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OUTCOME OF CORE DECOMPRESSION IN EARLY AVN OF FEMORAL HEAD USING MULTIPLE SMALL DIAMETER DRILLING

Anatomy

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ABSTRACT

AVN of femoral head is seen commonly in younger patient .AVN is a disease with wide range of aetiology with various theories of pathogenesis. Core decompression has historically been used in early stages of AVN or pre-collapse stage in an attempt to halt the progression of disease . Typically , 8-10 mm wide cannula trephine is used to do this procedure .In this study ,author uses multiple small drilling with 3.2 mm Steinman pin to effectuate the core decompression. In this study, there were 40 of 62 hips (64.5% ;50 patients) with a successful clinical result at mean follow up of 1 year(range 12-18 months). Twenty of 20 stage I hips(100% ;15 patients) have successful outcome compared with 20 of 42 stage II hips (47.6%;35 patients) with no surgical complications with this technique. This procedure may be effective in delaying the need for total hip arthroplasty in younger patients with early (pre-collapse) stages of femoral head Avascular necrosis.

KEYWORDS

Avascular necrosis, core decompression, multiple drilling

INTRODUCTION:

Core decompression has been used often for the treatment of early Avascular necrosis of the femoral head.,,,,,,The procedure has been found to be most efficacious in patients who have pre-collapsed lesions in hips,,,,,,,,Results have been much worse when lesions are large and collapse occurred[10,13,14,],. The indications and use of this procedure are still controversial, and some studies have reported variable efficacy of the procedure,,,,,,,,,,,There are some reports noting high complication rates that can be 10% or greater when the procedure is not done correctly,, The most common method of doing core decompression involves the use of an 8–10 mm trephine or cannula inserted under fluoroscopic guidance to penetrate the lesion. Sometimes this core tract is left open whereas other times it is filled with autogenous bone graft or bone graft substitutes.For example ,in one study ,author uses bone marrow graft . Complications can occur when multiple drillings with the use of these large-diameter trephines weaken the femoral head or when the trephine penetrates the femoral head, injures the articular cartilage, and enters the joint space. For example, in one study(10) the technique involved coring through the femoral head cartilage and removing a cartilage plug; however, this was not typical of other studies.,,,,,,,,,,,In addition, if the core tract is started in the subtrochanteric or diaphyseal area, rather than entering through the metaphyseal region of the proximal femur, the stress riser created can lead to a subtrochanteric fractureThis is a potential complication of vascularized fibular grafts as well, in which a preliminary core tract is made for the graft and occasionally this core tract is made too distally in the diaphysis, which can lead to subtrochanteric hip fracture,,.

The use of multiple small drilling for core decompression has been presented as recently as 2003 at the annual Association Research Circulation Osseuse (ARCO) meeting by Kim et al They reported a lower rate of collapse (14.3%) compared with traditional core decompression methods (45% collapse; n _ 0.03) 3 years after surgery. Because of what seemed to be a low morbidity technique, authors instituted the use of small multiple drillings (3.2 mm Steinman pin) to do core decompressions. The current study was done to determine the early clinical and radiographic success rates of this procedure. We wanted to assess for any morbidity of the procedure including risk of femoral fracture.

MATERIALS AND METHODS:

The study period was from **JAN 2018 - AUG 2019** in Gandhi Medical College and Associated Hospitals, Bhopal.

The sample size for the study would be 50 patients, 62 hips who were affected by avascular necrosis (AVN) and are undergoing the procedures of core decompression by multiple small diameter drilling technique described below. Patients were followed up for for period of 12 months and assessed clinically and radiologically at each follow up during 0,3,9,12 months . There were 10 female ,40 male who had a mean age of 38 years (range 26-50 years).

Inclusion criteria for the study were all the patients above the age of 18 and less than 50 yrs of age , patients complaining of pain in the hip, patient having FicatArlet stage I avascular necrosis(20 hips) and stage II avascular necrosis(42 hips) are included in study. Patients who had any evidence of radiographic collapse(stage III or above) were not candidates for core decompression.

Table 1:Demographic characteristics of study population.

Age		
	Frequency	**Percent**
Below 45 years	32	64.0
Above 45 years	18	36.0
Mean ± SD	37.35 ± 11.49	
Gender		
	Frequency	**Percent**
Female	10	20.0
Male	40	80.0
Smoking		
No	38	76.0
Yes	12	24.0
Alcohol		
N	43	86.0
Y	7	14.0
Steroid		
N	43	86.0

Y	7	14.0
Type of Affection		
Bilateral	12	24.0
Left Side	20	40.0
Right Side	8	36.0
Stage(62 hips)		
I	20	32.0
IIA	30	48.0
IIB	12	20.0

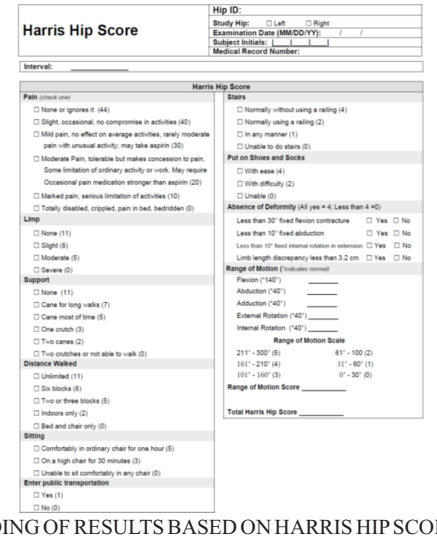
Table 1 depicted the demographic characteristics of study population. The frequency of age was found to be high in cases below 45 years with a percentage of 65.0% and the cases above 45 years is found to have a low frequency with percentage of 35.0% and mean of age of study group was found 37.35 years (SD±11.49). In this study the percentage of male was found to be higher (80.0%) than the female cases (20.0%). Preoperatively, patients were assessed clinically and radiologically.

I. Radiological and clinical evaluation :-

- Ficat and Arlet stage

Stage	Symptoms	Radiography	Bone scan	Pathological findings	Biopsy
0	None	Normal	Decreased uptake?		
1	None/mild	Normal	Cold spot on femoral head	Infarction of weight-bearing portion of femoral head	Abundant dead marrow cells, osteoblasts, osteogenic cells
2	Mild	Density change in femoral head	Increased uptake	Spontaneous repair of infarcted area	New bone deposited between necrotic trabeculae
2A		Sclerosis or cysts, normal joint line, normal head contour	Increased uptake		
2B		Flattening (crescent sign)			
3	Mild to moderate	Loss of sphericity, collapse	Increased uptake	Subchondral fracture, collapse, compaction, and fragmentation of necrotic segment	Dead bone trabeculae and marrow cells on both sides of fracture line
4	Moderate to severe	Joint space narrowing, acetabular changes	Increased uptake	Osteoarthritic changes	Degenerative changes in acetabular cartilage

- Here for grade 1 and 2 AVN ,we are performing core decompression with bone marrow grafting
- Where as for grade 3 and 4 ,THR is suitable option
- Patient assessed clinically using Harris hip score preoperatively and post operatively.



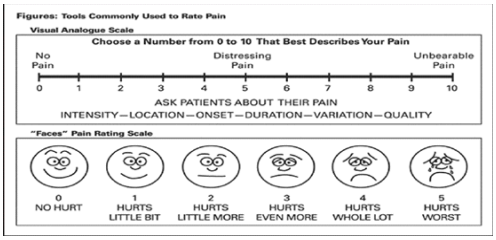
GRADING OF RESULTS BASED ON HARRIS HIP SCORE

Category	HSS
Excellent	90-100
Good	80-89
Fair	70-79
Poor	< 70

Data collection and assessment were performed by two independent observers who were not involved in the surgery.

- Hip pain was assessed using a visual analogue scale (VAS)

Visual Analogue Scale (VAS)
It is a measurement instrument that tries to measure a characteristic or attitude that is believed to range across a continuum of values and cannot easily be directly measured.



Patients requiring additional procedures such as osteotomy, bone grafting ,repeat core decompression or total hip arthroplasty (THA) were considered disease exist. Disease remission was defined as Harris Hip Score greater than equal to 80 with no further operative procedure. Preoperative radiographic evaluation included Anteroposterior radiographic and Magnetic Resonance Imaging(MRI) and was assessed by two of the authors to determine staging system according to system of Ficat and Arlet.

Core decompression surgical procedure:

Patient positioning :

The patient is positioned supine on a fracture table.

It is necessary to ensure that AP and lateral views can be taken with a fluoroscope before preparing the patient to mark the position of femoral head. Draping should be performed in a sterile manner that provides exposure of the anterosuperior iliac spine proximally and continues below the knee distally .

The C-arm is used to locate the starting point , which will provide landmarks for the lateral skin marking. This should be at the lateral cortex at the location of the lesser trochanter or proximal to it A 3-4 cm skin incision is then performed at the corresponding entry point over the lateral aspect of the femur, just below the vastus ridge of the trochanter. The starting point is maintained proximal to the level of the lesser trochanter and distal to the vastus ridge. When the ideal starting point has been obtained, the Steinmann's pin is advanced from lateral to medial under fluoroscopy. Anteroposterior and lateral fluoroscopic views were necessary while advancing the pin to ensure that it remained in the medullary canal of the femoral neck. The authors did three passes through using one common entry point. An effort was made to avoid penetration of the femoral head cartilage when leisons advancing the pin with the surgeon making sure the Steinmann's pin location matches the area of AVN .Once the drilling was completed ,pin was removed and wound was closed with nylon sutures.

Post operatively, patients were maintained at approximately 50% weightbearing for 1 month using a cane or crutch in the opposite hand from the hip that was operated. Deep venous thrombosis prophylaxis was not used because patients were immediately mobilized. If the patient had bilateral core decompression, 2 crutches were used for a 4-point gait. After 1 month the patients were advanced to full weightbearing as tolerated. High-impact loading such as jogging and jumping was not permitted for 12 months. Hip abductor strengthening and ROM exercises was encouraged throughout. If patients were asymptomatic at 10–12 months postoperatively with no radiographic evidence of collapse, they were allowed to resume all usual activities, including higher impact loading activities (such as running).

Figure 1 A- Position of patient on ot table

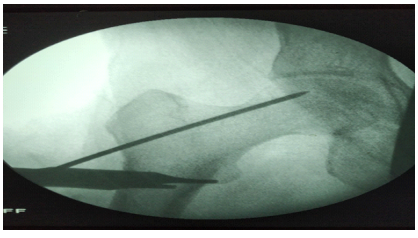


Figure 1 B- C arm image showing placement of Steinman pin

Follow up :
Patients were followed up by OPD visits and interviews.
Functional assessment was done using HHS.
Follow up done at TSR, 3 month, 6 month, and 1 year

RESULTS :

Table 2: Table representing the stage and the status of the disease.

Stage * Status of disease					
			Status of disease		Total
			Exist	Remission	
Stage	I	Count	0	20	20
		% within Stage	0.0%	100.0%	100.0%
	IIA	Count	15	15	30
		% within Stage	50%	50%	100.0%
	IIB	Count	7	5	12
		% within Stage	58.4%	41.6%	100.0%
Total	Count	22	40	62	
	% within Stage	35.5%	64.5%	100.0%	

From Table 2: we observe that out of 50 cases ,62 hips, 20 cases which belong to Stage I samples had a chance of remission of 100.0% after the surgery, whereas Stage IIA had totally 30 cases, out of which 15 samples had an existence of the disease after surgery (50%) and 15 samples had a possibility of remission (50%). Moreover, the Stage IIB had 12 samples, in which 7 was found to have the existence of the disease (58.4%) and 5 had a risk of remission of the disease even after the surgery was successful (41.6%). In 62 Hips ,22 hips had a existence of disease ,where the percentage was found to be 35.5 % and rate of remission was found to be high in 40 hips with a percentage of 64.5 % in all three stages after operation.

Table 3: Table representing the mean of the Harris Hip Score (HHS) during pre and post-surgery.

	Harris Hip Score (HHS) during pre and post-surgery				
	Pre-operative	After 1 months	After 3 months	After 6 months	After 12 months
Mean	60.15	64.1	67.35	70.8	80.4

From the Table 3, we observe that the mean of Harris Hip Score (HHS) was found to be very less during the pre-operative period (60.15), and gradually increased during the post-operative period. However, a statistically significant change was noted after 1 month in which the mean was found to be 64.1,and after 3 months of follow-up the mean value was 67.35, which then improved after 6 months it was noticed to be 70.8 and finally after a year the mean of HHS was found to be 80.4. The functional improvement is directly correlated with the length of follow-up.

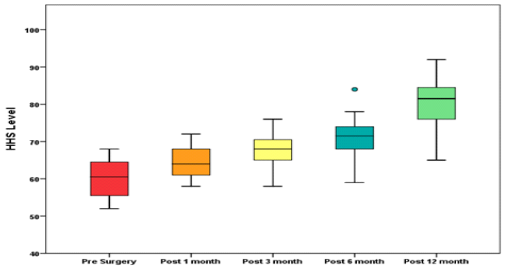


Figure 2: Figure representing the Harris Hip Score (HHS) during pre and post operation.

Table 4: Table representing the mean of VAS pain score during pre-operative, after 6 months and after 12 months of the surgery.

	VAS pain score		
	Pre-operative	After 6 months	After 12 months
Mean	5.25	3.76	2.45

Table 4 suggests that the mean of VAS pain score was found to be high during the pre-operative period (5.25), whereas the mean slowly decreased after 6 months (3.76) and reached a value of 2.45 after a year.

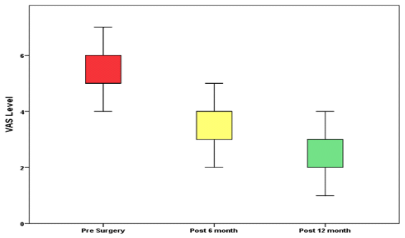


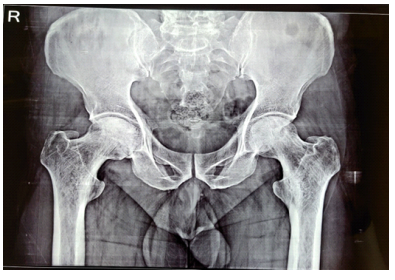
Figure 3: Figure representing the VAS pain score during pre-operation and post operation

Case 1: 55 yr male having bilateral AVN grade II(B) on right side and grade II (A) on left side.

Figure 4 A-Preop xray

Figure 4 B- Immidiate post op x ray

Figure 4 C -X ray at 12 months



DISCUSSION:

This study was done to see if core decompression could achieve good clinical results with low morbidity with a purportedly less-invasive procedure. It is postulated that one of the reasons why core decompression works is by effectuating a reduction in intraosseous pressure when the drilling occurs in the fixed bony envelope of the femoral head7,35,36,39,46. Traditionally, this reduction in intraosseous pressure is achieved by sing large bore trephines (8 mm–10 mm cannulas). Kim et al50 introduced a technique to reduce intraosseous pressure by multiple small trephines (3 mm) drilling. This was similar to the drilling used in this study. In the current study we were able to use this technique in 62 hips and were able to accomplish a 64.5% success rate with minimal morbidity with no serious complications. Limitations of the study include the small number of hips studied (62) with short-term followup (mean of 12 months) with no control patients treated with core decompression with other methods or patients treated nonoperatively. Nevertheless, the authors are encouraged by these results because this procedure compared favorably with the historical use of standard core decompression in terms of clinical results and the technique led to no fractures or other serious complications.Mont et al in his study shows that thirty-two of 45 hips (71%) had a successful clinical result (23 excellent, 9 good) at followup (mean 2 years). Twenty-four of 30 (80%) Stage I hips (23 patients) had a successful outcome, and 8 of 15 Stage II hips (12 patients) were clinically successful (57%). This study supports our

study as results are comparable .In a review of outcomes of core decompression in a meta-analysis of all published studies before 1996, Mont et al 41showed that the results of core decompression were best for early stage lesions and were worse for patients with postcollapse disease. In their analysis of 1206 hips treated with core decompressions from 42 reports, they found success rates of 84% for Stage I diseased hips, 65% for Stage II diseased hips, and 47% for Stage III diseased hips. In the current study Stage I lesions had better clinical results than Stage II lesions (100% versus 47.6% had Harris hip scores greater than 80 points), which were similar to the meta-analysis result study. The authors do not advocate this procedure in postcollapse disease where the results of core decompression have been less than optimal. In studies published since 1996, the results are similarwith more successful results seen in early stage lesions . In these 10 published studies since 1996, there were 530 successful clinical results of 782 hips for an overall success rate of 68%, which is comparable to the current study rate of 64.5%. The current procedure also compares favorably to historical complication rates for core decompression that often occurred 10–15% of the time and included femoral fracture or head blowout9,18,23,39,46. In the current series there were no serious complications that would be expected as an advantage of using 3.2-mm Steinman pins to do the procedure. Although this was a prospectively conducted study, this technique was not compared concurrently with other treatment methods for osteonecrosis of the femoral head. Certainly this procedure can be compared with nonvascularized or vascularized fibular grafting, or osteotomies for precollapse disease14,31,34,43,47,. However, the authors believe that the core decompression is of such low morbidity that if the procedure fails or does not obtain pain relief for the patient, it does not preclude the use of these other procedures.

CONCLUSION :

We think that many patients may be spared much larger, more invasive procedures by using this multiple drilling technique. It has advantages over a standard core decompression, which can lead to risk for head collapse, subtrochanteric fracture, and requires a surgical incision. The excellent results found in the current study underscore the importance of early diagnosis and treatment with core decompression in precollapse stages. We see this as a low morbidity procedure, which takes a short period of time to do. So far there have been no surgical complications associated with this technique and patients can be treated as outpatients. We think this is an appropriate use of core decompression when treating symptomatic patients with precollapse lesions.

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