

Is Bone Cementing the Better Choice for Bipolar Hemi-Arthroplasty? A Comparative Study of Functional Results in Cemented and Uncemented Bipolar Prosthesis for Intra Capsular Femur Neck Fractures

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Abstract:

Background: Hemi arthroplasty is a useful procedure to recommend for intra capsular femur neck fractures. There is controversy regarding the role of bone cement for fixation of the femoral prosthetic stem. Advantages of cementing are stable, secured fixation that allows early mobilization with fewer incidences of implant loosening and post-operative thigh pain. It comes with the burden of longer duration of surgery and relatively increased blood loss. Uncemented prosthesis is associated with less operative time and blood loss. It is associated with implant loosening and peri prosthetic fracture. This study aims to identify the better option between cemented and uncemented prosthesis in management of intra capsular femur neck fractures.

Patients and Method: A prospective comparative study on thirty patients with intra capsular femur neck fracture, randomized into two equal groups and treated with either cemented or uncemented bipolar prosthesis. Patients were followed up for at least one year and the functional outcome was analysed using modified Harris hip score.

Results: Mean modified Harris hip score in the cemented and uncemented groups observed at the end of one year follow up was 56.06 and 61.86 respectively.

Conclusion: The functional outcome, complication and mortality rates observed between the groups were not statistically significant to recommend one procedure over the other.

Keywords: Avascular necrosis, Bone cement implantation syndrome (BCIS), Dorr's classification, Harris Hip score.

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Introduction

Intra capsular fractures of the femur neck are common in elderly population. Non-surgical management is related with higher rates of non-union, avascular necrosis of femoral head and displacement. Reconstructive procedures include total and hemi arthroplasty. The guidelines given by "National Institute for Health and Care Excellence" (NICE) advice surgeons to consider total over hemi arthroplasty for displaced fractures

in patients who either require minimal support or are independent outdoors; cognitively intact; and who are considered fit for surgery decided by orthopaedic surgeon and anaesthetic teams. Hemi arthroplasty is reserved for patients who require low mobility and do not satisfy these criteria. Total hip replacement is recommended in the active population due to better outcome with regard to mobility [1,2,3,4,5]. Hemi arthroplasty is

commonly employed as it is an economical procedure. There are no clear guidelines about the use of cement in hemiarthroplasty. This study was done with the purpose of comparing the outcomes of cemented and uncemented hemiarthroplasty. We here report a prospective comparative study on patients with displaced intra capsular femur neck fracture treated by cemented or uncemented mode of bipolar hemi arthroplasty. Patients were followed up for a minimum of one year and the results were analysed.

Patients and Method: A prospective comparative study was carried on thirty patients with intra capsular femur neck fractures, admitted to our institute between November 2020 and October 2022. Preliminary evaluation was done to assess the type of femur fracture and rule out other associated injuries. Blood and other routine investigations as necessary for pre anaesthetic clearance were done. Patients were included in the study after obtaining a written informed consent from them. Patients were randomly allotted in one of the two groups A and B through a randomization code. In group A patients, cement was used for fixing the bipolar prosthesis. In Group B patients, uncemented bipolar prosthesis was used.

Statistical analysis: Sample size calculated using a pilot study conducted at our institute was 28 (prevalence -1.8%, error 7% and confidence limits 80%). A total of 30 patients were included to account for loss to follow up (10%). Epi Info Software was used to generate the sample size using formula $N = Z^2PQ/E^2$ (N-sample size, Population proportion: 1.8%, P-Proportion, Q=1-P). Dependent variables were normally distributed. Skewed variables were converted into log values to

attain normal distribution. Descriptive statistics included frequency and percentage. Mean and SD were used for numerical values. Comparison between categorical findings and associations were done using chi-square test. Non-parametric test was used when the data was qualitative.

Patients aged 60 or more with intra-capsular femur neck fracture, medically fit for surgery, ambulatory prior to injury and consented for the study were included. Patients with pathological fractures, poly trauma patients, those with history of symptomatic disease of hip such as osteoarthritis and non-ambulatory patients prior to the trauma episode were excluded from the study. Thorough detailed history was elicited from patients followed by clinical examination.

Surgical procedure: All patients were operated either under general or spinal anaesthesia. Lateral decubitus position was preferred (Fig 1a). Southern Moore's approach was standardly chosen in all patients. After exposing the joint, head was extracted out first, followed by a neck cut to appropriate level (one finger breadth from lesser trochanter).

Acetabulum was cleared off redundant tissue, femoral canal was prepared through reaming and broaching. Different sized reamers were used to match the stem size. Bipolar size was determined based on the extracted head measurement (Fig 1b). In cementing group, 20 or 40 grams of bone cement was used as per the canal size and requirement. Short external rotators were repaired before wound closure (Fig 1c). Suction drain was routinely used in all patients. Immediate post-operative x rays were taken to confirm joint reduction and placement of implant (Fig 2).

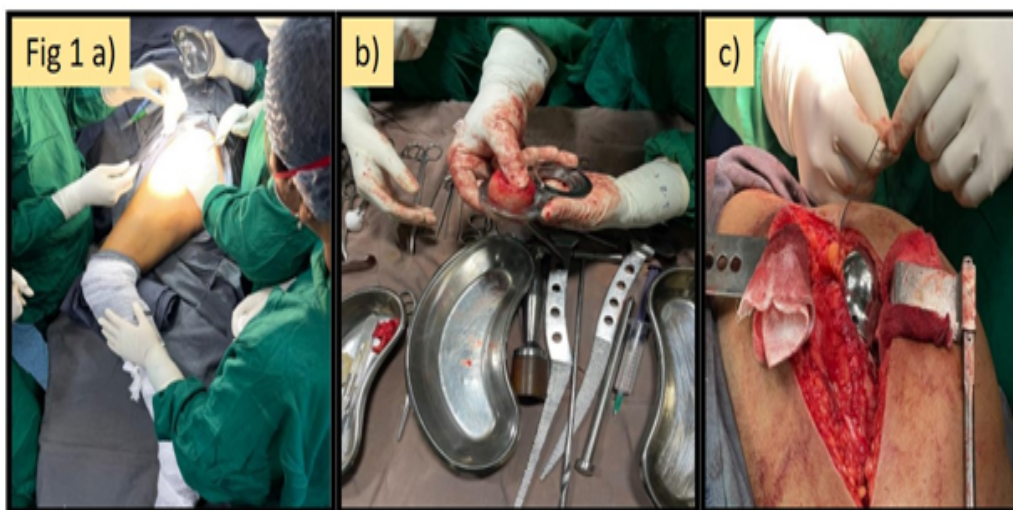


Figure 1: Intra operative image showing a) Lateral decubitus positioning of the patient. b) femoral head measurement serves as a guide for bipolar prosthesis size c) repair of short external rotator muscle group being performed.

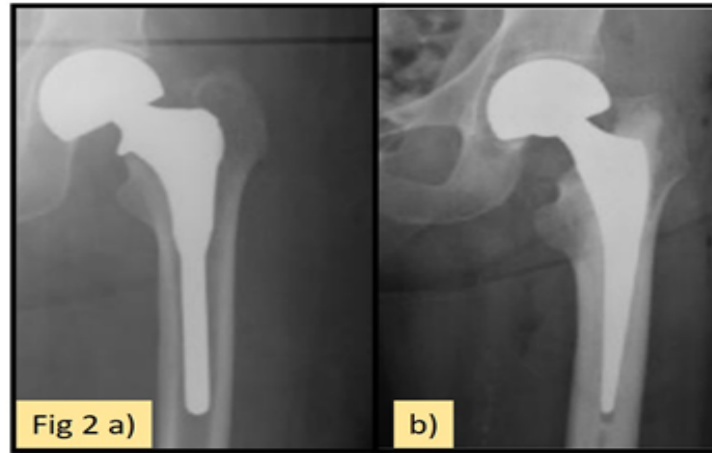


Figure 2: Post-operative radiographic image showing a) uncemented and b) cemented bipolar prosthesis

Post-operatively, patients were advised to maintain the operated hip in abduction with the support of abduction pillow.

Internal rotation, adduction, extreme flexion of the limb was avoided. Gluteal and quadriceps exercises were commenced from the first post-operative day. From second day, patients were allowed to sit upright. Partial weight bearing with walker was

started from 3rd post-operative day with progressive weight bearing encouraged gradually. Suture removal was done on 10th post-operative day. All patients were followed up at regular intervals up to a minimum of one year.

Modified Harris Hip Score (Fig 3) was noted and radiographs (Fig 4) of the affected hip were taken during follow up visits.



Figure 3: Clinical evaluation of the patient for range of hip and knee movements at one year follows up

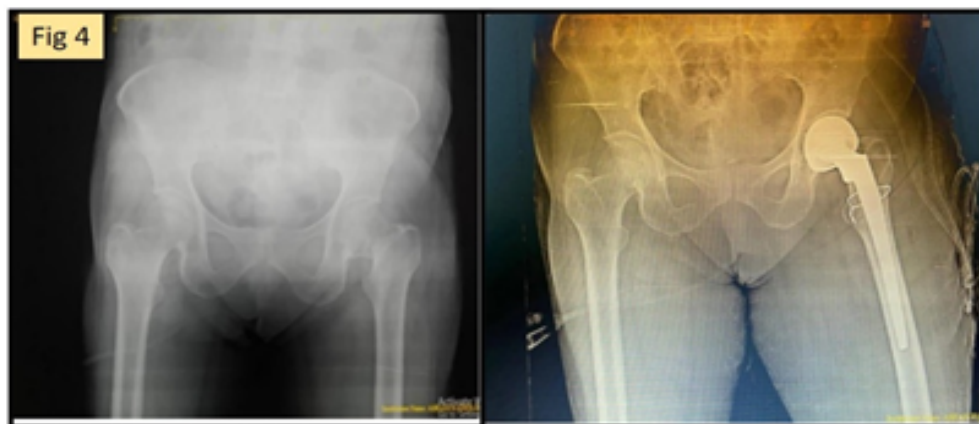


Figure 4: Pre and one year follow up post-operative radiographic images of the operated hip showing implant in well retained position

Results

Thirty patients with intra capsular femur neck fracture were randomized into two groups of fifteen each. Group A patients were treated with bone cement and Group B patients were treated with uncemented bipolar prosthesis. Functional outcome assessed using modified Harris hip score was performed at one year follow up.

The mean age of the study group was 68 ± 7.3 years (range of 60 to 84 years). Among 30 subjects, 17 (56.67%) were males and 13 (43.33%) were females, (male to female ratio of 1.3). Four patients in group A and five in group B were diabetic. Four patients in group A and two in group B were anaemic. No significant association was noticed between co morbid status and treatment performed in the allotted groups ($p=0.64$ by chi-square analysis).

Mean duration of surgery was 81.33 ± 4.85 minutes in cemented group and 62.33 ± 4.51 minutes in uncemented group. Mean surgery duration in cemented hemi arthroplasty was higher than uncemented hemiarthroplasty ($p<0.001$). Intra operative blood loss (IOBL) was 352 ± 69.6 ml during cemented hemiarthroplasty procedure and 210 ± 60.05 ml in uncemented group and this difference was statistically significant ($p<0.001$). Eleven patients in cemented group and one patient in uncemented group had intra operative blood loss of more than 300ml. A total of six patients (four in cemented group and two in uncemented group) required blood transfusion. Two patients in the total study had stable varus deformity in uncemented group. Remaining 28 patients had prosthesis in neutral position.

Mean modified Harris hip score observed at immediate post-operative period in the cemented and uncemented group was 80.13 and 82.86 respectively (p value 0.03). At three months follow up the mean modified HH score for cemented and uncemented groups was 73.04 and 68.53 respectively (p value 0.58). Final modified HHS recorded at the end of one year for the cemented group was 56.06 and in uncemented group was 61.86 (p value 0.56).

In cemented group one patient had calcar fracture and one patient developed deep wound infection. Superficial wound infection was noticed in one patient of uncemented group.

Discussion: In India, the incidence of hip fractures is 159/100000 and femur neck fractures account for half of the volume [6]. With increase in age and life expectancy, frequency of these fractures is steadily increasing [7,8]. By 2050, number of hip fractures is estimated to be around 4.5 million globally [9]. Direction of fall is one of the factors to consider in

elderly patients. Chances of hip fracture are more in sideways fall [10].

The treatment of displaced femur neck fractures is determined by functional demands and mobility of the patient [11]. Conservative management is associated with higher incidence of non-union, fracture displacement and avascular necrosis. Fixation with cannulated screws or sliding hip screw is also associated with implant failure, non-union and avascular necrosis. Reconstruction surgery which includes hemi and total arthroplasty is popular for management of these fractures. Bipolar prosthesis causes less damage to acetabulum as the actual movement occurs between the metal head and polyethylene cover.

Cement fixation of bipolar stem in hemiarthroplasty, allows early mobilization and is associated with lesser incidence of post-surgical thigh pain. Prosthesis cementing provides secured fixation with resultant less thigh pain and reoperation rates [12]. However, cementing the prosthesis carries a risk of arrhythmia and respiratory collapse due to fat emboli and cement reaction [13,14,15]. This bone cement implantation syndrome (BCIS) includes features like hypoxia, hypotension and loss of consciousness. Revision of arthroplasty is also much more difficult for cemented prosthesis. Uncemented prosthesis is devoid of such cement related effects [16].

Uncemented fixation relies on osteo integration between the press fit stem and medullary canal of femur. In elderly patients with poor bone stock peri prosthetic fractures, mid-thigh pain, implant loosening and gait abnormalities can occur [17]. Many studies suggest cemented hemiarthroplasty as it reduce the pain and provides good functional outcome [18,19,20,21].

In theory, cemented prosthesis generates secured fixation that reduces revision rates related to aseptic loosening of prosthesis. NICE Guidelines recommend "cemented prosthesis in patients with hip fractures undergoing arthroplasty", while SIGN guidelines recommend "cemented prosthesis for hemiarthroplasty, unless cardiorespiratory complications are excluded particularly in elderly patients" [22].

Pawar ED et al (2019) observed that the functional outcome was better in cemented group along with better mobility and improvement in VAS recordings post-surgery. They relied on Dorr's classification to make choice of cemented or uncemented fixation in their patients [23].

Figved et al reported similar functional outcome between cemented and uncemented groups with no significant difference in the complication and mortality rates [24].

Lo et al reported less thigh pain and higher functional score in cemented group [25]. In a meta-analysis by Li et al, operative time and blood loss were more in cemented group but only difference in duration of surgery was statistically significant. Better Harris hip scores were reported in the cemented group and the difference was found to be statistically significant [26]. In another meta-analysis by Ning et al it was stated that only longer duration of surgery in cemented group was statistically significant, while other differences like blood loss, residual thigh pain, complications, and mortality rates were not significant.

Veldman HD et al (2017) in their systematic review and meta-analysis stated that cardiovascular complication rate was similar in both the groups in contrast to the popular notion held in the literature that cementing was associated with high cardiovascular risk due to BCIS [27]. Cementless group was associated with a greater number of complications like peri prosthetic fractures, implant loosening and dislocations. Most of the studies have reported no significant difference in the mortality, need for revision surgery or complication rates between the cemented and un cemented groups.

Limitations of this study are small sample size, single centre nature of the study with relatively shorter follow up period. Studies with larger sample and longer follow up duration are encouraged to draw meaningful conclusion for suggesting recommendations regarding the use of cement for fixation of bipolar prosthesis in hemiarthroplasty.

Conclusion: Femur neck fractures in elderly patients deserve surgical management to avoid complications like non-union and avascular necrosis seen in conservative management. Among surgical options, hemiarthroplasty offers economic advantage over total arthroplasty.

Though higher Intra operative blood loss and longer duration of surgery are associated with cementing technique, only the difference in duration was found to be statistically significant. Differences in other parameters like functional outcome, pain relief, complication rate and mortality were not significant to recommend one procedure over other.

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