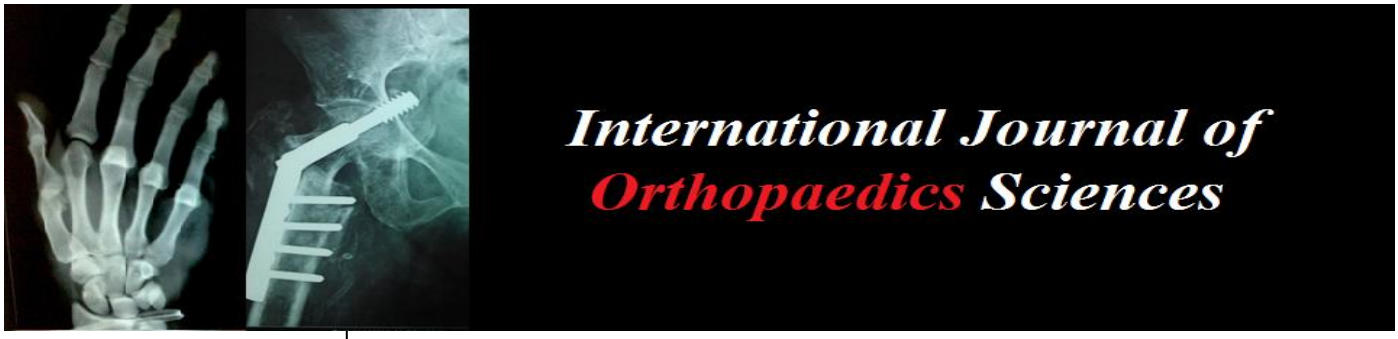

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A comparative study of functional outcome of fracture neck femur treated with cemented bipolar and bipolar with femoral head as a bone graft

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Abstract
Introduction: The advantages and limitations of cementing and uncementing during hemiarthoplasty for the fracture neck of femur in elderly patients, is a matter of debate. Though cementing gives good initial fix, it has the risk of bone intraoperative hypotension. On the other hand uncemented implants are associated with periprosthetic fractures and are expensive. Femoral head can be use as source of autologous bone graft to fill the medullary cavity of femur, thus reducing the complications associated with cemented bipolar hemiarthoplasty.
Aim: To do a comparative study of functional outcome of fracture neck femur treated with cemented bipolar hemiarthoplasty and bipolar hemiarthroplasty with femoral head as a bone graft.
Methods: This study was a prospective study which was conducted in tertiary care hospitals in Mangalore from the year 2018-2020. Patients with fracture neck femur were included in study. Patients were divided into 2 groups having 15 patients each. Group A which underwent bipolar hemiarthroplasty with femoral head as a bone graft and Group B which underwent cemented bipolar hemiarthroplasty. Functional outcome was compared between the two groups.
Results: At the end of one year in the Bone Graft group 11 patients (73.3%) had excellent results; 4 patients (26.6%) had good results; whereas in the cemented group 5 patients (33.3%) had excellent results; 5 patients (33.3%) had good results; 4 patients (26.6 %) had fair results, 1 patient (6.6%) had a poor result. The result was significant (p value<0.05). There was a statistically significant difference in the functional outcome between cemented bipolar and bipolar with bone graft.
Conclusions: Bipolar hemiarthroplasty with femoral head as a bone graft is comparatively a better treatment option for fracture neck femur in elderly patients compared to cemented bipolar hemiarthroplasty.

Keywords: Bipolar, cement, bone graft, hemiarthroplasty

Introduction
Femoral neck fractures are a rising problem in our aging society, frequently troubled with multiple and severe co-morbidities, and are associated with high morbidity and mortality [1]. The incidence of these fractures has increased with improvement in life expectancy and is expected to double in the next 20 years and triple by 2050 [2]. The risk of femoral neck fracture is about 40-50% in females and 13-22% in males [3].
Epidemiologic studies have recognized several risk factors for femoral neck fracture, including BMI <18.5, Insufficient sunlight, low activity, smoking, history of osteoporosis related fracture. This fracture commonly occurs in the 7th decade and in women with osteoporosis (after menopause), following a very trivial torsional trauma (slipping). Sir Astley Cooper was convinced about this fact way back in 1800's and said "A patient sustains a fracture and then falls and not that he falls and then sustains this fracture.'' The usual cause of this fracture is a simple fall in which force is transmitted from greater trochanter to femoral neck [4]. Other mechanism is leg external rotation with increased force on the capsule and ilio-femoral ligament [5]. Intracapsular femoral neck fractures account for about 50% of hip fractures. The union rate is low because of low blood supply due to intracapsular synovial fluid having angiogenic inhibitory properties; it is also sometimes associated with femoral head necrosis and delayed segmental necrosis. In recent years, the improvement of health services and

increased life expectancy has dramatically increased the incidence of this type of fracture.

Surgery is the mainstay of treatment for displaced femoral neck fractures, hemiarthroplasty being a common operation in elderly patients. Hemiarthroplasty could be cemented or uncemented. Whether to cement the hemiarthroplasty or not is a perennial argument [3]. Cementation of the prosthesis achieves good initial fix in an osteoporotic bone, however arthroplasty using a cemented implant may be associated with increased mortality and morbidity compared with an arthroplasty using an uncemented implant, as it has the risk of increased incidence of prosthetic joint infections (PJI), bone marrow and fat embolization with resulting intraoperative hypotension and increased incidence of deep vein thrombosis [6, 7]. Aseptic loosening is now recognized as the leading cause for late clinical failure after cemented hip arthroplasty. The scope and clinical significance of this problem have been reported in several long-term follow-up studies [8, 9, 10]. The total hip arthroplasties that demonstrated migration of the prosthesis by separation at the stem-cement interval, fracture of the cement mantle or prosthetic stem, or shift of the prosthesis (subsidence) were defined as definite criteria for aseptic loosening. The femoral components that demonstrated a complete radiolucent line at the bone-cement interface were defined as probable aseptic loosening. Arthroplasties with greater than a 50% radiolucent line but less than a complete radiolucent line at the bone-cement interface were defined as possible aseptic loosening.

An uncemented implant may be associated with complications such as stress shielding and a higher risk of periprosthetic fracture.

Many studies have suggested that cemented hemiarthroplasty reduces the risk of residual pain and affords better functional results. In a few studies uncemented implants yield the same clinical results as cemented implants when used to treat displaced femoral neck fractures. Nonetheless, the postoperative rate of prosthesis loosening is higher after uncemented hemiarthroplasty.

While using an uncemented implant bone grafting of the femoral canal can be done by using the autologous cancellous bone graft of the head of femur. This is cost effective method of making the implant press fit without introducing foreign material. Though many uses of bone graft have been studied, its use in primary hemiarthroplasty has never been studied. Autologous bone graft have the least chance of immunological reaction and rejection [7]. As autologous cancellous bone graft of the femoral head is easily available at primary hemiarthroplasty we intend to study the functional recovery following bipolar with bone graft.

Need for study

In the current research scenario there are not much studies/literature been reported wherein the use of femoral head as a bone graft in the stabilization of femoral stem prothesis as an alternative for cemented bipolar hemiarthoplasty being done. Hence we are carrying out the study to compare the functional outcome in cemented bipolar hemiarthroplasty and bipolar using bone grafts.

Objectives of the study

1. To compare relief of pain and range of motion and functional recovery using Harris Hip Score following Cemented Bipolar and Bipolar with Bone Graft.
2. To study implant related complications and chances of reoperation following cemented bipolar and bipolar with bone graft.
3. To compare intraoperative time and blood loss and other complications.

Methods

This study was a prospective study which was conducted in a tertiary care hospital in Mangalore from the year 2018-2020. All the patients that came to Emergency Department / Casualty of those tertiary care hospitals with fracture neck femur were the candidates taken up for study. Patients were divided into 2 groups by block randomization method. Group A consisted of patients which underwent bipolar with femoral head as a bone graft and Group B consisted of patients which underwent cemented bipolar hemiarthroplasty.

Detailed history was taken with particular emphasize on mode of injury and associated medical illness. In depth, clinical assessment was carried out in each case. In all patients preoperatively skin traction with appropriate weight was applied, to the fractured lower limb, with the aim of relieving pain, preventing shortening and to reduce unnecessary movements of the injured limb. Anteroposterior radiographs of the affected hip joint was taken for all the patients. Routine blood investigations for anaesthesia fitness was obtained. Patients with associated disorders like Diabetes Mellitus, Hypertension, Chronic Obstructive Pulmonary Disease, Cerebrovascular Accident, Ischaemic Heart Disease, Anaemia, were evaluated and treated by Physician in the early period of hospitalization. The patients were taken up for surgery only after they became medically fit for the surgical procedure. Preoperative intravenous antibiotics was given an hour before the surgery. A day prior, patient was given proctolysis enema to void bowel. All surgeries were done on an elective basis using standard aseptic precautions and were performed by First (Senior) Author and assisted by other three authors. Surgery were performed under epidural + spinal anaesthesia

Procedure: All the operative procedure irrespective of group was performed in lateral position with the patient lying on the unaffected side. For all patients posterolateral approach was used, Moore's Approach (Southern exposure). Fenestrated bipolar prosthesis was used. In case of cemented group cementing of the femoral canal was done by using hand technique by pushing cement into the femoral canal and remaining cement was applied to the stem of prosthesis. In case of the bone graft group the extracted femoral head was taken and cartilage was removed. Then head nibbled into pieces and single large piece introduced into the canal to act as restrictor and then prepared cancellous bone graft packed into the femoral canal and also inside the fenestra's in the stem of prosthesis and then prosthesis was introduced. Post operative monitoring of temperature, pulse, blood pressure and respiration rate was done. Patients were followed up at an interval of 6 weeks, 3 months, 6 months, and 12 months and functional outcome was analyzed by modified Harris hip scoring system.

Statistical analysis

Sample size was calculated by using G* power software. By taking effect size 0.8 and 10% of level of significance with 80% power. The sample size in each group was 15.

Patients enrolled in the study were followed up for the period of 1 year.

- Data obtained was recorded in MS Excel sheets and statistical data analysed using Windows SPSS version 22 software program.
- Mann-whitney U test was used for comparing functional outcome between two groups.
- Independent- sample t- test was used to compare blood loss and operative timings.
- Chi-square test was used to compare the complications between the two groups.

Results

Between January 2018 and January 2020, 30 elderly patients with displaced femoral neck fractures were treated surgically with hemiarthroplasty at our hospital.

Table 1: Baseline Data of Patients

Number of Cases	Group A	Group B
Average mean Age (SD)	60.04 ± (2.4)	65.36 ± (2.9)
Sex	Male: 05, Female: 10	Male: 08, Female: 07
Total number of cases: 30	15 cases	15 cases

The average age of the patients in our bone Graft group was 60.04 years and cemented group was 65.36 years. In our series there were 17(57 %) female patients and 15 (50%) male patients.

Table 2: Depicts the Side Involvement of Fracture Neck Femur

Left sided fracture neck femur	11 (36.6%)
Right sided fracture neck femur	19 (63.3%)

Majority of the patients (25 patients out of 30 i.e. 83 %) had minimal trauma most of them slipped and fell down on flat ground or in bathroom and were not able to walk or stand.

Table 3: Depicts Final Analysis between the Two Groups

	Group A (Bone graft)	Group B (Cemented)	p Value
Mean duration of Surgery (SD)	90 minutes± (8.5 mins)	116.2 minutes ± (15.3 mins)	<0.0001
Mean amount of blood loss (SD)	194.59 mililiters± (25.74 ml)	298 milliliters ± (47.54 ml)	<0.00001
Mean duration of weight bearing (SD)	24 days± (5.8days)	4.27 days± (2.33 days)	p = 0.00001

In the Bone Graft group we did not incur any complications (0%). Whereas in the cemented group we had 1 case (6%) with deep infection, which was treated with thorough surgical debridement and joint lavage, two cases (13%) with superficial wound infection which responded to antibiotics and dressing. One case in cemented group expired on post op day 9th due to medical co-morbid complications. One case in group B weight bearing was not encouraged as the patient was bedridden for 8 months due to neglected fracture neck femur and also patient was cachexic, in that case only Inbed mobilization was intiated, enabiling the patient to sit and help the caretakers to carry out back care. As per the Harris hip scoring system the anterior thigh pain component was measured. In the Bone Graft group 13 patients (83.3 %) had no pain; 2 patients (13.3%) had mild pain. Where as in the cemented group 8 patients (53.3%) had no pain; 6 patients (40%) had slight pain and 1 patient (6.66%) had mild pain at one year follow up. In the Bone Graft group 11 patients (73.3%) had no limp; 4 patients (26.66%) had slight limp, whereas in the cemented group 6 patients (40%) had no limp; 5 patients (33.3%) had slight limp and 4 patients (26.66%) had moderate limp. The result was statistically significant (p value <0.05). In the Bone Graft group 10 patients (66.6%) had range of movement between 211°-300°;5 patients (33.3%) had range of movement between 161°-210°; whereas in the cemented group 07 patients (47%) had range of movement between 211°-300°;08 patients (53%) had range of movement between 161°-210°. The result was statistically significant (p value <0.05) In the Bone Graft group 11 patients (73.3%) had excellent results; 4 patients (26.6%) had good results; whereas in the cemented group 5 patients (33.3%) had excellent results; 5 patients (33.3%) had good results; 4 patients (26.6 %) had fair results, 1 patient (6.6%) had a poor result. The result was significant (*p* value < 0.05).

Discussion

Fractures around hip are more common in the elderly age group. Osteoporosis, comorbidities, and increased levels of minor trauma increase the incidence and complicate the treatment of such fractures. Cemented hemiarthroplasty is generally done in older age group with osteoporotic bone stock, so as to get firm fix of prosthesis to bone and uncemented prosthesis in cases where quality of bone is good and preferably in relatively younger age. But nevertheless complications with both of them are present which are well documented in various literatures. Hence we undertook this study to compare hemiarthroplasty using bone graft of the femoral head with cemented hemiarthroplasty. As of now there are very less study in literature regarding that has been reported and also documented. All the previous studies have compared cemented hemiarthroplasty with the uncemented one, so in this study we specify the use of autogenous bone grafts obtained from femoral head in place of using cement which can be considered as the gold standard for bone replacement, mainly because they offer minimum immunological rejection, complete histocompatibility and provide the best osteo conductive, osteogenic and osteoinductive properties [7, 8]. Use of autograft from femoral head has many advantages such as it causes less post operative thigh pain, limp, post-op infections, loosening of prosthesis risks. Firm fit for the prosthesis stem causes good osteointegration.

In literature there are well documented evidences of use of bone grafts from the femoral head for treatment of acetabular deficiency in primary total hip arthroplasty. In the study done by Anil Thomas O *et al.* [13] concluded that use of bone grafts in Total hip replacement provided suitable option in the management of acetabular defects giving good outcome in 26 patients out of 30 total hip replacement cases by providing good bone stock which in turn gave good stability for the acetabular component.

In the Bone Graft group the mean duration of surgery was 90.00 minutes with a mean amount of blood loss of 194.59 millilitres, where as in the cemented group the mean duration of surgery was 116.2 minutes and mean amount of blood loss being 298 millilitres. There was a significant difference between the groups. In the similar study done by Eknath D *et al.* [14] the mean duration of surgery and amount of blood loss was 84 minutes and 188.95 mililiters respectively in the bone graft group wheraeas in the cemented hemiarthroplasty was 101.2 minutes and mean blood loss was 288 mililiters. Wender Figved MD *et al.* [15] reported duration of 70.2 min

with a blood loss of 300ml in uncemented group and 82.6 min with a blood loss of 390ml in the cemented group. Surgical time was greater for the cemented cohort than the uncemented (95 minutes versus 80 minutes, respectively).

Wender Figved MD *et al*. [15] reported Intraoperative periprosthetic fracture one case (0.9%) in cemented group & 2(1.9%) in uncemented groups. R.J.K. Khan *et al*. [16] reported three iatrogenic periprosthetic fractures, all occurring in the uncemented group. Whereas in our study we did not face any intraoperative periprosthetic fractures both in cemented group and bipolar with bone graft group. Wender Figved MD *et al*. [15] only one case of superficial infection (0.9%) in the cemented group. In our study we had one case of deep infection in cemented group but no infection in bone graft group.

In our study 13(83.3%) patients out of 15 patients had no thigh pain at all in the bone grafts group whereas 2 !13.3%) patients did have a pain. Whereas in cemented group only 5 (33.3%) patients had no thigh pain and almost 10 patients (77%) had a persistent thigh pain, which was statistically significant. But the other studies done between cemented and uncemented group did not show any statistical difference in both groups in terms of persistent thigh pain.

The mean Harris Hip Score in bone graft group was 80.52 at 1 year follow up; whereas in the cemented group the mean Harris Hip Score was 98.88 at 1 year follow up. There was a statistically significant difference in the functional outcome (P <0.05) between the two groups in our study. According to Wender Figved MD *et al*. [13] 1 year Harris Hip Score results were equivalent in the cemented and the uncemented groups and there were no differences in ability to walk, use of analgesics, or place of living in both the groups.

In the study by Balderston R *et al*. [17], there was a constant rate of occurrence of high-grade femoral bone-cement demarcation demonstrated within any single follow up year between 3 and 10 years after total hip arthroplasty.

In our study both the groups did not show any incidence of prosthesis loosening. Since the use of patient's own femoral head as bone graft, the cost of cement was cut down which made surgery cost effective and also minimized risk related to use of bone cement.

Conclusion

- In our study patients those underwent bipolar hemiarthroplasty using femoral head as a bone graft were relatively pain free as compared to those who underwent cemented bipolar hemiarthoplasty.
- The rate of infection in patients belonging to bipolar hemiarthoplasty with bone graft were less as compared to those in cemented bipolar hemiarthroplasty.
- Patients those underwent bipolar hemiarthoplasty benefitted by decrease in the total time taken for the surgery and also in reduction in total blood loss.
- Use of autologous femoral head as a bone grafts instead of bone cement is a cost effective procedure and does not introduce any foreign material into the body. Also the known hazards of cementing are minimized.
- Revision surgeries when required at a later date are easier to perform in the bone graft group as they are associated with improved bone stock on the femoral side incomparison with the cemented bipolar group wherein removal of the implant during revision surgeries are difficult.
- To conclude in our study we found that hemiarthroplasty with bone graft of the femoral head is a comparatively better treatment option in elderly patients.

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