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# Autologous Stem Cell Therapy

## A NATUROPATHIC APPROACH FOR THE TREATMENT OF CHRONIC MUSCULOSKELETAL PAIN CONDITIONS—Part II of II

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*Part I of this series, published in the Fall 2015 issue of The Pain Practitioner, provided an overview of the fundamental methods employed by the naturopathic physician for laying a foundation of optimal cellular metabolism, connective tissue health, and overall function in order to optimize stem cell therapy. Part II details the methods for harvest and concentration/isolation of bone marrow aspirate concentrate (BMAC) and adipose-derived stromal vascular fraction (SVF) and includes original research comparing three arms treating low back pain and osteoarthritis of the knee: 1) the use of bone marrow aspirate concentrate (BMAC) alone; 2) the use of adipose-derived stromal vascular fraction suspended in platelet rich plasma (SVF/PRP); and 3) the use of adipose-derived stromal vascular fraction suspended in BMAC (SVF/BMAC).*

### Summary

An emerging approach to the treatment of chronic musculoskeletal pain is the use of autologous mesenchymal stem cells (MSCs) harvested from a patient's own bone marrow or adipose tissue for reinjection into damaged or degenerated joints, ligaments, tendons, and muscles. The purpose of this retrospective survey was to compare patient-reported outcomes after treatment of osteoarthritis of the knee or low back pain in three treatment groups: patients injected with bone marrow aspirate concentrate (BMAC), patients injected with adipose-derived stromal vascular fraction suspended in platelet rich plasma (SVF/PRP), and patients injected with adipose-derived stromal vascular fraction suspended in bone marrow aspirate concentrate (SVF/BMAC). Based on patient reports, patients injected with BMAC had consistently satisfactory results, patients injected with SVF/PRP either had results superior to BMAC or no improvement at all, and patients injected with SVF/BMAC had consistently satisfactory results superior to BMAC alone. There were no adverse outcomes in any patient surveyed (N = 95). Based on these results, injection of SVF/BMAC for osteoarthritis of the knee and low back pain appears to be safe and produces consistently satisfactory results.

### Introduction

Mesenchymal stem cells (MSCs) have been dubbed “patient-specific drug stores for injured tissues” because of their ability to secrete bioactive factors and signals at variable concentrations in response to local microenvironmental cues (1). MSCs are found throughout the body in many tissue types, but they are particularly abundant and easily harvested from the medullary cavity of flat bones and from adipose tissue (2,3). MSCs can be easily concentrated from bone marrow with simple centrifugation. With slightly more effort, MSCs can be isolated from adipose tissue through a multistep process of incubation/enzymatic digestion with collagenase followed by centrifugation and filtration. When injected into the site of damage or degeneration, MSCs release a spectrum of antiinflammatory, immunomodulatory, and trophic factors that trigger the regeneration and healing of connective tissues through activation of stem cells endogenous to the site.

As the pool of data continues to grow, the site-specific injection of autologous stem cells has shown promise in musculoskeletal pain conditions such as osteoarthritis (4), sports or traumatic injury (5), low back and discogenic pain (6), neck pain with or without cervicogenic headaches (7), and osteonecrosis (8). Of note, concurrent bodies of data continue to grow that appear to refute the validity of arthroscopic surgery for knee pain (9-11) and cast doubt upon the validity of steroid epidural injections for low back pain (12,13).

Currently in the United States there are a growing number of pain clinics offering autologous stem cell therapy to patients suffering with musculoskeletal pain conditions. Based on rudimentary internet searches and my own familiarity with the industry, the majority of clinics that offer autologous stem cell therapy offer either BMAC or SVF/PRP, while significantly fewer clinics offer both. According to their websites, clinics offering BMAC often claim bone marrow-derived stem cells to be superior because of the greater body of data supporting their use. Clinics offering SVF/PRP often claim adipose derived stem cells to be superior because of the much larger total MSC count produced





**FIGURE 1**  
Bone marrow aspiration from the iliac crest.

compared to BMAC. I am not aware of any studies directly comparing bone marrow-derived stem cells to adipose-derived stem cells and have seen no data evaluating the combination of the two (SVF/BMAC) in a single treatment. The purpose of this retrospective survey was to compare patient-reported outcomes after treatment of osteoarthritis of the knee and low back pain in three treatment groups: patients injected with BMAC, patients injected with SVF/PRP, and patients injected with SVF/BMAC.

### Methods

Patients presenting to Docere Clinics in Park City, Utah, between July 15, 2014, and November 15, 2014, who were deemed candidates for autologous stem cell therapy, were asked to choose between being treated with BMAC or SVF/PRP. The conversation can be summarized as follows: “I can do a bone marrow aspiration and treat you with BMAC, with which I have five years of experience and am aware of data supporting its use, or I can do a lipoaspiration and a blood draw and treat you with SVF suspended in PRP, which has the potential to provide us with a far greater yield of stem cells and, theoretically, a superior outcome. However I have little experience with it and there are very few data supporting its use.” Patients then self-selected into the BMAC or the SVF/PRP group.

Patients treated with BMAC underwent a fluoroscopically guided bone marrow aspiration of 40 to 120 mL from a single puncture at the site of the iliac crest. The puncture was made on the thickest part of the posterior superior iliac spine. The needle was oriented to be parallel to the flat bone,

and was rotated 90 degrees and advanced 0.5 cm after every 10 mL of marrow aspirated (Figure 1). The marrow was then centrifuged for 10 minutes at 1,000 g and the buffy coat drawn into one or more 10 mL treatment syringes.

In patients treated with SVF/PRP, 100 mL of adipose tissue, 50 mL per side, was aspirated from the flank region and 40 mL to 120 mL of venous blood was drawn. In order to isolate SVF, the adipose tissue was incubated and enzymatically digested with collagenase, then centrifuged and filtered (the entire process took approximately 45 minutes). The blood was centrifuged for 10 minutes at 1,000 g and concentrated in a “pure,” or “acellular” manner (devoid of RBCs or WBCs). SVF was suspended in one or more 10 mL syringes of PRP.

Patients treated for osteoarthritis of the knee received a fluoroscopically guided, intra-articular injection into the knee (Figure 2). Ultrasound guidance was added for patients who reported pain on palpation to the medial collateral and lateral collateral ligament or supra/infra-patellar tendon (Figure 3).

Patients treated for low back pain received fluoroscopically guided injections bilaterally at the following locations,



**FIGURE 2**  
Fluoroscopically guided, intra-articular injection of the knee.



**FIGURE 3**  
Ultrasound-guided injection of MCL.



**FIGURE 4**  
Lumbar transforaminal  
epidurals with stem cells.



**FIGURE 5**  
Injection of stem cells into intervertebral discs

2 mL of injectate per location: perifacet at L2/3-L5/S1 levels, and iliolumbar ligament, proximal and distal insertions, and the sacroiliac ligament, in three locations. Patients reporting radiculopathy/paresthesia received additional lumbar transforaminal epidural injections of 5 mL of stem cells (Figure 4). Intradiscal injections of 1.5 mL stem cells were given to patients who reported mid-line pain that worsened when bending forward and whose MRIs showed desiccation (Figures 5).

Patients who had experienced pain for a minimum of one year prior to treatment were asked to rate their percentage of improvement on a numerical scale and whether they experienced any adverse effects from treatment.

During this period and during preliminary follow-up with patients, I began to notice a trend that many SVF/PRP patients reported higher satisfaction than those in the BMAC group, but the remainder were experiencing no improvement at all. Beginning November 16, 2014, I began offering patients SVF prepared as described above but suspended in BMAC rather than PRP, hypothesizing that the combination could offer the consistency of BMAC with the augmented outcomes of SVF.

On August 1, 2015, we reviewed the charts of all patients with knee arthritis and low back pain who were treated with SVF/BMAC between November 15, 2014, and March 15, 2015, to identify those who had experienced pain for a minimum of one year prior to treatment. They were asked to rate their percentage of improvement on a numerical scale and whether they experienced any adverse effects from treatment.

## Results

Results (Table) were consistent between the two BMAC groups. The average improvement reported in the knee

osteoarthritis group ( $n = 21$ ) was 75.7%. One patient reported only 10% improvement; the remainder reported 50% or better improvement. In the low back pain group ( $n = 9$ ), the average improvement was 70.6%. Only one patient reported no improvement at all, and everyone else reported 50% or better improvement.

Results were also consistent between the two SVF/PRP groups. The average improvement reported in the knee osteoarthritis group ( $n = 26$ ) was 61.7% and in the low back pain group ( $n = 14$ ) the average improvement reported was 61.1%. However, in each group, there was a relatively higher percentage of patients who did not respond to treatment (26.9% and 28.6%, respectively). Patients who did respond to treatment improved, on average, more than those in the BMAC groups. Among responders, 84.5% of patients with knee osteoarthritis reported improvement and 85.5% of those with low back pain reported improvement.

Results were consistent between the two SVF/BMAC groups. In the SVF/BMAC:OA knees group ( $n = 14$ ), one patient reported no improvement at all but everyone else reported 75% or better improvement resulting in an average of 81.5% improvement. In the BMAC:OA low back pain group ( $n = 11$ ), one patient also reported no improvement but everyone else reported 80% or better improvement resulting in an average of 80.9% improvement.

None of the patients surveyed ( $N = 95$ ) experienced complications or adverse reactions other than mild post-procedure soreness.

## Discussion

Based on patient reports, patients injected with BMAC had consistently satisfactory results, patients injected with SVF/PRP either had results superior to BMAC or no improvement at all, and patients injected with SVF/BMAC had con-

**TABLE**  
**Treatment Results for Autologous Stem Cell Therapy Options**

	BMAC: OA knee	BMAC: LBP	SVF/PRP: OA knee	SVF/PRP: LBP	SVF/BMAC: OA knee	SVF/BMAC: LBP
Number of patients	21	9	26	14	14	11
Male/female ratio	13 to 8	6 to 3	16 to 10	8 to 6	9 to 5	7 to 4
Age range/avg	35-83/60	29-76/45.7	38-85/63.7	38-71/58.9	44-81/59.5	39-73/54.8
BMI range/ave	21.9- 54.8/26.9	21.3-31/23.9	19.9-39.1/27.0	23.2-35.4/27.2	21.6-29.3/25.6	20-32.2/25.4
Avg number of treatments	1.1	1.3	1	1	1.1	1
Avg % satisfaction (total)	75.70	70.60	61.70	61.10	81.50	80.90
Number of nonresponders (%)	0	1(11.1)	7(26.9)	4(28.6)	1(7.1)	1(9.1)
Avg % satisfaction (responders)	75.70	79.39	84.50	85.50	87.65	89.0

**MAC =**  
Bone marrow aspirate concentrate

**SVF/PRP =**  
Adipose-derived stromal vascular fraction suspended in platelet-rich plasma

**SVF/BMAC =**  
Adipose-derived stromal vascular fraction suspended in bone marrow aspirate concentrate

sistently satisfactory results superior to BMAC alone. There were no adverse outcomes in any patient surveyed (N = 95).

These results caused me to question what was responsible for the high non-responder rate in the SVF/PRP groups. It appears that for those who responded, SVF/PRP rendered a superior outcome to BMAC in both the OA knee and lower back pain groups; however, nearly 30% of the SVF/PRP patients treated had no benefit at all. An analysis of results from responders only in all the groups confirmed that the SVF/BMAC recipients had consistently satisfactory results superior to BMAC and SVF/PRP alone.

It is entirely possible that the MSCs did not survive the isolation process in the non-responder groups, which would account for the high percentage of nonresponders in the SVF/PRP group. A major flaw in the study is that flow cytometry was not performed to determine MSC total cell count and cell viability. I have since obtained a flow cytometer and I am measuring cell count and cell viability in all patients treated with stem cell therapy. Future study will compare total cell count and cell viability to patient-reported outcomes.

Based on these results, injection of SVF/BMAC for osteoarthritis of the knee and low back pain appears to be safe and produces consistently satisfactory results.

Clearly, this series of simple surveys does not claim to provide any hard evidence; it is merely intended as an empirical report of one clinician's experience in this new and rapidly growing field.

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**Harry Adelson, ND**, opened Docere Clinics in Salt Lake City in 2002, and from day one his practice has been 100% regenerative injection therapies for the treatment of musculoskeletal pain conditions. In 2006 he incorporated platelet rich plasma and ultrasound-guided injection into his armamentarium; in 2010, bone marrow aspirate concentrate and adipose-derived stem cells; and in 2013, fluoroscopic-guided injection. Since February of 2010, Dr. Adelson has performed more than 3,000 bone marrow and adipose-derived adult stem cell procedures, placing him in the company of those most experienced in the world with use of autologous stem cells for the treatment of musculoskeletal pain conditions.

