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Results of Cementless Total Hip Arthroplasty in Patients Below 50 Years for Ficat and Arlet Stage Iii and Iv Avascular Necrosis of The Femoral Head

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Abstract

Background: Total hip replacement has proven to be the treatment of choice for patients with intolerable pain and limitation of hip movement due to avascular necrosis of the femoral head suffering for many years. Cementless hip arthroplasty has taken over in recent times and replaced conventional cemented total hip arthroplasty in young adults.

Objective: To evaluate the results of cementless total hip arthroplasty in patients below 50 years for Ficat and Arlet stage III and IV avascular necrosis of the femoral head.

Methods: This study was a prospective observational study and was conducted in the Department of Orthopaedics, National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka over a period of one year from May 2022 to April 2023 through non randomized purposive sampling. All patients were admitted with diagnosis of avascular necrosis of the femoral head Ficat and Arlet stage III and IV satisfying the inclusion and exclusion criteria. Functional, postoperative complications and radiological outcome was studied. Functional outcome was evaluated by Modified Harris Hip Score.

Results: The mean age of the patients was 33.20 ± 6.86 years with range 21-49 years. Majority of patients were male (69.7%). 39.4% were businessman and 9 out of 10 women (27.3% of total) were housewives. Idiopathic AVN was encountered in 57.6% cases and 33.3% was steroid-induced. Majority, 54.5% cases had left hip involvement. The mean per-operative blood loss was 491.2 ± 48.4ml. Only 1 patient (3.03%) had superficial surgical site infection and 3 (9%) had limb shortening. Radiological findings revealed 100% neutral aligments of implants. Evaluation of final outcome by Modified Harris Hip Score showed excellent (69.7%), good (24.2%) and fair (6.1%) result.

Conclusion: The outcome of cementless total hip arthroplasty has shown excellent results in terms of pain relief, relief from limp, improved functional capabilities of the patient, fewer postoperative complications and good radiological outcome.

Keywords: Cementless; Arthroplasty; Avascular necrosis; Femoral head; Ficat; Arlet stage

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Introduction

Avascular necrosis (AVN) of the femoral head is an increasingly common cause of musculoskeletal disability, and it poses a major diagnostic and therapeutic challenge. The disease affects mostly young adults within their 3rd and 5th decade, the majority of the patients being men [1]. In developing countries, the aetiology of AVN showed that 70% of the patient developed AVN of hip joint without any known cause (idiopathic), 16.7% developed AVN secondary to corticosteroids, and 13.3% to be post- traumatic [2]. The early manifestation of AVN of the femoral head includes joint pain and stiffness. In advanced cases movement is restricted and there may be fixed deformities [3]. The management of AVN of the femoral head ranges from conservative to invasive. Initial stages can be treated conservatively but total hip arthroplasty is the preferred treatment of choice for stage III and IV AVN that can be cemented or cementless [4].

Cementless total hip arthroplasty (THA) is rapidly being accepted as the surgery for arthritic disease of the hip joint. The bone in-growth rate in porous-type cementless implants was about 90% over 10 years after surgery, showing that biological fixation of cementless total hip replacement was well maintained on both the stem and cup sides [5]. Cementless THA in patients below 50 years provided outstanding long-term fixation and significant pain relief well into second decade [6].

Karimi et al. [4] conducted a study termed 'Functional outcomes of Cementless THA in AVN of the hip: A prospective study'. A total of 30 patients were taken into consideration. He concluded that cementless THA has reassuring results, not associated with any significant early or late complications and has outstanding functional outcome [4]. Yamada et al. [5] concluded that surgeons increasingly use cementless THA because biological fixation in which the prosthesis is directly fixed to the bones is an ultimate fixation method; and the absence of cement may be considered to reduce a mechanically unstable interface [5]. Corten et al. [7] conducted a randomized control study comparing total hip arthroplasty performed with and without cement. The study included 250 patients with advanced Osteoarthritis who were managed with THA between October 1987 and January 1992. Patients were followed for a mean of 20 years. 126 patients underwent cementless replacement and 124 patients underwent cemented replacement. With regards to revision rate, the cementless implants significantly outperformed the cemented implants both on the femoral side and acetabular side [7]. Pospula et al. [8] conducted a retrospective analysis regarding cementless and cemented THA. 76 patients with mean age 53.7 years underwent cemented procedure and 89 patients with mean age 46.7 years underwent cementless procedure. The average follow-up periods were 60 months for cemented and 36 months for cementless. A better clinical outcome and lower revision rate was observed in in patients who underwent cementless procedure compared to cemented group ($p<0.05$) [8]. Cementless implants were introduced approximately three decades ago in order to address aseptic loosening of cemented hip prosthesis with the aim of early mobilization, better functional outcome and bone stock preservation [9].

Figure 1: Patient positioned laterally and draped.

Figure 2: Acetabular reaming.

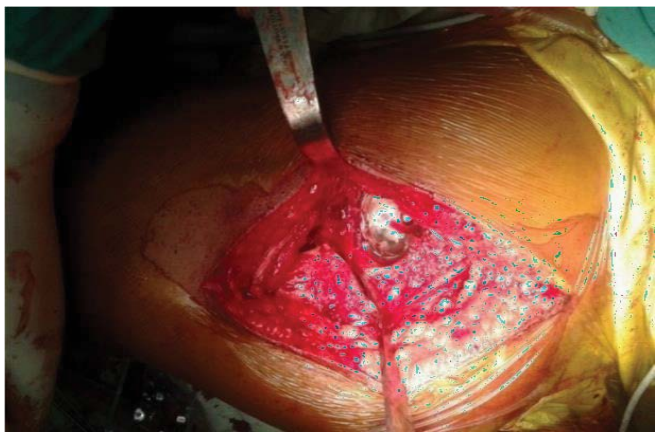

Figure 3: Insertion of Acetabular component.

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Figure 4: Flexible drill bit to create hole for Acetabular screw insertion.

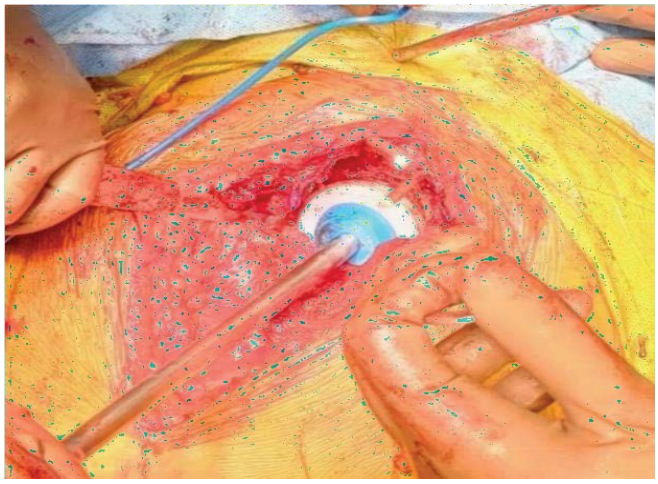

Figure 5: Acetabular liner placement.

Figure 6: Femoral rasps are used to broach the Femoral canal.

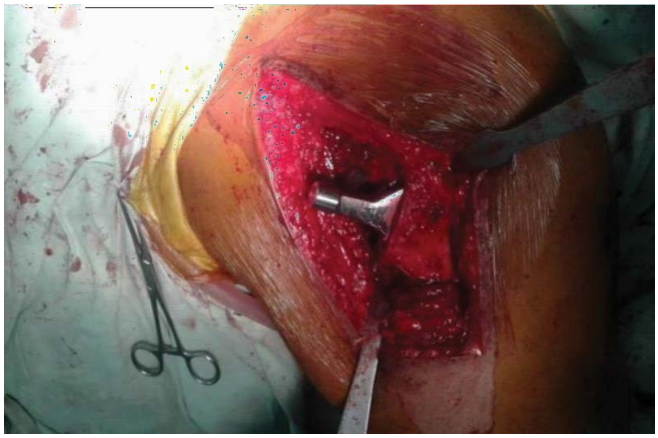

Figure 7: Placement of Femoral stem.

Figure 8: Femoral head trial and introduction of appropriate head size.

Figure 9: Preoperative X ray of Pelvis with both Hip joints antero-posterior (A/P) view.

From the literature it is evident that in developed countries cementless prosthesis are being preferred for younger patients. In our country, use of cementless prosthesis is still in initial stages mainly due to lack of data regarding the outcome. Most of the national literature available or thesis work done involved only cemented procedure. The purpose of this research article was to inform the results of cementless THA in patients below 50 years with AVN of the femoral head Ficat and Arlet stage III and IV with respect to functional outcome, postoperative complications and radiological findings.

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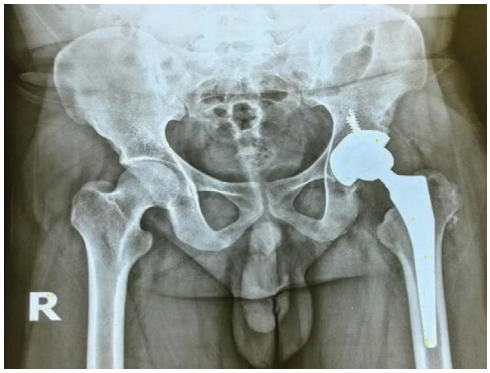

Figure 10: Post-operative X ray of Pelvis both hip joint A/P view.

Figure 11: Pre-operative X ray of left hip A/P and lateral view.

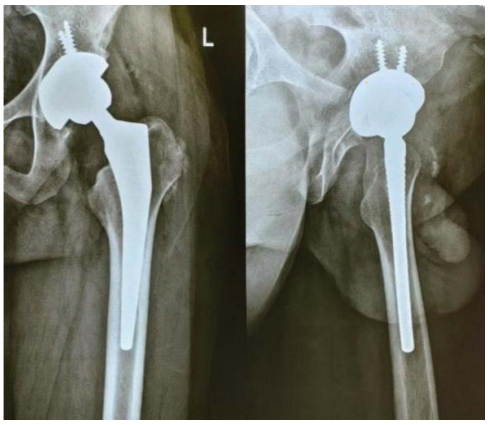

Figure 12: Post-operative X ray of left hip A/P and lateral view.

Methodology

This was a observational study carried out at National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka during May 2022 to April 2023. For the research, a total of 33 patients were selected aged below 50 years and admitted from Outpatient department, NITOR. They were interviewed by specific questionnaire and followed up ranging 6 weeks to 12 months and findings of the study derived from data analysis. Non-randomized, purposive sampling was done according to availability of the patients and strictly considering the inclusion and exclusion criteria. The inclusion criteria included: (1) age below 50 years (2) both sex (3) any side (4) AVN-Ficat and Arlet stage III and IV irrespective of cause (5) mentally stable patients. The exclusion criteria: (1) age and or above 50 years (2) previous replacement surgery in involved hip (3) septic hip. Ethical clearance for the study was obtained according to the Declaration of Helsinki and informed consent was obtained before the surgery. The Hardinge (Direct Lateral Trans gluteal) approach was used for the procedure in all the cases and spinal anaesthesia was used. The important steps of the surgery are shown in Figure 1-8.

The post-operative care and rehabilitation protocol:

The day of operation: (a) Abduction pillow to keep operated limb 15° abducted, (b) Flexion, adduction internal rotation of operated limb was restricted, (c) Broad spectrum antibiotic coverage and analgesics was ensured

1st post-operative day: (a) Patient was allowed to sit in semi-recumbent position with assistance, (b) Exercise: breathing, isometric quadriceps exercise, gluteal exercise, isometric abduction with self-resistance and (c) Pneumatic compression calf-stocking

2nd post-operative day: (a) Check X- ray was done, (b) Walker-advised to walk 30 minutes a day with help of a walker, (c) Advised to use high toilet, After 48 hours: Removal of drain

3rd post-operative day: (a) Patient was discharged with 7 days of oral antibiotic coverage

Advise during discharge: (a) Patient was advised not to squat, stoop, cross legs and not to lie on effected side. (b) Driving prohibited for 6 weeks, (c)Manual labour to be avoided, (d) Gradually increase the walking distance with the aid of walker, (e) Hip exercises to be continued along with hip extension exercises in prone position. (f) After 2 weeks: Advised for stitches off.

Follow-up protocol: The patients were followed up at 6 weeks, 3 months, 6 months and at 1-year.

Fullweight- bearing: After 6 weeks walker was discontinued, and patient was allowed full weight- bearing.

Outcome measure: At each follow-up, history of the patient with reference to pain, limp, range of motion was taken carefully. Clinical examination of hip and neurological status of the involved limp was carried out. Range of motion was measured by a goniometer and limb length measured by a measuring tape. If wound infection was suspected, then a wound swab was sent for antibiogram. Antibiotic

was prescribed accordingly and regular sterile dressing was carried out till infection subsided. Radiology of pelvis with both hip antero-posterior view and lateral view of operated hip was done and prosthetic alignment was noted. Any periprosthetic fracture, loosening, dislocation and subsidence was noted.

Data collection, processing and statistical analysis: Data was recorded in a predesigned data collection form and functional outcome was recorded in Modified Harris Hip Score sheet. The data was handled and stored in accordance with the tenets of the Declaration of Helsinki. Statistical analysis of the results was obtained by using window-based Microsoft Excel and Statistical Package for Social Sciences (SPSS-24). The data was tabulated and quantitative parameter were summarized in terms of mean and range. Standard deviation (SD) was computed to understand variation present in the data. Descriptive data was expressed by frequency, percentage, mean and SD. Association and co-relation was done by paired t test analysis. For all statistical tests, we considered p value < 0.05 as level of statistically significant at 95% confidence interval.

Results

Table 1 shows that out of 33 patients, 7(21.2%) were in 26-30 and 7 in 36-40-years age group. 6(18.2%) were in 21-25 years age group. 8 patients (24.2%) were in 31-35 years age group. 4 patients (12.2%) were in 41-45 years age group and only 1 patient (3.0%) was in 46-50 years age group. Out of 33 patients, 23(69.7%) were male and 10(30.3%) were female. The Male: Female = 2.3:1. The distribution of occupations of the patients. Table show that 13(39.4%) were businessman. 9 (27.3%) were housewives, service holder 5(15.2%), student 4(12.1%) and 2 farmers (6.1%). Idiopathic nature was majority, which was 19 patients (57.6%). Steroid-induced cases were 11(33.3%). 2 patients had history of trauma (6.1%) and only 1(3%) patient had history of prolonged alcohol consumption (Table 2). 18 (54.5%) were affected at left side, 15 (45.5%) % patients were affected at right side.

Table 1: Baseline distribution of the patients of the study patients (n=33).

Age group (years)	N=33	%	Mean ±SD
21-25	6	18.2	33.2±6.86
26-30	7	21.2	
31-35	8	24.2	
36-40	7	21.2	
41-45	4	12.2	
46-50	1	3	
Gender Distribution			
Male	23	69.7	
Female	10	30.3	
Occupation Distribution			
Businessman	13	39.39	
Housewife	9	27.27	
Service	5	15.15	
Student	4	12.12	
Farmer	2	6.06	
Causes of Illness			
Idiopathic nature	19	57.57	
Steroid	11	33.33	
Trauma	2	6.06	
Alcohol	1	3.03	
Side of Hip affected			
Right	15	45.5	
Left	18	54.5	

The patients (12.1%) had Postoperative complication, of which, 3 patients (75%) had limb shortening and 1 patient had SSSI. 30 patients (91%) had no limb shortening, 2 patients (6.0%) had 1cm shortening and 1 patient (3.0%) had 1.5 cm shortening postoperatively. Radiological findings showed no prosthesis mal-alignment. 100% neutral positioning of implant was achieved. No periprosthetic fracture, loosening, dislocation and subsidence, was observed in subsequent follow up.

Table 2: Distribution of Pattern of Complication, Postoperative limb shortening and Radiological Prosthesis alignment.

	n	%
Pattern of Complication		
Limb shortening	3 (out of 4)	75
Superficial surgical site infection (SSSI)	1 (out of 4)	25
Nerve palsy	0	0
Postop Limb Shortening		
Nil	30	91
1.0 cm	2	6
1.5 cm	1	3
Prosthesis alignment		
Neutral	33	100
Varus	0	0
Valgus	0	0

Table 3: Distribution of the patients by Per-operative blood loss.

Amount (ml)	N=33	%	Mean ±SD
401-450	8	24	
451-500	17	52	
501-550	2	6	491.2± 48.4
551-600	6	18	
Total	33	100	

Table 3 shows that most of the patients (52%) had blood loss in the range 451-500 ml. 8 out of 33 (24.2%) patients required 1 unit of blood transfusion as they lost more than 500ml of blood per operatively. The average blood loss calculated is 491.2 ± 48.4 ml.

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Table 4: Distribution of patients by pre- and post-operative pain status and pre and post- operative limp.

	Pre-operative		Post-operative		Mean±SD
	n	%	n	%	
Severity of pain					
None (44)	0	0	2	6.1	22.06±6.45
Slight (40)	0	0	29	87.8	
Mild (30)	4	12.1	2	6.1	
Moderate (20)	17	51.5	0	0	
Severe (10)	12	36.4	0	0	
Disabled, Crippled, Bedridden (0)	0	0	0	0	
Limping					
None (11)	1	3.03	21	63.6	4.12± 2.20
Slight (8)	10	30.3	12	36.4	
Moderate (5)	20	60.61	0	0	
Severe (0)	2	6.06	0	0	
Total	33	100	33	100	

Table 4 shows that the pain status among patients revealed that pain significantly decreased following operation ($p<0.00001$). The Statistics shows majority of the patients,17, had moderate (51.5%) and 12 patients had severe (36.4%) pain before surgery. 4 patients (12.1%) had mild pain. After operation, no pain was observed in 2 patients (6.1%). 29 patients (87.8%) had slight pain and only 2 (6.1%) patients had mild pain. Before surgery,1 patient (3.03%) had no limp, 10 patients (30.3%) had mild limp, 20 patients (60.61%) had moderate limp, and 2 patients (6.06%) had severe limp. Following operation, 21 patients (63.6%) had no limp, and 12 patients (36.4%) had only mild limp. This indicate that following operation limping feature of the patients significantly decreased ($p<0.00001$).

Table 5 shows that the preoperative HHS range and mean HHS improved from 13-64 to 72-97 and 37 to 90 respectively.

Table 6 shows that it was evident that 33 patients (100%) had poor HHS before operation. Following operation, the HHS improved to excellent in 23 patients (69.7%) and good in 8 patients (24.2%) ($p<0.0001$).

Table 5: Distribution of patients by preoperative and postoperative HHS range and mean.

Traits	Pre-operative	Post-operative
Range	13-64	72-97
Mean HHS	37	90

Discussion

Total hip arthroplasty is now the most widely used surgical procedure in the treatment of avascular necrosis of the femoral head [10]. In the last few decades, cementless THA has gained popularity and is performed in both young and elders. The basic aim of the procedure is to relieve intractable hip pain and provide painless mobile hip [11].

In this study, out of 33 patients, 7(21.2%) were in 26-30 years and 7(21.2%) in 36-40 years age group. Six patients (18.2%) were in 21-25 years age group, 8 patients (24.2%) were in 31-35 years age group, 4 patients (12.2%) were in 41-45 years age group and only 1 patient (3.0%) was in 46-50 years age group. The mean age of the patients was 33.2 years. Kim et al. [12] showed that average age was 38.2 and majority of young patients were between age group 24-45 years [12], Huda et al. [13] showed that mean age was 35.57 years where majority of the study population was between 21-40 years age group [13]. Both the literature findings coincide with this study.

Out of 33 patients, 23 (69.7%) were male and 10 (30.3%) were female. The male: female ratio was 2.3:1. Kumar et al. [14] in his study had 38 (76%) males and 12 (14%)

Table 6: Distribution of patients by pre- and post-operative functional outcome.

Functional outcome	Pre-operative		Post-operative		Mean ± SD
	n	%	n	%	
Excellent (90-100)	0	0	23	69.7	
Good (80-89)	0	0	8	24.2	53.33± 11.81
Fair (70-79)	0	0	2	6.1	
Poor (<70)	33	100	0	0	
Total	33	100	33	100	

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females suffering from AVN (male: female ratio 3.1:1) [14]. Mattigunta et al. [15] observed 76.7% male and 23.3% female in his study [15]. The gender distribution in this study matches with studies from the literatures mentioned [15].

Out of 33 patients, 18(54.5%) had left hip involvement whereas 15(45.5%) had right hip involvement. This finding correlates with the study by Mattigunta et al. [15] which showed more than 50% patients had left hip replacement [15]. Most of the patients, 13, were businessman (39.4%), 9 out of 10 females were housewives (27.3%). Among others, 5 patients were service holder (15.2%), 4 students (12.15%) and 2 farmers (6.1%). From the study, it is evident that active and young working population are affected more from AVN.

The causes of AVN of femoral head, revealed that 19 (57.6%) cases were idiopathic, 11 (33.3%) were steroid-induced, 2 patients had prior history of trauma (6.1%), and only 1 (3.1%) alcohol abuse. Celebi et al. [16] showed aetiology of avascular necrosis was idiopathic 52%, use of steroids 36%, alcohol abuse 8% [16]. Johannson et al. [17] also reported most common causes in patients operated, were, idiopathic 35%, alcohol abuse 26%, and corticosteroid use was 20% [17]. Though the causes are similar to my study, only 1 patient (3.1%) developed AVN following alcohol consumption. This difference is due to the fact that lifestyle and cultural differences exist between Europe and South-East Asia.

In this study, mean per-operative blood loss was 491.2±48.4ml. Eight patients (24.2%) required 1 unit of blood transfusion as more than 500 ml blood was lost during surgery. Abbas et al reported mean per- operative blood loss 680± 321ml and 82% of cases requiring blood transfusion [18]. The reasons for less per-operative blood loss in this study compared to the literature were that preoperatively optimal physiological status was ensured, meticulous handling of soft tissues and proper haemostasis, rationale use of electrocautery, maintenance of normal body temperature and availability of good surgical expertise.

Among the 33 patients operated, only 1 (3.0%) developed superficial surgical site infection in early postoperative period. Treatment was given with antibiotics according to culture and sensitivity report and local wound care. No patient required revision surgery. Celebi et al. [16] reported that 8% cases developed surgical site infection [16]. In my study, infection rate was lower due to the fact, that, strict asepsis was maintained throughout the perioperative stage, rationale choice of antibiotics, administration of 1st dose of antibiotic before the procedure, surgery was not prolonged and was uneventful, and good operating theatre environment. Good control of comorbidity of patients was also a major factor. Blood and urine culture, throat swab for culture and sensitivity was routinely performed in every patient and surgery was done only if the reports were negative. Thirty patients (91%) had no limb shortening, 2 patients (6.0%) had 1cm shortening and 1 patient (3.0%) had 1.5 cm shortening postoperatively. This study corelates with Mattigunta et al. [15] who revealed 93.3% of the patients had no limb shortening, 6.7% had 1cm and 6.7% had 1.5cm shortening [15]. Nerve palsy did not occur because of meticulous handling of soft tissues during surgery in this study.

Considering radiological findings, all patients (100%) had neutral alignment of prosthesis. This was due to careful preoperative templating and good surgical technique. None of the patients experienced circumferential aseptic loosening, of the femoral stem or acetabular component, periprosthetic fracture. In a study carried out by Hemant et al. [19], only 1 patient (2%) suffered from dislocation, 80% had neutral alignment of prosthesis whereas 16% had valgus and 4% had varus malalignment. No aseptic loosening, fracture and subsidence was observed [19]. Kim et al. [12] also reported excellent radiological results following cementless THA with only 1 (1%) case of dislocation [12].

Comparison between pre and postoperative pain status revealed that pain significantly decreased after surgery (p value<0.05). Seventeen patients (51.5%) had moderate pain, 12 patients (36.4%) had severe pain and 4 patients (12.1%) had mild pain. Postoperative findings revealed 2 patients (6.1%) had no pain, 2 (6.1%) patients had mild pain whereas 29 patients (87. 8%) had only slight pain which does not hamper daily activities. Mclaughlin and Lee [20] revealed that 22% had slight pain, 6% mild pain and 4% moderate pain and no patient had severe pain following the procedure [20]. Considering limp of the patient, preoperative clinical evaluation revealed that 2 patients (6.06%) had severe limp, 20 patients (60.61%) had moderate limp and 10 patients (30.3%) had slight limp. Following surgery 21 patients (63.6%) had no limp and 12 patients (36.4%) had slight limp showing significant improvement. Karimi et al. [4] concluded that after cementless hip procedures, patients do not have pain and limp [4].

Regarding functional outcome by Modified HHS, preoperatively 33 patients (100%) were in poor category. Postoperatively 23 patients (69.7%) had excellent outcome. Eight patients (24.2%) had good outcome and only 2 patients (6.1%) had fair outcome. There was significant increase of preoperative mean value of 37 points (range 13-64) to postoperative mean 90 points (range 72-97) in this study. Kim et al. [12] showed that mean preoperative HHS was 52.9 (range 22-58) points which improved to 96 (range 85-100) points at final follow-up examination [12]. Huda et al. [13] in his study calculated that preoperative HHS in 19 patients was poor and mean was 41.84. [13].

Following THA, mean HHS was 84.42 where 9 patients (47.4%) had excellent outcome and 6 patients (31.6%) had good outcome and 4 patients (21%) had fair outcome [13]. Celebi et al. [16] revealed in his study mean HHS increased from 41.5 (range 33-53) to 87.5(range 74-96) [16]. Hemant et al. [19] in his study of 50 patients showed average HHS improved 36 points to 90 patients at final follow-up. Ninety-two percent had excellent outcome and only 4% had good and fair outcome each [19]. Byun et al. [21] showed that mean preoperative HHS was 52.9 points (range 37-59) which improved to 98.2 points (range 80-100) [21]. The study from the literature supports the findings in this study.

Conclusion

The study showed that cementless THA in patients below 50 years suffering from AVN of the femoral head Ficat & Arlet stage III and IV is a safe and effective procedure. In light of the findings in this study, the patients are relieved of pain, limp and has significant functional, radiological outcome and fewer postoperative complications. Therefore, I would like to suggest to carry out this procedure in young, active population suffering from advanced stage AVN.

Recommendation

This study can serve as a pilot to much larger research involving multiple centers that can provide a nationwide picture, validate regression models proposed in this study for future use and emphasize points to ensure better management and adherence.

Acknowledgements

The wide range of disciplines involved in results of cementless THA in patients below 50 years for Ficat and Arlet stage III and IV avascular necrosis of the femoral head research means that editors need much assistance from referees in the evaluation of papers submitted for publication. I am grateful to my colleagues and family who encouraged me to complete the study.

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