A study on AVN cases attending at a tertiary care hospital: Etiological factors and treatment

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Abstract:
Introduction: Avascular necrosis is defined as a group of symptoms, dominated by pain, loss of function and bony collapse caused by anoxemia and other deficiency in arterial nutrition of the head of the femur, prolonged enough to result in the marked degeneration, even necrosis of bone.
Methodology: Data collected included: Pre-clinical studies – model of AVN, variety and dosage of SC, histologic and imaging analyses. Clinical studies – study design, classification and etiology of AVN, and treatment protocol.
Results: It was also noticed that 9 hips (28.13) with stage III, 8 hips (25%) with stage II and 2 hips (6.25%) associated with stage I disease. There was one hip (3.13) of Stage V and VI each. This was according to classification by Steinberg et al.
Conclusion: Thus, a focus on early disease management aimed at joint preservation by preventing or delaying progression is key.

Key words: Avascular necrosis, Femoral head, Treatment

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Introduction

Osteonecrosis is a disorder resulting from a temporary or permanent loss of blood supply to the bone. Blood carries essential nutrients and oxygen to the bones. When the blood supply is disrupted, the bone tissues (osteo) begin to break down (necrosis). This can weaken the bone and eventually result in its collapse. If this occurs near a joint, it can lead to the collapse of the joint surface, resulting in pain and inflammation (arthritis). Osteonecrosis is also referred to as avascular necrosis or "AVN", "aseptic necrosis", and "ischemic bone necrosis".[1]

Avascular necrosis is defined as a group of symptoms, dominated by pain, loss of function and bony collapse caused by anoxemia and other deficiency in arterial nutrition of the head of the femur, prolonged enough to result in the marked degeneration, even necrosis of bone. Its most frequent cause is abrupt disruption, thrombosis or embolism of a large amount of coronary artery (Chandler FA, 2001).[2]

It is a progressive devastating disease with wide ranging etiology and poorly understood pathogenesis commonly affecting patients in the third, fourth, or fifth decade of life. The development of osteonecrosis can have a major impact on an individual's lifestyle. The bones commonly affected are, the femoral head, humeral head, scaphoid, lunate, talus, medial condyle of tibia and capitellum, of which the femoral head is the commonest site.[3] Osteonecrosis can occur in a single bone, but more commonly occurs in several bones at one time (multifocal osteonecrosis).[1]

Osteonecrosis can sometimes be disabling, depending on what part of the bone is affected, how large an area is involved, and how well the bone rebuilds itself. Normal bone continuously breaks down and rebuilds itself. This process keeps the bones strong. Osteonecrosis is the result of bone tissues breaking down faster than the body can repair them. If the disorder progresses, it can lead to pain and arthritis.[1]

There are several etiological factors of osteonecrosis of femoral head. They may be traumatic (after femoral neck fractures or dislocations of hip joint), idiopathic, Corticosteroid induced, alcohol abuse, following infection, Haemoglobinopathy, post-irradiation, Caisson's disease, Gaucher's disease and associated with gout.

According to Kenzora the term avascular necrosis should be reserved exclusively for the post-traumatic group, because they originate in ischemia as a result of interruption of blood flow. When the etiology of the necrosis has not been established clearly, or it is obscure it is best to call in idiopathic osteonecrosis.[4]

The ultimate goal of treating osteonecrosis of the hip is preservation of the femoral head. However, this is difficult since the condition is associated with a number of different diseases and neither the etiology nor the natural history has been definitively determined. The diagnosis of osteonecrosis accounts for 5% to 12% of total hip replacements performed.[5]

Methodology

The present study includes 20 cases of avascular necrosis of bone. They were found as complications following traumatic and non-traumatic causes who attended and treated in Basaveshwara Medical College, Chitradurga, Karnataka.

Inclusion Criteria:

a. All stages of osteonecrosis of bone
b. All cases of traumatic & non-traumatic causes
c. Any age and both sexes

Methods

The present study was carried out under the following headings:-

a. Clinical profile of the patient
b. Radiological study
c. Treatment suggested.

On admission of the patient all the patients were assessed clinically. A detailed history was obtained thorough following proforma. Radiological investigations included plain X rays in the form of X- ray pelvis with both hips AP and lateral views. In patients with unilateral symptoms and in affordable patients MRI was done to assess the condition of the opposite hip and also to confirm the diagnosis and staging of the disease.

Results

Table 1: Showing Age Sex Distribution

Age(years)	Male	Female	No	%
10-20	1	2	3	15
21-30	3	1	4	20
31-40	4	1	5	25
41-50	4		4	20
51-60		1	1	5
>60		3	3	15
Total	12	8	20	100

From the table 1 it was observed that the age of these patients ranged from 13 to 75 years with a median age of 39.5 years. The majority of our cases were in the 4th decade. The second peak of incidence was noted in 3rd and 5th decade (4 cases each: 20%).

Out of 20 patients, 12 were males (60%) and 8 were females (40%). The ratio of M: F being 1.5.

Table 2: Showing regional distribution

Districts of Assam	No of patients	%
Dibrugarh	9	45
Jorhat	3	15
Sibsagar	3	15
North Lakhimpur	1	5
Tinsukia	4	20

From the table 2 it was observed that incidence of AVN as per our data distribution is tabulated above. Maximum numbers were from Dibrugarh district (45%).

Table 3: Distribution in relation to socioeconomic status.

Socio-economic status	Total no. of cases	%
Lower class (Poor)	2	10
Lower middle class	9	45
Upper middle class	5	25
Upper class	4	20

From table-3 it was observed that 45% of patients were from lower middle class according to their annual income, as per economic survey done by Govt. of India on 1992 -1993 as follows:

1. Lower –Annual income Rs. 8500/-or less
2. Lower middle - Annual income Rs.8501/- to 40,000/-
3. Upper middle - Annual income Rs. 40,001/- to 1,25,000/-
4. Upper - Annual income Rs.1,25,000/-or more

Next higher number 5 (25%) were belonged to upper middle class, 4 patients (20%) were belonged to upper class and 2 patients (10%) were belonged to lower class.

All patients had pain in the affected joint. Difficulty in walking was noticed in 5 patients (20%). It shows that all patients are symptomatic.

Table 4: Showing Duration of Pain

Duration	No of patients	%
< 2 months	2	10
2-4 months	2	10
4-8 months	5	25
8-12 months	6	30
1-2 years	4	20
2-5 years	1	5

From the table-4 it was observed that duration of symptoms ranged from 2 months to 5 years with an average of about 2.4 years. Majority of the patients were in 8-12 months group (30%). 5 patients (25%) were in 4-8 months.

Table 5: Showing in Relation to Severity of Pain

Severity	No of patients	%
Mild	6	30
Moderate	10	50
Severe	4	20

From the table 5 it was observed that pain was the main presenting feature of necrosis which occurred in all patients (100%). The intensity of pain varied from mild, moderate and severe type. The majority of cases (50%) had moderate intensity according to restriction of activities.

1. Mild pain-- Where pain does not interfere with daily activity.
2. Moderate pain-- Where pain interfere with daily activity but does not restrict work
3. Severe pain- Where the pain restrict all activities

Table 6: Unilateral vs. Bilateral

Laterality	No. of cases	%
U/L cases	13	65
B/L cases	7	35
Total	20	100

From the table-6 it was observed that most of the cases were unilateral (65%). Bilateral AVN were noticed in 8 patients (40%).

Table 7: Side Affected in U/L Cases

Side	No. of cases	%
Right	5	38.46
Left	8	61.54
Total	13	100

From the table 7 it was observed that out of all 13 unilateral patients AVN affects predominantly in left side (61.54%) compared to right side (38.46%).

Table 8: Showing in Relation to Aetiology Distribution

Symptoms	No. of cases	%
Traumatic	3	15
Steroid	4	20
Alcohol	6	30
Smoking	8	40
Haemoglobinopathy	2	10
Idiopathic	7	35

From the table 8 it was observed that avascular necrosis of femoral head was associated in 6 alcoholic patients (30%) and in 8 smoking patients (25%). Traumatic causes like posterior dislocation of hip (10%) and fracture neck of femur (5%) was implicated in the causation of osteonecrosis of femoral head. Steroid was implicated in causation of AVN in 5 patients (25%). Patients of Hemoglobinopathies like sickle cell disease are more prone to develop AVN of bone. In our study 2 AVN patients (10%) were due to sickle cell anaemia. Cases in which no etiology was found were labeled as idiopathic. In 7 patients (35 %) cause that could not be elicited.

Table 9: Showing Common Symptoms and Signs

Examination findings	Total no. of cases	%
Pain	20	100
Difficulty in walking	5	25
Pallor	9	45
Icterus	2	10
Edema	1	5
Antalgic gait	11	55
Tenderness at hip joint	18	90

From the table 9 it was observed that pain was the main presenting feature of necrosis which occurred in all patients (100%). On examination most of the patients were found to be anemic (45%). Icterus was present only in 2 patients (10%). Edema noticed in one patient, who was taken steroids for nephrotic syndrome. Antalgic gait was noticed in 11 patients (55%).

Table 10: Showing Shortening of Affected Limb

Shortening	No of cases	%
Nil	9	45
≤1 cm	8	40
1.1-2 cms	1	5
> 2.1 cms	1	5

From the table 10 it was noticed that ≤ 1 cm shortening of affected limb in 8 patients (45 %). Limb length discrepancy was not found in 9 patients (45%).

Table 11: Showing the Stage of Disease

Stages	Unilateral		Bilateral		Total	%
	Right	Left	Right	Left		
I	0	1	1	0	2	6.25
II	0	2	2	4	8	25
III	0	2	4	3	9	28.13
IV	2	2	4	3	11	34.38
V	0	0	0	1	1	3.13
VI	1	0	0	0	1	3.13

From the table 11 it was observed that 11 hips (34.38%) with stage IV disease. It was also noticed that 9 hips (28.13) with stage III, 8 hips (25%) with stage II and 2 hips (6.25%) associated with stage I disease. There was one hip (3.13) of Stage V and VI each. This was according to classification by Steinberg et al.

Table 12: Showing the Types of Treatment

Treatment options	No of patients	%
Conservative	5	25
Core decompression and impaction bone grafting	4	20
Core decompression and fibular grafting	4	20
Bipolar arthroplasty	3	15
Total Hip Replacement	2	10
Referral	2	10

From the table 12 it was observed that 5 patients (25%) were preferred conservative method of treatment and operative method of treatment was suggested in 13 cases (65%). Core decompression and impaction bone grafting was done in 4 cases (20%), Core decompression and fibular grafting was done in 4 cases (20%), Bipolar arthroplasty was done in 3 cases(15%) and Total Hip Replacement was done in 2 cases(10%). Two patients (10%) were referred to other centers for further evaluation.

Discussion

Dun and Grow[6] (1977) in their study had age group ranging between 26 to 59 years. In Bukley[7] et al (1991) study the age group ranged from 31years to 55 years. In John Paul Jones et.al [8] (2001) study the average (mean) age of the patients when necrosis was diagnosed was, for the transplant group 21.3 years and for the non-transplant group, 43.1 years. In Mont[9] and Michael et al (2003) study the age group ranged between 19years to 42 years.

Table 13

Series	Age group
Dunn and Grow	26 –59 years
Buckley et al	31-55 years
Mont et al	19-42 years
Our study	13-75 years

In our study the majority of the cases were in their 4th decade with median age of 39.5 years and ranging between 13 –75 years. Our observations are comparable with Mont et al.

1. Sex distribution: Barnes et al[24] (1976) reported AVN was more common in females than males.[19] In Dunn and Grow (1977)[6] series 76% were males and 24% were females. In Buckley et al (1991)[7] study 68% were males and 32% were females. John Paul Jones et.al[8] (2001) - Thirteen patients were males and 19 were female. In Mont et al[9] series 57% were females with 43% males. Marciniak et al[11] study 58% were males and 42% were females. In Roy K. Aaron[12] (2007) study the male-to-female ratio was approximately 4:1.

Table 14

Series	Male	Female
Dunn and Grow	76%	24%
Buckley et al	68%	32%
Mont et al	43%	57%
Marciniak et al	58%	42%
Our study	60%	40%

Our observations are comparable to results of Marciniak et al with male 58% and female 42%.

2. Patients presentation: Pain is the usual presenting symptom; it can be very intense and sudden in onset, as in an infarct, or it can be insidious and chronic. It is most often reported in the groin, but radiating pain to the anterior or anteromedial thigh is common. Less commonly, buttock pain is noted. Pain is present at rest and is worse with hip motion and weight bearing.[13]

Osteonecrosis of femoral head has been reported to be bilateral in 50% or more of cases. Boettcher WC 1970, Hauzeur JPH 1987, Jacobs B 1978, Marcus ND 1973). Hauzeur JPH et al. 1987 reported an incidence of bilaterality, diagnosed by biopsy of 89%. Of the 35 hips studied, 17 were in the preradiographic stage (Ficat stage I); 8 were Ficat stage II, 5 were stage III, and 5 were stage IV.[13]

Ito *et al.* [2003] studied the natural history of osteonecrosis by following the lesions in the contralateral hip of patients in whom unilateral symptomatic collapse had originally been diagnosed (60 hips in 60 patients) or by screening patients with collagen disease (30 hips, 17 patients). Follow-up ranged from 5 to 16 years (mean, 9 years). Using the Steinberg classification system, there were 39 stage I hips, 40 stage II, and 11 stages III.[14]

Merle D Aubigné et al (1965) reported that in patients with bilateral osteonecrosis, simultaneous onset was rare and the second hip was involved at onset in 13%, at 6 months in 24%, at 1 year in 26%, and at 2 years in 36% of cases.[15]

In 1973 Marcus et al identified six stages in idiopathic ischemic necrosis based on clinical, roentgenographic, and histological criteria. In Stages I and II, the patient is asymptomatic and the hip is ‘‘silent’ despite early roentgenographic and histological changes.[16] In our series pain was the main presenting feature of necrosis which occurred in all patients (100%). The next common finding was difficulty in walking in 5 patients (25%). The intensity of pain varied from mild, moderate and severe type. The majority of cases had moderate type.

In our study most of our patients came relatively late reporting to the hospital. Duration of symptoms ranged from 2 months to 5 years with an average of about 2.4 years. Maximum number (30%) of patients reported during 8-12 months after onset of disease. 5 patients (25%) reported at 4-8 months. 4 patients (20%) reported after 1 year but within 2 years.

Majority of the cases were unilateral (65%) when they presented to us. Bilateral AVN was noticed in 7 patients (35%). In unilateral cases MRI was done to rule out AVN of opposite hip. Out of all 13 unilateral patients AVN affected left side (61.54%) as compared to right side (38.46%).

3. Etiology and risk factors

a) AVN due to dislocation: John Paul Jones et al (1971) stated that about 10% of posterior hip dislocations are complicated by avascular necrosis of the femoral head.[14] The incidence of ONFH after hip

dislocation is reported to be 10% to 25 %. (Epstein HC 1973, Roeder LF Jar 1980).[1] In Bravo EA (1962) series, 52% of hips dislocated for more than 12 hours developed ONFH, compared with 22% of those reduced within 12 hours. Hougaard and Thompson reported osteonecrosis in 4% of hips reduced within 6 hours and in 58% of hips that remained dislocated for more than 6 hours.[17]

Stewart and Milford reported osteonecrosis in 15.5% of hips treated by closed methods and in 40% of hips treated by open techniques, an overall osteonecrosis rate of 21.2%.[17]

Table 15

Author	Incidence
John Paul John et al	10 %
Roy K Aaron	10-25 %
Stewart and Milford	21.2%
Our series	10 %

We found 2 cases of avascular necrosis following traumatic dislocation of hip joint. One case was presented with neglected posterior dislocation of hip of 5 months duration. The other case was presented with AVN following history of dislocation (6 months back), which was closely reduced after 12 hours of injury.

b) Fracture neck of femur: Rohrabacher et al. (2001) reported that avascular necrosis developed in nearly 20 percent of all fracture types after surgical management.[18] Gómez-Castresana et al.(2002) reported that the mean of avascular necrosis rate were 8.5% and 29.3% respectively for nondisplaced and displaced fractures.[19]

Catto et al. (1965) found total or partial capital necrosis after 13 days in 83% of 109 cases.[20] John Paul Jones et al. (1971) stated that approximately 35% of displaced fractures of the femoral neck, the proximal fragment eventually become necrotic.[14]

In our series one patient JD 38 year male patient had sustained injury in the right hip due to fall 2 years back. X-ray examination revealed transcervical fracture neck of the femur. Cancellous screw fixation was done after 20 days following fracture neck femur. X-rays done after 1½ years, revealed increased density of the head with slight collapse of the femoral head. Cancellous screws were removed for pain and he was advised crutch walking. This time he presented with pain and x-ray revealed further collapse of head with definite radiological evidence of arthritic changes of AVN.

Smoking

De Bastiani el al., (1984) found that smoking is strongly associated with ON patients.[33] Cigarette smokers were defined as those who smoked at least one cigarette per day. Smoking habits were classified as nonsmokers, former smokers, and current smokers. The current smokers were classified according to the daily number of cigarettes smoked, <20 or ≥20 per day. Former smokers were combined with non- smokers.[21]

In our series history of smoking was found in 40% of total cases.

Alcoholism

Alcohol drinkers were defined as those who consumed over 8 ml of alcohol at least once a week. Drinking habits were classified into nondrinkers, former drinkers, occasional drinkers (at least once a week, but not daily), and regular drinkers (daily consumer).[21]

Table 16: Risk of osteonecrosis associated with alcohol (Matsuo K et.al., 1988)[22]

Dose (mL/wk)	Risk
0	1.0
<400	3.3
400-1000	9.8
>1000	17.9

In 1962, Massias confirmed etiologic role of alcohol in AVN. Frequency varied from 10% to 42%.[21] Patterson et al. (1964) compared the proportion of alcoholics between ON patients and a random sample of 84 patients with either degenerative joint disease or osteoarthritis of the hip. The alcoholics accounted for 17% of the ON patients and for less than 5% of the comparison group.[21]

Sugioka et al. (1976) observed a rate of 2% of Osteonecrosis among 152 alcoholics selected from an institution.[22] Malka noted that three of his six patients with necrosis of the femoral head were alcoholics.[12]

Serre & Simon and Patterson et al, found that 19% and 17% of their respective series of patients with avascular necroses had a significant alcoholic history.[8] Ono and Sugioka et al. (1993) stated that exposure to corticosteroids and alcohol intake accounted for approximately 90 per cent of all reported associated causes of avascular necrosis.[15]

Osteonecrosis of the femoral head associated with alcohol intake makes up 10% to 40% of osteonecrosis of femoral head cases in several series (Arlet J 1992, Jacobs B 1978, Patterson RJ 1964).[13]

Table 17

Author	Frequency
Massias et al (1962)	10-42%
Patterson et al.,(1964)	17%
Sugioka et.al.,(1976)	2%
Serre and Simon	19%
Japanese orthopedic surgeons committee (1988)	21.8%
Our series	30%

In our series alcoholism was associated with 30% of total AVN cases. Our results are comparable to Massias et al (1962) results.

Steroid

In cross-sectional studies, 10% to 30% of the cases of osteonecrosis have been associated with corticosteroid administration. However, the few prospective longitudinal studies (Felson DT 1987) indicated that osteonecrosis might occur in only 8% to 10% of patients exposed to corticosteroid therapy.[23]

In 1988 Committee survey by Japanese Orthopedic Surgeons estimated the non-traumatic ANFH occurred in 2500-3300 adults during 1988 alone. Of these cases, 34.7% were due to CS treatment, 21.8% to alcohol abuse, and 37.1% were considered idiopathic.[21]

Bravo (1967) and associates reported the first prospective clinical study of avascular necrosis after renal homotransplantation. In five of sixty patients, three to eight months after operation and the beginning of corticosteroid immunosuppression, avascular necrosis developed in the femoral head bilaterally in four and in the distal end of one femur in one.

Table 18

Series	Frequency
Japanese Orthopedic surgeons committee (1988)	34.7%
Felson DT 1987	8-10%
Our series	25%

In our series 20% of osteonecrosis of femoral head was due to steroid intake. PD 13 year's female patient was a known case of nephrotic syndrome and treated with steroids. She developed osteonecrosis of both femoral heads due to prolonged steroid intake. Another patient RG 32 year female patient was a known case of SLE and treated with steroid for a long duration. She presented with bilateral AVN of femoral head. LG 62 year female patient developed symptomatic AVN of right femoral head after prolonged steroids intake for peripheral neuropathy. MRI examination shows AVN changes in left side also. MR 26 year male patient had taken steroid for ankylosing spondylitis for about 5 months. Now he presented with bilateral AVN.

Hemoglobinopathies

Tanaka KR (1956) had shown that incidence of ONFH in sickle cell disease is 4% to 12%.[13] Iwegbu CG (1985) studied 899 patients with sickle cell disease, 29 were reported to have ONFH, an overall incidence of 3.2%.[13] Hernigou P (2003) reported that natural history of symptomatic osteonecrosis in adults with sickle cell disease, 65 of 75 hips (87%) without collapse of the femoral head at the initial evaluation demonstrated collapse within 5 years after diagnosis.[13] Tanaka KD (1956) & Barton CJ (1962) reported prevalence of osteonecrosis in sickle cell disease patients has been 4% to 20%.[13]

The patient with proven osteonecrosis of femoral head due to sickle cell disease should be observed closely since 50% to 80% of the patients develop bilateral affection. (Merle D'Aubingne, R. Postel M. et al. 1965. Boettcher W.G. et al. 1970; Ficat R.P., 1983).[22]

Pauling (1949) found the use of electrophoresis that erythrocytes from the patient of Sickle cell trait contained approximately 60% normal haemoglobin and 40% abnormal haemoglobin.[13]

Table 19

Series	Frequency
Tanaka KR (1956)	4-12
Iwegbu CG (1985)	3.2%
Hernigou P (2003)	87%
Our series	10%

In our series patient named TK 25 years female presented with bilateral AVN of femoral heads. On Hb typing hemoglobin S was found. Patient was expired on 3rd postoperative period due to sickle cell crisis. Another 16 years female patient JY developed AVN due to sickle cell disease. In our series 9 patients (45%) presented with pallor at presentation Antalgic gait was noticed in 11 patients (65%). Limb length discrepancy noted in 8 patients (40%). Shortening noticed was less than 1 cm.

Stages of AVN hip

We studied 20 patients with osteonecrosis of femoral head by following traumatic and non-traumatic causes in 32 hips. Out of 32 hips 11 hips (34.38%) with stage IV, 9 hips (28.13) with stage III, 8 hips (25%) with stage II and 2 hips (6.25%) associated with stage I disease. There was one hip (3.13) of Stage V and VI each. This was according to classification by Steinberg et al.

Treatment

Conservative: In our series 5 patients (25%) were preferred for non-operative treatment. Two patients are referred to other centers for further evaluation.

Core decompression: Ficat (1980) claimed core decornpression is only indicated in pre-collapse stage. The mean percentage of good results is 75% for Stage I and 57% for Stages 11 and I.[21] Hungerford (1983) found encouraging results for stage I and stage II lesions.[24] Mont et al.(1995) reviewed 24 studies of core decompression, and found satisfactory clinical results in 741 of 1166 hips (63.5%). For pre-collapse lesions there was a 71% success rate in the core decompression group compared with a 34.5% success rate in the non-operative group.[24]

Core decompression and fibular grafting: In pre-collapse and early post-collapse disease in which articular cartilage is viable, bone grafting has numerous theoretical advantages. It allows for removal of weak necrotic bone, decompression of the femoral head, and stimulation of repair and remodeling of subchondral bone. Bone grafting also provides for maintenance of articular congruity and prevention of collapse. Cancellous bone and cortical bone can both be used.[25] Strut-grafting (non-vascularized fibular grafting) procedures, was originally described by Phemister (1949).[26]

At a mean of eight years, Buckley et al. (1991) reported excellent results in eighteen (90%) of twenty hips in which a Ficat Stage-I or II lesion had been treated with core decompression combined with tibial auto grafting and fibular grafting. [26]

Bipolar arthroplasty: Cabanela (1990) found 10 successful clinical outcomes in 17 patients (59%) that had a bipolar prosthesis for stage III or IV osteonecrosis at a mean follow-up of 9.2 years.[27] Bipolar hip prostheses are preferred for the treatment of advanced ANFH, provided that stable initial fixation can be achieved.[28] Ito et al (2000). Reported that 48 hips in 35 patients with a mean age of 37 years who underwent primary bipolar Hemiarthroplasty were observed for an average of 11.4 years.[29] Bipolar arthroplasty was suggested in 3 patients (15%) as per indications.

THR

Fye et al. (1998) reported the results of 72 arthroplasties at a mean follow-up of 84 months. Good to excellent results were reported in 94% of all the hips.[24] Garino and Steinberg et.al (1997) considered that THR was the best available treatment in most cases of advanced osteonecrosis of the femoral head and the often appearing secondary osteoarthritis.[24] In our series total hip arthroplasty was suggested to 2 patients (10%) as per indications.

Conclusion

Core decompression with modification of technique is still one of the safest and most commonly employed procedures with evidence based success in the pre-collapse stage of AVN of femoral head.

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Conflict of Interest: Nil

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