



QUADRATUS FEMORIS MUSCLE PEDICLE GRAFTING (MEYERS PROCEDURE) AS A SALVAGE PROCEDURE IN AVASCULAR NECROSIS OF FEMORAL HEAD

Dr. Sanjay V. Popere	M.S. Orthopaedics, Associate Professor, Department of Orthopaedics, Rajiv Gandhi Medical College, Thane, India.
Dr. Mohit R. Shete	DNB Orthopaedics, Assistant Professor, Department of Orthopaedics, Rajiv Gandhi Medical College, Thane, India.
Dr. Abhay Kulkarni	M.S. Orthopaedics, Head of Department of Orthopaedics, Rajiv Gandhi Medical College, Thane, India.
Dr. Siddharth S. Vakil*	M.S. Orthopaedics, Senior Resident, Department of Orthopaedics, Rajiv Gandhi Medical College, Thane, India. *Corresponding Author
Dr. Tejas S. Tribhuwan	M.S. Orthopaedics, Senior Resident, Department of Orthopaedics, Rajiv Gandhi Medical College, Thane, India.
Dr. Rakesh S. Patel	Diploma in Orthopaedics , F.C.P.S. Orthopaedics, Junior Resident, Department of Orthopaedics, Rajiv Gandhi Medical College, Thane, India.

ABSTRACT

Introduction: There are various management modalities in avascular necrosis of femoral head. If progresses to secondary arthritis total hip arthroplasty may be necessary. We objectively aimed to study the radiological and functional outcomes in young patients who underwent quadratus muscle pedicle grafting in stage 1, stage 2, stage 3 according to Ficat Arlet as a salvage procedure in order to Avoid Total Hip arthroplasty. **Methodology:** Our prospective sample was chosen from a pool of patients visiting our Hospital for hip pain between March 2012 and March 2020. Patients underwent quadratus femoris muscle pedicle grafting fixation with a 3.5 mm partially threaded cancellous crew. Intraoperative parameters and postoperative functional outcomes over a period of 60 months. **Results:** During the study period 60 patients (61 hips) with avascular necrosis of femoral head Ficat Arlett - stage 1 , Stage 2 and Stage 3 were operated in our department, Mean Average preoperative HHS was 36.53 and postoperative HHS was 83.16 . 22 hips had hip scores of 91 to 100 (excellent) , 28 had hip scores of 81 to 90 (good), 10 patients had hip scores of less than 70 (poor): 36.67% (22 patients) showed remission of the disease (no collapse radiographically) compared to preoperative stage at 2-year follow-up, in 46.67% (28 patients) disease did not progress further and 16.67% (10 patients) progressed and required arthroplasty. **Conclusions:** We found quadratus femoris muscle pedicle bone grafting as an excellent alternative management in young patients who require femoral head preserving surgery instead of Total hip Arthroplasty in both early & even in advanced stages of the avascular necrosis unless there is arthritis.

KEYWORDS :

INTRODUCTION

Avascular necrosis (AVN) of the femoral head is a progressive, multifactorial, challenging and debilitating disease which is on the rise & commonly affects young adults between the third & fifth decade of life. It is mostly idiopathic in aetiology but also occurs with the use of alcohol, steroids and following neck of femur fractures mostly in middle age population.

Early presentation of avascular necrosis of femur head may be painless; however the ultimate presentation is painful limitation of hip motion. [1]

Males are predominantly affected. Other causes of AVN are sickle cell disease, radiation exposure, chemotherapy, deep sea divers & autoimmune diseases. Formerly referred to as avascular necrosis, the term osteonecrosis is now preferred. Simply defined, osteonecrosis means "dead bone." The "avascular" state of the necrotic bone is the result of a loss of circulation from numerous potential causes. When the disease is symptomatic, it generally leads to collapse of the femoral head and eventually deterioration of the hip joint. Ficat described a four stage (I through IV) classification system for AVN, which is based on standard radiographs. [2]

Steinberg *et al*, expanded the Ficat system by dividing Stage III lesions into femoral heads with and without collapse or hips with acetabular involvement. [3]

The disease has got a tremendous impact on the socio-economic aspect as this progressively disabling condition

takes away the peak working years of the patient.

The need for multiple surgical procedures and unsatisfactory end results may add further to this misery. Many patients in this young age group ultimately require arthroplasty. Total hip arthroplasty with current techniques has a high ten-year survivorship. (Mont 2015) [4]

While many patients with the advanced AVN end up mostly with hip arthroplasty, some of those with early diagnosis of the lesion have been managed with hip salvage surgery. [5]

Meyers MH (1978) first reported the application of muscle-pedicle bone graft for the treatment of femoral head ON in 23 patients. With follow-up available between 6 months and 2 years, good results were found in all 8 patients who had Ficat stages I or II disease, but in only 5 of 15 patients who had Ficat stages III or IV disease. [6]

With longer life expectancy and at most 10 year survivorship of arthroplasty implants, revision surgeries and multiple surgeries seem inevitable. So femoral head salvage procedures are preferred in younger age group which delays Total hip arthroplasty and at best altogether avoids it. [7]

Many other studies have evaluated the Quadratus Femoris Muscle pedicle grafting for AVN femur. [8-10]

Cao Z *et al* evaluated the comparison of free vascularized iliac bone flap grafting versus pedicled iliac bone flap

grafting for the treatment of osteonecrosis of the femoral head. [11]

We evaluated the long term results of Retrospective study of Meyer's procedure (muscle pedicle grafting with cc screws) for the treatment AVN of the femoral head in irrespective of stage of the disease.

MATERIALS AND METHODS

This was a prospective longitudinal observational study conducted during the period 2012 April to 2020 March Mean follow up was 6.3 years

Inclusion criteria: 61 hips with avascular necrosis of femoral head in 60 patients were included in the study. 38 males and 22 females. The distribution of patients in our series according to Ficat and Arlet classification as follows.

- 14 hips - Stage I;
- 35 hips - Stage II;
- 12 hips- Stage III;

1. Patients aged less than 50 years
2. Physiologically active
3. Ficat type I, II, III AVN

Exclusion criteria:

1. Patients aged more than 50 years
2. Previously operated hips,
3. hips with implants,
4. presence of active infection and patients with chronic hepatorenal diseases were excluded from the study.
5. Ficat Arlett Stage IV – acetabular involvement

After recording a complete history and performing a thorough clinical examination, necessary investigations including MRI and bone scan were done to confirm the diagnosis and proper staging of the disease. Pre-operative functional assessment was performed. Post-operatively, patients were followed at regular intervals clinicoradiologically.

Radiological progression was assessed as described by Ficat-Arlet staging as follows.

- Stage I – Normal
- Stage II – Sclerosis, cysts, flattening
- Stage III – Collapse with normal joint space
- Stage IV – Collapse with joint space loss.

Radiographs were examined for signs of osteoarthritis; a good result was defined as improvement of bone structure or no change, and a poor result was defined as progression to osteoarthritis and cases getting converted to Total Hip Arthroplasty. Clinical outcome was evaluated using Harris hip score system.

Operative Procedure

The patients were operated in lateral position with lying on the unaffected side. The skin over the hip was scrubbed with povidone-iodine. The lower extremity from the groin to the toes was draped in sterile towels separately to enable easy manipulation of the limb during surgery. For all patients posterior approach (Moore's Approach also labelled as Southern exposure) was used in the study. Skin incision starting from a point 10 cm distal to posterior superior iliac spine taken and extended distally and laterally parallel to the fibres of gluteus maximus to the posterior margin of the greater trochanter and then directed about 10 cm parallel to the femoral shaft. Deep fascia was exposed and divided in the line with the skin incision as also was the fascia over gluteus maximus, which was then split in the direction of its fibres using blunt dissection. By retracting the proximal fibres of the muscle proximally, the greater trochanter was exposed. Distal fibres are retracted distally and partly divided at their

insertion into the linea aspera in line with the distal part of the incision. We explored & identified quadratus femoris muscle. Then it was elevated with a bone pedicle of around length 4 cm, width 2 cm & depth 1 cm from its insertion on the posterior aspect of femur with help of osteotome. This graft was secured & separated by passing roller gauge around it. The sciatic nerve was usually not exposed. It was protected with finger in the medial part of the wound and was gently retracted out of the way. The gemelli, obturator internus and the piriformis tendon were divided at their insertions after tagging them for easier identification and reattachment. The posterior part of the capsule thus exposed was incised from distal to proximal along the line of neck of femur and at right angle to it, thus making a T shaped opening in the capsule. Now neck was exposed. A window of about 1.5 x 1.5 cm is taken from the neck close to the head and necrotic area curetted out. Multiple drill holes were done to decompress the femoral head. The muscle pedicle bone graft was rotated & placed posteriorly over the neck & fixed into femur head with one 4mm cannulated cancellous screw in posterior to anterior direction. Absolute haemostasis was obtained during procedure. The external rotators were sutured, the wound was closed in layers over a sanction drain, which was removed at the first change of dressing after 48 h. Post operatively, patient was kept immobilised in well padded Thomas splint. Radiographs of pelvis with both hips & involved hip lateral view was obtained. Dressing was done after 48 h with removal of drain. I.V. antibiotics (cephalosporin & amikacin) were given for 5 days & after that shifted to oral antibiotics. Suture removal was done on 14th post operative day. Operated hip kept in Thomas splint for 6 weeks. Physiotherapy & partial weight bearing allowed gradually. Full weight bearing was allowed depending on radiological evaluation ((mostly after 3 months)). Patients were followed up at an interval of 6 weeks, 3 months, 6 months and 1 year atleast. The functional outcome was analysed by modified Harris hip scoring system. At each follow up radiograph of the hip was taken for radiological analysis.

RESULTS

Results were assessed in terms of functional & radiological outcome. The functional outcome after muscle pedicle grafting of AVN femoral head was graded as excellent, good and fair after adding the scores given for each criteria for assessment of hip. In Present Series total Harris hip score at the end of twelve months ranged from 34 to 100. There were 14 patients from stage 1, 35 from stage 2 and 12 cases from stage 3. The mean HHS scores in all the stages improved significantly postoperatively in all the stages (p < 0.05 – table 1).

Table 1: Preop and postop HHS values of the patients in different stages of AVN.

	Stage I	Stage II	Stage III
Number of pt.	14	35	12
Pre op HHS	60.7 ± 15.2	54.8 ± 12.3	46.8 ± 09.5
Post op HHS	88.3 ± 24.2	87.4 ± 31.5	80.9 ± 27.8
P Value	0.001	<0.001	<0.001

Twenty three surgeries had Harris hip scores from 91 to 100 (excellent) of which 9 were of patients in Stage I, 12 were from Stage II and 2 were from Stage III. Twenty four had hip scores 81 to 90 (good). 9 hips were rated hip scores in range of 70-79 (fair) whereas 5 hips had scores less than 70 (poor). There was significant association between the HHS post op and stage of the disease (p = 0.016). Stage I and II patients showed better results than stage III patients. [table 2]

Table 2: Post-operative HHS classification according to the stages of AVN

Stage	HHS post op				Total
	90-100 (Excellent)	80-89 (Good)	70-79 (Fair)	<70 (Poor)	

Stage I	9	5	0	0	14
	64.3%	35.7%	-	-	100%
Stage II	12	16	5	2	35
	34.3%	45.7%	14.3%	5.7%	100%
Stage III	2	3	4	3	12
	16.7%	25%	33.3%	25%	100%
Total	23	24	9	5	61
	37.7%	39.3%	14.8%	8.2%	100%
$\chi^2 = 15.59, df = 6, p = 0.016, \text{Significant}$					

Thus 47 hips (77.04% of the hips) were classified as having a good to excellent results and 5 hips (8.19%) of the patients had a poor result. 2 patients had superficial wound infection most likely iatrogenic. One of the patients was a known diabetic and was on insulin injection. She developed signs of infection in the first week of operation and was treated with proper antibiotics after pus culture and sensitivity and daily dressings.

In 7 patients there was collapse of head into advance stage, leading to hip joint arthritis. They needed total hip replacement. Out of which 3 were from stage II, one patient at 5 years and 2 at 7 years follow up and 4 were from Stage III, 2 patients each at 5 years and 7 years follow up. [Table 3]

Table 3: Collapse at subsequent follow ups

Stage	Collapse at 1 year	Collapse at 5 years	Collapse at 7 years	Total
Stage 1	0	0	0	0
Stage 2	0	1	2	3
Stage 3	0	2	2	4

DISCUSSION

Osteonecrosis of femoral head is a multifactorial progressive condition that can lead to femoral head collapse, fragmentation, degenerative change, and joint destruction, ultimately requiring total hip arthroplasty. The incidence of AVN of femoral head is high in young patients. If arthroplasty is done in such young patients, revision arthroplasty is mostly inevitable due to increased life expectancy and at most 10 years survivorship of implants. So there arises a need of femoral head preserving and salvage procedures.

As joint-preserving interventions have a much better prognosis when instituted early in the course of disease, and because the results of joint replacement are poorer in younger age groups, diagnosing AVN as early as possible is critical to prevent or delay progression of the disease. Many of these interventions show promising results when implemented early in the course of disease; the significantly poorer outcomes in more advanced stages of AVN show the importance of accurate early diagnosis. [12]

Although a plethora of treatment modalities have been proposed for hip avascular necrosis in this challenging patient population, none has yet presented repeatable and sustainable results. The past mainstay of the treatment for osteonecrosis of femoral head was core decompression. Several studies have proved that this procedure hardly will arrest the progression of the disease. Several studies show that only 27% of hips survived after core decompression. The necessity of second and sometimes third surgical procedure was very high after core decompression. Steinberg ME in a series of 300 cases of core decompression and bone grafting showed that 35% needed total hip arthroplasty at 12 years follow up. [13]

Most of the femoral head preserving operations, being extra-articular procedures, fail to rectify the associated intracapsular pathological alterations, particularly in advanced stages, thereby, they fail to provide satisfactory long-term outcomes, in spite of their good results during early follow up. [14]

Chang et al. reported progressive radiological collapse in 70% of 84 hips treated with core decompression stressing the failure of this method to arrest the pathology though it may give short term pain relief only. [15]

There is a recent surge in implanting a microanastomosed vascularised fibular graft in the treatment of osteonecrosis with varying results. The procedure is time consuming, technically demanding and has a very steep learning curve and many authors have reported failures ranging from 5 to 30%. [16, 17]

The vascularised fibular or iliac crest grafting procedures are technically demanding and, based on a single arteriovenous pedicle, patients may undergo torsion or injury or thrombosis peri-operatively, resulting in the loss of the vascularity and viability, which may be the reason behind their unsatisfactory long-term results. While, numerous vascular communications of MPBGs are well protected within the muscle bed, unless muscle fibres undergo any acute angulation or torsion, then the grafting procedures appear relatively easier technically.

Lee and Rehmatullah treated ten adult patients with the "silent hip lesion" of idiopathic ischemic necrosis of the femoral head by the muscle-pedicle bone and cancellous bone graft procedure. They were followed postoperatively for mean 42.4 months. They observed seven patients have remained asymptomatic, showing progressive healing of the hip lesions whereas three patients were found to have failure as observed by collapsed femoral head or appearance of "crescent sign" in radiographs. They concluded that surgical procedure consisting of curettage of necrotic bone with a cancellous bone and muscle-pedicle bone graft can provide good results for Stages 1 and 2 of the idiopathic ischemic necrosis of femoral head. [18]

Baksi et al. in his long case series of 152 patients with 187 osteonecrotic hips found Excellent and good results according to the Hospital for Special Surgery (HSS) score were obtained in 100% of cases in Stage I, 92% in Stage II and 80.4% in stage III, with a survivorship of 91% in Stage II and 82% in Stage III cases. [14]

In our series, immediate relief of pain was achieved by relief of increased sub-articular venous pressure in osteonecrosis and intra-osseous pressure in the presence of osteoarthritis by multiple drilling and the judicious curettage of necrotic area. The permeation of granulation tissues into the drilled area growing from the adjacent MPBG helps in revascularisation of the necrotic area, causing long-lasting pain relief.

Overall, we observed an 11.48% (7 out of 61 hips) incidence of collapse in our series, in a mean follow up of 7 years, they required total hip arthroplasty.

Table 4: Comparison of pre & post-operative Harris Hip Score of previous Studies.

	Pre-operative Harris hip score	Post-operative Harris hip score
Sim Yan et al. 2015 [19]	58 (range 46–89)	86 (70–94)
Berend et al. 2003 [20]	54.5	81
Our study - 2020	54.1 (38-73)	85.5 (64-92)

We agree with the Meyers conclusion that the posterior approach does no significant damages to the vascularity of the femoral head as the main lateral epiphyseal vessel lies in the superior part rather than in the posterior part of the capsule. We have not encountered any arterial bleeding during cutting the capsule posteriorly. [21]

This procedure requires no special equipment over and above that used for a standard internal fixation procedure and that prosthetic replacement can be easily carried out as a revision

surgery in the failed cases.

CONCLUSION

We concluded that a femoral head preserving surgery should be the preferred choice of treatment in young individuals both in early & even in advanced stages of the avascular necrosis unless there is arthritis, badly deformed head or collapse of more than 5 mm. Considering its technical simplicity as compared to the use of other vascularized bone grafts like vascularized fibular or vascular pedicle iliac crest graft, above method of muscle pedicle grafting with quadratus femoris can be recommended as a salvage procedure in young patients where AVN is common.

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FIGURES



Fig-1 Case 1- Pre-op Radiograph of 40 year male with Grade 3 AVN



Fig 2 – Case 1 – Immediate Postoperative Radiograph. Patient was kept immobilized in Thomas Splint for 6 weeks.



Fig 3 – Case 1 – 60 months follow up Radiograph



Fig 4 a & b – Case 1 - postoperative clinical functional outcome at 60 months follow up

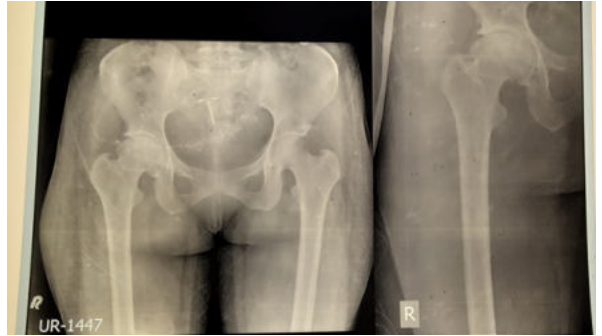


Fig 5 – Preoperative Radiograph of 28 years old female suffering from Grade 3 AVN



Figure 6- Immediate Postoperative Radiograph



Figure 7 – Post operative 36 months follow up Radiograph





Figure 8 abc – Patient able to sit cross legged down on the floor which is not possible after Total Hip Arthroplasty. Good Postoperative functional outcome at 36 months follow up even in Grade 3 AVN.

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