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Case Report Open Access

Combined Cellular Therapy for Osteoarthritis and Osteonecrosis of the Hip: A Case Report with 2 Year Follow-up

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Abstract

Introduction: The use of autologous bone marrow aspirate, adipose tissue, and platelet-rich plasma has the potential to provide pain relief and improve function in individuals with orthopedic conditions. This case report reflects the results of an individual who was treated with cellular therapy for osteoarthritis and osteonecrosis of the hip. This provides some evidence that combined cellular medicine has the potential to halt the progression of osteoarthritis and osteonecrosis and delay or prevent the need for surgical intervention.

Case presentation: The patient in this report is a 43 year old male who presented with osteoarthritis and osteonecrosis of the left hip. After failing conservative treatment, the patient was considering surgical intervention but instead elected to proceed with combined cell therapy.

Conclusion: Two years after treatment the patient was able to return to activities of daily living and physical activity, including bike riding, after one treatment. An MRI revealed no further progression of osteoarthritis or osteonecrosis and no collapse of the femoral head. The patient was satisfied with treatment and reports very little to no pain at all. This report, combined with the array of knowledge within the field of orthobiologics, has the potential to alter standard treatment in orthopedics and reduce the necessity of surgical intervention.

Keywords: Cell therapy; Osteonecrosis; Fat graft; BMAC; PRP; Osteoarthritis; Hip; Orthobiologics

Introduction

Avascular necrosis (osteonecrosis) is a condition, most commonly affecting the femoral head, that results from a reduction of blood supply to bone and elevated intraosseous pressure [1]. In earlier stages of osteonecrosis, core decompression is commonly performed in an attempt to restore blood flow to the necrotic region. In its advanced stages, osteonecrosis can lead to collapse of the femoral head, and ultimately the need for a total hip replacement [2]. Osteoarthritis is a very common musculoskeletal ailment affecting many people worldwide, especially older patients [3]. There are many standard-of-care options available to treat the symptoms of osteoarthritis, which often include steroid injections, viscosupplementation, bracing, non-steroidal anti-inflammatory medications (NSAIDs), and physical therapy. Once these conservative options are exhausted, arthroscopic surgery and ultimately total joint replacement become the patient's last option. The purpose of this paper is to report on a regenerative medicine technique in which osteoarthritis and osteonecrosis are treated using the patient's own cells in an attempt to change the natural progression of the disease in the joint.

Autologous cell based medicine and orthobiologics, which use the patients' own cells to help initiate the body's natural healing process, have been gaining attention in recent years [4,5]. Within the literature, one prospective, controlled, double-blind pilot study showed that autologous bone marrow mononuclear cell implantation was effective in reducing pain and delaying the progression of the disease in early stages of osteonecrosis [6]. In a case series by Pak, probable bone regeneration was evident in osteonecrosis of the femoral head following an injection of autologous adipose-tissue-derived stem cells and platelet-rich plasma [3]. In a landmark article by Hernigou and Beaujean, osteonecrosis was treated using core decompression and bone marrow aspirate concentrate. Of those patients in earlier stages of osteonecrosis, only 20% went on to require a total hip replacement [7]. These studies in addition to others using cell based treatment for osteoarthritis and osteonecrosis show that orthobiologics are becoming more widely used in orthopedic medicine.

For this study, a combination of autologous bone marrow aspirate concentrate, autologous fat graft, and autologous platelet-rich plasma was used to treat the symptoms of osteoarthritis and osteonecrosis of the hip. Studies have shown these biological components to be safe and effective in both animal and human studies to treat various musculoskeletal disorders [8,9]. Platelet-rich plasma contains important growth factors and secretory proteins that may induce the body's natural healing response [10]. Bone marrow aspirate is a rich source of hematopoietic and Multipotent Mesenchymal Stem Cells (MSCs), which have the ability to differentiate into a variety of cell lineages, including chondrocytes, adipocytes, fibroblasts, osteoblasts, and marrow stroma [11]. An autologous fat graft obtained from aspirated adipose tissue has been described as a living bioscaffold that plays a very important role in cellular therapy. The living bioscaffold is important because the cells obtained from the bone marrow aspirate concentrate require adherence to proliferate and differentiate within the microenvironment [12]. The growth factors and proteins in the platelet-rich plasma and the cells obtained from the bone marrow

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adhere to the fat graft to provide a rich healing environment. Studies have described the rationale and possible benefit of combining these biological elements for use in regenerative medicine [13,14].

Of all the studies published using cell based medicine for orthopedic conditions, many lack valid clinical outcome measures, standard processing methods, and standard combination of biological products. This is a report based on one patient who underwent combined cell therapy as part of a large study. A well established protocol for extraction, processing, and injection of biological products was followed in compliance with the minimal manipulation recommendations set out by the FDA [15]. The patient in this report is part of a prospective, IRB-approved study of 150 patients which uses combined cell therapy to treat osteoarthritis of many joints, including the knee, shoulder, and hip.

Case Presentation

The patient in this report is a Caucasian male, who is 6'6" tall and 250 lbs with a body mass index of 28.9. At the time of treatment, the patient was 43 years of age. The patient had a long history of left hip pain and underwent multiple procedures over the years, including steroid injection, viscosupplementation injection, and physical therapy with mixed results. The patient's profession required prolonged periods of standing and ambulation. He also reported leisurely participating in multiple high energy activities and sports.

Upon initial consultation with the patient, he was diagnosed with osteoarthritis of the left hip using radiographic images and physical examination. The images showed evidence of moderate osteoarticular abnormality along with subchondral cysts, subchondral sclerosis and joint space narrowing. An MRI of the left hip revealed evidence of osteonecrosis, mild degenerative changes, and minimal bilateral symmetrical effusions and minimal bilaterally symmetrical greater trochanteric bursitis. After discussing all treatment options available to him, he elected to proceed with combined cellular therapy to the left hip.

This study was approved by the Institute of Regenerative and Cellular Medicine Institutional Review Board (IRB). Informed consent was obtained prior to beginning any study related activities. Prior to treatment, the patient completed a Visual Analog Scale (VAS) and the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) to obtain baseline levels of pain and function.

Method

For the collection of platelet-rich plasma, 60 mL of blood was drawn from the patient and processed in a centrifuge to separate the Platelet-Poor Plasma (PPP), Platelet-Rich Plasma (PRP), and red blood cells. The PRP was drawn up into a syringe, inserted into ultraviolet light for activation, and placed under a laminar flow hood until ready for injection.

For adipose tissue aspiration, the patient was placed in the lateral recumbent position so that the left hip was exposed. The skin was prepared using sterile technique and the area was anesthetized with 6 mL of a lidocaine and epinephrine mixture. After proper anesthesia was achieved, a small stab incision was made to access the underlying fat tissue. Tumescent fluid was introduced into the subcutaneous fat layer of the left hip using a micro-cannula. A 10 minute time lapse was allowed to ensure proper anesthesia of the area. The micro-cannula attached to a 40 mL syringe was reintroduced and 30 mL of adipose tissue was aspirated. The incision site was cleaned and closed with steri-strips and a large bandage. The aspirated tissue was transferred to a laminar flow hood and washed twice using 0.9% sodium chloride. Once the fat graft was thoroughly washed, it was placed into the ultraviolet light for activation and placed under the laminar hood until injection.

For bone marrow aspiration, the patient was placed in the prone position and the right superior posterior iliac crest was prepared using sterile technique. The skin and subcutaneous tissue was anesthetized with 10 mL of lidocaine. The deep tissue and periosteum were anesthetized with 10 mL of 0.25% marcaine. A small stab incision was made over the iliac crest, an 11G bone marrow trocar was introduced into the superior posterior iliac crest, and 65 mL of marrow was withdrawn. The incision site was cleaned and dressed with steri-strips and a large bandage. The bone marrow aspirate was placed in a filter bag, put in a centrifuge cup, and processed to separate concentrated bone marrow aspirate. The concentrated aspirate was activated using ultraviolet light and placed under a laminar flow hood until injection.

For the injection, the patient was placed in the supine position and the left anterior hip was exposed and prepared using sterile technique. Using ultrasound guidance, 5 mL of 1% lidocaine was injected into the hip for anesthesia. The left hip was then injected with 12 mL of bone marrow aspirate concentrate, followed by 20 mL of fat graft, then 10 mL of PRP. Lastly, 2.5 mL of dexamethasone was injected and the site was dressed with bandages.

The patient tolerated this procedure well and after a 15 minute rest period, he was able to stand and ambulate. He was released to go home with his spouse.

Results and Discussion

At baseline, the patient reported a VAS pain score of 60 out of 100 and a WOMAC score of 41. Two weeks after the procedure, the patient reported the ability to ascend and descend stairs with no problem. He also reported that he was no longer limping, as he had been for years. Six weeks after the procedure, the patient reported a VAS pain score of 20 out of 100 (67% improvement) and a WOMAC score of 22 (46% improvement). He reported that he was able to return to almost all normal activities with very little to no pain. From his perspective, the patient reported that he felt 80-90% better compared to baseline.

Two years after the procedure, the patient reported a VAS pain score of 11 out of 100 (82% improvement from baseline) and a WOMAC score of 9 (78% improvement from baseline). X-rays revealed some evidence of osteoarticular abnormality, but this appeared stable compared to pre-procedure x-rays (Figure 1). An MRI revealed no further progression of osteoarthritis or osteonecrosis and no collapse of the femoral head (Figures 2 and 3). The patient reported continued ability to ascend and descend stairs and ride a bike with no problem.

Although this report only reflects one patient that underwent this treatment, the results show that this procedure has the potential to significantly reduce pain, increase function, and prevent the progression of osteoarthritis and osteonecrosis with a short recovery time. Two years out from one single treatment of autologous bone marrow aspirate concentrate, platelet-rich plasma, and adipose tissue, the progression of osteoarthritis and osteonecrosis appears to have halted. Although this single case report cannot be generalized to the population, this treatment has the potential to be a great alternative to surgery, allowing the body to heal itself with very little to no adverse effects.

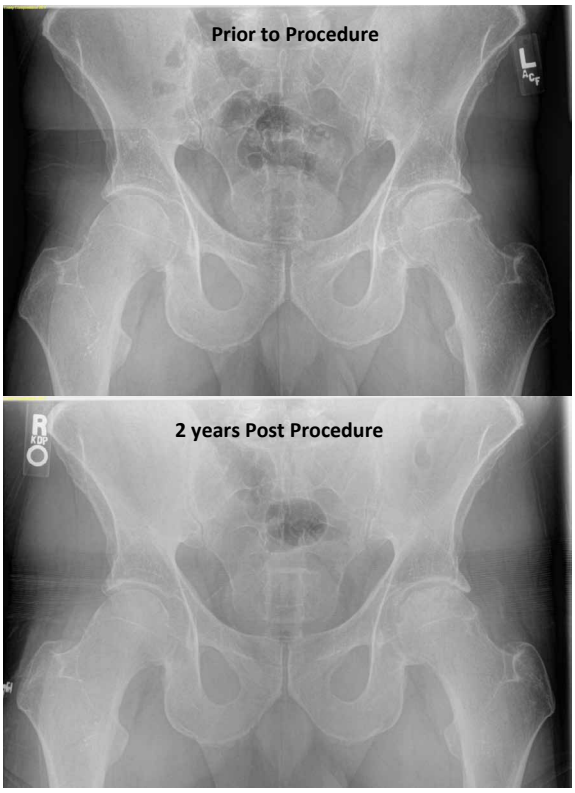

Figure 1: Radiographic Comparison of Left Hip.

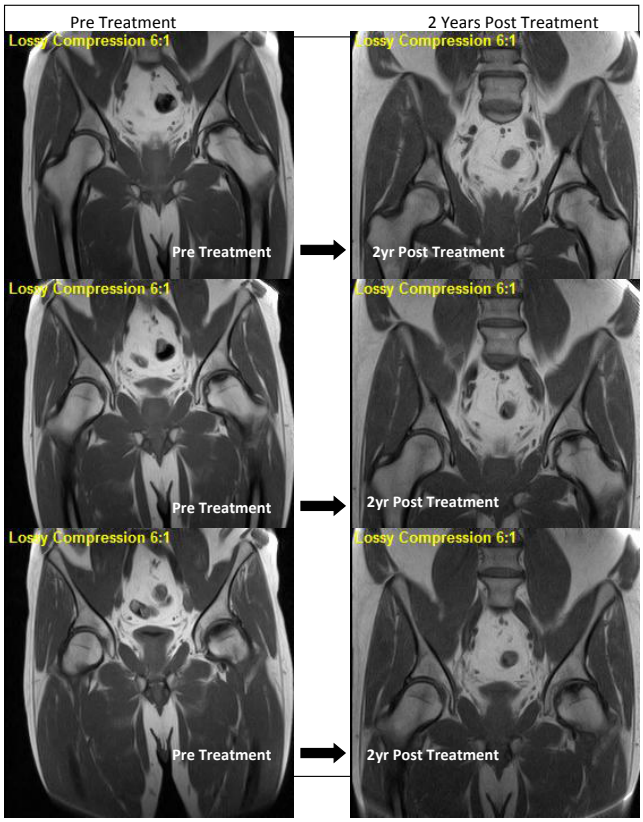

Figure 2: Coronal View Comparison of Left Hip MRI.

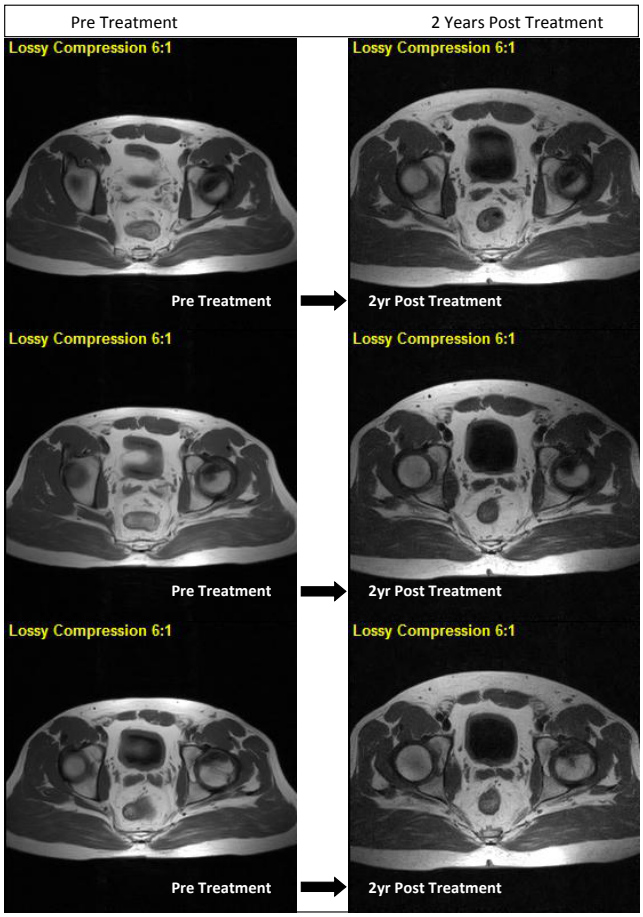

Figure 3: Axial View Comparison of Left Hip MRI.

Author Contributions

Conceptualization: K.F.D and K.M.D, Methodology: K.F.D, Formal analysis: K.M.D, Investigation: K.F.D and K.M.D, Data Curation: K.M.D, Writing-Original Draft: K.M.D and K.F.D, Writing-Review & Editing: K.F.D and K.M.D, Supervision: K.F.D, Project Administration: K.F.D.

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