

EARLY FUNCTIONAL RECOVERY AFTER PERCUTANEOUS CORE DECOMPRESSION AUGMENTED BMAC IN FICAT STAGE III FEMORAL HEAD AVASCULAR NECROSIS: A CASE REPORT IN AN ADOLESCENT ATHLETE

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ABSTRACT

Background: Avascular necrosis (AVN) of the femoral head is a debilitating condition that commonly affects young individuals and may progress to femoral head collapse if untreated. Joint-preserving strategies are particularly important in adolescents to delay or avoid arthroplasty. **Case Presentation:** A 16-year-old male professional badminton player presented with chronic right hip pain for a duration of 11 months period duration. Clinical examination revealed restricted hip movements, an ectomorphic build, an antalgic gait, and Grade II tenderness over the anterior hip and medial groin region. MRI confirmed Ficat stage III AVN of the right femoral head. The patient underwent percutaneous core decompression augmented with bone marrow aspirate concentrate (BMAC). At 3-month follow-up, there was marked clinical and functional improvement in the pain. Pain, assessed

using the Visual Analogue Scale (VAS), improved from 6/10 to 2/10, with restoration of normal gait. Hip flexion improved from 100° (painful) to 125° (mild pain), extension from 15° to 20°, and internal rotation from 10° to 30°. Muscle strength improved from 4/5 to 5/5 on the Oxford MMT scale. The patient successfully returned to sports activity. **Conclusion:**

BMAC augmented core decompression may serve as an effective joint-preserving strategy in adolescent patients with mid-stage AVN, facilitating early recovery and return to high-demand activities.

KEYWORDS: Avascular necrosis, percutaneous core decompression (PCD), Bone Marrow Aspirate concentrate, Femoral head.

INTRODUCTION

Avascular necrosis (AVN) of the femoral head is a progressive and potentially disabling disorder resulting from compromised blood supply, leading to osteocyte death, structural weakening, and eventual articular collapse.^[1] The condition predominantly affects young and middle-aged individuals, significantly impacting joint function, mobility, and quality of life. If left untreated, AVN may progress to secondary osteoarthritis, often necessitating total hip arthroplasty at a relatively early age.^[1,2]

The etiology of AVN is multifactorial, including both traumatic and non-traumatic causes. Common risk factors include corticosteroid use, alcohol consumption, trauma, hemoglobinopathies, and idiopathic mechanisms. Irrespective of etiology, the pathophysiology involves vascular compromise, increased intraosseous pressure, bone ischemia, and eventual subchondral collapse.^[1,3] Management strategies are stage-dependent. Early stages (I and II) may respond to conservative or minimally invasive approaches, whereas advanced stages often require joint replacement. Percutaneous core decompression (PCD) is a well-established treatment modality that reduces intraosseous pressure, improves perfusion, and promotes healing.^[4] However, its effectiveness in stage III disease is limited due to reduced regenerative capacity and structural compromise.^[5,6]

Biologicals augmentation strategies, particularly bone marrow aspirate concentrate (BMAC), have gained increasing attention. BMAC contains mesenchymal stem cells, hematopoietic progenitors, and growth factors that enhance angiogenesis and osteogenesis.^[6,7] Combining BMAC with percutaneous core decompression (PCD) addresses both mechanical and biological aspects of AVN. In this context, the present case report highlights the clinical effectiveness of BMAC-augmented percutaneous core decompression (PCD) in an adolescent athlete with Ficat stage III AVN of the femoral head, demonstrating significant pain relief, functional recovery, and early return to sport.

Case Presentation

Patient Information

A 16-year-old male patient presented with Right Hip joint Pain and discomfort while sporting activities

Medical History

On examine the patient November 2025, the patient presented with complaints of insidious onset of pain in the right hip joint and groin region for 11 months and aggravated during activities like lunges, pivoting movements and jumps / jump smashes. There was no history of trauma, corticosteroid use, or alcohol abuse.

Family History

No such cases were reported in the family.

Psychosocial History

No formal psychiatric consultation was sought.

Genetic Information

No relevant genetic testing was performed.

Relevant Past Interventions

Patient complaints with Right hip joint Pain and discomfort while sporting activities

Clinical Findings

The patient presented with right hip joint Pain and discomfort while sporting activities

Diagnostic Assessment

Clinical examination revealed mild tenderness (Grade III) on deep palpation over the right anterior hip medial groin regions. The Visual analogue scale (VAS) score was 6/10. Range of motion (ROM) assessment demonstrated significant restriction on the affected side: hip flexion was 100° on the right (painful), extension was 15° and internal rotation was 10°.

Muscle strength, assessed using the Oxford Manual Muscle Testing (MMT) scale, showed reduced power in the affected limb: hip flexors were graded 4/5, hip extensors 4/5, and hip abductors 4/5.

Therapeutic Intervention

The patient was admitted for management of right hip AVN. Spinal anaesthesia, the hip region was prepared and draped under sterile conditions. Under fluoroscopic and PCD guidance BMAC augmented with PRP was performed using a decompression needle power drive.^[8,9] The patient was discharged in stable condition after 24 hours of hospitalization.

Follow-up and Outcomes

Clinical outcomes were assessed at baseline (day of intervention) and at 3 months post-procedure using the visual analogue scale (VAS), hip range of motion (ROM), and muscle strength evaluated by the Oxford Manual Muscle Testing (MMT) scale.

A marked reduction in pain was observed, with the VAS score improving from 6/10 at baseline to 2/10 at 3 months, indicating substantial symptomatic relief. Hip range of motion demonstrated significant functional improvement over the follow-up period. At baseline, hip flexion was 100°(painful) in the right hip, which improved to 125° (mild pain) at 3 months. Hip extension improved from 15° to 20°. Internal rotation increased from 10° at baseline to 30° at follow-up (Table 1).

Muscle strength assessment using the Oxford MMT scale revealed progressive improvement across all muscle groups. Hip flexor strength improved from 4/5 at baseline to 5/5 at 3 months. Hip extensor strength increased from 4/5 to 5/5, Similarly, Hip abductor strength improved from 4/5 to 5/5 (Table 2).

Table 1: Time line Range of Motion.

Time Line	Hip Flexors		Extension		Internal Rotation	
	Right	Left	Right	Left	Right	Left
0 Day – Day of Treatment	100°	145°	15°	20°	10°	35°
3 Months	125°	145°	20°	20°	30°	35°

Table 2: Muscle Power (Oxford MMT Scale).

Time Line	Hip Flexors		Hip Extensors		Hip Abductor	
	Right	Left	Right	Left	Right	Left
0 Day – Day of Treatment	4/5	5/5	4/5	5/5	4/5	5/5
3 Months	5/5	5/5	5/5	5/5	5/5	5/5

DISCUSSION

AVN of the femoral head in adolescents presents a unique clinical challenge due to the high functional demands of this population and the long-term implications of joint-preserving versus joint-replacing procedures. In the present case, a 16-year-old professional badminton player with Ficat stage III AVN demonstrated substantial clinical and functional recovery following core decompression augmented with bone marrow aspirate concentrate (BMAC), supporting the growing body of evidence favouring biologic augmentation in mid-stage disease.^[10,11]

Core decompression remains a well-established intervention aimed at reducing intraosseous pressure and improving femoral head perfusion. However, its effectiveness as a standalone procedure in stage III AVN is debated, primarily due to the presence of subchondral collapse and limited intrinsic regenerative capacity at this stage.^[10,11] Previous studies have reported variable outcomes with isolated decompression in advanced stages, often showing progression to femoral head collapse and eventual need for total hip arthroplasty.^[12,13] This limitation has led to increasing interest in adjunctive biologic therapies such as BMAC.

BMAC is rich in mesenchymal stem cells, hematopoietic progenitors, and growth factors that contribute to osteogenesis, angiogenesis, and tissue repair.^[8,9,13] The rationale behind combining BMAC with core decompression lies in addressing both the mechanical and biological aspects of AVN. While decompression relieves pressure and creates a conduit for revascularization, BMAC enhances the regenerative microenvironment within the necrotic region. Studies by Hernigou *et al.* demonstrated that higher concentrations of progenitor cells are associated with improved outcomes and reduced rates of disease progression, particularly in early and mid-stage AVN.^[14]

In the present case, the patient showed marked improvement in pain (VAS reduction from 6/10 to 2/10), hip range of motion, and muscle strength within 3 months post-procedure. Notably, internal rotation improved significantly (10° to 30°), which is often one of the earliest and most affected movements in AVN. The restoration of full muscle strength (5/5) and normalization of gait further indicate functional recovery. Importantly, the patient was able to return to high-level sporting activity, which is a critical outcome in adolescent athletes and underscores the success of joint-preserving strategies. The rapid clinical improvement observed in this case aligns with findings from recent literature suggesting that BMAC augmentation may accelerate recovery and delay structural deterioration. Additionally, the

minimally invasive nature of the procedure, shorter hospital stay, and reduced morbidity compared to more invasive surgical options make it particularly suitable for young patients.

Despite these promising outcomes, certain limitations must be acknowledged. This is a single case report with a relatively short follow-up duration of 3 months. AVN is a progressive condition, and long-term follow-up is essential to determine whether the observed benefits are sustained and whether femoral head collapse is effectively prevented. Furthermore, variability in BMAC preparation techniques, cell concentration, and procedural protocols may influence outcomes, highlighting the need for standardized methodologies and larger controlled studies.

CONCLUSION

This case highlights the potential effectiveness of (BMAC)–augmented core decompression as a joint-preserving strategy in adolescent patients with mid-stage avascular necrosis of the femoral head. The intervention resulted in significant pain reduction, improved hip range of motion, restoration of muscle strength, and early return to high-level sporting activity within a short follow-up period. The findings suggest that combining mechanical decompression with biologic augmentation may enhance regenerative capacity and functional recovery, even in stage III disease where conventional treatments often show limited success. However, given the short-term follow-up and single-case design, further large-scale, long-term studies are required to validate the durability of outcomes and establish standardized treatment protocols.

Author Contributions

Vijayalakshmi Venkatesan: Worked on the manuscript and expertise in regenerative/Orthobiologics for cell transplantation.

Venkatesh Movva: Principal clinician to diagnose the disease pertaining to the Musculoskeletal diseases (MSDs) and sports injuries and an interventional therapist using the Orthobiologics (BMAC) and post follow up of the patients.

Anand Alluru: Clinician working with the patients suffering from MSDs and sports injuries as well as to treat the patients using the Orthobiologics (BMAC) and post follow up of the patients.

Syed Khaleel: Specialization in physiotherapy and rehabilitation of the patients receiving the therapy.

Sunitha Manne Mudhu: Participated in the preparation of Manuscript.

Informed Consent Statement: Written informed consent has been obtained from the patient to publish this paper.

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