 
ultrasound-guidance (13-6 MHz linear array probe; 5-
2 MHz curved probe for subject 1) (Fig. 1) and us-
ing prolotherapy technique (0.5 ml with each needle 
contact of the ligament-bone interface) at Hackett’s 
Points A, B, and C (Fig. 2). Injections were given after 
local anesthetic (preservative-free buffered lidocaine) 
was administered to the overlying skin and underlying 
muscle-fascia for patient comfort. Other than a “full-
ness discomfort” lasting 10–15 minutes post-injection, 
no adverse reactions were reported. Each patient re-
cieved two sessions of PRP treatment. Statistical anal-
yses and comparison of relative patient pain scores 
pre- and post-treatment was carried out using one-way 
ANOVA followed by Dunnett’s Multiple Comparison 
test $P<0.05$ (Fig. 3).

4. Results

Follow-up data for patients was obtained at 1-year 
and 4-years post-treatment, with the primary efficacy 
endpoint for PRP therapy in SI joint instability eval-
uated by changes in low back pain. Patients did not 
seek any alternative therapy during the follow-up pe-
riod. The pooled data from all patients demonstrated a 
clinically and statistically significant reduction in pain 
at 1-year post treatment, as evidenced by a 93%, 88%, 
and 75% reduction in the mean SFM ($P<0.0001$). 
NRS ($P<0.001$) and Oswestry Low Back Pain and 
Disability ($P<0.0001$) scores respectively (Fig. 3). 
The clinical benefits of PRP were still significant at 
4-years post-treatment. Critically, patients achieved an 
improvement in their quality of life, and returned to 
their pre-injury statuses.

5. Discussion

PRP is autologous blood plasma containing an en-
riched platelet concentration of approximately 1 mil-
ion platelets per microlitre – five times the base-
line level [11]. The exact mechanisms by which PRP 
promotes tissue repair are poorly understood, but are 
likely to involve platelet degranulation and release of 
growth factors [12–18] (Table 3). 

Currently, PRP is most frequently used in muscu-
loskeletal tendinous and ligamentous injuries, where 
natural healing capacity is limited by poor vascular-
ity. Indeed, one in vitro study demonstrated that PRP 
accelerated healing in tendinopathies through VEGF-
induced neovascularization [19]. PRP was also shown 
to enhance gene expression of type I and type III col-
lagen in equine tendons [20]. Further evidence was
Table 2
Orthopedic tests for evaluating SI joint dysfunction

<table>
<thead>
<tr>
<th>Test name</th>
<th>Position</th>
<th>Method</th>
<th>Positive signs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression</td>
<td>Supine</td>
<td>Exert a medial force bilaterally from the anterior superior iliac spine (ASIS)</td>
<td>Increased pressure sensation in the SI joints</td>
</tr>
<tr>
<td>Distraction</td>
<td>Supine</td>
<td>Press bilaterally downwards and laterally on the ASIS</td>
<td>Unilateral gluteal or posterior leg pain</td>
</tr>
<tr>
<td>FABER/Patrick’s</td>
<td>Supine</td>
<td>Place the test leg into flexion, abduction, and external rotation with the ankle resting above the patella of the opposite extended leg. Depress the knee towards the horizontal.</td>
<td>Pain before the knee depresses to the level of the opposite straight leg</td>
</tr>
<tr>
<td>Fortin Finger</td>
<td>Standing</td>
<td>Point to the area of the pain</td>
<td>Pain is localized with one finger, the area is immediately inferomedial to the posterior superior iliac spine (PSIS), and identified consistently over the last 2 trials</td>
</tr>
<tr>
<td>Gaenslen’s</td>
<td>Supine</td>
<td>Flex both legs with knees against the chest and lower the test leg into extension</td>
<td>SI joint pain</td>
</tr>
<tr>
<td>Gillet’s</td>
<td>Standing</td>
<td>Stand on one leg whilst bringing the opposite knee up towards the chest</td>
<td>Movement of the SI joint on the side the knee is flexed in a superior direction</td>
</tr>
<tr>
<td>Goldthwait’s</td>
<td>Supine</td>
<td>Perform a straight leg raise</td>
<td>Pain before movement occurs at the interspinous spaces</td>
</tr>
<tr>
<td>Piedallu’s Sign</td>
<td>Sitting</td>
<td>Compare the heights of each PSIS</td>
<td>The lower PSIS elevates above the PSIS of the opposite side on forward flexion</td>
</tr>
<tr>
<td>Prone Knee Bending</td>
<td>Prone</td>
<td>Flex patient’s knee so that the heel is brought to the gluteal muscles</td>
<td>Rotation of the ipsilateral ASIS before the knee reaches 90° flexion</td>
</tr>
<tr>
<td>Shear</td>
<td>Prone</td>
<td>Apply pressure in a rostral direction to the sacrum near the coccyx, with simultaneous counter pressure against the leg</td>
<td>SI joint pain</td>
</tr>
<tr>
<td></td>
<td>Supine</td>
<td>Apply pressure through along axis of femur with thigh flexed, abducted and laterally rotated 45 degrees from midline</td>
<td>SI joint laxity</td>
</tr>
<tr>
<td>Straight Leg Raising</td>
<td>Supine</td>
<td>Flex the leg with knee fully extended</td>
<td>SI joint pain</td>
</tr>
<tr>
<td>Yeoman’s</td>
<td>Prone</td>
<td>Flex the opposite knee to 90° and extend the same hip</td>
<td>SI joint pain</td>
</tr>
</tbody>
</table>

Fig. 1. PRP-injections performed under ultrasound guidance.
Fig. 2. PRP-injection sites. Injections were performed at Hackett's Point A, B (medial to the PSIS), and C (inferior to the PSIS).

Fig. 3. Comparison of relative patient pain scores pre- and post-treatment. PRP therapy significantly improved patients (a) SFM, (b) NRS, and (c) Oswestry pain scores. Bars with 1 asterisk indicates a significant pain reduction compared to pre-treatment values based on a one-way ANOVA followed by Dunnett’s Multiple Comparison test, $P < 0.05$. Bars with 2 asterisks indicate $P < 0.001$, and 3 asterisks indicate $P < 0.0001$.

provided by a rabbit patellar tendon defect model, whereby PRP therapy was significantly associated with IGF-1 overexpression and accelerated tendon healing as compared to controls [21]. Percutaneous PRP injections into a transected Achilles tendon in a rat model also increased tendon callus strength and stiffness by 30% after one week [22]. Collectively, improved tendon mechanical properties in PRP treatment groups were observed [23]. Another clinical indication for PRP is osteoarthritis (OA) [24,25], since hyaluronic acid synthesis is stimulated by platelet released growth factors [26]. PRP injections have also been found to shorten recovery time after muscle strain injuries [27]. Thus, PRP appears beneficial in healing soft tissue injuries.

To our knowledge, this is the first study investigating the use of PRP therapy in SI joint related low back pain. PRP has previously been successfully used in the management of various soft tissue injuries. In the treatment of elbow epicondylar tendinosis, a single PRP injection resulted in a sustained and significant reduction in pain over time [28], and was subsequently proven to be superior to corticosteroid injections in a double-blinded randomized...
control trial [29]. In a separate prospective double-blinded randomized-controlled study of 53 patients with complete rotator cuff tear, surgical repair with PRP treatment was associated with a greater reduction in pain and improvement in strength than surgery alone at 3-months post-treatment [30]. The use of PRP therapy in conjunction with open surgical repair for Achilles tendon rupture in athletes was also linked to an earlier return to baseline function [31]. More recently, studies demonstrated that PRP injections showed significantly more, as well as longer efficacy than hyaluronic acid injections in reducing pain and recovering articular function in patients with OA [32]. A FDA-sanctioned study demonstrated effectiveness and safety for OA of the knee [33]. Conversely, other studies have reported no additional benefit of PRP over standard treatments for both OA [34] and tendinous injuries [35]. Potential reasons for the differing results may arise from small study sizes, differences in PRP preparation, and patient group selection. Thus, PRP appears to be broadly beneficial in the treatment of both tendinopathies and degenerative cartilaginous lesions.

Current guidelines for the management of confirmed SI joint dysfunction begins with physiotherapy and oral analgesics. If no significant pain relief is achieved within six weeks, a trial of intra-articular corticosteroid injections is usually offered. Alternative options including radiofrequency denervation offer limited success in reducing pain and improving SI joint stability [36]. Since SI joint instability is associated with osteoarthritic degenerative changes, as well as ligamentous and tendinous injuries, we anticipate that PRP treatment will improve SI joint stability and consequently reduce low back pain.

In this case series, we observed that patients achieved a clinically and statistically significant reduction in low back pain at follow up 1-year and 4-years post-treatment. However, the therapeutic benefit was noticeably less at 4-years post-treatment when evaluated by the SFM and NRS scores. It is plausible that the difference in the NRS score is erroneous – not only have previous studies found the NRS score to have limited accuracy [37], but there was no loss of therapeutic benefit between 1-year and 4-years post-treatment when evaluated by the more specific Oswestry Low Back Pain and Disability Index. Alternatively, the clinical benefits from PRP treatment may diminish over time [30,38].

There was also several limitations to our study. We diagnosed SI joint instability on the basis of positive patient history, provocative tests, and imaging. However, the diagnostic value of examination tests for SI joint pain is limited [39]. Whilst the use of the provocative SI joint manoeuvres in combination improves accuracy [40], a definitive diagnosis requires a 90% or greater reduction in pain following fluoroscopically guided intra-articular injections of local anesthetic [41]. Moreover, needle stimulus also has therapeutic effects [42]. Without appropriate blinding and controls, it is not possible to determine its contribution to the overall clinical benefits derived from PRP injections. Consequently, further studies are needed to assess the efficacy of PRP in treating SI joint instability and low back pain.

6. Conclusions/take home messages

- Sacroiliac joint dysfunction-instability is a cause of chronic low back pain.
The theoretical basis for the use of platelet-rich plasma therapy in tissue repair involves growth factors which stimulate angiogenesis and collagen production.

We demonstrated that the use of platelet-rich plasma therapy in the treatment of sacroiliac joint instability resulted in a clinically and statistically significant decrease in low back pain at 1- and 4-year post-treatment.

Larger double-blinded randomized-controlled trials are needed to evaluate overall risks and benefits of platelet-rich plasma therapy in sacroiliac joint dysfunction.

Conflict of interest

The authors have no conflict of interest to report.

References


