

Comparative Study of Core Decompression with Fibular Grafting versus Reverse Bone Grafting in the Management of Precollapse Non-Traumatic Osteonecrosis of the Femoral Head

Peeyush Kumar Sharma¹, Praveen Kumar Deegwal², Vivesh Kumar Singh³

¹MBBS, MS (Orthopaedics), Assistant Professor, Department of Orthopaedics, PMCH Udaipur, Rajasthan, India

²MBBS, MS (Orthopaedics), Consultant, Department of Orthopaedics, Jeevan Rekha Hospital Jaipur, Rajasthan, India

³MBBS, MS (Orthopaedics), Assistant Professor, Department of Orthopaedics, PIMS Udaipur, Rajasthan, India

Received: 01-08-2025 / Revised: 16-09-2025 / Accepted: 28-10-2025

Corresponding Author: Dr. Praveen Kumar Deegwal

Conflict of interest: Nil

Abstract

Osteonecrosis of the femoral head (ONFH) is a progressive disorder caused by compromised blood supply to the bone, often resulting in joint dysfunction and disability. Early-stage management aims to preserve the femoral head and delay total hip replacement. Among available techniques, core decompression with fibular grafting and reverse bone grafting are hip-preserving surgical options. This study compares the clinical and functional outcomes of these two procedures in precollapse, non-traumatic ONFH.

Materials and Methods: This hospital-based observational analytical study was conducted in the Department of Orthopedics, Jodhpur, from May 2022 to April 2023, following institutional ethical approval. Thirty patients aged 20–60 years with stage I, IIA, and IIB ONFH (Ficat and Arlet classification) were enrolled and divided equally into two groups: 15 underwent core decompression with fibular grafting and 15 underwent reverse bone grafting. Functional outcomes were assessed one year postoperatively using the Harris Hip Score (HHS), Modified Merle d'Aubigné (MMA) Score, and Visual Analog Scale (VAS). Data were analyzed using paired t-test and Chi-square test, with a significance level of $p < 0.05$.

Results: Both groups demonstrated significant improvement in HHS, MMA, and VAS scores postoperatively ($p < 0.05$). Although reverse bone grafting showed a higher proportion of favourable outcomes (86.7%) compared to fibular grafting (73.3%), the difference was not statistically significant. Minor complications such as postoperative limping and donor site pain were self-limiting.

Conclusion: Both reverse bone grafting and fibular grafting following core decompression are effective in early-stage non-traumatic ONFH. Reverse bone grafting demonstrated marginally better functional outcomes, suggesting its potential as a technically simpler and promising alternative for femoral head preservation.

Keywords: Avascular Necrosis, Core Decompression, Femoral Head, Fibular Graft, Reverse Bone Grafting.

This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

Introduction

Osteonecrosis of the femoral head (ONFH) is a progressive condition that, if left untreated, can result in hip dysfunction.[1-2] It may occur due to both traumatic and non-traumatic events, leading to compromised blood flow to the bone.[3] ONFH is a debilitating condition often linked to factors such as trauma, blood coagulation disorders, prolonged or high-dose steroid usage, moderate to heavy alcohol consumption, and other contributing factors.[4-5]

The avascular necrosis of the femoral head management involves medical treatments like nonsteroidal anti-inflammatory drugs, bisphosphonates, hyperbaric oxygen therapy, and

extracorporeal shock wave therapy have been explored, however many research suggests their limited effectiveness. In contrast, surgical interventions, including femoral head preservation or hip salvaging procedures, as well as hip replacement surgeries, are considered. However, prosthetic hip replacement in this population is particularly challenging due to the extended life expectancy of the patient and the limited lifespan of the prosthesis. Avascular necrosis accounts for 5% to 12% of total hip replacements. [9]

Core decompression, vascularized and nonvascularized bone grafting, and various osteotomies are additional treatment options for

femoral head avascular necrosis.[9] The principle underlying core decompression involves relieving intraosseous pressure caused by vascular congestion, with the goal of improving vascularity and potentially slowing the progression of the disease. Post-core decompression, further improvement can be done by employing structural bone grafting techniques, including cortical bone, cancellous bone, vascularized bone graft, and removal of necrotic bone from the femoral head. Central core decompression alone has achieved a success rate of 64%. These procedures may be performed independently or in combination with different types of vascularized bone grafting, non-vascularized fibular graft autologous bone transplant, and other adjuvant therapies. Clinical success rates ranging from 33% to 95% have been reported for these combined surgical approaches.[10-11]

Opting for a non-vascularized fibular graft rather than a vascularized one is often preferred due to its lower technical skill requirement and potential reduction in donor-site morbidity. This approach aims to disrupt the cycle of ischemia and interosseous hypertension by decompressing the avascular lesion and removing necrotic bone. To provide structural support to the subchondral bone and articular cartilage, thus preventing collapse during the repair process, cortical fibular bone strut grafts are recommended.

In a novel approach to core decompression, a reverse bone graft is utilized. This technique involves a minimally invasive procedure, using a 2 cm lateral incision and an 8.5 mm core reamer to extract a bone core up to the subchondral bone.

Subchondral cysts are successfully treated under fluoroscopic guidance in this approach. After removing the demarcated avascular bone segment, cortical bone is employed for support to prevent collapse, strategically placing the reversed bone graft.

Objective

To compare the treatment outcome of core decompression with Fibular graft versus Reverse Bone grafting in precollapsed stage of Non traumatic Head of femur Osteonecrosis.

Materials and Methods

This hospital-based observational analytical study was carried out in the department of Orthopedics at a tertiary care facility, Jodhpur. Data collection for the study was started in 01 May 2022 after clearance from the Institutional Ethical Committee (IEC) of the institution, and data collection was completed in 30 April 2023. Additional three months was taken for data analysis and writing report.

Sample Size: was calculated at 95% confidence level assuming 85.7% excellent favorable outcome [by Modified Merle D Aubigne score] in Core decompression with fibular grafting in treatment of precollapsed stage of non-traumatic hip osteonecrosis.[12] At the absolute allowable error of 13% the required sample size was 28 subjects so total 30 subjects were taken as a final sample size. Out of 30 subjects, 15 have undergone fibular grafting and the rest 15 have undergone reverse bone grafting.

The study's inclusion and exclusion criteria comprised patients aged 20-60 with stage I, IIA, and IIB AVN of the Femoral Head, as per the Ficat and Arlet classification. Those who underwent Core Decompression with Fibular Grafting or Reverse Bone Grafting and provided written informed consent were included. Patients with post-traumatic avascular necrosis of the femoral head were excluded. Treatment outcomes were evaluated one year post-surgery using a predesigned semi-structured questionnaire. Assessment criteria included the avoidance of total hip replacement, Modified Merle d'Aubigne score (MMA), Harris Hip Score (HHS), and Visual Analog Scale (VAS). Technique for Core Decompression and Fibular Grafting

The surgical procedure involved the use of C-arm guidance for image intensification. A limited skin incision was made on the lateral aspect of the proximal femur, starting from the tip of the greater trochanter and extending to a point 3 cm below it. The patient was positioned in a supine state under anesthesia.

Dissection proceeded down to the bone by dividing the fascia latae and splitting the vastus lateralis muscle. Under fluoroscopic supervision, a guide wire was inserted along the femoral neck, advancing it to the region of femoral head necrosis, approximately 5 mm from the subchondral plate. Complete curettage of the cavity was performed to eliminate any necrotic bone.

For the fibular graft, the middle third of the fibula from the ipsilateral leg was carefully inserted into the cavity and hammered to reach the subchondral bone where needed. The procedure concluded with the reconnection of the vastus muscle and fascia latae using interrupted sutures. The wound was thoroughly irrigated and closed in layers.

In the Reverse Bone Grafting Technique, the patient was positioned supine on the operating table following preoperative cleaning. A 2 to 3 cm midlateral longitudinal incision was made under image intensification guidance. This incision served as the entry point for a 3.2 mm threaded guide pin, carefully directed between the lateral cortex of the inferior section of the greater

trochanter and the distal portion of the lesser trochanter.

The graft harvesting involved the use of a specialized tool, the Graft Harvester cum Tunneler, with a serrated tip for precise shaping. After shaping and introducing an 8.5 mm core reamer to extract a core of diseased bone up to the subchondral bone, a cancellous bone graft was obtained. Under C-ARM guidance, the subchondral cyst was treated. Using a graft pusher, a demarcated avascular bone piece was removed, and a cylindrical bone graft was polarity-reversed, with

the inside end inserted outside. The cortical bone's support played a crucial role in preventing collapse.

Statistical Analysis: The collected data was promptly entered into a Microsoft Excel Sheet by the investigator to minimize data entry bias. Discrete data was expressed as percentages/proportions and analyzed using the Chi-square test. Continuous data was summarized by providing mean and standard deviation. The significance level was set at 95%.

Results

Table 1: Profile of patients

Variables		Number	Percentage
Age Group (Years)	20-30	10	33.33
	31-40	12	40
	41-50	7	23.33
	51-60	1	3.33
Affected side	Left	14	46.67
	Right	16	53.33
Causative factors	Idiopathic	14	46.67
	Steroids induce	10	33.33
	Alcohol induce	6	20
Ficat and arlet stage	1	0	0
	2A	9	30
	2B	21	70
Opposite side Ficat and arlet stage	0	18	60
	2A	4	13.33
	3	8	26.67
Total		30	100

Table 2: Improvement in HHS, MMA score and VAS score

Variables	Fibular bone graft		p value	Reverse bone graft		p value
	Pre op (Mean±SD)	Post op (Mean±SD)		Pre op (Mean±SD)	Post op (Mean±SD)	
HHS	55.35±4.63	80.12±11.11	<0.0001	57.77±6.14	82.21±10.76	<0.0001
MMA Score	11.6±1.50	14.53±2.77	<0.0001	11.4±1.63	15.33±2.09	<0.0001
VAS Score	5.53±0.83	1.73±0.96	<0.0001	5.06±1.10	1.46±0.74	<0.0001

Table 3: Comparison in treatment outcome between subjects of both groups

Variable		Reverse Bone graft	Fibular bone graft	p value
Conversion into Total Hip Replacement within 1 year	Yes	2(13.3)	4(26.7)	0.648
	No	13(86.7)	11(73.3)	
HHS	Excellent	4(26.7)	3(20)	1.000
	Good	6(40)	5(33.3)	
	Fair	3(20)	3(20)	
	Poor	2(13.3)	4(26.7)	
MMA	Excellent	4(26.7)	3(20)	1.000
	Good	6(40)	5(33.3)	
	Fair	3(20)	3(20)	
	Poor	2(13.3)	4(26.7)	

[Table 1] maximum 12(40%) subjects were in the 31-40 years of age group. Among one third subjects have steroid induced osteonecrosis, followed by

alcohol induced in six (20%) subjects. [Table-II] There was significant improvement in harris hip score (HHS), Modified Merle d Aubigne score

(MMA) and VAS score in subjects of both study groups using paired t test (p value < 0.05). [Table-III] There was no significant difference in treatment outcome between subjects of both groups (p value > 0.05). Only two patients had pain on fibular graft side which subsided on giving appropriate analgesic drug. Six patients had post-operative limping. Six patients had progression of disease and worsening of symptom due to which they will convert into THR an average 8 months. We did not face any complications such as fracture along neck of femur, perforation in the femoral head or deep vein thrombosis.

Discussion

The literature consistently highlights that early diagnosis and prompt treatment result in better outcomes for AVN of the femoral head. [13] However, there is a lack of uniformity in the frequency of the types of surgeries performed for AVN of the femoral head, indicating a lack of consensus on the optimal surgical approach to delay the progression of the disease.

The most commonly affected was belongs to 30-40 years age group, followed by the 16-30 years age group. In contrast, Kang et al. from Korea reported a slightly higher peak age group of 40-59 years. Similarly, Sugano et al. reported mean age for the same was approximately 44 years. This suggests that the disease is prevalent among young Asian individuals during their active years. Notably, all patients in the current study were male, indicating a higher prevalence of ONFH in male individuals in the Asian subcontinent, consistent with findings from other studies. [14,16,17]

In the present study, 40% of cases exhibited bilateral involvement of the hip, a trend consistent with findings in other Asian studies. Sugano et al. from Japan reported 47.6% bilateral ONFH, Wang et al. found 49% bilateral involvement in Chinese patients, and Kang et al. from Korea noted 37% of their patients having bilateral disease. [14,15] These consistent figures indicate a comparable prevalence of bilateral hip involvement across diverse Asian populations.

Regarding the causes of osteonecrosis of the femoral head (ONFH) in the current study, idiopathic factors accounted for 46.7%, followed by steroid use at 33.3%, and alcohol consumption at 20%. These results closely align with those reported by Laxminarayana et al., where idiopathic causes constituted 46% of cases, steroid use was reported in 39.4%, and alcohol consumption in 14.4% of cases. These findings underscore a similar distribution of causative factors for ONFH in these studies. The study observed no significant change between the preoperative Harris Hip Score (HSS) and the scores at the 3-month follow-up. This lack

of change is likely influenced by the fact that patients were advised relative rest during the initial 3 months postoperatively, leading to functional inactivity. However, a statistically significant change was noted in both the scores at 3 months versus 6 months and preoperative versus 6 months. This change can be attributed to the fact that patients were allowed to mobilize after the initial 3 months post-operation and were permitted to engage in household and occupational activities. The study suggests that functional improvement is directly correlated with the length of follow-up, highlighting the importance of considering the postoperative timeline when assessing patient outcomes.

In our study, based on Harris Hip Score (HHS) and Modified Merle d'Aubigne (MMA) Score, excellent results were observed in 26.7% of patients undergoing Reverse Bone Grafting, with 40% classified as good, 20% as fair, and 13.3% as poor. For Fibular Bone Grafting, excellent results were seen in 20%, good in 33.3%, fair in 20%, and poor in 26.7% of patients. The proportion of patients with a favorable outcome (not requiring total hip replacement within 1 year) was 86.7% for Reverse Bone Grafting and 73.3% for Fibular Bone Grafting. Although Reverse Bone Grafting showed slightly better improvement than Fibular Bone Grafting, this difference was not statistically significant. Babhulkar [20] reported femoral head-preserving surgeries' results based on HHS as very good in 27.5%, good in 39.1%, medium in 10.3%, fair in 18.8%, and poor in 4%, which is comparable to our study.

Marker et al. [21] reported the outcome of core decompression (CD) with excellent results in 48%, good results in 13%, fair results in 1%, and a poor outcome in 38%. Similar results were found by Shah et al. [22].

It's important to note the limitations of our study, which include a relatively short one-year follow-up period. Additionally, cases of bilateral affected osteonecrosis were included, where the opposite side hip had a higher Ficat and Arlet staging of AVN, potentially influencing the treatment outcome negatively in these instances. These considerations should be taken into account when interpreting the study results.

Conclusion

Femur osteonecrosis is a crippling condition with poorly known aetiology and pathogenesis. We came to the conclusion that good to outstanding results can be obtained after core decompression if reverse bone grafting or femoral bone grafting is carried out during the precollapse period. Additionally, reverse bone grafting has somewhat better outcomes than fibular bone grafting.

Therefore, these methods can be used in the future to address femur osteonecrosis.

References

1. Malheiros CD, Lisle L, Castelar M, et al. Hip dysfunction and quality of life in patients with sickle cell disease. *ClinPediatr* 2015; 54:1354–8.
2. Sugano N. Osteonecrosis of the Humeral Head[M]//Osteonecrosis. 2014; Springer, Berlin, Heidelberg:389-394.
3. Nixon JE. Avascular necrosis of bone: a review. *J R Soc Med* 1983;76(8):681-92.
4. Hungerford DS, Mont MA. The role of core decompression in the treatment of osteonecrosis of the femoral head. In: Urbaniak JR, Jones JP, eds. *Osteonecrosis: etiology, diagnosis and treatment*. Rosemont, IL: American Academy of Orthopaedic Surgeons, 1997:287–92.
5. Stulberg BN, Davis AW, Bauer TW, Levine M, Easley K. Osteonecrosis of the femoral head: a prospective randomized treatment protocol. *Clin Orthop* 1991; 268: 140–51.
6. Cornell CN, Salvati EA, Pellici PM. Long-term follow-up of total hip replacement in patients with osteonecrosis. *Orthop Clin North Am* 1985; 16:757–69.
7. Fyda TM, Callaghan JJ, Olejniczak J, Minimum ten-year follow-up of cemented total hip replacement in patients with osteonecrosis of the femoral head. *Iowa Orthop J* 2002; 22:8–19.
8. Steinberg ME, Mont MA. Osteonecrosis. In: Chapman MW, ed. *Chapman's orthopedic surgery*. Third ed. Philadelphia: Lippincott, Williams & Wilkins, 2001:3263–308.
9. Mont MA, Hungerford DS. Non-traumatic avascular necrosis of the femoral head. *J Bone Joint Surg [Am]* 1995; 77-A: 459–74.
10. Steinberg ME, Larcom PG, Strafford B, et al. Core decompression with bone grafting for osteonecrosis of the femoral head. *ClinOrthopRelat Res* 2001;(386):71-8.
11. Mont MA, Hungerford DS. Non-traumatic avascular necrosis of the femoral head. *J Bone Joint Surg Am* 1995;77(3):459-74.
12. Attia ME. Core Decompression and Fibular Graft in Treatment of Precollapsed Stages of Non-Traumatic Hip Osteonecrosis. *The Egyptian Orthopedic Journal*; 2020 June (1), 55: 49-55
13. Weinstein SL, Buckwalter JA, editors. *The adult hip*. In: Turek's Orthopaedics: Principles and their Application. 6th ed. Philadelphia: Lippincott Williams & Wilkins; 2008. p.533.
14. 14.Prevalence of osteonecrosis of the femoral head: a nationwide epidemiologic analysis in Korea. Kang JS, Park S, Song JH, Jung YY, Cho MR, Rhyu KHJ *Arthroplasty*. 2009 Dec; 24(8):1178-83.
15. Diagnostic criteria for non-traumatic osteonecrosis of the femoral head. A multicentre study. Sugano N, Kubo T, Takaoka K, Ohzono K, Hotokebuchi T, Matsumoto T, Igarashi H, Ninomiya SJ *Bone Joint Surg Br*. 1999 Jul; 81(4):590.
16. The epidemiology of osteonecrosis: findings from the GPRD and THIN databases in the UK. Cooper C, Steinbuch M, Stevenson R, Miday R, Watts NB *Osteoporos Int*. 2010 Apr; 21(4):569-77
17. 17.Nationwide epidemiologic survey of idiopathic osteonecrosis of the femoral head. Fukushima W, Fujioka M, Kubo T, Tamakoshi A, Nagai M, Hirota Y *Clin Orthop Relat Res*. 2010 Oct; 468(10):2715-24.
18. Etiological and clinical analysis of osteonecrosis of the femoral head in Chinese patients. Wang XS, Zhuang QY, Weng XS, Lin J, Jin J, Qian WW *Chin Med J (Engl)*. 2013 Jan; 126(2):290-5.
19. Lakshminarayana S, Dhammi IK, Jain AK, Bhayana H, Kumar S, Anshuman R. Outcomes of core decompression with or without nonvascularized fibular grafting in avascular necrosis of femoral head: Short term follow-up study. *Indian J Orthop* 2019; 53:420-5.
20. Babhulkar S. Osteonecrosis: Early diagnosis, various treatment options and outcome in young adults. *Indian J Orthop* 2006; 40:138-46.
21. Marker DR, Seyler TM, Ulrich SD, Srivastava S, Mont MA. Do modern techniques improve core decompression outcomes for hip osteonecrosis? *ClinOrthopRelat Res* 2008; 466: 1093-103.
22. Shah SN, Kapoor CS, Jhaveri MR, Golwala PP, Patel S. Analysis of outcome of avascular necrosis of femoral head treated by core decompression and bone grafting. *J Clin Orthop Trauma* 2015;6:160-6.