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Assessment of Functional Outcome in Osteonecrosis of Femoral Head Patients Managed with Core Decompression

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ABSTRACT

Introduction

Osteonecrosis of the head of femur is defined by the femoral head's structural collapse over time due to the marrow's cellular components dying off because of a poor blood supply. The etiological reasons include chronic alcohol, steroid use, collagen vascular disease, sickle cell disorders, and coagulopathies. Up until Ficat & Arlet stage 2A of the disorder, core decompression is carried out to save the head and halt the osteonecrosis from advancing. This study was conducted to evaluate the efficacy of Core decompression in the management of femoral head osteonecrosis.

Methodology

For aperiod of 12 months, a prospective observational study was conducted in the orthopedics department of GEMS & Hospital. In our study Males are more commonly affected than females (60%) in the 41 hips with avascular necrosis of the head of the femur undergoing core decompression. Most cases (53%) belong to the 2A group. 30% of cases are idiopathic in nature.

Results

Core decompression for hip osteonecrosis in its early stages is often successful. Analysis revealed that there was no statistically significant p value for stage 2 hips. However, 12 out of 22 hips exhibited no disease development, and 17 hips had positive outcomes. Although the statistical outcome might not indicate it, this demonstrates that the treatment did have an impact.

Conclusion

Core decompression in stage 1 and stage 2A disease

affords symptom relief, slows the progression of the disease and delays total hip replacement.

Keywords

Osteonecrosis, core decompression, Ficat & Arlet Staging

INTRODUCTION

A vascular necrosis refers to the loss of blood supply that causes tissues to die & refer to as osteonecrosis when it affects the bones. The head of the femur is one of the areas where avascular necrosis occurs frequently. After trauma or even without any history of trauma, the head of the femur can become avascularly necrotic. Patients commonly describe generalized pain or discomfort when moving their hips, which over time evolves to excruciating agony that renders them completely immobile. Even though the origin of avascular necrosis of the femoral head is unknown, it is hypothesized that any mechanical, physical, pharmaceutical, or hereditary insult to the already unstable blood supply to the femoral head might set off a series of events that leads to osteonecrosis. Radiological information from x-rays, MRIs, etc. is often used in concert with clinical findings to make a diagnosis of avascular necrosis of the femoral head. The Harris hip score can be used to determine functional improvements following surgery. The therapy options aim to reduce illness morbidity by slowed the disease's progression. Most available treatment options involve femoral head replacement and preservation operations. Core decompression of the femoral head with or without cancellous bone grafting seeks tohalt the development of the condition and postponehip replacement by removing the dead bone from the femoral head, filling the defect, and allowing new blood vessels to develop into the femoral head.

OBJECTIVES

Any treatment for osteonecrosis of the femoral head should primarily focus on relieving symptoms while delaying the disease's progression and postponing hip replacement surgery. The functional outcomes of surgical core decompression for femoral head avascular necrosis in Ficat and Arlet stages 1 and 2A are examined in this study. To investigate the radiological development of avascular necrosis after core decompression.

FICAT & ARLET STAGING SYSTEM

Stage	Radiological findings
I	Plain radiograph, magnetic resonance imaging, and scintigraphy: normal
IIA	Sclerotic and cystic lesion (absence of subchondral cystic formation)
IIB	Subchondral collapse (crescent sign) and/or subchondral aliasing
III	Irregular femoral contour
IV	Collapse of the femoral head, acetabular involvement, and articular destruction (osteoarthritis)

CORE DECOMPRESSION[2,3,4,5,6,7,8,9,10,11,12]

Early in 1960, Paul Ficat and Jaques Arlettinvestigated the illness and developed the idea of functional exploration of the bone. This process included core decompression, which led to a reduction in pain and a halt in the radiological progression. When performed before the femoral head reaches the point of structural failure, it is found to be more effective. It is now utilised in two situations: in the early stages of the disease to stop disease progression and in advanced cases where there is a risk for major procedures.

INDICATIONS FOR CORE DECOMPRESSION

- Treatment and diagnosis of painful but radiologically normal hips in patients whose risk

factors for osteonecrosisfavors diagnosis. Core decompression can stop the disease's progression and alleviate pain.

- Stage 2 of Ficat is the common indicator.
- A secondary indication is for relief of hip pain brought on by AVN in an advanced stage of the disease.
- Depending on the patient's age, risk factors, weight, life expectancy, and acceptance, core decompression may be performed in stages 3 or 4.

ADVANTAGES

- Can be performed for pain management in the initial stages of painful hip disease when there are no visible signs on an x-ray.
- In the latter stages as a palliative measure.
- Only requires a minor incision, quick surgery, and a shorter hospital stay.
- Does not obstruct further surgery, such as hip replacement.

PRINCIPLES OF CORE DECOMPRESSION

Regardless of the ailment's origin or etiology, there appears to be a blockage of the osseous microcirculation with intramedullary stasis. Increased pressure from osseous microcirculation blockage with intramedullary stasis can cause metabolic abnormalities that result in anoxia and ultimately necrosis.

The compartmental character of the bone, wherein the entire bony system behaves as a stiff closed cavity, and the walls of the trabecular cavities, and the cortical foramina, behave as a variety of tunnels, provides an explanation for the pathophysiology of the disease. Like other compartment syndromes, this system is susceptible to pressure increases, notably those of roughly 30 mm hg. Early involvement of the sinusoids and the tiny marrow capillaries is accompanied by increased pressure and venous outflow. Before they reach the cortex, reflex spasm can even block the nutritional arteries to the bones.

Core decompression functions similarly to fascial release in compartment syndrome or decompression surgery for nerve tunnel syndrome. Core decompression reduces medullary hypertension, which interrupts the vicious cycle. When the outer cortex is breached, pain is frequently relieved instantly. The tissue congestions are relieved as venous drainage is restored. Several intricate paths are used to start the revascularization of the femoral head.

Core decompression causes vasodilation, decalcification, and hypervascularity across the entire joint. Decompression of the intramedullary sinusoids and cortical foramina relieves arterial spasm.

Core decompression works on multiple levels to stop the avascular necrosis of the femoral head by enhancing microcirculation and restoring normal metabolic function.

METHODOLOGY

The functional results of core decompression surgery for avascular necrosis of the femoral head are the subject of this prospective study. Thirty patients—a total of 41 hips—that underwent core decompression surgery in the Department of Orthopaedics, Great Eastern Medical School & Hospital, Srikakulam from January 2021 to January 2022 were studied. These hips belonged to 19 patients who had unilateral hip surgery and 11 patients who had bilateral hip surgery.

The Ficat staging method is used to classify the disease (1985). The medical records that were available were examined. They have been followed up clinically and radiologically.

Type of study

Prospective study

CLASSIFICATION

The classification suggested by Ficat[5] (1985) is used in this investigation. This categorization was selected because it uses a straightforward methodology, is based on radiography, and can be used consistently in all cases. The study omitted those individuals who had painful hips but no radiological signs of avascular necrosis and couldn't afford an MRI scan. However, the stage 1 illness patients in this study were able to undergo an MRI scan.

INCLUSION CRITERIA

- Individuals with avascular necrosis of femoral head (unilateral and bilateral) in stages 1 & 2.
  Giving consent for surgery.

EXCLUSION CRITERIA

- Patients with late stages of avascular necrosis where femoral head cannot be preserved, and arthroplasty is the only option left.
- Patients undergoing some other modality of treatment along with core decompression with or without bone grafting.

EVALUATION OF THE PATIENT

Preoperative preparation

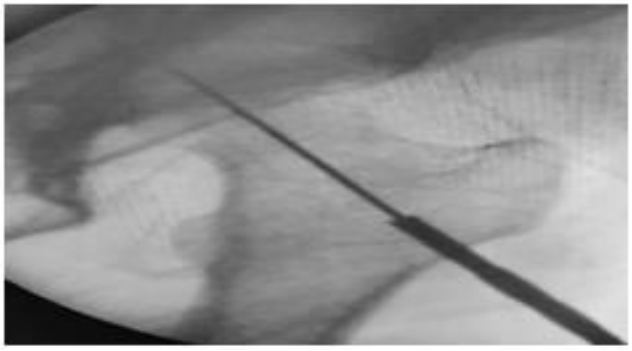
- A history of the symptoms and how they were treated, including how long each treatment lasted, the drugs and dosages used, and any hip surgeries that may have occurred.
- Risk factors that are connected: SLE, radiation, alcoholism, steroid use, and trauma.
- Investigations: X-ray -AP and Frog leg lateral view of pelvis with both hips. Physical examination of the patient.
- Using Ficat categorization based on the radiographs to stage the hip.
- MRI is used to confirm diagnoses in pre-radiological patients and sometimes
- Routine testing for blood and urine, among other tests.
- Anesthesia examination and evaluation of surgical readiness.
- Hip assessment utilizing the Harris hip scoring system.
- Patient counselling regarding the nature of the disease and its course.
  - In relation to the process.
  - The anticipated result.
  - The graft site morbidity and potential consequences.
  - Alternative therapies.

THE PROCEDURE

The contralateral limb is kept abducted and hip-flexed while the patient is lying on a traction table, allowing for image intensification during the treatment. The affected leg is kept extended and rotated sufficiently internally to counteract femoral neck anteversion. The affected hip is then prepared and draped.

To achieve sub periosteal exposure of the lateral portion of the proximal femur, the fascia is sectioned and the vastus lateralis muscle is bluntly separated along the path of its fibers.

The mid-lateral cortex, where the bone starts to flare laterally, is punctured with a small drill hole. A guide wire is inserted into the depth of the subchondral bone in the center of the lesion, close to the anterosuperior corner of the femoral head, under the guidance of an image intensifier. The guide wire is advanced while being careful not to pierce the joint with a cannulated drill.



C-arm image showing reaming

Under the guidance of image intensification, a triple reamer with an 8 mm diameter is inserted over the guide wire. A core track is reamed up to approximately 5 mm of the articular cartilage, and the core of the necrotic bone is removed.

Cancellous bone from the iliac bone is packed and affected inside the core decompression tract. Every wound is stitched up in layers.

POST OPERATIVE PROTOCOL

Following surgery, antibiotics are taken for a total of three days, and bandages are changed the second day. After the wound has healed, the sutures are taken out. No weight bearing is permitted; the patient is provided a crutch; and, in bilateral situations, it is advised to walk with a swing through gait. After 6-8 weeks, full weight bearing is permitted.

FOLLOW UP PROTOCOL

For the first three months, the patient is followed up on monthly, then every 1.5 months for the following three months, and finally every 3 months. At each review, the Harris hip score is calculated, the patient is questioned about the symptom alleviation, and a clinical examination is performed.

A hip radiograph is acquired from the AP and frog leg lateral views, and the radiographic stage is evaluated.

In the current investigation, a maximum of 12 months of follow-up was allowed for 30 patients and 41 hips. There was no patient lost to follow-up.

ASSESSMENT OF RESULTS

The Harris hip score before and after surgery, the Ficat stage of the disease determined by radiography, and any additional surgery performed because of the disease's progression are all taken into consideration when evaluating the treatment's effectiveness.

To determine the statistical significance of the difference in scores stage-wise, a paired T test is used. The Anton Y P et al.[13] method is utilized to evaluate the outcomes.

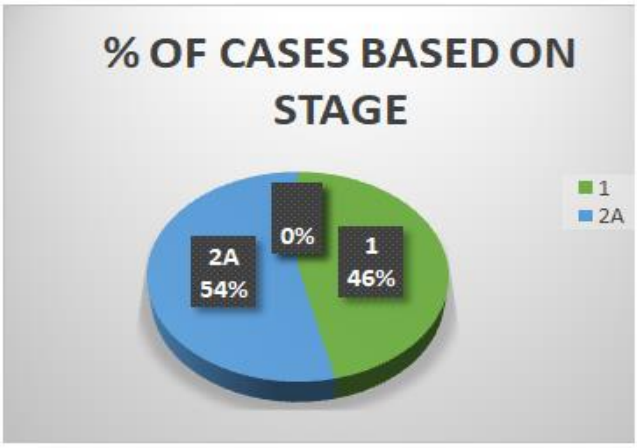
If the hip score is 91 to 100, the outcomes are considered excellent; 81 to 90, good; 71 to 80, fair; and < 70, poor.

They are analyzed by classifying the outcomes based on stage and contrasting any improvement or deterioration with the same stage.Additionally recorded are the radiographic progression to the following stage and the need for additional surgery during the observation period. Clinical developments are evaluated and connected.

RESULTS

Distribution of Cases Based On Stage

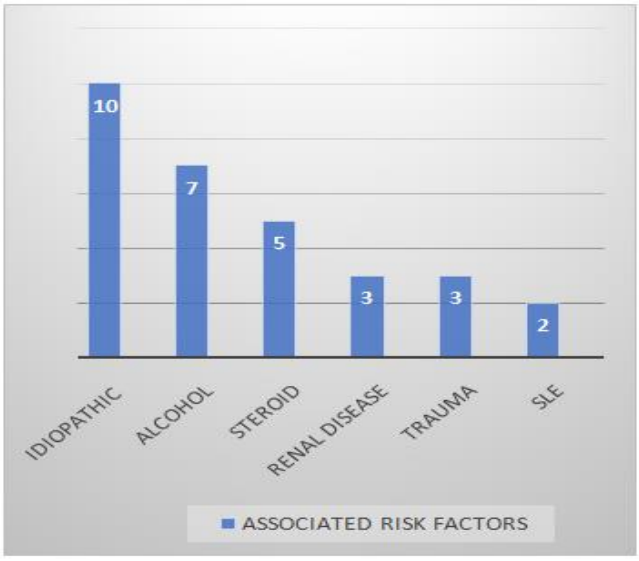
Stage	Count	Percent
1	19	46.33
2a	22	53.66



ASSOCIATED RISK FACTORS

After talking to patients, potential risk factors were identified. Because most patients had no useful medical history, idiopathic avascular necrosis of the head of the femur was the most common diagnosis. the second-highest rate of alcohol-related hip damage.

Risk factors	Count	Percent
IDIOPATHIC	10	33.3
ALCOHOL	7	23.3
STEROID	5	16.6
RENAL DISEASE	3	10
TRAUMA	3	10
SLE	2	6.66



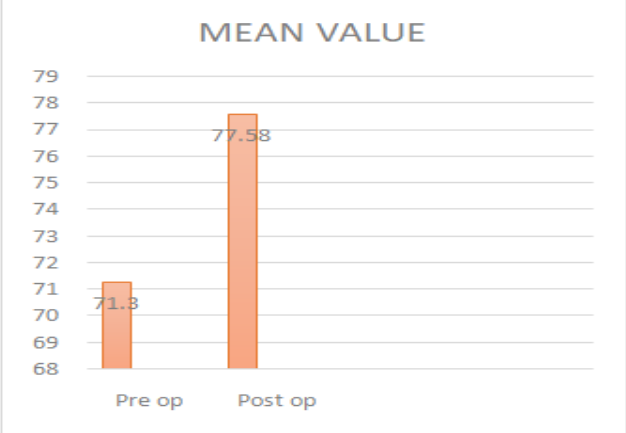
DISTRIBUTION OF HARRIS HIP SCORE

HIP SCORE	PRE-OP		POST-OP	
	COUNT	%	COUNT	%
POOR	13	31.7	4	9.7
FAIR	26	63.4	22	53.6
GOOD	2	4.9	13	31.7
EXCELLENT	0	0	2	4.9

EVALUATION OF HIP SCORE

The hips under this study have shown an overall improvement in the Harris hip score as the mean of the scores has increased from 71.3 to 77.58 in the post operative hip score.

Hip score	Mean	SD	N	Mean difference	Paired t test	P value
Pre op	71.3	7.1	41	4.7	4.72	<0.001
Post op	77.58	10.6	41			



FINAL ANALYSIS OF THE RESULTS

On analyzing the results stage wise, we found that,

Stage 1

All but one of the 19 hips in the Ficat stage 1 classification demonstrated post-operative improvement in the hip score. None of them experienced any issues following surgery. None of them needed any additional steps.

When x-rays were performed for the complaints of the opposite hip and revealed a greater level of illness, 5 of the 19 hips in stage 1 were identified. In 14 cases, unilateral hip disease was found.

Stage 2

17 of the 22 hips operated on in stage 2A improved their Harris hip score after surgery. During the follow-up period, there was a post-operative hip score drop in 5 hips. These 5 hips also demonstrated radiological disease progression. Despite the Harris hip score improving, 7 hips had radiological signs of the illness progressing.

Seven of the 22 hips operated on in stage 2A had good outcomes (hip scores between 81 and 90), 11 had fair results (hip scores between 71 and 80), and four had poor results (hip scores below 70).

DISCUSSION

The avascular necrosis of the femoral head progresses relentlessly and has a variety of risk factors. Its cause is unknown. Patients of a young age group are affected. The youngest patient in our study was 26 years old, and the oldest was 46 years old. The mean age was 37 years. Out of the 30 patients, 21 were between the ages of 20 and 40. Joint replacement surgery may not be efficient to allow these patients to resume their typical activities due to wear-and-tear issues, and another revision surgery may be necessary. Therefore, the goals of treatment are to identify the condition as early as possible, particularly in those patients who have avascular necrosis risk factors, to slow or stop the progression of the disease to postpone joint replacement surgery, and to relieve the patient's symptoms.

In 1949, Phemister[14] provided a description of the process, which was used by Bonfiglio and Voke[15], who have reported positive outcomes. The disease has progressed by the time surgery is performed today or must be performed in all hips presenting with pain and with risk factors, assuming the pathology to osteonecrosis. In the early days, the investigatory modalities available could not detect osteonecrosis in stage 1 and may even be in stage 2. As explained by Ficat[5,6]doing a biopsy was one way to confirm the condition. The diagnosis can be made in the early stages thanks to the improvements in imaging techniques and the broad application and accessibility of MRI and bone scan, especially for individuals with risk factors.

A relatively straightforward, dependable, and affordable method is the core decompression surgery for avascular necrosis with cancellous bone grafting. The drawback of arthroplasty is that it does not fit with young patients' active lifestyles. As a result, the total hip replacement surgery is delayed in favour of the head-preserving procedure. Core decompression, one of the head-preserving techniques, assumes an even more significant role in the Indian context since, if the pathology is diagnosed early, it is a straightforward, affordable procedure.

Most of the patients in our study were being monitored for risk factors such alcoholism, pancreatitis, SLE, renal illnesses, malignancies, rheumatoid arthritis, etc. for the relevant specialties, and as a result, they arrived at our department pretty early in the course of the disease. Since this was a tertiary care facility, the availability of MRI and other imaging modalities aided in the discovery of cases in stage 1 and early stage 2.

The radiological classification served as the study's foundation because it was practical for patients in the low socioeconomic group. MRI was only used in this investigation during the pre-radiological stages when further diagnostic tools were required.

The following benefits of the technique were identified by our research:

- Relatively straightforward and less technically challenging than vascularized fibular graft.
- Economical.
- It takes little time. For unilateral patients, the average surgical time was determined to be 38 minutes, and for bilateral cases, it was 58 minutes. It does not compromise a future hip replacement surgery if needed.
- After a period of about 2 to 4 months, patients can resume their active lifestyle without the use of implants.

Early detection of osteonecrosis provides a chance to postpone joint replacement and aid in maintaining the

head of the femur, which is the main goal of any treatment for osteonecrosis of the head of the femur.

According to our observations, the typical blood loss was around 200 ml. There was no graft slippage, and the graft was not secured with k wire.

19 hips from patients with stage 1 illness were monitored, and 2 of them had outstanding results while the other 17 had good results. At 0.001, the P value was highly significant.

In stage 2A hips, 17 out of the 22 hips showed good results. 10 hips showed radiological progression of disease even though they showed reduction in their symptoms as evidenced by increment of the Harris hip score. Evidently, the radiological progression is not mirrored in the clinical examination findings, and thishas been confirmed by other investigators[4] as well.

After doing statistical analysis using Paired T test and comparing the preoperative and post operative hip scores stage wise,

- In stage 1 hip disease, the value is extremely statistically significant with
  $p<0.001$.
  This may indicate that the technique is quite successful in treating stage 1 illness.
- Analysis revealed that there were no statistically significant post-operative complications in stage 2A hips with P values greater than 0.05. 12 of the 22 hips, however, did not exhibit disease development. And 17 hips produced positive outcomes.

Even though the statistical outcome might not indicate it, this demonstrates that the treatment did have an impact.

The 5-year, 10-year, and 15-year hip survival rates in the long-term follow-up results of core decompression alone published by Fairbank and Bhatia[15] were, respectively:

- Stage 1- 100%, 96% and 90%
- Stage 2 -85%, 74% and 66%
- Stage3 -58%, 35% and 23%.

Even though the clinical outcomes were typically positive, 60.7% of the hips had radiologically advanced at least one Ficat stage at that point. Our study's average follow-up is only 12 months. All patients with the exception of 1 with stage 1 disease and 17 hips with stage 2A disease exhibited clinical improvement, indicating that core decompression and cancellous graft do relieve symptoms, reduce radiological progression,

and postpone the need for joint replacement surgery.

Conclusion

- Avascular necrosis of the femoral head is a relentlessly progressing disorder that, if not identified and treated early, typically develops to arthritis, and necessitates total hip replacement.
- In this study, most cases were idiopathic, with alcoholism coming as the second most common causative factor.
- To identify avascular necrosis of the head of femur at an early stage, it is important to inform patients who are receiving treatment and those who have risk factors about the potential for the condition. Patients should also be advised to seek therapy and go through screening.
- For at least two months after the procedure, the patients must continue to partially bear weight
- All patients, except for one who was in stage 1 of the condition, experienced symptom improvement after the treatment.

- Since no stage 1 patient receiving core decompression experienced disease progression throughout the follow-up period and statistical analysis showed a significant improvement in hip scores, core decompression is strongly advised in stage 1 disease.
- In stage 2A, the procedure is advised because it is relatively straightforward, preserves the femoral head, delays joint replacement, and has provided symptomatic relief as demonstrated by an increase in the Harris hip score in 17 patients and a delay in disease progression in 12 hips that are currently being monitored.
- A bigger sample size could be required to statistically validate and determine the efficacy of stage 2A.
- The radiographic stage of the disease is not clinically reflected, and radiological progression may occur despite clinical improvement.
- In stage 1 and stage 2A of the illness, the clinical outcomes of core decompression surgery with or without cancellous bone grafts are quite encouraging.
- The primary determinant in delaying arthritis and joint replacement surgery is early detection and therapy.
- Because the surgery provides symptom alleviation, reduces the disease's course, and postpones total hip replacement, we advise it for patients with stage I and stage 2A illness.

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