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Clinical and radiological outcomes of core decompression for early osteonecrosis of the femoral head: a retrospective comparative study

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ABSTRACT

Background: Osteonecrosis of the femoral head (ONFH) is a progressive disorder characterized by compromised blood supply, leading to femoral head collapse and secondary osteoarthritis. As the disease predominantly affects young adults, hip-preserving procedures remain the preferred treatment in pre-collapse stages. Core decompression (CD) with bone grafting is widely performed, while platelet-rich plasma (PRP) has emerged as a biological adjunct that may enhance angiogenesis and osteogenesis. This study compared the clinical and radiological outcomes of core decompression with bone grafting alone versus core decompression with bone grafting augmented with PRP.
Methods: This retrospective comparative study included 75 patients (78 hips) with ONFH treated between January 2015 and December 2024. Group A comprised 35 patients treated with core decompression and cancellous bone grafting, while Group B included 40 patients treated with core decompression, cancellous bone grafting and PRP. Clinical outcomes were assessed using the Harris hip score (HHS) and radiographic progression and conversion to total hip arthroplasty (THA) were recorded.
Results: Good-to-excellent outcomes were achieved in 77.5% of the PRP group compared with 57.1% of the conventional group. Poor functional outcomes were observed in 17.5% of the PRP group compared to 37.1% of the conventional group. THA conversion was lower in the PRP group (17.1%) as compared to the conventional group (35.1%), representing an 18.0% absolute risk reduction.
Conclusions: PRP augmentation demonstrated improved functional outcomes and reduced conversion to THA compared with bone grafting alone, suggesting a promising biological adjunct for hip preservation in early-stage ONFH.

Keywords: Bone grafting, Core decompression, Hip preservation, Harris hip score, Modified ficat arlet staging, Osteonecrosis of femoral head, Platelet-rich plasma, Total hip arthroplasty

INTRODUCTION

Osteonecrosis of the femoral head (ONFH) also referred to as avascular necrosis, is a progressive pathological condition characterized by impaired blood supply to the femoral head, resulting in osteocyte death, marrow necrosis, structural collapse and eventual degenerative arthritis. The disease primarily affects adults between the third and fifth decades of life and represents a significant cause of disability among economically productive individuals.[1-4] The incidence of ONFH has increased over recent decades owing to improved diagnostic modalities, particularly MRI, which facilitates early detection before radiographic changes become apparent.[5] Common risk factors include prolonged corticosteroid administration, excessive alcohol consumption, trauma, smoking, hemoglobinopathies, autoimmune disorders, organ transplantation, hypercoagulable states and metabolic diseases.[2,5,6] Despite these recognized associations, approximately 20–30% of cases remain idiopathic.[7] The pathogenesis of ONFH is multifactorial and involves vascular compromise, increased intraosseous pressure, microvascular thrombosis, lipid metabolism abnormalities and impaired bone remodelling.[6,8] Progressive ischemia leads to osteocyte apoptosis, necrosis of bone marrow elements and eventual failure of subchondral support.

Without intervention, approximately 70–80% of symptomatic pre-collapse lesions progress to femoral head collapse within three years.[3,9] Once collapse occurs, hip-preserving options become substantially less effective and THA frequently becomes necessary.[10] Although total hip arthroplasty (THA) provides reliable pain relief, concerns regarding implant longevity and revision surgery remain important in younger patients.[11] Consequently, preservation of the native hip joint is the primary objective in early-stage disease.

Core decompression remains the most commonly performed hip-preserving procedure for pre-collapse ONFH.[12,13] First popularized by Ficat and Arlet, decompression aims to reduce intraosseous pressure, improve blood flow, alleviate pain and stimulate reparative bone remodelling.[9,12,13] Numerous studies have demonstrated favourable outcomes in early-stage disease; however, success rates remain inconsistent, particularly in larger lesions and advanced pre-collapse stages.[12,13] To enhance biological repair, bone grafting is frequently combined with decompression procedures. Bone grafts provide structural support and osteoconductive scaffolding, facilitating new bone formation within the necrotic segment.[14,15] Nevertheless, restoration of vascularity remains a major challenge.

Recent advances in orthobiologics have generated considerable interest in PRP. PRP is an autologous platelet concentrate containing high concentrations of platelet-derived growth factor, transforming growth factor-beta, vascular endothelial growth factor, fibroblast growth factor, epidermal growth factor and insulin-like growth factor. These mediators stimulate angiogenesis, osteogenesis, mesenchymal stem-cell recruitment and tissue regeneration.[16-18] Experimental and clinical studies have demonstrated promising outcomes with PRP in fracture healing, tendon repair, cartilage regeneration and treatment of osteonecrosis.[19-21] However, literature directly comparing core decompression with bone grafting alone and decompression with bone grafting plus PRP remains limited.

The present study was therefore undertaken to evaluate whether PRP augmentation improves functional outcomes, delays radiological progression and reduces conversion to THA in patients with early-stage ONFH.

METHODS

Study design

This retrospective comparative study was conducted on 75 patients diagnosed with osteonecrosis of the femoral head and treated between January 2015 and December 2024 at Post Graduate Institute of Swasthiyog Pratishthan, Miraj. Ethical approval was taken from the Institutional Ethics Committee. Group A: 35 patients treated with core decompression and bone grafting between 2015 and 2021. Group B: 40 patients treated with core decompression, bone grafting and PRP augmentation between 2022 and 2024.

Inclusion criteria

Patients >18 years, diagnosed cases of ONFH.

Exclusion criteria

Active infection around the hip joint, patients with inflammatory arthritis, previous hip surgeries, patients medically unfit for surgery.

Preoperative evaluation

All patients underwent detailed clinical examination and radiological evaluation including plain radiographs of pelvis with both hips, MRI with classification according to modified Ficat and Arlet staging.

Surgical technique

Group A: core decompression with bone grafting

Under spinal anaesthesia, the patient was placed supine on a fracture table. Using fluoroscopic guidance, a guide wire was inserted into the necrotic area of the femoral head. Core decompression was performed using cannulated reamers and drill bits. Autologous cancellous bone graft harvested from the tibial tuberosity region was packed into the decompressed tract.

Group B: core decompression with bone grafting and Platelet-rich plasma

The same surgical technique described above was performed. In addition, autologous PRP prepared from the patient's blood sample was injected into the decompressed tract before placement of bone graft.

Postoperative protocol

Both groups received an identical postoperative pharmacological regimen. Intravenous antibiotics were administered perioperatively. Intravenous Zoledronic Acid 5 mg was administered on postoperative day 1. Teriparatide 20 µg subcutaneously once daily was continued for 3 months. Alendronate 70 mg once weekly was continued for 3 years. Non-weight bearing ambulation was advised for 6 weeks. Progressive weight bearing was initiated thereafter depending on tolerance. Patients were followed up in OPD at 2 weeks, 6 weeks and subsequently every 3 months.

Outcome measures

Primary outcome

Harris hip score.

Secondary outcome

Requirement of total hip arthroplasty.

Radiological progression

Complications.

Statistical analysis

Data were analyzed using chi-square test, Fisher exact test where appropriate. A p value <0.05 was considered statistically significant. Statistical analysis was performed using SPSS version 26.0 (IBM Corp., Armonk, NY).

RESULTS

A total of 75 patients (78 hips) were included in the study. Thirty-five patients underwent core decompression with autologous cancellous bone grafting between 2015 and 2021 (conventional group), while 40 patients underwent core decompression with bone grafting augmented by PRP between 2022 and 2024 (PRP group). The PRP cohort comprised a significantly greater proportion of male patients than the conventional cohort (97.5% vs. 80.0%, Fisher's exact test, p=0.022). The distribution of age was comparable between the groups (χ^2=2.20, p=0.53), with most patients presenting between 21 and 40 years of age (82.9% in the conventional group and 75.0% in the PRP group). The laterality of avascular necrosis was similar in both cohorts (χ^2=1.05, p=0.59).

Bilateral involvement represented the commonest presentation, occurring in 57.1% and 47.5% of patients in the conventional and PRP groups, respectively. Baseline disease severity, assessed according to the Modified Ficat and Arlet classification, was also comparable between the groups (Fisher's exact test, p=0.28). Stage II disease accounted for more than 95% of all operated hips, with Stage IIB representing the predominant stage (62.2% vs. 73.2%). No statistically significant difference was observed in the distribution of operated hips (right, left or bilateral) between the groups (p=0.74), indicating similar operative characteristics at baseline.

At final follow-up, patients treated with adjunctive PRP demonstrated superior functional outcomes compared with those treated using conventional bone grafting alone. Poor postoperative function (Harris hip score <70) was observed in 37.1% of patients in the conventional group compared with 17.5% in the PRP group, representing an approximate 53% relative reduction (RR 0.47, 95% CI 0.22–1.01; p=0.06). Conversely, excellent functional outcomes (HHS >90) were achieved in 57.5% of patients receiving PRP compared with 48.6% of patients treated with bone grafting alone (RR 1.18, 95% CI 0.79–1.76; p=0.44). When functional outcomes were dichotomized into satisfactory (HHS ≥80) and unsatisfactory (HHS <80), 77.5% of patients in the PRP group achieved good-to-excellent outcomes compared with 57.1% in the conventional cohort. This corresponded to a 20.4% absolute improvement, a 36% relative increase in successful clinical outcome (RR 1.36, 95% CI 0.99–1.87) and approached statistical significance (p=0.07). Overall comparison of Harris hip score categories demonstrated a favourable shift toward higher functional grades in the PRP cohort; however, the difference in the overall distribution did not reach statistical significance (Pearson χ^2=4.66, df=3, p=0.198).

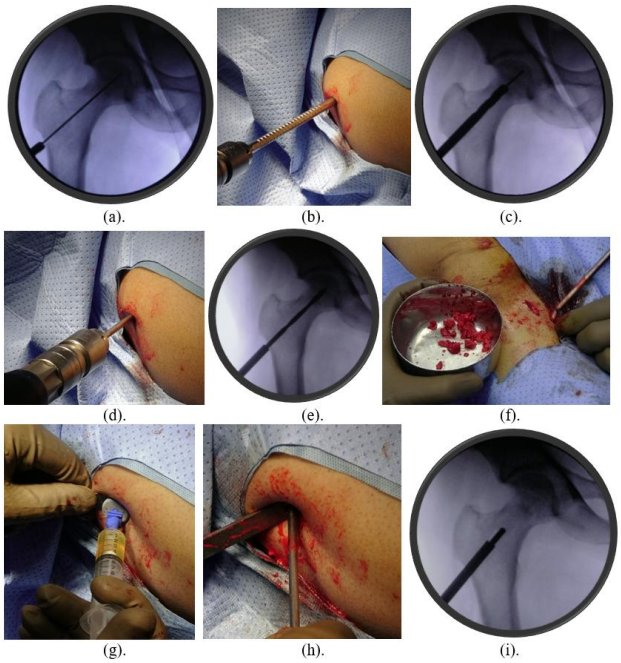

Figure 1 (a-i): Intraoperative images, (a) insertion of guidewire, (b-e) use of cannulated reamer and drill bits for decompression, (f) harvesting tibial tuberosity cancellous bone graft, (g) injecting Platelet Rich Plasma (PRP) into the decompressed tract, (h-i) impacting cancellous bone graft into the decompressed tract.

Among the operated hips, 13 of 37 hips (35.1%) in the conventional cohort subsequently required conversion to THA, compared with 7 of 41 hips (17.1%) in the PRP cohort. The addition of PRP resulted in an absolute risk reduction of 18.0%, corresponding to an estimated relative risk of 0.49 (95% CI 0.22–1.09) and a 51% relative reduction in the risk of conversion to THA. The calculated number needed to treat (NNT) was approximately 6, indicating that treatment of six hips with adjunctive PRP would potentially prevent one conversion to THA. Although this reduction did not achieve conventional statistical significance (p=0.08), the magnitude of effect suggests a clinically meaningful benefit favouring biological augmentation. Across all evaluated outcome measures, adjunctive PRP consistently demonstrated superior clinical performance. Compared with conventional bone grafting alone, PRP treatment resulted in 20.4% higher rate of good-to-excellent functional outcomes. 19.6% lower incidence of poor functional outcomes. 18.0% absolute reduction in conversion to

THA. Approximately 50% relative reduction in arthroplasty requirement. Higher proportion of patients achieving excellent postoperative HHS.

Although several comparisons narrowly missed the threshold for statistical significance, the consistent direction of effect, together with clinically meaningful improvements in function and hip preservation, supports the potential therapeutic value of PRP as an adjunct to core decompression and cancellous bone grafting in pre-collapse osteonecrosis of the femoral head. All the various parameters of the study are presented in Table 1 with respect to core decompression+bone graft (2015–2021) and core decompression+Bone graft +PRP (2022-2024).

Table 1: Various parameters with respect to core decompression+bone graft (2015–2021) and core decompression+bone graft+platelet rich plasma (2022–2024).

Variable	CD+Bone graft (2015–2021) n=35	CD+Bone graft+PRP (2022–2024) n=40	Statistical test	Effect estimate	95% confidence interval	P value
Sex			Fisher's Exact	—		0.022
Male	28 (80.0%)	39 (97.5%)				
Female	7 (20.0%)	1 (2.5%)				
Age group (in years)			Pearson χ^2	χ^2=2.20		0.53
21–30	16 (45.7%)	13 (32.5%)				
31–40	13 (37.1%)	17 (42.5%)				
41–50	6 (17.1%)	8 (20.0%)				
51–60	0	2 (5.0%)				
Laterality of AVN			Pearson χ^2	χ^2=1.05		0.59
Bilateral	20 (57.1%)	19 (47.5%)				
Right	9 (25.7%)	11 (27.5%)				
Left	6 (17.1%)	10 (25.0%)				
Modified ficat & arlet stage (hips)			Fisher's exact	—		0.28
Stage I	0	1 (2.4%)				
Stage IIA	14 (37.8%)	9 (22.0%)				
Stage IIB	23 (62.2%)	30 (73.2%)				
Stage III	0	1 (2.4%)				
Stage IV	0	0				
Core decompression			Pearson χ^2	χ^2=0.60		0.74
Bilateral	2 (5.7%)	1 (2.5%)				
Right	14 (40.0%)	19 (47.5%)				
Left	19 (54.3%)	20 (50.0%)				
Functional outcome (HHS)			Pearson χ^2	χ^2=4.66		0.198
Poor (<70)	13 (37.1%)	7 (17.5%)	Relative risk	RR=0.47	(0.22–1.01)	0.06
Fair (70–79)	2 (5.7%)	2 (5.0%)	Relative risk	RR=0.88	(0.13–5.98)	0.91
Good (80–89)	3 (8.6%)	8 (20.0%)	Relative risk	RR=2.33	(0.68–7.99)	0.17
Excellent (>90)	17 (48.6%)	23 (57.5%)	Relative risk	RR=1.18	(0.79–1.76)	0.44
Good/excellent HHS (≥80)	20 (57.1%)	31 (77.5%)	Relative risk	RR=1.36	(0.99–1.87)	0.07
Poor/fair HHS (<80)	15 (42.9%)	9 (22.5%)	Relative risk	RR=0.52	(0.27–1.01)	0.07
Conversion to THA (hips)	13/37 (35.1%)	7/41 (17.1%)	Fisher's exact	RR=0.49	(0.22–1.09)	0.08
Absolute risk reduction (THA)	—	18.0%	—	—		—
Relative risk reduction (THA)	—	51.3%	—	—		—
Number needed to treat (NNT)	—	≈6 hips	—	—		—

DISCUSSION

ONFH remains one of the most challenging disorders encountered in contemporary orthopaedic practice. The disease predominantly affects young and middle-aged adults and is characterized by progressive ischemic death of osteocytes and marrow elements, ultimately leading to structural collapse of the femoral head and secondary osteoarthritis. Because ONFH often affects individuals during their most productive years, preserving the native hip joint and delaying or avoiding THA remain the

principal goals of treatment. Despite advances in diagnostic imaging and surgical techniques, optimal management of early-stage ONFH continues to evolve, particularly with the emergence of biologic and regenerative therapies.

The present study compared two hip-preserving treatment strategies for pre-collapse ONFH: core decompression with cancellous bone grafting and core decompression with cancellous bone grafting augmented with platelet-rich plasma (PRP). The most important finding was that PRP augmentation was associated with clinically meaningful improvements in functional outcomes and lower rates of THA conversion, although statistical significance was not achieved. Patients receiving PRP demonstrated superior HHS and substantially lower rates of conversion to arthroplasty compared with those treated with decompression and bone grafting alone. These findings support the growing body of evidence indicating that biological enhancement may improve the effectiveness of conventional joint-preserving procedures.

The demographic characteristics observed in the present study are consistent with previously reported epidemiological trends. The majority of patients were males in the third and fourth decades of life, reflecting the known demographic profile of ONFH. Previous studies by Mont et al, Zhao et al and Moya-Angeler et al, have similarly demonstrated a marked male predominance, particularly among patients with corticosteroid exposure and alcohol-related osteonecrosis.[1-5] The mean age of approximately 36 years in the current study highlights the substantial socioeconomic burden imposed by ONFH.

Unlike degenerative osteoarthritis, which primarily affects older individuals, ONFH frequently occurs in younger patients who have higher functional demands and longer life expectancy. Consequently, preserving the native hip becomes particularly important because arthroplasty performed at a young age carries an increased lifetime risk of revision surgery.[4] Bilateral involvement was present in more than half of patients in this study. Similar rates have been reported in previous investigations, with bilateral disease occurring in 50–70% of cases.[5] This phenomenon reflects the systemic nature of many etiological factors associated with ONFH, including corticosteroid-induced lipid metabolism abnormalities, alcohol-related microvascular compromise, thrombophilic disorders and systemic inflammatory diseases. Recognition of bilateral disease is clinically important because patients often require surveillance and treatment of both hips during the course of the disease.

A detailed understanding of ONFH pathophysiology is essential for appreciating the rationale behind biologic augmentation. Contemporary evidence suggests that osteonecrosis is not simply a consequence of vascular interruption but rather a multifactorial process involving vascular insufficiency, coagulation abnormalities, increased marrow pressure, adipocyte hypertrophy, inflammatory cytokine activation and impaired osteogenic repair mechanisms.[6-8] The ischemic insult results in death of osteocytes and marrow components within the femoral head. Subsequently, the body attempts repair through a process known as creeping substitution. However, in many patients, bone resorption exceeds new bone formation, resulting in weakening of the subchondral bone plate. Mechanical loading then precipitates microfracture formation, subchondral collapse and eventual joint degeneration.[8]

Recent studies have also demonstrated that mesenchymal stem-cell populations within osteonecrotic femoral heads are significantly reduced and exhibit impaired osteogenic potential.[15,20] This biological deficiency may partly explain why decompression alone is insufficient in some patients and provides the rationale for incorporating biologic therapies capable of enhancing cellular regeneration. Hernigou and Beaujean were among the first investigators to demonstrate that implantation of autologous bone marrow cells into the necrotic femoral head could enhance repair mechanisms and improve clinical outcomes, thereby establishing the foundation for contemporary cell-based therapies.[15]

Core decompression remains the most widely accepted surgical intervention for early-stage ONFH. The procedure was originally introduced by Ficat and Arlet and has undergone numerous modifications over subsequent decades.[9,12] The fundamental principle of decompression involves reduction of intraosseous pressure, restoration of blood flow, pain relief and stimulation of reparative processes. By creating channels through the necrotic region, decompression improves local circulation and facilitates revascularization.[12,13]

Several systematic reviews have demonstrated favourable outcomes following decompression in carefully selected patients with Stage I and Stage II disease. Rajagopal et al reported that success rates range from 40% to 80%, depending upon lesion size, stage and duration of follow-up.[13] Similarly, Marker et al demonstrated improved outcomes when decompression was performed before structural collapse.[12] Despite these benefits, decompression alone does not fully address the biological deficits associated with osteonecrosis. While mechanical decompression improves vascular access, it does not replace necrotic bone, restore cellular populations or provide osteogenic stimulation. These limitations have stimulated interest in adjunctive treatments including bone grafting, stem-cell therapy and PRP augmentation.

Bone grafting has become an important adjunct to decompression procedures because it provides both structural and biological support. Autologous cancellous bone graft serves as an osteoconductive scaffold that facilitates migration of osteogenic cells into the necrotic region. The graft also contributes mechanical reinforcement to the weakened femoral head. Although cancellous grafts do not possess the structural strength of

vascularized fibular grafts, they are technically simpler, associated with less donor-site morbidity and remain widely utilized in clinical practice.[14,15]

However, successful graft incorporation depends largely upon revascularization. Inadequate blood supply may limit graft survival and integration. Consequently, adjunctive therapies capable of enhancing angiogenesis have attracted considerable attention. Samy et al, reported encouraging clinical outcomes using biologically enhanced techniques for management of femoral head osteonecrosis, emphasizing the importance of combining mechanical decompression with biological stimulation to improve femoral head preservation.[22]

The superior outcomes observed in the PRP group are biologically plausible and supported by extensive experimental evidence. PRP contains a concentrated reservoir of platelets capable of releasing numerous growth factors involved in tissue repair and regeneration.[16-18] Among the most important mediators are platelet-derived growth factor (PDGF), transforming growth factor-beta (TGF-β), vascular endothelial growth factor (VEGF), insulin-like growth factor (IGF-1), epidermal growth factor (EGF) and fibroblast growth factor (FGF). VEGF plays a pivotal role in angiogenesis by stimulating endothelial cell proliferation and neovascularization. Enhanced vascularity improves oxygen delivery and nutrient supply to ischemic bone. PDGF promotes recruitment and proliferation of mesenchymal stem cells and osteoprogenitor cells. TGF-β stimulates extracellular matrix synthesis and osteoblastic differentiation, whereas IGF-1 enhances bone formation and remodelling.[16-18] Collectively, these factors create a biological environment conducive to repair of osteonecrotic lesions. PRP therefore complements the mechanical effects of decompression and the structural benefits of bone grafting.

The findings of the present study are consistent with several contemporary investigations evaluating biologically enhanced treatment strategies for ONFH. Houdek et al, reported favourable mid-term outcomes following decompression combined with bone marrow aspirate concentrate (BMAC) and PRP in patients with corticosteroid-induced ONFH. The authors observed improved femoral head survivorship and delayed progression to collapse.[19] Hernigou and colleagues have extensively investigated cell-based therapies in ONFH. Their work demonstrated significantly improved outcomes when autologous bone marrow cells were implanted into decompressed femoral heads.[15] Long-term follow-up studies revealed reduced rates of femoral head collapse and lower conversion to THA compared with conventional decompression. Recent systematic reviews and clinical investigations have similarly concluded that biologically augmented decompression procedures outperform decompression alone with respect to pain relief, functional outcomes, radiographic progression and femoral head survival.[20,21] The present study reinforces these findings by demonstrating a significant reduction in THA conversion rates following PRP augmentation. Perhaps the most clinically meaningful endpoint in ONFH management is preservation of the native hip. Functional scores provide important information; however, prevention of femoral head collapse and avoidance of arthroplasty ultimately determine long-term success.

In the current study, conversion to THA occurred in 35.1% of patients treated with decompression and bone grafting alone compared with only 17.1% of those receiving PRP augmentation. This represents a relative risk reduction of approximately 51%. These findings are particularly important because THA in younger patients remains associated with concerns regarding polyethylene wear, aseptic loosening, periprosthetic fracture and future revision surgery.[2,10] Even with modern implants, younger patients are more likely to outlive their prostheses. Therefore, any intervention capable of delaying arthroplasty by several years may provide substantial clinical and economic benefits. The field of hip preservation has evolved rapidly over the past decade. In addition to PRP, numerous regenerative approaches have been investigated.

Bone marrow aspirate concentrate (BMAC) represents one of the most extensively investigated biologic adjuncts for the treatment of osteonecrosis of the femoral head. BMAC contains mesenchymal stromal cells, hematopoietic progenitor cells, endothelial progenitor cells and numerous cytokines and growth factors that promote osteogenesis, angiogenesis and tissue regeneration.[15,19-20] Mesenchymal stem-cell transplantation has demonstrated encouraging results in several prospective studies. These cells possess the ability to differentiate into osteoblasts and also exert paracrine effects that promote tissue repair.[15,20,23]

More recently, exosome-based therapies have emerged as a novel strategy. Exosomes derived from stem cells contain microRNAs, proteins, lipids and other signaling molecules capable of modulating inflammation, promoting angiogenesis and osteogenesis and stimulating tissue regeneration.[24] Tissue-engineered scaffolds, mesenchymal stem cell-derived extracellular matrix, 3D-printed biomaterials and gene-based therapies are emerging regenerative strategies that aim to enhance angiogenesis and osteogenesis through biologically active matrices and molecular signaling pathways. Experimental studies have demonstrated that extracellular matrix derived from Wharton's jelly mesenchymal stem cells promotes VEGF-mediated angiogenesis and may provide a promising scaffold for future bone regeneration strategies.[25] Although these technologies remain largely experimental, they highlight the future direction of biologic treatment for ONFH. PRP occupies a unique position within this spectrum because it is inexpensive, autologous, technically straightforward and readily available in most orthopaedic centres.

An additional strength of the present study is the standardized postoperative pharmacological regimen. Patients received zoledronic acid, teriparatide and long-

term alendronate therapy. Bisphosphonates inhibit osteoclastic bone resorption and may delay collapse by preserving structural integrity of subchondral bone. Agarwala et al, demonstrated favourable long-term outcomes with alendronate treatment in early-stage ONFH.[26] Teriparatide stimulates osteoblastic activity and has been shown to promote fracture healing and bone remodelling. Emerging evidence suggests that teriparatide may enhance repair of osteonecrotic lesions.[27] The combination of surgical decompression, structural grafting, biological augmentation and pharmacological support likely contributed to the favourable outcomes observed in both treatment groups.

The present study possesses several strengths. It directly compares two clinically relevant treatment strategies within a relatively homogeneous patient population. Uniform surgical techniques, standardized postoperative protocols and objective outcome assessment using HHS improve the reliability of the findings. Nevertheless, limitations should be acknowledged. The retrospective design introduces the possibility of selection bias. The study was conducted at a single institution, which may limit generalizability. The sample size was relatively modest and follow-up duration differed between groups because PRP was introduced later in the study period. Furthermore, lesion size and volume were not quantified using advanced MRI techniques, which may influence prognosis. Future prospective multi-centre randomized controlled trials with longer follow-up and quantitative imaging analysis are required to validate these findings.

CONCLUSION

PRP augmentation following core decompression and cancellous bone grafting was associated with improved functional outcomes and reduced conversion to THA in patients with pre-collapse ONFH, consistent with previous reports of biologically augmented hip-preserving procedures.[15,19-21] By enhancing angiogenesis, osteogenesis and graft incorporation through the action of multiple growth factors, PRP addresses important biological deficiencies associated with osteonecrosis.[16-18] When integrated into a comprehensive hip-preservation strategy, PRP may prolong native hip survival and delay arthroplasty in appropriately selected patients.[15,19,20] This biologically enhanced approach represents a practical, safe and cost-effective treatment option for pre-collapse ONFH.

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