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# Tensor fascia lata muscle pedicle grafting for avascular necrosis femoral head

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## ABSTRACT

**Background:** Osteonecrosis of femoral head (AVN) is a disabling condition with ill-defined etiology and pathogenesis. In more than 60% it leads to osteoarthritis of hip joint. Treatment for this condition includes both operative and non-operative methods with variable success rates. Surgical options being aimed at both conservation of femoral head and arthroplasty of hip joint. Aim of our study was to evaluate the efficacy of tensor fascia lata muscle pedicle grafting in the management of osteonecrosis of femoral head.
**Methods:** 27 cases with a mean age of 38.7 years (range from 24 to 52) who underwent tensor fascia lata muscle pedicle grafting in the management of osteonecrosis of femoral head were prospectively evaluated with a mean follow up period of 7.3 years (range from 3 to 12 years). Watson-Jones approach was used in all patients. Average hospital stay was 12 days. Harris hip score was used for the evaluation of clinical outcome.
**Results:** In our series of 27 cases, the Harris hip score was excellent (90-100) in 19, good (80-89) in 5, fair (70-79) in 2 and poor (<70) in 1 case at final follow up.
**Conclusions:** Tensor fascia lata muscle pedicle grafting is an effective, technically easier, pain relieving head-preserving procedure and will improve outcome in properly selected patients with osteonecrosis of femoral head.

**Keywords:** Avascular necrosis, ONFH, Femur head, Osteonecrosis, Muscle pedicle grafting, Tensor fascia lata

## INTRODUCTION

Osteonecrosis, also known as avascular necrosis (AVN) and aseptic necrosis, is a particularly devastating condition of the human skeleton because of its propensity to strike young adults and its often unrelenting progression despite treatment.

Proposed causes of pathogenesis are ischemia, intra osseous compartment syndrome or accumulative cell stress as shown by Kenzora et al.[1] 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.

Avascular necrosis of femoral head is caused by inadequate blood supply leading to death of the osteocytes. Subsequently it progresses to collapse of the femoral head and advanced joint destruction. ONFH thus leads to significant disability in the most productive years of life and is one of the common causes of hip arthroplasty in young individuals. Both traumatic and non-traumatic etiologies have been described for AVN. The common causes include corticosteroid medications, fractures and dislocations of hip joint and chronic alcohol intake.[2,3] Chronic renal failure and caissons disease are rare causes of AVN. In about 30% patients, it is idiopathic. Bilateral presentation is frequently seen and males are more commonly affected. Contralateral hip may be affected in about 55% of the patients within 2 years.[4]

At an early stage of AVN hip joint is painless. However it becomes painful and there is limitation of hip range of movements with advancement of disease. Multiple diagnostic and treatment modalities have been described for AVN but with varying limitations. Earliest radiographic findings of AVN take at least 2 months to develop, but may take as long as 6 months. Sclerosis and cystic changes are early radiographical changes. With progression of disease there is asphericity of femoral head (femoral head collapse) and joint space reduction (secondary arthritis). Magnetic resonance imaging (MRI) is the most sensitive diagnostic modality for ONFH. MRI has sensitivity of 90-100% and specificity of 100% in diagnosis of osteonecrosis.

It is also useful for early detection of asymptomatic AVN. The characteristic appearance of the infarcted area is a hypo-dense on T1image surrounded by a single hypo-dense line separating normal and osteonecrotic bone. T2 image shows another line within this line representing increased vascularity in granulation tissue. The appearance of the interface is more important in the diagnosis, and the density of the necrotic central part will change with the change in fat content due to death of adipocytes and appearance of reparative tissue.[5,6] MRI can help in identifying patients at risk of collapse of the femoral head. Presence of bone marrow edema, increased fat content in the proximal femur and joint effusion on MRI are important prognostic factors. Dynamic MRI may be the future investigation for early prediction of vascular insult to femoral head. Altered hemodynamic changes in the vascular phase of bone scintigraphy may be seen as early as first 24 h of vascular insult. MRI also will help to assess the quantity and quality of the cartilage that may remain viable by the synovial fluid.[7-9]

Because the treatment of osteonecrosis is determined in large part by the stage of the disease, it is important to use a reliable and effective method of classification and staging. In addition, it is extremely difficult to compare one method of treatment with another and to evaluate accurately the results of various studies. This difficulty arises in part because of the many variables used to determine the method of treatment, follow progression or resolution, and evaluate the outcome. Several methods of classification and evaluation have been used, and it is hard to make a correlation between them. There are many classification systems that describe the clinical and radiological severity/progression of AVN. Marcus-Enneking, Sugioka, University Pennsilvania, Japanese committee for AVN classifications were described before 1990's.[10-14] The Ficat and Arlet staging system is still one of the most commonly used system.[15] It is based on radiological findings, but does not consider the extent of necrosis. Quantification of the size of the lesion is helpful in predicting the collapse of the femoral head. Kerboul et al estimated the extent of necrosis radiographically in the early-stages by measuring the sum of arc of area of the femoral head involved on anteroposterior and lateral radiographs.[16] Clinical outcomes were better if this value was <200°. These measurements have also been obtained on mid-sagittal and mid-coronal MRI scans and is useful in predicting outcomes. Steinberg et al added quantification of femoral head involvement to the classification system, but could not gain wide popularity as it was difficult to apply.[17] The association research circulation osseous (ARCO) system of classification incorporated features of both the Ficat and Arlet system and the Steinberg classification.[18]

## METHODS

This was a prospective longitudinal observational study conducted during the period 2004 April to 2015 March at the department of orthopaedics, Government TD Medical college, Vandanam, Alappuzha, Kerala, India.

The mean age of patients in our study was 38.7 years (range 24-52 years). The mean follow up was 7.3 years (2-12 years). 27 hips of 20 patients were included in the study. Harris hip score was used to assess the outcome and proportion of different outcomes to the total study group was given. Our study group involved 16 male patients and 4 females.

***Aetiology of the osteonecrosis was as follows***

Idiopathic in 12 patients – 2 bilateral hip involvement, chronic steroid use was observed for the disease in 5 patients (8 hips) out of which 3 were females. 3 patients (5 hips) in our series were chronic alcoholic.

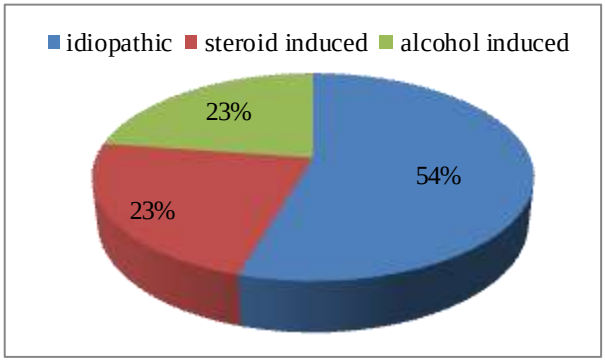


**Figure 1: Pie chart showing amount of patients under different etiology.**

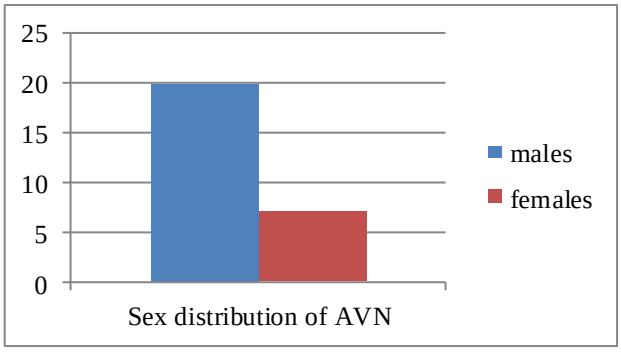


**Figure 2: Bar chart showing sex distribution.**

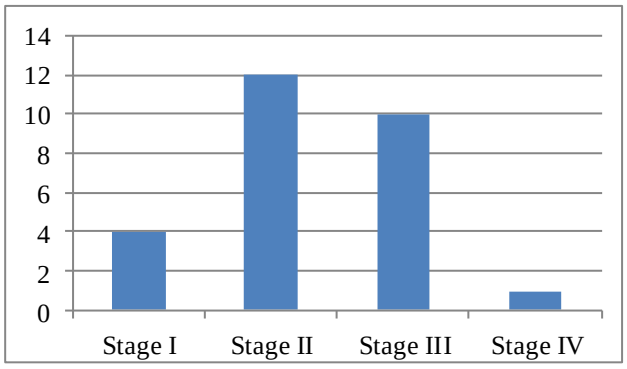


**Figure 3: Bar chart showing patient distribution under different stages of AVN.**

***Inclusion criteria***

27 hips with of avascular necrosis in 20 patients were included in the study. 16 males and 4 females. The distribution of patients in our series according to Ficat and Arlet classification as follows. 4 hips - Stage 2A; 12 hips - Stage 2B; 10 hips- Stage III; 1hip - Stage IV.

***Exclusion criteria***

Previously operated hips, hips with implants, presence of active infection and patients with chronic hepatorenal diseases were excluded from the study.

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 clinico-radiologically. 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. Clinical outcome was evaluated using Harris hip score system.

***Operative procedure***

Standard Watson-jones approach was used in all patients. Limited exposure of the antero lateral aspect of the joint was performed as this approach will directly lead the surgeon to the anterolateral quadrant of the femoral head which is the mostly involved area of osteonecrosis and also preserves the posterior retinacular vessels. 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 are made through the window to the head to facilitate the revascularization.

Next, the incision is extended over to the middle third of iliac crest and a 2×2 cm bone with the attached muscle pedicle of tensor fascia lata (TFL) is carefully detached and turned down with care taken not to stretch the vascular pedicle. TFL gets main blood supply by the ascending branch of lateral circumflex femoral artery but, frequently a branch of superior gluteal artery also supplies this muscle. Bone piece is shaped to fit into the window and fixed with cannulated screw**.** Wound closed over suction drain in layers.

Post-operatively, static gluteal and thigh muscles were started as soon as the pain is relieved. Sutures were removed on the 10$^{th}$ post-operative day. ROM exercises allowed after 2 weeks. Toe touch down non-weight bearing was observed till 6$^{th}$ post-operative week and gradual weight bearing with crutches allowed upto 12 weeks. Unprotected full weight bearing was allowed after 12 weeks.

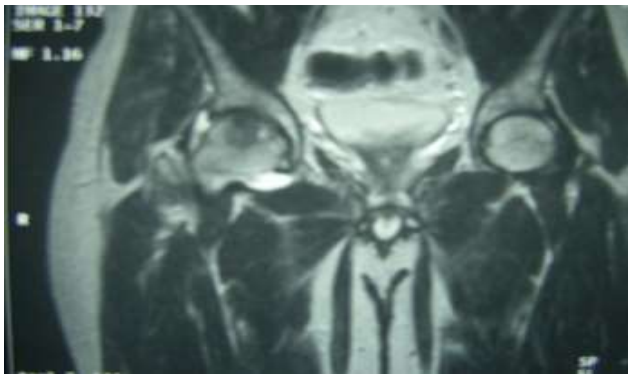

**Figure 4: MRI showing AVN hip.**

**Figure 5: X ray showing graft fixed with screw.**

**Figure 6: Patient able to squat after 6 months postoperatively.**

**Figure 7: Patient able to squat after 8 months postoperatively.**

**Figure 8: Dissected specimen showing exact location of graft placement and fixation.**

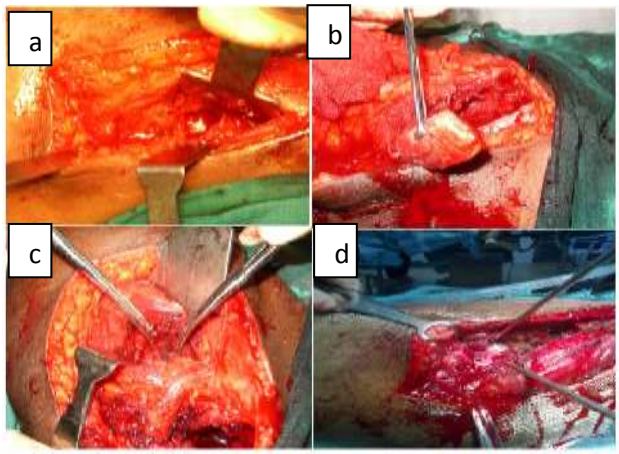


**Figure 9: Peroperative photos. a) window created after curettage for graft placement; b) harvesting of iliac crest graft with attached TFL; c) fixation of graft with screw into the window at head neck junction; d) graft fixation completed.**

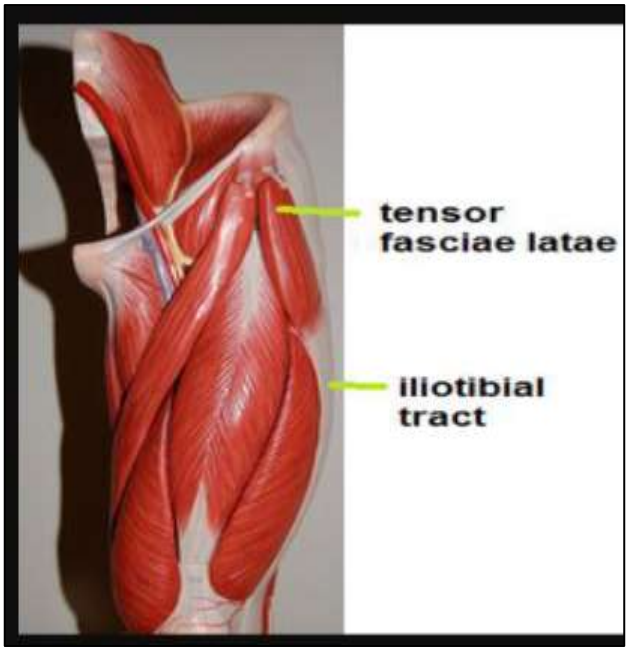


**Figure 10: Muscular origin of TFL.**

## RESULTS

All patients were followed up at regular intervals. All the selected parameters were evaluated according to the prescribed Harris hip scoring system. The mean age of patients in our study was 38.7 years (range 24-52 years). The mean follow up was 7.3 years (2-12 years). 80% of studied group were males and 20% were females.

Results were categorised and graded. 19 hips (70.37%) showed excellent result; 5 hips (18.5%) showed good result; 2 hips (7.4%) showed fair and 1 hip (3.7%) poor result.

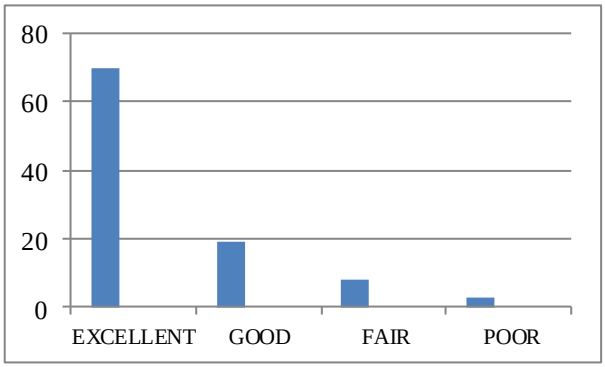


**Figure 11: Bar chart showing functional outcome.**

## DISCUSSION

Osteonecrosis of the femoral head, or avascular necrosis AVN, is a common cause of musculoskeletal disability. AVN is a progressive condition that can lead to femoral head collapse, fragmentation, degenerative change, and joint destruction, ultimately requiring hip arthroplasty.

Although the exact mechanism of mechanical failure is not definitively known, the epidemiology suggests multifactorial pathogenesis involving vascular compromise, bone and cell death, and defective bone repair.[19] AVN occurs in association with a wide spectrum of diseases, including steroid use, trauma, infection, hemoglobinopathies, alcoholism, pancreatitis, storage disorders, hyperbaric events, and radiation.[20] A significant number of idiopathic cases of AVN with no obvious etiologic factor have also been described. It often occurs in young active patients and can present a major diagnostic and therapeutic challenge. Despite extensive literature on the subject, the etiology and natural history of the disease remain incompletely defined, and treatment options remain controversial. Because 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.[21]

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.[22]

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.[23]

Rotational osteotomies that displace the necrotic part of the femoral head away from the major weight-bearing zone of acetabulum have been described by pioneers like Sugioka, Mole and Kempf.[24,25] These procedures are technically difficult, may further jeopardise vascularity and give unpredictable results(47% favourable outcome) depending on the volume of necrotic part and the type and amount of rotation required as described by Langlais et al.[26]

There is a recent surge in implanting a micro-anastomosed 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%. [27,28]

In many series, average age for total hip replacement in osteonecrosis is 38. Since the outcomes are discouraging in this young age group due to high incidence of complications and the need for difficult revisions, especially if done for osteonecrosis**.** Although there is a growing evidence of more successful results with contemporary components and techniques, treatment of avascular necrosis with total hip replacement remains a major challenge and the role of replacement in certain stages of AVN is still controversial.[29]

In patients who experience non-traumatic avascular necrosis of the femoral head before 45 years of age, conservative surgical procedures that can postpone total hip replacement (THR) by 10 to 20 years are useful.

Muscle-pedicle grafts have been described in the literature by many authors. Meyer et al described quadratus femoris based pedicle graft and Baksi et al reported excellent clinical and radiological outcome with tensor fascia lata muscle pedicle graft placed in the prepared window to the necrotic area which also will serve decompress the lesion.[30,31]

A TFL-muscle pedicle graft onto the affected area of head of femur will definitely increase the vascularity and prevent the further collapse of the head. The procedure is technically less demanding but, more rewarding with a less steep learning curve for the average orthopedic surgeon.

In our series of 27 hips treated with this procedure, all the patients had pain relief though radiological improvement was minimal in stage III and IV. One patient with poor result had a collapsed head with early OA changes which is an ideal case for replacement.

All stage II patients in our series had excellent outcome both clinically and radiologically. One-third of stage III hips operated showed excellent outcome. Overall, we obtained 96.2% favourable clinical outcome with a mean follow up of 7.3 years (P value =0.01) which is statistically significant. No correlation was observed in the outcome with age and sex of the patients. It was observed that only 5 stage III hips had undergone radiological progression of the disease within the follow up period. All stage II hips showed radiological recovery as evidenced by preservation of head shape with uniform joint space and fading of sclerotic area.

## CONCLUSION

Tensor fascia lata muscle pedicle grafting in the management of osteonecrosis of femoral head may improve outcome when an early diagnosis is made and if the procedure performed before the lesion has become too large, or there is radiographic evidence of femoral head collapse and arthritic change. Unlike other head preserving procedures this technic preserves head with

arrest of the pathology and return of vascularity evidenced by the reduction of pain and improvement of function.

Our study proved the efficacy of TFL-MPG in the early and moderately advanced stages of AVN. It improves the function of the affected hip besides avoiding the need for replacement. We strongly recommend this procedure in selected stages of AVN in younger patients since it gives predictably excellent results.

***Limitations of this study***

This longitudinal prospective study was performed in a limited number of patients. The distribution of patients in each stage of the disease being evaluated is not uniform and follow up period differs between individuals.

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