BENEFITS AND SURVIVAL OF VASCULARIZED FIBULAR GRAFT IN YOUNG POPULATION WITH AVASCULAR NECROSIS HIP

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ABSTRACT

Objective: To highlight the benefits and long term survival of vascularized free fibular graft in the management of avascular necrosis of femoral head and substantiate the fact that it is the best operative treatment modality in younger patients with Ficat Stage III or below.

Study Design: A retrospective study.

Place and Duration of Study: A retrospective study was carried out at the department of burns and plastic surgery, CMH Rawalpindi from Apr 2009 till Apr 2016.

Material and Methods: The study was conducted at department of burns and plastic surgery, CMH Rawalpindi. A total of 42 patients of both sexes with various stages of avascular necrosis of hip mostly Ficat stage II and III disease were operated upon with vascularized free fibular graft over a period of 7 years from Apr 2009 till Apr 2016. The patients were diagnosed on the basis of plain radiography and MRI in all the cases. All the free fibular flaps were performed by the same surgeon, using the same technique in all cases. All patients under went three monthly follow up, serial radiographs, bone scan at three months and post OP MRI at one year. The follow up period ranged from 8 months to 6 years.

Results: All patients had significant pain relief at 4 to 6 weeks post operatively and could walk, sit and stand without support at three months. All flaps survived completely, confirmed by well vascularized femoral head and neck showing increased activity on bone scan. Repeat MRI scan at 1 year showed halting of disease progression and some improvement in internal architecture of the femoral head. In none of the case repeat surgery in the form of hip arthroplasty was required.

Conclusion: Vascularized fibular graft can be termed as the gold standard for the management of AVN hip in younger patients with Ficat I to III disease. The biggest benefit being early pain relief, improved quality of life and prevention of need for early hip arthroplasty in these young patients.

Keywords: AVN hip, Aseptic necrosis, Free micro-vascular tissue transfer, Infarction, Ischemic bone necrosis, Pain hip, Osteonecrosis, Vascularized fibula.

INTRODUCTION

Avascular necrosis (AVN), also called osteonecrosis, aseptic necrosis or ischemic bone necrosis, is a very painful and challenging condition that occurs when there is loss of blood to the bone. This disruption causes bone to die. If not stopped, this process eventually causes the bone to collapse. Osteonecrosis of the femoral head was first described in 1738 by Munro. In approximately 1835, Cruveilhier depicted femoral head morphologic changes secondary to interruption of blood flow[1]. Since 1962, when Mankin described 27 cases of AVN, the number of reported AVN cases has increased steadily. AVN of the femoral head is not a very uncommon condition presenting with severe pain in hip joint. So much so that it may severely affect the mobility of the individual and also be the cause of significant physical, social and Psychological disruption. AVN hip may develop in 20% or more of people who dislocate a hip. As many as 20,000 people develop AVN each year. Most are in their twenties. Femoral head has a very large portion of its total surface covered with articular cartilage through which vessels do not penetrate and blood flows to this bone through very restricted spaces, and there is

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limited collateral Circulation. When principal route of the circulation to this bone is interrupted by trauma or disease, the collateral circulation is inadequate and infarction / necrosis ensues. In this infarcted area, there is death of marrow elements & of osteocytes. As vessels approach necrotic area, osteoclastic resorption of dead bone may so weaken the femoral head that a portion of it will collapse, resulting in an irregular articular surface that sets the stage for painful degenerative arthritis[2].

There are multiple causes of AVN hip. Idiopathic and trauma being the most frequent causative factors[3]. Alcoholism though a major contributor is not a cause in our country. Injudicious and prolonged use of steroids however is a significant contributor in our setting[2,3].

The most frequent presentation of this disease is pain in the hip joint. The intensity of pain is very variable. During early stages pain is on weight bearing and prolonged standing. But at later stages this may even be present at rest lying in bed. The diagnostic tools used to clinch the diagnosis in a painful hip are, plain x-ray of the hip joint, CT scan or MRI and to some extent Bone scan. Multiple studies have demonstrated that MRI is the most accurate of all imaging modalities. MRI can also show the re-vascularization front and gives objective evidence of tissue changes in response to treatment allowing sequential evaluation of AVN lesions on follow-up. On the basis of radiological finding number of classifications have been devised but we in our institution follow the "Ficat stages of bone necrosis". The management and outcome of treatment depends upon the stage of the disease. The best time is to treat the disease in pre collapse stage. In our setup the patients are diagnosed, staged and prepared for surgery by the orthopedic surgeon.

The rationale of the present study was to identify the benefits and long term survivability of vascularized free fibular graft in the management of avascular necrosis of femoral head.

MATERIAL AND METHODS

A retrospective study was carried out at the Department of Burns and Plastic Surgery, CMH Rawalpindi. A total of 42 patients were operated upon for AVN Hip with vascularized fibular bone graft over a period of 7 years from Apr 2009 till Apr 2016. All young patients with Ficat stage I to III disease operated upon were included in the study irrespective of gender. Older patients and those with Ficat stage IV osteoarthritic hips were not considered fit for this procedure and were offered hip arthroplasty instead (table). Pain was the predominant presenting complaint in all. Majority seek treatment due to difficulty in coping up with day to day life activity. Base line investigations were carried out in all.

Plain radiographs and MRI were carried out in all cases. Preoperative Bone scan was done in 13 cases only.

A two team approach was used. Reaming was done by our orthopedic colleagues. Greater

Table: Ficat Classification of avascular necrosis of femoral head.

Stage	Clinical Features	Radiographs
Early		
0 Preclinical	0	0
I Preradiographic	+	0
II Precollapse	+	Diffuse Porosis, Sclerosis, Cysts
Transition:		Flattening, Cresent Sign
III Collapse	++	Broken Contour of Head Certain Sequestrum, Joint Space Normal
IV Osteoarthritis	+++	Flattened Contour Decreased Joint Space

trochanter was exposed and under image control the neck and head of femur were sequentially reamed to approx. size 13 to 15 reamer, taking care not to perforate the cortex of the femoral head and include the subchondral ischaemic part. Simultaneously from the contralateral leg a fibular segment approx. 9 to 11 cm was dissected out. An 8 cm distal segment of fibula was left intact so as not to compromise the integrity and stability of ankle joint. A 6 to 8 cm segment of proximal fibula was also included in initial osteotomy and was later discarded to gain at least 8 to 10 centimeter pedicle length comprising of peroneal vessels. Once the bone was harvested and good vascularity was confirmed with release of tourniquet. The operative team shifted to recipient site where a branch of lateral circumflex femoral artery usually the descending branch was isolated and prepared for micro anastomosis. Heparin (5000 i.u) was given IV to the patient and the pedicle was divided. The depth and caliber of cavity was assessed and compared to fibular diameter. Further reaming was done if required so as to allow easy snug fitting of fibula into the recipient cavity. After the graft was fitted in to the reamed cavity the microvascular anastomosis was carried out. One artery and two veins are anastamosed in each case. Once the good vascularity of graft was confirmed by medullary and periosteal bleed both thigh and leg wounds are closed primarily with suction drains inserted. Post operatively patient was kept in intensive care unit for 48 hours. Heparinized for 3 to 5 days and was then switched to oral anti platelet drug (tab dispirin 150 mg x OD) for additional 10 days. Plain radiograph was taken to confirm the position of the graft. Patient was allowed non weight bearing ambulation from day 15 onwards on crutches. Partial weight bearing was started after 6 weeks and gradually allowed full weight bearing by 3 months.

Patients were followed up monthly for 3 months and then three monthly with clinical examination and plain radiographs. Bone scan was performed at 3 months after surgery to confirm the vascularity of the grafted fibula and changes in vascularity of the femoral head. MRI hip was repeated at 1 year postoperatively in all the cases. The data were analyzed using SPSS 13 on the basis of parameters like objective symptomatic improvement in hip pain, range of pain free ambulation, radiological, bone scan and MRI changes compared with preoperative scans and any complications at operative or donor site.

RESULTS

Total patients who underwent vascularized fibular grafting in this study were forty two. The average age of the patients was 27.5 years, ranging from 23 years to 42 years. There were 5 (12%) females and 37 (88%) males. A relevant history of trauma could be confirmed in 6 (14%) patients only. Ten (24%) had prolonged history of steroid usage. None was alcoholic. This proves that the predominant etiology in our patients is idiopathic 26 (62%). All the patients presented in orthopedic clinic where requisite diagnosis was confirmed on plain radiographs and MRI in all the cases. Preoperative Bone scan was done in only 13 (31%) cases. All the patients were staged on the basis of Ficat classification. 30 (71.42%) of 42 were Ficat stage II and rest 12 (28.57%) were Ficat stage III. All patients made smooth postoperative recovery. The most striking benefit seen was relief from the preoperative pain for which they underwent surgery. Monthly follow was done for 3months, followed by 3 monthly visits. Bone scan was performed in all cases at 3 months. All cases had viable well vascularized fibular graft with significantly increased vascularity in the head and neck area of femur on the operated side. Almost 38 (90.47%) of 42 patients were freely ambulating by 3 to 4 months without any support, 4 (9.52%) patients needed some form of support like one crutch or a walking stick. These were the patients who had advanced disease with some degree of collapse of the head at the outset. The patients were then followed up 3 monthly. The pain relief persisted throughout the follow up period max upto 6 years as long as the study permitted. A repeat MRI scan was done in all the cases at 1 year

which on comparison with previous MRI showed cessation of disease progression, improved vascularity of the bone and integrity of the internal bony architecture. Twenty one (50%) out of 42 patients had their follow up for more than 3 years. Nine of 21 were followed up upto 6 years. All were noticeably pain free, ambulating and performing their daily activities without any difficulty. None of the patients at the end of the study needed any type of repeat surgery for the affected hip. Only two patients had temporary neuropraxia of peroneal nerve which recovered in 3 to 4 months. One patient had wound infection at donor site which was successfully treated with antibiotics and dressings (figure).

DISCUSSION

It is well proven that in avascular necrosis of femoral head, early diagnosis and treatment is the only way to halt disease progression and avoid the disastrous collapse and secondary osteo- arthritis of femoral head. The ideal time to intervene is in pre-collapse stage[4,8]. There is no one particular treatment option that may be labeled as gold standard for all the patients. Review of literature proves that a wide variety of methods of treatment of this debilitating disease has been tried over the past century with very variable results. The various options for treating this debilitating disease[9-11]. There are a wide variety of options for the treatment of avascular necrosis of the hip in the young patients. The conservative method of management is taking off the weight from femoral head by reducing mobility and use of crutches to take the weight off the bone. Over the last century, various methods of treatment ranging from non-operative to various operative techniques have been tried. Treatment options include joint preserving procedures such as electrical stimulation[12], drilling, core decompression[13], mesenchymal cell grafting[14], marrow transplant[15], morphogenetic proteins infusion[16], hyperbaric oxygen[17], cancellous or cortical bone grafting[18], various types of osteotomies, vascularized or non-vascularized fibular grafting and joint replacement procedures such as resurfacing and hemi- or total hip arthroplasty[19]. Yoo and Kim et al[20] in their study of 110 cases showed survival of graft and prevention of hip arthroplasty in 92% cases at 10 years and 83% at 20 years. Yoo et al and Urbaniak et al[21] also found better graft survival in patients aged 35 years and younger.

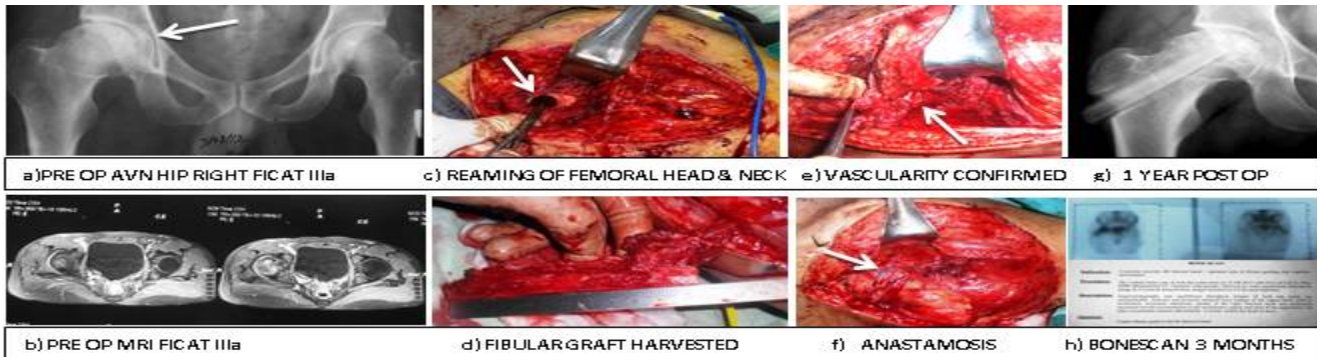

Figure: a) Pre op AVN hip right Ficat IIIa. b) Pre op MRI Ficat IIIa. c) Reaming of femoral head & neck. d) Fibular graft harvested. e) Vascularity confirmed. f) Anastamosis. g) Radiograph 1 year post op. h) Bonescan 3 months postop.

In comparison to that in our study with medium term follow-up up to 6 years, 100% graft survival with avoidance of hip arthroplasty was seen. One of the contributing factors could be that the average age of patients in our study was 27.5 years.

Reports on core decompression, osteotomies, electrical stimulation, and cancellous or cortical bone grafting have all failed to give consistent and significant disease modification or preventing progression[11,13,17]. The results are also difficult to interpret because there are very few

prospective controlled studies in the literature. There are only two methods which have given consistent and significant pain relief and slowing or stopping the disease progression.

Vascularized bone grafting has proven to be the best available technique to treat this condition with major benefits in young people[2,3,18]. Although partial or more so total hip replacement is the best option for this disease in older patients[9]. In younger patients due to the higher incidence of complications of bone cement and lack of resilience to wear and tear of metallic alloys, repeated joint replacements is not a viable option. In younger age group vascularized microvascular free fibular graft is the best option. The advantages of this procedure in younger patients include lesser morbidity of the donor site, it does not preclude the later conversion to a total hip arthroplasty rather hip arthroplasty is easier than after hip osteotomies. As compared to total hip replacement there is far less chances of infection. When the procedure is performed before collapse there is a chance that the graft will remain viable for the life of the patient. Yoo and Kim et al[12] in their study of 110 cases showed survival of graft and prevention of hip arthroplasty in 92% cases at 10 years and 83% at 20 years. Yoo et al[12] and Urbaniak et al[19] also found better graft survival in patients aged 35 years and younger. In comparison to that in our study with medium term followup up to 6 years, 100% graft survival with avoidance of hip arthroplasty was seen. One of the contributing factor could be that the mean age of patients in our study was 27.5 years. The graft, theoretically, treats many of the ongoing processes of osteonecrosis. It decompresses the femoral head, reduces intra osseous pressure[22]. Removal of necrotic bone which can inhibit healing and replacement with cortico-cancellous bone which has osteoinductive and conductive factors[23]. It is also agreed that the graft does have a longer rehabilitation time and does not afford as complete pain relief as a total hip arthroplasty. Also the operative time for vascularized fibula is almost 2 times more than a standard hip arthroplasty[24]. The lifelong benefit of having a single procedure and hip arthroplasty still possible at any later stage undoubtedly makes this procedure the preferred technique in early AVN of hip[5]. There is a recent renewed interest in the treatment of osteonecrosis with bone marrow and fat derived stem cells but the results cannot be substantiated before long term follow up[4,10].

CONCLUSION

Vascularized bone grafting for AVN hip is undoubtedly the gold standard in younger age group with Ficat I to III stages. There are several unique benefits, namely its ability to preserve the native hip in young patients for long time, early pain relief and improved quality of life.

In addition, there are no bridges burned should this procedure fail because hip arthroplasty can be performed at any stage without any added difficulty. There is strong possibility to return to full-time activity in heavy work or athletics, more so if the operation is done in pre collapse stage. The biggest disadvantage is need of prolonged protective weight bearing approximately 3 to 4 months if operated in pre collapse stage, and 6 months if preoperative collapse was present.

CONFLICT OF INTEREST

This study has no conflict of interest to declare by any author.

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