



RESULTS OF SURGICAL MANAGEMENT OF EARLY AVASCULAR NECROSIS OF HEAD OF FEMUR WITH CORE DECOMPRESSION, AUTOLOGOUS CANCELLOUS BONE GRAFTING AND PLATELET RICH PLASMA: A PROSPECTIVE STUDY IN THE POST COVID-19 SCENARIO

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ABSTRACT

Background: Incidence of avascular necrosis of head of femur is increasing in the post COVID-19 scenario. Early diagnosis and management of AVN is of paramount importance in order to preserve the femoral head. Early intervention has favourable impact on the prognosis of disease, if implemented at the pre-collapse stage. This study was conducted to evaluate the results of surgical management of early AVN of head of femur with core decompression, autologous cancellous bone grafting and platelet rich plasma and to find out the possible complications associated with the procedure. **Materials & Methods:** It was a prospective, and interventional study. After obtaining ethics committee approval, total 35 hips (22 patients) were included for treatment, as per inclusion and exclusion criteria. Core decompression with autologous cancellous bone grafting with PRP done for all patients. Assessment of the results, was based on the Harris Hip Score and VAS at preoperative, 2 weeks, 4 weeks, 6 weeks and 3, 6, and 9 months post-operatively. **Results:** In the present study, the preoperative mean Harris Hip Score was 32.77 ± 7.23 . At 3 Months and 6 months, it was 85.49 ± 6.87 and 85.17 ± 13.69 respectively. At final follow up of 9 Months, the mean Harris Hip Score was 84.91 ± 18.25 . Similarly, the preoperative mean VAS was 7.62 ± 0.43 . At 3 Months, VAS was 3.35 ± 0.67 . At 6 Months, the mean VAS was 2.67 ± 1.43 . At final follow up of 9 Months, the mean VAS was 2.66 ± 1.57 . In reference to functional assessment criteria of HHS, all 35 hips had a poor score preoperatively. At 9 months follow-up 26 hips (74.3%) had excellent Harris Hip grade, 3 hips (8.6%) had good grade, 2 hips (5.7%) had fair grade and 4 hips (11.4%) had poor grade. **Conclusion:** The combined approach with core decompression, autologous cancellous bone grafting, & PRP produces better HHS/functional outcomes for the treatment of early avascular necrosis of head of femur without increasing the risk of complications.

KEYWORDS : Avascular necrosis, FICAT-ARLET grade, Harris Hip Score, VAS.

I. INTRODUCTION

Avascular Necrosis (AVN) of femoral head is aseptic necrosis or ischemic bone necrosis due to disruption of blood supply to the proximal femur resulting in the death of osteocytes and the collapse of the articular surface, finally leading to degenerative arthritis¹. As it is a progressive condition, it should be detected with a high index of suspicion at an early stage, especially in patients with unilateral symptoms due to the high likelihood of developing AVN in the opposite side. The exact prevalence of AVN is not known. The incidence of AVN head of femur is significantly increasing in the Indian population after COVID-19 pandemic. Men are more commonly affected than women^{2,3}, with ratios from 3:1 to 5:1. The mean age affected is 34.71 years (range 14-70 years). Most common aetiology is non traumatic like medications/steroids followed by traumatic as fractures following road traffic accidents⁴.

The management of AVN of the femoral head ranges from conservative to operative and depends on stage of disease. The aim of treatment is to preserve rather than replace femoral head & cartilage particularly in young patients with present at an early stage. A variety of head/ joint preserving treatment options are available but none has proved its worth in terms of curing the disease permanently. With recent advance in surgical techniques, better implant survival, increased familiarity with the procedure and government schemes providing free of cost surgeries there is ever increasing temptation to prefer replacement surgery as first line or only treatment option, even in early AVN. however, it is not indicated in young patients presenting with early stages of AVN. Early diagnosis and management of AVN is of paramount importance in the post- COVID-19 scenario in order to preserve the femoral head. Early intervention, if implemented at the pre-collapse stage, has favourable impact on the prognosis of disease. It may progress to

subchondral fractures within only 2 to 3 years, if not intervened⁵.

Use of Core decompression, autologous cancellous bone graft with or without PRP in early AVN should be encouraged due to its promising results and multiple advantages. It preserves the natural anatomy of femoral head and normal biomechanics of hip which is lost in fibular grafting and osteotomies and hence an easier conversion to THR is possible. There is minimum surgical morbidity owing to smaller incision with minimum blood loss, lesser duration of surgery with a short hospital stay. Surgeries with muscle pedicle bone graft and vascularized fibula graft are cumbersome and have significant surgical morbidity. No immunologic reactions are possible as autologous graft and PRP are being used. PRP in addition provides various growth factors like VEGF, PDGF, FGF, etc. which increase the vascularity of necrotic area.

In the post-COVID-19 scenario, we underwent this study to evaluate the functional results of core decompression & autologous cancellous bone grafting with platelet rich plasma in early avascular necrosis of head of femur and to identify the complications associated with the procedure.

II. MATERIALS & METHODS

This study was conducted at Department of Orthopaedics, JLN Medical College, Ajmer (Rajasthan) from February 2021 to August 2022. It included 35 hips (22 patients) who presented to the OPD with AVN of femoral head. It was a prospective, and interventional study. Patients presented to the OPD with history of pain over hip were examined clinically and AVN of femoral head was confirmed with plain radiographs and MRI of the affected hip, FICAT and ARLET grading was done and patient were included in the study after informed written consent as per the Institutional Ethical Committee guidelines.

Inclusion criteria:

Age 18 - 60 years, FICAT-ARLET Stage I, II AVN, Unilateral or bilateral disease. **Exclusion criteria:** FICAT-ARLET Stage III and IV AVN, Sickle cell anemia, infective/autoimmune conditions, with neuromuscular or neurodegenerative disorders, Pregnancy and Renal compromised patients The selected patients who satisfied the above inclusion criteria were then registered, history and clinical details were recorded as per the proforma. Prior to surgery, all patients were counselled in their own language in detail about the nature of the disease, anesthesia and the operative procedure and its possible complications and informed written consent was taken. They were informed that they were free to opt out of the study at any point of time without affecting the further management.

Pre-operative preparation:

Detailed history to look for possible cause of AVN, clinical examination to look for hip function, X rays Both Hips AP and Lateral Views, MRI Both Hips, sickling test (to rule out SCA), VAS scores, Harris Hip Score, Informed written consents, PAC investigations and fitness for surgery.

Surgical technique:

PRP Preparation: One hour prior to surgery, 30ml of autologous blood was withdrawn by venous puncture in acid citrate dextrose (ACD) tubes. The ACD vial containing blood was taken to the blood bank for centrifugation. 1st stage centrifugation: its aim is to separate the erythrocytes and is done by centrifuging the sample at 2400 rpm for a period of 10 minutes. After the above step the obtained PRP containing platelets was poured into other sterile tube (without anticoagulant). 2nd stage centrifugation: its aim is to concentrate the platelets and is done by centrifuging the sample at 3600 rpm for a period of 15 minutes. 5 ml of Platelet rich plasma was prepared.

Core Decompression:

Using a 2.5mm guide wire multiple percutaneous drill holes were made in the involved areas of femoral head by entering through the lateral wall, below greater trochanter under fluoroscopic guidance.

Bone graft harvesting:

A 3 cm transverse incision was given 2-3cm proximal to ASIS along outer lip of iliac crest. Dissection done and retractors were used to expose the iliac crest. 8mm hollow mill along with trocar was used to harvest the bone graft.

PRP and Bone Graft Insertion:

The exact location of necrotic segment of femoral head on MRI was noted and 2.5mm guide wire was passed through the lateral wall, below greater trochanter into the segment and was confirmed under C-arm guidance in AP and Lateral view. A 1.5 cm longitudinal incision was given along the entry of guide wire. 8mm ACL reamer was used to the drill and decompress the tract up to the subchondral area. 5ml of PRP was loaded aseptically in a syringe from the ACD vial. Fracture table was tilted to opposite side. Using a 16G spinal needle, PRP was inserted into the necrotic area through the decompressed channel. Immediately after PRP insertion, the trocar which was already filled with autologous cancellous bone graft was passed through the drilled area. Using a trocar and plunger, graft was punched into the necrotic area and it was confirmed under C-arm and was evident by radiodensity occupying the radiolucent area in the necrotic segment. Thorough wash, suturing and dressing done. Table was tilted back to normal. Patient was taken out of OT.

Postoperative protocol:

Partial weight bearing was started on Day 2 in unilateral cases patient was kept non weight bearing for 1 month in bilateral cases allowing only activities of daily living.

Dynamic quadriceps and knee range of motion exercises were started on POD 2. Suture removal was done at 2 weeks. Full weight bearing started at 6 weeks. DVT prophylaxis was given postoperatively in high-risk cases.

Follow-up protocol:

All patients were followed up at 2 weeks, 4 weeks, 6 weeks, 3 months, 6 months and 9 months thereafter. Harris Hip scoring system (HHS) and Visual Analogue Scale (VAS) was used for evaluation of functional outcome and radiological outcome was assessed by x-ray of the affected hips. Minimum follow up in our study was 9 months.

Statistical analysis:

The data was expressed as mean± SD. Descriptive statistics was presented in the form of numbers and percentages. For calculating P- values, online statistical software GraphPad and EpiInfo were used. P- value of <0.05 was taken statistically significant.

III. RESULTS

Our study results are represented here in tabulated form (Table 1, and Table 2), and in figures (Fig. 1, Fig. 2, and Fig. 3).

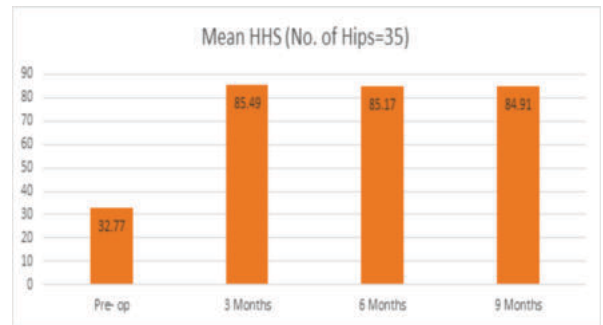


Fig.1: Comparison of Harris Hip Score (HHS) at different time intervals after treatment with (CD+BG+PRP).

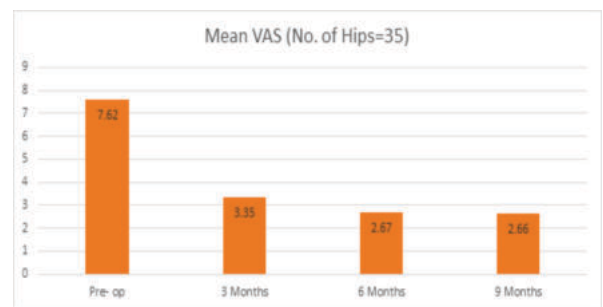


Fig. 2: Comparison of Visual Analogue Scale (VAS) at different time intervals after treatment with (CD+BG+PRP).

Table 1: Comparison of mean HHS & mean VAS Preoperatively and at 9 months follow-up.

Score	Pre-op [Mean ± SD]	Post-op (9 months) [Mean ± SD]	P-value
HHS	32.77 ± 7.23	84.91 ± 18.25	0.001*
VAS	7.62 ± 0.43	2.66 ± 1.57	0.001*

P- value < 0.05 was taken as statistically significant; HHS= Harris Hip Score, VAS= Visual Analogue Scale.

Table 2: Results of the study at 9 months follow-up in terms of Harris Hip Grading.

Harris Hip Grading	No. of Hips	Percentage (%)
Excellent	26	74.3
Good	3	8.6
Fair	2	5.7
Poor	4	11.4
Total	35	100

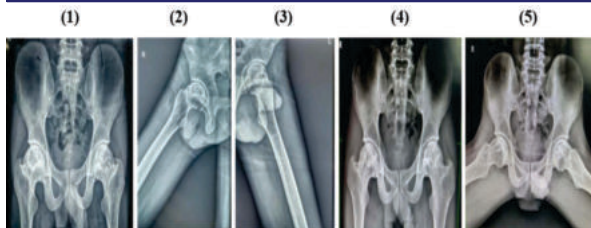


Fig. 3: Pre-operative (1, 2, & 3) and 9 months post-operative (4, & 5) X-rays of 22 years old male with AVN grade-2 of bilateral femoral head with history of steroid intake during COVID-19 treatment.

IV. DISCUSSION:

In our study, 22 cases comprising 35 hips with early stage AVN (FICAT-ARLET grade 1 and 2). Core decompression with autologous cancellous bone grafting with PRP was done in all the cases.

In the present study, the mean age was 32.00 ± 10.49 years. The maximum age was 58 years and minimum 19 years. About 93.8% affected cases were below 40 years of age. In similar study results observed by Sri Krishna Soni et al⁸. In another study conducted by Martina Rochhi et al⁷, younger patients with hip pain were more commonly diagnosed with AVN. This is could be due to multifactorial etiology and risk factors like steroid abuse during COVID-19 pandemic, alcohol intake, immunological diseases, congenital conditions and trauma being more prevalent at younger age and also due to development of diagnostic modalities like MRI, bone scan which can identify disease at an early stage.

Out of total 22 patients, male predominance was seen as 17 (77.27%) patients were males and 5 (22.73%) patients were females. Male dominance was also seen in similar studies done by Martina Rochhi et al⁷, which is comparable to our study. Thus, we concluded that males were more frequently affected than females with a male: female ratio of 3.4:1. This could be due to intake of alcohol, steroids and trauma/accidents being more frequent in male population.

In the present study, 13 patients with bilateral involvement and 9 with unilateral involvement. Similar study results obtained by Martina Rochhi et al⁷ and Tushar et al⁸. We can conclude that bilateral presentation is more common than unilateral and most unilateral cases invariably lead to involvement of opposite hip also.

In our study, 5 hips (14.29%) were in FICAT-ARLET grade I, while 30 hips (85.71%) were in Grade II. Stage III and IV were not included in the study. Sri Krishna Soni et al⁸ conducted a similar study in which out of 38 hips, according to FICAT and ARLET grading, 28 (73.7%) hips had stage II (sclerosis and cysts) and 10 hips (26.3%) had stage I (Normal radiologically), which is comparable with our study. In Indian scenario where due to low socioeconomic status and less awareness patients do not present to hospital for treatment of mild symptoms. Thus, most patients present with higher grades as compared to stage I which can drastically affect the treatment options and prognosis.

Duration of symptoms was less than 6 months in 21 hips (60%), while in 14 hips (40%), duration of symptoms was more than 6 months. Most patients presented within 6 months of onset of symptoms suggesting the rapidly progressive nature of disease and hence early diagnosis in early stages (pre collapse stage) and intervention is required to halt the disease process at an early stage and prevent progression to stage of arthritis.

In most cases, no definitive etiology could be identified (idiopathic). In others, alcohol was most common etiology

followed by steroid overuse during COVID-19 treatment. Similar results observed in the studies conducted by Sri Krishna Soni et al⁸ and Kalpit N. Shah et al⁹.

The preoperative mean Harris Hip Score was 32.77 ± 7.23 . At 3 Months and 6 months, it was 85.49 ± 6.87 and 85.17 ± 13.69 respectively. At final follow up of 9 Months, the mean Harris Hip Score was 84.91 ± 18.25 . In reference to evaluation criteria of HHS, all 35 hips (100%) had a poor score preoperatively. At 9 months follow-up 26 hips (74.3%) had excellent Harris Hip grade, 3 hips (8.6%) had good grade, 2 hips (5.7%) had fair grade and 4 hips (11.4%) had poor grade. These findings are comparable with the studies conducted by Sri Krishna Soni et al⁸ and Tushar et al⁸.

Similarly, the preoperative mean VAS was 7.62 ± 0.43 . At 3 Months, VAS was 3.35 ± 0.67 . At 6 Months, the mean VAS was 2.67 ± 1.43 . At final follow up of 9 Months, the mean VAS was 2.66 ± 1.57 . It can be concluded that our treatment modality is successful in providing pain relief at 9 months follow up. Similar results observed in the study conducted by Martina et al⁷.

Radiological outcome was assessed based on X-rays at 9 months follow up which showed progression of disease in all cases of our study. In cases of AVN, X-rays may not correlate with the functional status of the patients. Therefore, both radiological and functional assessment should be done together. The progression could not be quantified or graded as MRI was not done at final follow up.

PRP should not be administered as a stand-alone therapy for AVN. It should always be used in conjunction with other treatment options such as bone grafting and core decompression. As AVN is characterized by osteocyte apoptosis as a result of the interruption of the blood supply, the most important steps for treating AVN are facilitating osteogenesis and angiogenesis, as well as restoring bone formation to reconstruct the support at the joint surface. Jun Han et al¹⁰ did a study in which they concluded that PRP must be administered in conjunction with core decompression with stem cells and bone grafts (autologous or allogeneic) in early stage AVN to generate osteogenic activity and promote stem cell differentiation.

The treatment modality in our study showed improved functional outcome and relief of pain at 9 months follow up. Individuals showed better improvement of functional outcome at final follow up compared to preoperative stages.

Complications:

We faced complication (infection) in only 2 patients (5.7%), in which antibiotic cement spacer was done and is planned for THR for further management. In another study using PRP conducted by Sri Krishna Soni et al⁸, there was one case of deep-seated infection. Thus, PRP is associated with risk of infection which can lead to complications like septic arthritis and hip subluxation following which patient will land up in THR at an early age than may be required with normal progression of disease.

Limitations of our study:

small size of study sample and short duration of follow ups are certain limiting factors in our present study. After 9 months of follow up, few patients still complained of persistent pain. AVN being a progressive disease, larger sample size with further long duration follow ups are required to look for how long the THR can be delayed due to its use.

V. CONCLUSION

It can be concluded with the present study that when combined with core decompression and bone grafting, PRP produces better HHS/functional outcomes. Addition of PRP

has associated risk of infection which can lead to serious complications, hence maintaining its sterility is of paramount importance. PRP should not be used alone as a treatment method, but rather in conjunction with other modalities such as core decompression and bone grafting to improve results and its efficacy. AVN being a progressive disease, require long term follow ups and further comparative studies to assess the improvement of scores, functional outcome and efficacy of these different procedures in delaying the THR.

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Declarations:

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Conflict of interest: None.

Ethical approval: This study was approved by the institutional ethics committee.

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