

Case Report

Radiological evidence of regeneration in bilateral humeral head avascular necrosis following bone marrow aspirate concentrate-augmented core decompression: a case report

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ABSTRACT

Avascular necrosis (AVN) of the humeral head is an uncommon but potentially debilitating orthopaedic condition characterized by compromised blood supply to the subchondral bone, leading to bone ischemia, structural collapse, and progressive joint dysfunction. In early stages, the disease may remain asymptomatic or present with mild shoulder pain; however, with disease progression functional impairment is evident. Early diagnosis and timely intervention are essential to prevent joint collapse and arthroplasty. Regenerative strategies using Orthobiologics aim to enhance bone repair, restore vascularity, and preserve joint integrity. We report the case of a 60-year-old female presenting with bilateral humeral head AVN without subchondral collapse. The patient underwent percutaneous core decompression (PCD) augmented with autologous bone marrow aspirate concentrate (BMAC) under fluoroscopic-guided suprascapular nerve block. At eight months post-intervention, the patient demonstrated significant clinical and radiological improvement. Pain, measured using the visual analogue scale (VAS), decreased from 8/10 pre-procedure to 1/10 post-procedure. Functional outcomes assessed by the Constant-Murley shoulder score (CMS) improved from 36 (right) and 42 (left) pre-procedure to 85 (right) and 81 (left) post-procedure. Follow-up magnetic resonance imaging (MRI) revealed marked resolution of subchondral altered marrow signal intensity in both humeral heads, indicating structural recovery without evidence of cortical collapse. Early-stage humeral head AVN without subchondral collapse can be effectively managed using PCD combined with autologous BMAC augmentation. This minimally invasive regenerative approach may promote biological repair, alleviate pain, and restore function, thereby serving as a joint-preserving alternative to arthroplasty in selected patients.

Keywords: Avascular necrosis, Humeral head, Bone marrow aspirate concentrate, Core decompression, Regenerative orthobiologics, Stem cell therapy

INTRODUCTION

Avascular necrosis (AVN) of the humeral head is a debilitating orthopaedic condition characterized by ischemic necrosis of the subchondral bone resulting from compromised vascular supply. Progressive interruption of blood flow leads to osteocyte death, structural weakening of the bone, and eventual collapse of the humeral head,

which may subsequently result in degenerative changes of the humeral joint if left untreated.

Although AVN most commonly affects the femoral head, involvement of the humeral head represents a smaller proportion of osteonecrosis cases but can significantly impair shoulder function and negatively affect quality of life.¹

Studies in the literature indicate that humeral head AVN may occur either as an isolated condition or in association with osteonecrosis affecting other skeletal sites, reflecting the systemic nature of the underlying vascular compromise in some patients.^{2,3}

Several etiological factors have been implicated in the pathophysiology of humeral head AVN, including prolonged corticosteroid therapy, trauma, excessive alcohol consumption, haematological disorders, and idiopathic causes. Among these corticosteroid use is considered one of the most common non-traumatic risk factors, primarily due to its effects on lipid metabolism, vascular integrity, and increased intraosseous pressure, ultimately leading to reduced bone perfusion.⁴

Management strategies for humeral head AVN largely depend on the stage of disease progression. Early-stage disease is typically treated with conservative or joint-preserving procedures, whereas advanced stages characterized by subchondral collapse often require surgical interventions such as hemiarthroplasty or total shoulder arthroplasty.^{2,3} Core decompression has been widely employed as a joint-preserving surgical technique aimed at reducing intraosseous pressure, improving local blood circulation, and stimulating bone regeneration. Early clinical studies have demonstrated favourable outcomes of core decompression in patients with early-stage humeral head osteonecrosis.⁵

In recent years, Orthobiologics and regenerative medicine approaches have been increasingly explored to enhance biological repair in osteonecrosis. BMAC contains mesenchymal stem cells, progenitor cells, and a variety of growth factors capable of promoting angiogenesis, osteogenesis, and tissue regeneration. When combined with core decompression, BMAC may enhance the reparative potential of necrotic bone and delay disease progression.⁶⁻¹⁰ Although BMAC-augmented decompression has been widely investigated for femoral head osteonecrosis, its application in humeral head AVN remains relatively uncommon and continues to be evaluated clinically.

Therefore, this case report describes the clinical and radiological outcomes following BMAC-based regenerative therapy combined with PCD as a joint-preserving treatment strategy in a patient with bilateral humeral head AVN.

CASE REPORT

Patient information

A 60-year-old female patient presented with complaints of bilateral shoulder pain and stiffness for 6 months. The symptoms were progressive and unresponsive to nonsteroidal anti-inflammatory drugs and the physiotherapy.

Medical history

On examine in outpatient unit of the clinic in March 2025, the patient presented with complaints of bilateral shoulder pain and stiffness for 6 months. The symptoms were progressive and unresponsive to nonsteroidal anti-inflammatory drugs and physiotherapy.

There was no history of trauma, corticosteroid use, or alcohol abuse. Vital parameters including blood pressure and complete blood profile (CBP) were assessed and found to be within normal limits.

Family history

No such cases were reported in the family.

Psychosocial history

Persistent shoulder pain significantly limited the patient's mobility and contributed to psychological stress. However, no formal psychiatric consultation was sought.

Genetic information

No relevant genetic testing was performed.

Relevant past interventions

Patient complaints with bilateral shoulder pain and stiffness for 6 months

Clinical findings

MRI of both shoulders demonstrated subchondral geographic altered marrow signal intensity in the humeral heads with preserved cortical margins, consistent with stage II AVN (Cruess classification).

Diagnostic assessment

Clinical examination revealed anterior shoulder tenderness bilaterally, with restricted abduction and external rotation. The VAS score was 8/10 for both shoulders, and CMS were 36 (right) and 42 (left). Routine laboratory parameters were within normal limits.

Therapeutic intervention

Following multidisciplinary evaluation, the patient elected to undergo bilateral PCD with BMAC augmentation under fluoroscopic-guided suprascapular nerve block.

The procedure was performed under strict aseptic conditions with the patient positioned in the beach-chair position. Bone marrow was aspirated from the bilateral posterior iliac crest using a multi-site aspiration technique to minimize peripheral blood dilution and subsequently processed to obtain autologous BMAC.⁸

Under fluoroscopic guidance, a cannulated drill was introduced percutaneously through a lateral approach into the necrotic region of each humeral head while carefully preserving the subchondral bone plate. The prepared BMAC was then slowly injected into the necrotic focus through the decompression tract to ensure deep intraosseous infiltration. Following the procedure, both arms were immobilized in slings for 48 hours. Assisted passive mobilization was initiated thereafter, and a structured physiotherapy protocol focusing on range-of-motion exercises and scapular stabilization was commenced after one week.^{9,10}

Follow-up and outcomes

Clinical outcomes were assessed at baseline (day of treatment), 3 months, and eight months post-procedure using the VAS for pain evaluation and the CMSs for functional assessment. The VAS showed a reduction in pain from 8/10 at baseline to 3/10 at 3 months and 1/10 at 8 months for both right and left (Table 1). Similarly, CMS scores demonstrated progressive improvement from 36 (right), 42 (left) at baseline to 65 (right), 65(left) at 3 months and 85 (right), 81 (left) at 8 months (Table 2). The Range of motion was normal and the day-to-day activities were fully resumed.

Table 1: Visual analogue scale.

VAS	Pre-procedure	Post-procedure 3 months	Post-procedure 8 months
Right	8	3	1
Left	8	3	1

Table 2: Constant-Murley shoulder scores.

CMS	Pre-procedure	Post-procedure 3 months	Post-procedure 8 months
Right	36	65	85
Left	42	65	81

Pain relief was noted within 4 weeks of the procedure. At 3 months, VAS had decreased to 3/10, and CMS improved to 65 bilaterally. At 8 months (November 2025) VAS reduced to 1/10 (90% reduction) and CMS: 85 (right), 81 (left)-representing 80% overall functional improvement. Although right was showing greater improvement.

Impressions from MRI

Significant resolution of subchondral geographic altered marrow signal areas along humeral head and acromioclavicular joint with two small serpiginous areas noted along superior and posterior aspect of humeral head showing central hyper and peripheral hypointense rims and smaller lesion noted along subarticular aspect of acromioclavicular joint along clavicle.

Acromioclavicular joint arthritis. Mild supraspinatus and infraspinatus tendinopathy with partial thickness interstitial surface tear at the footprint measuring-11 mm in ap dimensions. Status quo as compared to previous MRI dated 04/03/2025. Mild subscapularis tendinopathy with possible small partial thickness tear at its insertion. Minimal shoulder joint, subcoracoid and subacromial subdeltoid bursal effusions. Bilateral humeral AVN although was treated both in the right and left shoulder joints the MRI depiction for the improvement with PCD and BMAC is illustrated only for the left shoulder joints.

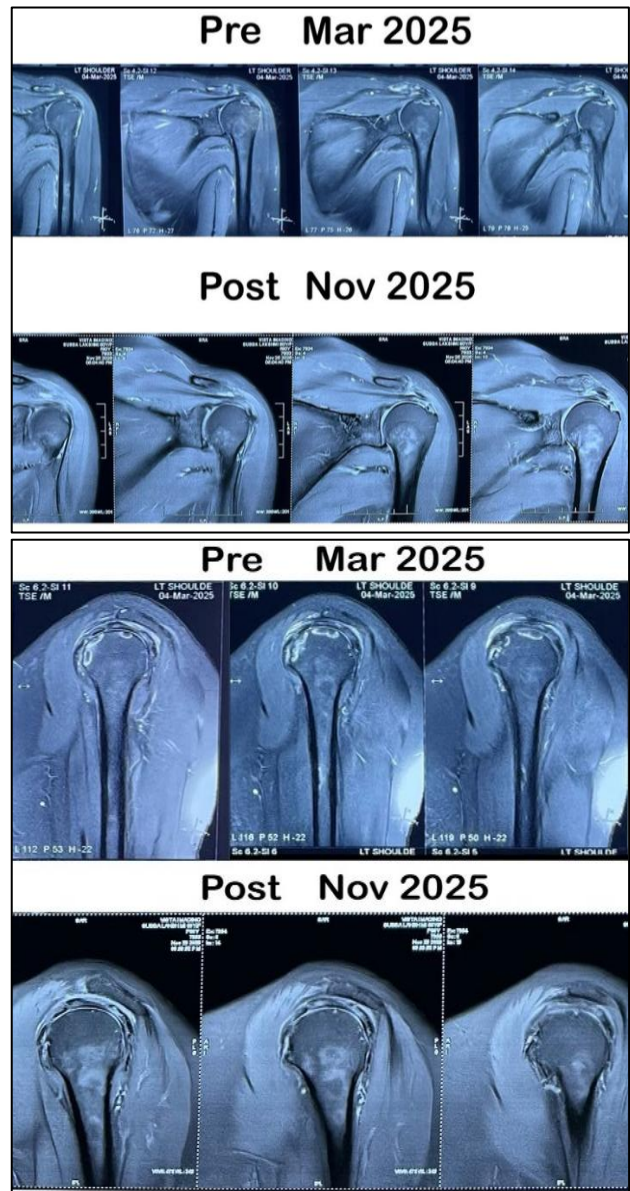


Figure 1: MRI.

Comparison between the pre and the post-operative MRI

The comparative imaging shows that Left shoulder MRI performed in March 2025 pre-procedure and post-procedure 3 and 8 months follow-up MRI in November 2025 demonstrated marked resolution of the subchondral

altered marrow signal with reconstitution of trabecular architecture and no progression or cortical collapse of lesion.

DISCUSSION

The present case report demonstrates the clinical and radiological efficacy of BMAC in combination with PCD in the treatment of bilateral humeral head AVN. The combined therapeutic approach resulted in substantial improvement in pain, functional outcomes, and radiological features, highlighting the potential advantages of biologically augmented decompression procedures in early-stage osteonecrosis.

Conventional core decompression alone primarily aims to reduce intraosseous pressure and improve vascular perfusion within the necrotic bone. However, decompression by itself may provide incomplete symptom relief and does not directly address the underlying cellular deficit responsible for impaired bone regeneration.¹¹ The addition of BMAC provides a concentrated source of mesenchymal stem cells, hematopoietic progenitor cells, and multiple growth factors, which collectively promote angiogenesis, osteogenesis, and modulation of the inflammatory environment within the necrotic bone.^{1,6} These biological mechanisms facilitate revascularization and bone remodelling, thereby enhancing the regenerative potential of the affected humeral head.

The concept of biologically augmented decompression was first described by Hernigou et al who has reported improved clinical and radiological outcomes in osteonecrosis following the implantation of autologous bone marrow-derived cells.¹ Subsequent studies have further supported the role of Orthobiologics therapies in enhancing bone regeneration and delayed disease progression in osteonecrosis. The findings observed in the present case are consistent with these earlier reports, demonstrating significant functional improvement and radiological recovery following BMAC-augmented decompression as indicated Figure, Table 1 and 2.

The presented case is of clinically significant because: It highlights the improvement in bilateral humeral AVN using minimal invasive technique with orthobiologics (VAS and CMS) enriched intervention in an elderly patient, where no cutting or suturing is involved. It emphasizes that suprascapular nerve block anaesthesia along with local anaesthesia for the skin allows safe bilateral shoulder interventional treatment option in a single session. The MRI findings confirm biological healing rather than transient symptomatic improvement, aligning with regenerative remodelling patterns previously observed with stem cell-based interventions.

CONCLUSION

Humeral head AVN, particularly in the early stages without subchondral collapse, may respond favourably to

regenerative interventional approaches combining percutaneous core decompression with autologous BMAC augmentation. This joint-preserving technique can provide significant pain relief, functional recovery, and radiological evidence of structural repair, potentially delaying or avoiding the need for arthroplasty in selected patients.

Nevertheless, larger prospective clinical studies and long-term follow-up data are required to establish standardized treatment protocols and to further validate the efficacy of biologic therapies in the management of humeral head osteonecrosis.

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Conflict of interest: None declared

Ethical approval: Not required

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