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Long-Term Results in the Treatment of Avascular Necrosis of Femoral Head with Free Vascularized Fibular Graft

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ABSTRACT

Objective: to evaluate outcomes of vascularized fibula flap used for Avascular necrosis of femoral head. Outcomes were recorded by post-operative Harris hip and radiological improvement of the femoral head.
Study Design: Retrospective longitudinal study.
Place and Duration of Study: Department of Plastic Surgery, Shifa International Hospital, Islamabad Pakistan, from Jan 2019 to Jan 2020.
Methodology: Cases were recruited from 2005-2018 (SIH) performed by the same Orthopaedic and Plastic Surgeon. Data from 30 patients was reviewed. Ethical approval and consent of the patient were taken before the utilization of their data.
Results: A total of 30 patients were included, comprising 27(90%) males and 3(10%) females. The mean age was 28.3± years. Pre-operative Harris Hip scores were fair in 17(56.7%) and poor in 13(43.3%) patients. Post operatively these scores improved and were noted to be excellent in 10(33.3%), good in 18(60%) and fair in 2(6,7%) patients. Radiological improvement was seen in 20(80%) patients, 8(23.3%) showed no change and 2(6.7%) went into progression. The radiological improvement was significantly associated with aetiology (p=0.004) and Avascular necrosis of HIP (p=0.007).
Conclusion: A vascularized fibular graft is an effective treatment option for avascular necrosis of the femoral head in terms of improved radiological outcomes and post-operative Harris Hip scores.

Keywords: Avascular femoral head necrosis, Harris hip scores and vascularized fibular graft.

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INTRODUCTION

Femoral head avascular necrosis accounts for over 10,000 new cases annually in the United States.[1] A type of osteonecrosis that results in proximal femur blood supply disruption. The incidence of femoral head avascular necrosis is 1.9/100000 individuals in Japan and India.[2] Avascular necrosis (AVN) of femoral head pathophysiology is multifactorial. During this necrosis, bone marrow and osteocyte death is due to inadequate blood supply to the proximal femur subchondral bone.[3] Cell death is associated with femoral head collapse and relevant osteoarthritis. Management of femoral head avascular necrosis involves lifestyle modifications and surgical treatment. Lifestyle modifications include alcohol cessation, pain control medications, cessation of steroid therapy, restricted weight bearing, physical therapy and pharmacological therapy.[4,5]

Free vascularized fibular grafting (VFG) is a joint-preserving surgical procedure with a midterm survival rate of 61 to 96% for 4-7 years.[6] One study reported that the survival rate of vascularized fibular graft is 67.4% for two years and 64.5% for five years in patients with femoral head osteonecrosis.[7]Another study reported that vascularized fibular graft results in better clinical results and is more effective for preventing femoral head collapse with larger osteonecrotic lesions and Steinberg stage IIC.[8]

Joint replacement, including total hip replacement, is a good option in older age groups with collapsed hip joint. Several studies discussed short and midterm results of fibular graft. However, more than data available on the long-term efficacy of graft is needed to reach any conclusion.[9,10] In Pakistan, limited work has been done on the prevalence population and the efficacy of radiology in terms of hip scores pre-and postoperatively. Therefore, the present study aims to determine the frequency of radiological improvement on x-rays and Harris Hip scores used pre- and postoperatively.

METHODOLOGY

The retrospective longitudinal study was conducted at the Department of Plastic Surgery at Shifa International Hospital, Islamabad Pakistan from January 2019-January 2020. Ethical approval was

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obtained from IERB (Ref # 295-785-2019), and consent was obtained from patients before using their data.

Inclusion Criteria: Patients aged >16-40 years, of either gender, diagnosed with femoral head avascular necrosis, Steinberg Classification I-III, AVN Hip and patients treated with free vascularized fibular graft, were included.

Exclusion Criteria: Patients with previous hip replacement surgeries, collapsed joints, severe steroid dependency and serious co-morbidities were excluded.

In this study, 30 patients were recruited, and surgeries were performed by the same Orthopaedic & Plastic Surgeon over 15 years. All patients had joint preservation surgeries with the vascularized fibula.

The mean follow-up period was five years, ranging from 3-10 years. Follow-ups were done through radiographs and clinical evaluation at least after six months and then yearly. Radiographic images were advised yearly for a minimum of 3 years and then, depending on the follow-up of the patients, after that as needed. Hospital records were looked at for information like age, gender, and aetiology. Post-operative Harris Hip scores and radiological improvement outcomes were analyzed and recorded. Post-surgical complications like wound infection, fracture, flap survival and Conversion to total hip replacement were assessed. Each patient had free vascularized fibular grafting for the unilateral hip, even in those cases where the disease was bilateral. In bilateral disease, we have reconstructed one side of the fibula as those patients are living a good quality of life so far.

A thorough clinical examination was done and rated using Harris hip scores in all patients. The Harris hip score was a tool applied for clinical evaluation and outcomes graded as excellent, good, fair and poor, each with its designated points.HARRIS Hip Score (100 points) has four components, i.e.,Pain 1 item (0-44),Function 7 item (0-47), Absence of deformity1 item (4 points) and Range of motion items (5 points).[11]

Pre-operative radiological scans (X-ray hip/ MRI) were done to stage the disease by Steinberg classification.[12]

These patients were radiologically assessed for the progression or regression of the lesion and changes in the contour of the femoral head by the radiologist and categorized as follows: 1) Improved: Cases which showed signs of new healing (new bone formation), crescent disappeared, the cystic lesion had trabecular formation at the end of vascularized fibular graft and subchondral collapse region looked more rounded on x-rays 2) No change: post-operative films were compared with pre-operative x-rays 3) Progression: Diseased progression to next Stage of Steinberg with > 3mm collapse.[13]

All procedures received general anaesthesia in the supine position. Harvesting of the vascularized fibula was done from the ipsilateral leg (lateral approach). A lateral approach (proximal thigh) was used for exposure of the proximal part of the femur from tensor fascia lata and vastus lateralis. A guided pin was introduced from the sub-trochanteric region to the necrotic lesion in the femoral head under fluoroscopic control. Reamers of size ranging from 8-19 cm in diameter were used for tunnel creation. Necrotic to subchondral bone was curetted using a high-speed burr under fluoroscopic image control. The average length of the harvested fibula usually ranged from 8 to 10 cm. A fibular graft was placed in the defect and recipient vessel, i.e., the descending branch of the lateral circumflex iliac artery, was identified, ligated distally and retrieved from the proximal thigh wound for anastomosis with peroneal vessels. Vascularization of the graft was confirmed through fibular graft bleeding from the proximal end. A posterior below-the-knee cast was done in all patients for at least two weeks. Post-operative thromboembolic prophylaxis was given, and the pedicle was monitored on Doppler throughout the hospital stay. Rehabilitation was guided by the orthopaedic team, who advised complete no weight bearing for one week, minimal weight bearing and ambulation with crutches for ten weeks, followed by partial weight bearing for the next six months and encouraged to bear full weight bearing after this period.

Statistical Package for Social Sciences (SPSS) version 24.0 was used for the data analysis. Quantitative variables were expressed as Mean±SD and qualitative variables were expressed as frequency and percentages. Chi-square test was applied to explore the inferential statistics. The *p*-value of ≤0.05 was set as the cut-off value for significance.

RESULTS

A total of 30 patients were included; among them, there were 27(90%) males and 3(10%) females. The mean age was 28.3±5.1 years. Patients' avascular necrosis of the femoral head was Stage by Steinberg classification and included 6(20%) in Stage 1, 13(43.3%) in Stage 2, and 11(36.7%) in Stage 3. Hip involvement was 24(80%) in unilateral and 6(20%) in bilateral.

Complications in terms of infection were superficial infections 4(13.3%), fracture 2(6.7%), Conversion to Total hip replacement within 5-10 years 3(10%) and after ten years 5(16.7%).

Pre-operative Harris Hip scores were fair in 17(56.7%) and poor in 13(43.3%) patients, while post-operatively, these scores were excellent in 10(33.3%), good in 18(60%) and fair in 2(6.7%). The majority of males showed good post-operative Harris Hip scores as compared to females. Patients with unilateral AVN HIP showed good post-operative Harris Hip scores compared to bilateral AVN HIP (p=0.001). Aetiology was also significantly associated with post-operative Harris Hip scores (p=0.002). However, Steinberg classification (p=0.819) and fracture (p=0.075) showed insignificant association with post-operative Harris Hip Scores, as shown in Table-I.

Table-I: Association between Post-operative Harris Hip scores and Study variables (n=30)

Variables	Post Operative Harris Hip Scores			*p*-value
	Excellent (90-100 Scores)	Good (80-89 Scores)	Fair (70-79 Scores)	
Gender				
Males Female	8(26.7%) 2(6.7%)	17(56.7%) 1(3.3%)	2(6.7%)	<0.001
Steinberg classification				
Type 1 Type 2 Type 3	4(13.3%) 3(10%) 3(10%)	2(6.7%) 9(30%) 7(23.3%)	1(3.3%) 1(3.3%)	0.819
Aetiology Idiopathic Steroid Induced				
Post traumatic Alcoholic	6(20%) 2(6.7%) 2.(6.7%)	10(33.3%) 2(6.7%) 6(20%)	1(3.3%) 1(3.3%)	0.002
Avascular Necrosis of				
Unilateral Bilateral	9(30%) 1(3.3.%)	15(53.3%) 4(13.3.%)	1(3.3.%)	0.876

Radiological improvement was seen in 20(80%) patients, 8(23.3%) showed no change and 2(6.7%) went into progression. Among all the patients who showed radiological improvement, 12(40%) had idiopathic aetiology, while 8(26.7%) had post-traumatic aetiology. Similarly, among all those with no change in radiology, 4(13.3%) showed steroid-induced aetiology, while 4(13.3%) showed idiopathic aetiology. Among all those with progression, 1(3.3%) showed alcohol induced, 1(3.3%) steroid induced etiology (p=0.004) as shown in Table-II. Figure 1 and 2 show cases with their pre-operative and post-operative findings.

Table-II: Association between Radiological Improvement and Study Variables (n=30)

Variables	Radiological Improvement at 5th Year			*p*-value
	Improved	No Change	Progression	
Gender				
Males Females	17(56.7%) 3(10.0%)	8(26.7%)	2(6.7%)	0.111
Steinberg classification				
Type 1 Type 2 Type 3	5(16.7%) 10(33.3%) 5(16.7%)	1(3.3%) 3(10.0%) 4(13.3%)	2(6.7%)	0.944
Etiology Idiopathic Steroid induced Post				
Traumatic Alcohol	12(40%) 8(26.7%)	4(13.3%) 4(13.3%) 0(0%)	0(0%) 1(3.3%) 1(3.3%)	0.004
Avascular Necrosis of Hip				
Unilateral Bilateral	17(56.7%) 4(13.3%)	7(23.3%) 1(3.3%)	1(3.3%)	0.01

Figure-1: 1-a) Right Hip of a twenty-one-year-old man who had Stage 2 diseases showing AP radiograph of the right hip, 1-b): The joint space was preserved and the patient remained asymptomatic for eight years after the reconstruction, 1-c): Post op Harris hip score which showed improved range of motion with no pain (flexion)

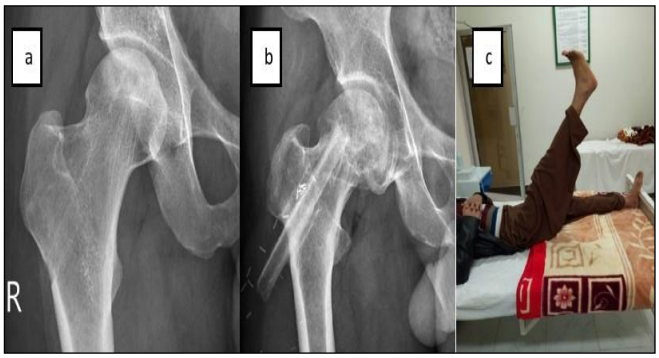

Figure-2: 2a) Anteroposterior radiographs of the right hip of a twenty-one-year-old man who had stage-2 disease. 2b) Post-operative radiograph obtained at 3 years showsed adequate placement of the fibular graft. 2c) A radiograph taken 7 years after the operation showing no progression of the disease. 2-d) The joint space was preserved and the patient remains asymptomatic 8 years after the reconstruction

DISCUSSION

The procedure is familiar, but utilizing the free vascularized fibular grafting (FVFG) technique in our country is only done by a single plastic surgeon with a long-term result.[12] In this study, we presented our experience in treatment with FVFG in a pre-collapse stage, which symptomatically improved the pain and delayed the conversion or replacement of the hip joint. Osteonecrosis or bone infarction of the femoral head most commonly affects younger adults.[13]

In our study, 33.3% of patients showed excellent and 60% good post-operative Harris Hip scores. These scores were improved compared to their pre-surgical x-rays (p=0.819). Cases with Stage I average hip score improved from 72-92, Stage II improved from 69-85, and Stage III from 41-82 points. However, Yoo *et al*. reported that patients showed 17% good, 7% showed fair and 2% showed poor outcomes. However, 71% were improved radiographically, and 11% showed worse radiographic results.[12]

In this study, idiopathic and post-traumatic aetiology showed more improvement with radiology (p=0.004). Berend *et al*. reported that a statistical difference was found in treatment outcomes.[14] Weinstein et al. reported the cell death of osteocytes in the femoral head of patients with steroid-induced osteonecrosis of the hip.[15] Similarly, another study reported that patients with alcohol-related osteonecrosis and idiopathic hip aetiology are more likely to have poor prognoses than corticosteroid-induced osteonecrosis. Unal *et al*. reported findings similar to our study; they reported that clinical scores and outcomes were worse in steroid-induced osteonecrosis as compared to other etiologies. The radiological improvement showed an insignificant association with Steinberg's classification.[16]

In the present study, conversion to total hip replacement >10 years was in 16.7% of patients and 5-10 years was in 6.7% of patients. Sotereanos *et a*l. reported that 30% of patients had a high probability of total hip replacement after fibular vascular grafting of the femoral head.[17] Similar studies reported that 44% of patients underwent total hip replacement due to two negative factors, including alcohol use and steroid induction therapy.[18,19]

Our results show that free fibula graft yields extremely good results in pre-collapse stages of the disease with long-term results. Age, Stage of osteonecrosis and aetiology have all been proposed as factors influencing the outcome of vascularized fibula graft. Therefore, it is the most recommended joint preserving procedure with a reliable outcome and effective in young patients.

LIMITATIONS OF STUDY

The study was limited because of the sample size, single-centre study, lack of awareness regarding surgical management among different specialities, and lack of referral.

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CONCLUSION

Free vascularized fibula graft is a salvaging procedure, especially in younger patients with AVN femoral head pre-collapsed. It is also very effective in terms of radiological and Harris hip score. In post-collapse osteonecrosis, the procedure delays the need for total hip arthroplasty in most patients.

Conflic of Interest: None.

Authors Contribution

Following authors have made substantial contributions to the manuscript as under:

NB & MR: Concept, data acquisition, approval of the final version to be published.

SH & SR: Data acquisition, data analysis, critical review, approval of the final version to be published.

HR & SM: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

REFERENCES

1. Urbaniak JR, Coogan PG, Gunneson EB, Nunley JA. Treatment of osteonecrosis of the femoral head with FVFG. A long-term follow-up study of one hundred and three hips. J Bone Joint Surg Am 2018; 77(3): 681–694. https://doi.org/10.2106/00004623-199505000-00004.
2. Moya-Angeler J, Gianakos AL, Villa JC, Ni A, Lane JM. Current concepts on osteonecrosis of the femoral head. World J Orthop 2016; 6(8): 590–601. https://doi.org/10.5312%2Fwjo.v6.i8.590.
3. Zhang Y, Li L, Shi ZJ, Wang J, Li ZH. Porous tantalum rod implant is an effective and safe choice for early-stage femoral head necrosis: a meta-analysis of clinical trials. Eur J Orthop Surg Traumatol 2017; 23(2): 211–217. https://doi.org/10.1007/s00590-012-0962-7.
4. Berend KJ, Roper JG, Wang JC. Demineralized bone matrix and spinal arthrodesis. Spine J 2018; 5(6): 217–223. https://doi.org/10.1016/j.spinee.2005.02.006.
5. Kim SB, Kock NB, Dijkstra PD, Taminiau AH, Nelissen RG. Treatment of avascular necrosis of the hip by a non-vascularised cortical graft. J Bone Joint Surg Br 2019; 88(4): 460–466. https://doi.org/10.1302/0301-620x.88b4.16950.

6. Ali AS, Christy MJ, Griesser JM, Awan H, Pan X, Ellis JT, et al. Treatment of avascular necrosis of the femoral head utilising free vascularised fibular graft: a systematic review. Hip Int 2014; 24(1): 5-13. https://doi.org/10.5301/hipint.5000076.
7. Zhao DW, Yu M, Hu K, Wang W, Yang L, Wang BJ, et al. Prevalence of Nontraumatic Osteonecrosis of the Femoral Head and its Associated Risk Factors in the Chinese Population: Results from a Nationally Representative Survey. Chin Med J (Engl) 2015; 128(21): 2843-2850. https://doi.org/10.4103/0366-6999.168017
8. Vardhan H, Tripathy SK, Sen RK, Aggarwal S, Goyal T. Epidemiological Profile of Femoral Head Osteonecrosis in the North Indian Population. Indian J Orthop 2018; 52(2): 140-146. https://doi.org/10.4103%2Fortho.IJOrtho_292_16.
9. Zalavras CG, Lieberman JR. Osteonecrosis of the femoral head: evaluation and treatment. J Am Acad Orthop Surg 2016; 22(7): 455–464. https://doi.org/10.5435/jaaos-22-07-455.
10. Nally FJ, Zanotti G, Buttaro MA, Dilernia FD, Mansilla IG, Comba FM, et al. THAconversion rate comparing decompression alone, with autologous bone graftor stem cells in osteonecrosis. Hip Int 2018; 28(2): 189-189. https://doi.org/10.5301/hipint.5000552.
11. Wei BF, Ge XH. Treatment of osteonecrosis of the femoral head with core decompression and bone grafting. Hip Int 2011; 21(2): 206-210. https://doi.org/10.5301/hip.2011.6525.
12. Yoo MC, Kim KI, Hahn CS, Parvizi J. Long-term follow-up of vascularized fibular grafting for femoral head necrosis. Clin Orthop Relat Res 2018; 466(5): 1133–1140. https://doi.org/10.1007%2Fs11999-008-0204-9.
13. Kawate K, Yajima H, Sugimoto K. Indications for FVFG for the treatment of osteonecrosis of the femoral head. BMC Musculoskelet Disord 2017; 8(3): 78-79. http://doi.org/10.1186/1471-2474-8-78.
14. Berend KR, Gunneson EE, Urbaniak JR. FVFG for the treatment of postcollapse osteonecrosis of the femoral head. J Bone Joint Surg Am 2017; 8(6):987–993.
15. Weinstein RS, Nicholas RW, Manolagas SC. Apoptosis of osteocytes in glucocorticoid-induced osteonecrosis of the hip. J Clin Endocrinol Metab 2000; 85(1): 2907-2912. http://doi.org/10.1210/jc.85.8.2907.
16. Ünal BM, CansuE, Parmaksızoğlu F, Cift H, Gürcan S. Treatment of osteonecrosis of the femoral head with free vascularized fibular grafting: Results of 7.6-year follow-up. Acta Orthop Traumatol Turc 2016; 50(5): 501–506. https://doi.org/10.1016%2Fj.aott.2016.01.001.
17. Sotereanos DG, Plakseychuk AY, Rubash HE. Free vascularized fibula grafting for the treatment of osteonecrosis of the femoral head. Clin Orthop 2017; 34(4):243–256.
18. Jaffré C, Rochefort GY. Alcohol-induced osteonecrosis--dose and duration effects. Int J Exp Pathol 2012; 93(1): 78-79. https://doi.org/10.1111/j.1365-2613.2011.00798_1.x.
19. Meyers MH. The surgical treatment of osteonecrosis of the femoral head withan osteochondral allograft. Acta Orthop Belg 1999; 65(Suppl 1): 66e7.