A Comparative Study of Hips Treated with Core Decompression Versus Vascularized Fibular Graft for Avascular Necrosis: A Survival Analysis.

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ABSTRACT:

Objective: To compare the effectiveness of core decompression and vascularized fibular grafting in terms of pain relief, functional recovery, prevention of disease progression, and short-term hip survival.

Methodology: This prospective observational comparative study was executed in department of orthopedic surgery, Shifa International hospital, Islamabad, from august 2025 to march 2026. Seventy-six patients were enrolled, with 38 in each group; those lost to follow-up were excluded from final analysis. Adults aged 18 to 60 years with radiologically confirmed Association Research Circulation Osseous classification (ARCO) stage II or III avascular necrosis were included.

Results: A total of 61 patients were analyzed, including 32 treated with core decompression and 29 with vascularized fibular grafting. Baseline age, preoperative Harris Hip Score (HHS) and preoperative visual analog scale pain score were comparable between groups. At 6 months, HHS remained higher (81.79 ±10.41 vs 74.75 ±12.83, p=0.023) and pain score remained lower (2.20 ± 1.16 vs 3.77 ±1.54, p<0.001) in the graft group. Disease progression, arthroplasty conversion, and Kaplan-Meier survival showed favorable but non-significant trends for grafting.

Conclusion: Vascularized fibular grafting demonstrated superior early outcomes compared to core decompression in patients with avascular necrosis of the femoral head, particularly in terms of functional recovery and pain relief. Although trends also favored grafting for disease progression and short-term hip survival, these differences did not reach statistical significance within the 6-month follow-up period.

Keywords: Avascular necrosis, core decompression, vascularized fibular graft, survival analysis.

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Introduction:

Avascular necrosis of femoral head, termed as osteonecrosis of femoral head, is a progressive disorder caused by impairment of vascular supply of femoral head, leading to osteocyte death, structural weakening, subchondral collapse and eventual osteoarthritis.[1,2] The condition is of clinical importance because it affects younger and economically active adults, in whom early joint destruction has substantial functional and socioeconomic consequences.[3] Recent evidence indicates that 10000 to 20000 new cases are diagnosed annually and nearly 10% of total hip arthroplasties are performed for this indication.[4] A 2025 epidemiological study further reported that hips osteonecrosis account for 40% of total osteonecrosis burden, with corticosteroid exposure identified as the leading risk factor.[5,6] Other associations include alcohol misuse, trauma, hemoglobinopathies, autoimmune disease and idiopathic disease.[7]

Despite the increasing use of hip preserving procedures, uncertainties remain regarding optimal surgical approach for patients with precollapse or early post collapse disease.[8] Core decompression (CD) remains broadly used because it is less demanding and is intended to reduce intraosseous pressure and improve circulation. But its long-term durability is inconsistent.[9] In an analysis of 49 studies including 2540 hips, Andronic et al. reported that 38% of hips ultimately underwent hip replacement after core decompression, (CD) with a mean time to arthroplasty of 26 months. In contrast, vascularized fibular grafting offers biological revascularization and structural support, which may be advantageous in stage II and III disease.[10] In a recent retrospective study of 54 patients treated with free vascularized fibular grafting (VFG), femoral head survival was 72.2%, mean HSS improved from 46.5 to 86.5 and mean VAS score improved from 8.2 to 1.3.[11,12] Furthermore, a 2023 network meta-analysis of 18 randomized trials found that bone graft based procedures, including vascularized bone grafting and free fibula grafting, delayed radiological progression more effectively than core decompression, although differences in total hip arthroplasty conversion and functional outcomes were less certain because of heterogeneity and limited direct comparisons.[13]

Although both core decompression (CD) and vascularized fibular grafting (VFG) are employed as hip-preserving procedures for avascular necrosis of the femoral head, comparative evidence regarding their relative effectiveness in stage II and III disease remains limited.[14] Most published studies have evaluated these interventions separately, while direct comparative data incorporating functional out-

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comes, pain relief, radiological progression, arthroplasty conversion, and hip survival within a single study are scarce. In view of these gaps, the present study was undertaken to compare outcomes of CD and VFG in patients with avascular necrosis of the femoral head.

Methodology:

This prospective observational comparative study was carried out in Department of Orthopedic Surgery, Shifa International Hospital, Islamabad, from August 2025 to March 2026. Ethical approval was obtained from institutional review board (408-25) and written informed consent was taken from all patients before enrollment. A sample size of 76 was calculated by assuming a femoral head survival rate of 65% in CD group and 89% in VFG group at a 90% confidence interval and 80% power.[15] All eligible patients were divided in to two groups either Group A treatment (Core Decompression, CD) or Group B treatment (Vascularized Fibular Graft, VFG). Six patients in CD group and nine patients in VFG group lost the follow up and excluded from final analysis. Patients aged 18 to 60 years of either gender with radiologically confirmed avascular necrosis of head of femur and ARCO stage II or III disease were considered eligible. Hips with ARCO stage I or IV disease, previous surgery on the affected hip, prior total hip arthroplasty, traumatic osteonecrosis secondary to fracture or dislocation, active infection, advanced degenerative arthritis, neoplastic disease involving the hip or incomplete records were excluded.

Baseline assessment included age, gender, body mass index, side of hip involved, duration of symptoms before surgery and comorbidities. Diagnosis was established on basis of clinical evaluation and imaging. Standard anteroposterior radiographs of pelvis with both hips and lateral views of affected hip were obtained in all cases. MRI was used to confirm diagnosis and stage the lesion accurately when required. Disease severity at presentation was classified according to the ARCO staging system. Functional status was evaluated preoperatively using Harris Hip Score and pain intensity was recorded using the Visual Analog Scale.

Follow-up was performed prospectively at 3 and 6 months after surgery. At each visit, clinical examination, HSS, VAS score and progression of disease were documented. At 6 months, conversion to total hip arthroplasty, hip survival status, time to failure and censoring status were recorded. Failure was defined as conversion to Total Hip Arthroplasty (THA) during follow-up.

Data were analyzed using SPSS v.26. Numerical variables were noted as mean ±SD while grouped variables were presented as number and percentage. Intergroup comparisons were done using the independent-samples t-test for numerical variables and the chi-square test for grouped variables. Hip survival was analyzed by Kaplan-Meier survival analysis with conversion to THA as endpoint and survival distributions were compared by log-rank test. A p-value of ≤ 0.05 was considered significant.

Results:

A total of 61 patients were included in final analysis. The mean age was 34.22 ±7.94 years in core decompression group and 32.69 ± 8.24 years in vascularized fibular graft group (p = 0.464). Baseline preoperative HHS of 62.13 ±10.73 in CD group and 62.07 ±10.73 in VFG group (p = 0.984), while preoperative VAS pain score was 6.50 ±1.02 and 6.31 ±1.35, respectively (p = 0.536) (Table 1).

Table No1: Baseline demographic and clinical characteristics.

Variable	Core decompression (n = 32)	Vascularized fibular graft (n = 29)	p-value
Age (years)	34.22 ± 7.94	32.69 ± 8.24	0.464
Age Group			
18 to 40 years	22 (68.8)	23 (79.3)	0.349
41 to 60 years	10 (31.3)	6 (20.7)	
Body mass index (kg/m²)	25.89 ± 3.39	25.88 ± 3.35	0.986
Duration of symptoms (months)	6.74 ±2.93	7.23 ±3.66	0.567
Gender			
Male	24 (75.0)	21 (72.4)	0.819
Female	8 (25.0)	8 (27.6)	
Side of Hip Involved			
Right	18 (56.3)	16 (55.2)	0.933
Left	14 (43.8)	13 (44.8)	
Diabetes mellitus	8 (25.0)	6 (20.7)	0.689
Hypertension	9 (28.1)	7 (24.1)	0.724
ARCO stage			
II	18 (56.3)	17 (58.6)	0.852
III	14 (43.8)	12 (41.4)	
Preoperative Harris Hip Score	62.13 ± 10.73	62.07 ± 10.73	0.984
Preoperative VAS score	6.50 ± 1.02	6.31 ± 1.35	0.536

At 3-month follow-up, the mean HSS score was 78.69 ±9.69 in VFG group compared with 72.28 ±9.80 in the CD group (p = 0.013). Similarly, the mean VAS pain score was lower in the vascularized fibular graft than in the core decompression, 3.03 ± 1.22 versus 4.38 ± 1.26 (p < 0.001)

Table No 2. Three-month postoperative outcomes according to treatment group.

Variable	Core decompression (n = 32)	Vascularized fibular graft (n = 29)	Test statistic	Mean difference / Odds ratio (95% CI)	p-value
Harris Hip Score	72.28 ±9.80	78.69 ±9.69	t = -2.564	-6.408 (-11.409 to -1.407)	0.013
VAS score	4.38 ±1.26	3.03 ±1.22	t = 4.247	1.351(0.714 to 1.987)	<0.001
Disease progression, n (%)	9 (28.1)	5 (17.2)	χ^2 = 1.019	0.532 (0.155 to 1.828)	0.313

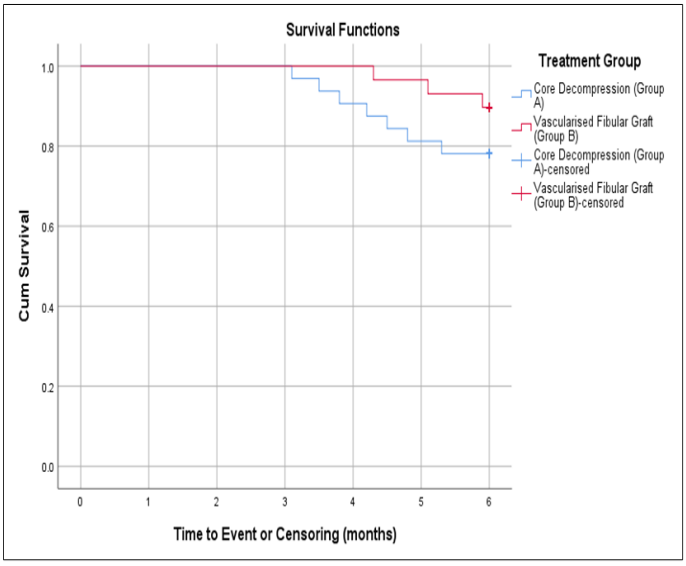
At 6 months, the mean HHS was 81.79 ± 10.41 in the vascularized fibular graft group and 74.75 ± 12.83 in the core decompression group (p = 0.023). Mean VAS pain score was 2.20 ± 1.16 in VFG group and 3.77 ± 1.54 in CD group, (p < 0.001). Disease progression was documented in 34.4% patients in the CD group and 17.2% patients in the VFG group (p = 0.129). Conversion to THA occurred in 21.9% patients (21.9%) in CD group compared with 10.3% patients in VFG group (p = 0.224) (Table 3).

Table 3. Six-month postoperative outcomes according to treatment group.

Variable	Core decompression (n = 32)	Vascularized fibular graft (n = 29)	Test statistic	Mean difference / Odds ratio (95% CI)	p-value
Harris Hip Score	74.75 ±12.83	81.79 ±10.41	t = -2.339	-7.043 (-13.068 to -1.018)	0.023
VAS score	3.77 ±1.54	2.20 ±1.16	t = 4.437	1.566 (0.860 to 2.272)	<0.001
Disease progression, n (%)	11 (34.4)	5 (17.2)	χ^2 = 2.308	0.398 (0.119 to 1.332)	0.129
Conversion to THA, n (%)	7 (21.9)	3 (10.3)	χ^2 = 1.476	0.412 (0.096 to 1.774)	0.224

Kaplan-Meier analysis demonstrated a numerically higher hip preservation rate in the vascularized fibular grafting (VFG) group compared with the core decompression (CD) group (log-rank χ^2 = 1.626, p = 0.202). During follow-up, failure occurred in 21.9% of hips in the CD group and 10.3% in the VFG group. The estimated mean survival time was 5.60 months (95% CI: 5.31–5.89) for CD and 5.91 months (95% CI: 5.78–6.03) for VFG (Fig. 1).

Figure 1: Kaplan-Meier survival curves comparing hip survival between the core decompression and vascularized fibular graft groups.



Discussion:

Avascular necrosis of the femoral head remains a considerable clinical challenge among young and middle-aged patients, where the primary objective of surgical management is to delay or prevent total hip arthroplasty. In the present study, hips managed with vascularized fibular grafting (VFG) attained significantly higher Harris Hip Scores at three months (78.69 vs. 72.28, p = 0.013) and six months (81.79 vs. 74.75, p = 0.023), alongside lower VAS scores at both time points (p < 0.001), compared with core decompression (CD). Radiographic disease progression was observed in 17.2% of hips in the VFG group versus 34.4% in the CD group, while conversion to total hip arthroplasty occurred in 10.3% and 21.9%, respectively; however, neither difference achieved statistical significance. Kaplan-Meier analysis demonstrated a numerically higher hip preservation rate in the VFG group, with an estimated mean survival of 5.91 months compared to 5.60 months for CD (log-rank p = 0.202). “In the present study, the two treatment groups were well matched at baseline. The mean age was 34.22 ± 7.94 years in the core decompression (CD) group and 32.69 ± 8.24 years in the vascularized fibular grafting (VFG) group. Baseline Harris Hip Scores were 62.13 ± 10.73 in CD and 62.07 ± 10.73 in VFG, while baseline Visual Analog Scale (VAS) pain scores were 6.50 ± 1.02 and 6.31 ± 1.35, respectively. The absence of significant differences across demographic and clinical variables supports the comparability of the two groups and allows a more meaningful interpretation of the postoperative differences observed in pain, function, and hip preservation.

The observed functional superiority of vascularized fibular grafting (VFG) in the present study is consistent with existing literature. Cao et al.[16] in a unique within-patient comparison where each individual underwent core decompression (CD) on one hip and VFG on the contralateral side, reported a Harris Hip Score difference of 9 points at six months that widened to 14 points by three years (p < 0.001). The elimination of inter-individual variability in that study strengthens the evidence for the biological advantage of vascularized grafting. Similarly, Yang et al.[17] documented significantly higher Harris Hip Scores in the VFG group (80.30) compared with CD (70.62) at three months (p < 0.001), closely approximating the 6.4-point gap observed in the present study. Ou et al.[18] further corroborated these findings, reporting excellent-to-good outcome rates of 80.64% following VFG compared with 55% after CD alone (p = 0.002). Nevertheless, it is noteworthy that Singh et al.[15] and Shah et al.[19] both demonstrated acceptable functional improvements with CD alone in early-stage disease, with mean Harris Hip Scores improving from 69.45 to 83.55 and from 71.18 to 88.23, respectively. These results suggest that the relative advantage conferred by fibular grafting may be stage-dependent, with greater benefit in intermediate stages where structural support and revascularization are critical.

The significant decrease in VAS scores at three and six months in the fibular graft group aligns with the findings of Yang et al.[17], who documented sustained pain advantages from four weeks through twelve months postoperatively. Ou et al.[18] reported similar results, with postoperative VAS scores of 2.07 in the graft group compared with 2.84 in the decompression group (p = 0.001). The pathophysiological basis for this observation relates to restoration of arterial inflow through the transplanted vascular pedicle, which not only alleviates intraosseous compartment pressure but also addresses the underlying ischemia.[20] This distinction

becomes particularly relevant when compared with the study by Khan et al.[21], which employed a non-vascularized fibular strut graft and found pain outcomes favoring core decompression at 12 weeks (19.6% vs. 30.4% with VAS > 3), though without statistical significance (p = 0.190). The discrepancy between their findings and those of the present study underscores the importance of graft vascularity as a determinant of pain resolution. This point was further emphasized by Aslam et al.[22], who observed that all 42 patients treated with vascularized free fibular grafting achieved substantial pain relief within four to six weeks, with 90.47% ambulatory without support by three to four months.

The non-significant differences in disease progression and arthroplasty conversion observed in the present study warrant cautious interpretation rather than outright dismissal. Ou et al.[18] reported crude failure rates of 16.13% in the graft group versus 25.00% in the decompression group, which were not statistically different (p = 0.225); however, Kaplan-Meier analysis revealed a significant survival advantage favoring grafting (log-rank p = 0.027). Similarly, Cao et al.[16], despite a 36-month follow-up, found no significant difference in arthroplasty conversion (log-rank p = 0.893), though radiological progression was significantly worse in the core decompression group at that time point (p = 0.027). In the present study, numerical trends were consistent with these longer-term data, with disease progression approximately double in the CD group (34.4% vs. 17.2%) and arthroplasty conversion also higher (21.9% vs. 10.3%). Although these differences did not achieve statistical significance within six months, the direction of effect suggests that vascularized fibular grafting may confer a survival advantage that becomes more evident with extended follow-up.

The strengths of this study include its prospective comparative design, use of clearly defined inclusion criteria, baseline comparability between treatment groups, and assessment of clinically relevant outcomes encompassing pain, hip function, radiological progression, arthroplasty conversion, and survival analysis. The study also reflects routine real-world practice in a tertiary care setting, enhancing its clinical relevance. However, several limitations should be acknowledged. The sample size was modest, follow-up was limited to six months, and treatment allocation was not randomized, which may permit residual selection bias. Furthermore, lesion size, lesion location, and etiology-specific subgroup effects were not evaluated, and the short follow-up may have underestimated later structural failure.

Conclusion:

Vascularized fibular grafting (VFG) demonstrated superior short-term clinical outcomes compared with core decompression (CD) in patients with ARCO stage II and III avascular necrosis of the femoral head. Patients treated with VFG achieved significantly higher Harris Hip Scores and lower VAS pain scores at both three and six months. Although radiological disease progression, conversion to total hip arthroplasty, and Kaplan-Meier hip survival also favored VFG, these differences did not reach statistical significance within the six-month follow-up period. Overall, VFG appears to be a more effective hip-preserving option than CD, particularly for improving early function and pain relief.

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Sohail Hafeez	Critical appraisal, Literature review, writing analysis
Asghar Ali	Results analysis, writing discussion, final proof read
Syed Talha Tariq	Data collection, data interpretation, revision
Ammara Khalil	Data collection, data interpretation, final approval
Hafiz Usman Jameel	Data collection, analysis, final approval