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Prosthetic replacement in geriatric intertrochanteric fracture

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Abstract

Fracture stability, bone strength, and early rehabilitation determined the final results in cases of intertrochanteric fractures of femur of patients having the age above 60 years. The role of the Fixation devices for osteosynthesis in unstable osteoporotic and severely comminuted intertrochanteric fractures is still to be defined. 37 patients who were treated with hemiarthroplasty were studied retrospectively. Only AO/OTA type 31-A2.2 and 31-A2.3 and Evans type III or IV fractures were included. We analyzed for the functional outcome and radiological follow up and compared the results of this study to those in the literature. At final follow-up the mean HHS was 84.8 ± 9.72 (range 58–97). A total of 6 patients (17.14%) were graded as excellent, 12 patients (34.28%) as good, 11 as fair (31.42%), 4 as poor (11.42%), and 2 as failed (5.71%). The medial offset was lower on the operated hip. The values of medial off set of operated hip were {Range 3.09-4.86, mean was of 3.73(SD 0.48)}, the values of non-operated hip were {Range 3.12-5.65, mean was of 3.99(SD 0.62)} and the p-value was 0.017. The vertical offset was higher on the operated hip. The values of vertical off set of operated hip were {Range 3.34-6.26, mean was of 4.46 (SD 0.79)}, the values of Contra lateral hip were {Range 2.90-5.65, mean was of 4.38 (SD 0.74)} and the p-value was 0.875. As observations made in, there is increase in vertical offset of the operated hips, which does not correlate with limb length shortening.

Keywords: Prosthetic replacement, geriatric intertrochanteric femur, fracture

1. Introduction

There were an estimated 1.66 million hip fractures worldwide in 1990. This worldwide annual number is rising rapidly with an expected incidence of 6.26 million by the year 2050. An increase in these fractures is on the rise due to the increased life expectancy of the people and osteoporosis [1]. The mechanism of injury is mostly trivial trauma. Bergstrom *et al* [2]. Found that low-energy trauma caused 53% of all fractures in persons 50 years of age and older. In those over 75 years, low-energy trauma caused >80% of all fractures. The contribution of osteoporosis related fractures is more important than previously thought. Stable fractures can be easily treated with osteosynthesis with predictable results. However, the management of unstable intertrochanteric (Evans type III or IV and AO/OTA type 31-A2.2 and 2.3) [3] fractures is a challenge because of difficulty in obtaining anatomical reduction. In the past, fixed nail plate devices used for the fixation of these fractures had high rates of cut-out and fracture displacement. Subsequently, a sliding hip screw was used with much success and became the predominant method of fixation of these fractures. Complications such as head perforations, excessive sliding leading to shortening, plate pullout, and plate breakage continued to be a problem especially with the unstable type of fractures [4]. Osteoporosis and instability are one of the most important factors leading to unsatisfactory results. Also in these elderly patients with unstable osteoporotic fractures, a period of restricted immobilization is suggested. This may cause complications like atelectasis, bed sores, pneumonia, and deep vein thrombosis [5]. Thus, fracture stability, bone strength, and early rehabilitation determined the final results in cases of intertrochanteric fractures. Intramedullary interlocking devices have shown reduced tendency for cut-outs in osteoporotic bones and also have better results in cases of unstable intertrochanteric fractures. However, the role of the intramedullary devices in unstable osteoporotic and severely comminuted intertrochanteric fractures is still to be defined.

Endoprosthetic replacements have also been shown to achieve early rehabilitation of the patient and good functional results. However, an ideal treatment method is still rather controversial because of the poor quality of bone mass, comorbid disorders, and difficulty in rehabilitation of these patients 38. The purpose of this study is to analyze the role of primary hemiarthroplasty in cases of unstable osteoporotic intertrochanteric femur fractures. This study was done to know the functional outcome and radiological follow up for prosthetic replacement in geriatric intertrochanteric fracture and to compare results of this study to those in the literature.

2. Materials and Methods

37 patients who were treated with hemiarthroplasty were studied retrospectively. There were 27 females and 10 males. All patients were above the age of 60 years (range 62-89 years). Patients having other associated fractures were excluded in this study. Patients were confirmed having osteoporosis on the preoperative x-ray using sing's index. The fractures were classified according to AO/OTA and Evans classification. Only AO/OTA type 31-A2.2 and 31-A2.3 and Evans type III or IV fractures were included in this study. Although the AO/OTA classification classifies these fractures as pertrochanteric, however since we also used the Evans classification we retained the terminology of the intertrochanteric fracture to avoid confusion. Patients with associated fractures that might significantly affect the final functional outcome, patients that were non ambulatory before injury and patients with psychiatric disorders were excluded from the study. All patients were community ambulatory prior to trauma. Twenty five were walking independently without support while rest of them required an aid like a cane or a walking stick. None of our patients had any significant preexisting hip pathology other than osteoporosis. All cases were operated by using a standard lateral approach in lateral position. The fracture anatomy was assessed and a cut was taken high up in the neck almost sub capital level to facilitate removal of the femoral head. With the removal of the head, the fracture now had three main fragments namely the greater trochanter, the lesser trochanter, and the shaft with the retained portion of the neck of femur. In 21 cases, the lesser trochanter was incontinuity with the neck of the femur and was reconstructed with the shaft and greater trochanter using steel wires. A neck cut was then taken roughly about 1-2 cm above the lesser trochanter depending upon the amount of comminution. At times, the lesser trochanter was found as a separate fragment with neck as a separate fragment; in these cases, it was difficult to reconstruct the calcar (n=11). In these cases, the lesser trochanter and the greater trochanter were fixed to the shaft using steel wires; however most of the portion of the neck had to be sacrificed. In five cases where the lesser trochanter was comminuted, the trochanter pieces were left attached to the soft tissue and the medial defect was reconstructed using a cement mantle (n=5). In 19 cases, the greater trochanter was the fracture en masse and was reattached to the main shaft using steel wires. In 9 cases where the greater trochanter was coronally split a tension band was applied beneath the gluteus medius tendon and a bony tunnel was drilled in the distal greater trochanter. In 7 cases the greater trochanter was found to be severely comminuted; here ethibond sutures were used to suture together the trochanter pieces and the soft tissue to make a stable construct. The gluteus medius, greater trochanter, and the vastus lateralis apparatus were maintained in continuity as a stable lateral sleeve. This was then fixed loosely to the shaft fragment with

steel wires or ethibond sutures. In 2 cases where both greater and lesser trochanters were comminuted, they were both segregated together with the ethibond sutures to form separate masses and were reattached to the shaft after the insertion of a cemented femoral stem. Thus at the end of reconstruction, the greater trochanter, the lesser trochanter, and the shaft were wired together using steel wires in 32 cases while only ethibond sutures were used in five cases which were severely comminuted. The femoral canal was broached with appropriate anteversion. A fixed mono-block bipolar prosthesis of size equal to extracted head size was inserted and trial reduction was done. With the trial prosthesis insitu traction was applied to the leg and compared with the opposite leg for limb length equality. Applied traction causes the femur to be pulled distally and, a note of distraction between the prosthesis and the femoral cut was made and the level on the prosthesis was marked. This gives an idea of how much the femur implant should sink into the proximal femur so as to achieve limb length at the time of final cementing of the implant. We used bone piece as cement restrictor in all cases. During the final fixation of the stem, the cemented stem was allowed to sink in the femoral canal up to the mark made on the prosthesis in previous step and for the remaining portion a cement mantle was made so that the final limb length was equalized. Implant was placed in 10 deg of anteversion taking distal femoral condylar axis as reference axis because lesser trochanter is separated. This procedure was especially required in cases where the lesser trochanter was fractured and separated from the neck portion. Once the prosthesis was fixed, the broken trochanter and calcar were again retightened by tensioning the wire cables. The sleeve of gluteus medius, greater trochanter, and vastus medialis if reconstructed was now reattached to the shaft by additional wires. All the layers were closed one by one after the drain insertion. All patients underwent a routine post-operative physiotherapy protocol that included early gait training in form of walking with the help of a walker starting third day to the day before they are discharged. The rehabilitation then progressed as tolerated by the patients. Patients were examined postoperatively at 6 weeks, 3 months, 6 months, 1 year, and there after annually. At each follow-up visit, a clinic-radiological examination was done and the Patient were evaluated using the Harris hip score (HHS) and were graded as <70 poor, 70-79 Fair, 80-89 Good and 90-100 Excellent. Antero posterior and frog leg lateral view radiographs of the pelvis were used for assessment of implant loosening and measurement of medial and vertical offset. They were obtained using a standardized protocol: the patient was supine with feet parallel using a 100cm focal radiograph distance and the beam aimed at the centre of the image plate, which was positioned to include the iliac crest at its superior edge and measurements were taken using DICOM software. Measurements were taken on radiographs fixing them at a standard 300DPI. The images were obtained pre-operatively, immediate post operatively, at 6 months and at 1 yr follow up. The biomechanical parameters were determined with widely used methods described by Woolson *et al* and Jolles *et al*. Femoral offset (medial offset) was defined as the distance from the centre of rotation of the femoral head to the central axis of the femur. Vertical offset was defined as the distance from the centre of rotation of the femoral head to the level of lesser trochanter.

3. Results

Out of 37 patients 27(73%) were females. The average age of patients was 77.1 years (range 62-89 years, SD 9.76). The age

frequency between 60 to 70 was 8(21.62%), between 70-80 was 13 (35.13%), between 80-90 was 16 (43.24%). Nine of our patients had associated co morbidities hypertension in 6 and diabetes in 6. Twenty five of our patients (67.6%) were walking independently without support before the fracture. All patients were operated within 14 days (mean delay of 5.61 ± 3.73 days, range 2 days to 14 days) with delay due to patients presenting late and time taken for patients to be fit for anaesthesia. Out of 37 patients 29(78.37%) were having Evans type 3 fracture. Using Singh's index osteoporosis in other hip was grade 4 in one patient (2.70%), grade 3 in 5 (13.51%) patients, grade 2 in 20 (54.05%) patients, grade one in 11(29.72%) patients. The average surgery time was 96 min (range 75–119 min, SD 9.65) with an average Intra operative blood loss of 350 ml (range 175–500 ml, SD 117.59). Six patients needed single unit blood transfusion each post operatively, rest of the patients did not require any blood transfusion. The patients started full weight bearing at an average 4.2 days after surgery (Range 3–8 days, SD 1.87). One patient refused to walk after surgery and had a poor result (HHS 58). The average stay in the hospital was 10.96 days (range, 5–21 days, SD 6.66).

One of the patients developed bed sore post operatively, and required a week more of hospital stay, till the healing of the sore. This patient was operated on 5th day post injury and did not have a pre-operative bed sore. Out of the 37; Survived 35 (94.59%) two patients expired due to unrelated causes both due to myocardial infarction. The first among these patients was an 85 year old female with hypertension, diabetes and ischemic heart disease and was operated on 8th day post trauma. She died 3 months after surgery due to myocardial infarction. The second patient was 78 year old male with ischemic heart disease and chronic renal failure, was operated on 4th day post injury and died 5 months post-surgery due to myocardial infarction. The remaining 35 patients having a minimum one year follow up were evaluated and data was further analyzed. The minimum follow up was average of 18 months (range, 12–24 months). One patient developed pneumonia which settled down with intravenous antibiotics. One patient had a periprosthetic fracture 6 months after surgery which was treated with a locking compression plate. The fracture healed and the patient went on to have an excellent result. At the end of 3 months, 4 patients (11.4%) were graded as excellent, 10 patients (28.35%) as good, 13 patients (37.14%) as fair, 6 patients (17.14%) as poor, and 2 patients (5.71%) as failed. At latest follow-up mean 18 months, range 12 months to 24 months, the mean HHS was 84.8 ± 9.72 (range 58–97). A total of 6 patients (17.14%) were graded as excellent, 12 patients (34.28%) as good, 11 as fair (31.42%), 4 as poor (11.42%), and 2 as failed (5.71%). Pre injury 25 patients were walking without support, 12 patients were walking with support (cane n=10, walker n=2). At last follow-up, 12 patients (34.28%) were walking without any aid, 9 patients (25.71%) had a limp and used a stick for walking, 10 patients (28.57%) used a walker, and 4 were (11.42%) wheelchair bound. All patients had shortening of the operated limb with an average shortening of 1.1cm (range 5–15 mm) which was well compensated by giving a shoe raise. A total of 22 patients had an abductor lurch at 3-month follow-up; however, only 6 patients had abductor muscle weakness with a positive Trendelenberg test at final follow-up. Most of these patients however could walk well with the use of a stick. One patient had grade 1 heterotopic ossification at 6-month follow up; however, this did not restrict the range of motion. Among the patients with poor results, three patients had a superficial

wound infection which settled down with a course of intravenous antibiotics for 2 weeks. However, the patient continued to have diffuse pain along the incision site and walked with a limp. The fourth patient of poor results also had pain and limp, but we could not find any obvious reason for this pain. One patient with the failed result was a case of Alzheimer's disease. The patient did not cooperate with the physiotherapy program and refused to walk postoperatively. Eventually, the patient developed a severe adduction contracture and was wheelchair bound. There were no dislocation, loosening, or late infections. The other patient with failed result had a stroke and has hemiplegia postoperatively. The patient is not compliant and is unable to walk and bound to bed. The medial offset was lower on the operated hip. The values of medial offset of operated hip were {Range 3.09–4.86, mean was of 3.73(SD 0.48)}, the values of non-operated hip were {Range 3.12–5.65, mean was of 3.99(SD 0.62)} and the p-value was 0.017. The vertical offset was higher on the operated hip. The values of vertical offset of operated hip were {Range 3.34–6.26, mean was of 4.46 (SD 0.79)}, the values of Contra lateral hip were {Range 2.90–5.65, mean was of 4.38 (SD 0.74)} and the p-value was 0.875. As observations made in, there is increase in vertical offset of the operated hips, which does not correlate with limb length shortening. This fallacy can be explained as the lesser trochanter is reconstructed and reattached at a lower lever when compared to operated hip. No implant loosening was appreciated in the follow up of the cases. They all require long term follow up to identify loosening. However S.S-wire breakage is noted in 6 cases. All the cups which were vertical had become horizontal as the patient started walking and oriented to weight bearing axis in the subsequent follow up.

4. Discussion

Hip fractures are associated with notable morbidity and mortality in elderly patients. Internal fixation has drastically reduced the mortality associated with intertrochanteric fractures; however, early mobilization is still avoided in cases with comminution, osteoporosis, or poor screw fixation. The poor mechanical properties of the weak and porotic bone in these Elderly patients do not usually provide a firm purchase for the screws leading to early biomechanical failure. This will lead to collapse with migration of the femoral head into varus and retroversion resulting in limping due to shortening and decreased abductor muscle Lever arm. Another complication of internal fixation in porotic weak bone is cutting-out of the implant from the femoral head leading to profound functional disability and pain. Thus, it has become clear that, although the use of internal fixation has decreased the mortality rate somewhat the rate of complications still ranges from 4 to 50 percent and walking with full weight-bearing before the fracture has healed is often impossible [6]. Primary hemiarthroplasty offers a modality of treatment that provides adequate fixation and early mobilization in these patients thus preventing postoperative complications such as pressure sores, pneumonia, atelectasis, and pseudo arthrosis. The Indian perspective regarding the use of primary arthroplasty as a modality of treatment for severe comminuted unstable intertrochanteric fractures has been commented on by few authors; Hemiarthroplasty has been used for unstable intertrochanteric fractures since 1971, however less frequently as compared to femoral neck fractures [7, 8]. Its initial use was as a salvage procedure for failed pinning or their complications. Tronzo [9] claimed to be the first to use long, straight-stem endoprosthesis for the primary treatment of

intertrochanteric fractures. Harwin *et al* [10], reported on fifty-eight elderly patients with osteoporosis in whom a comminuted intertrochanteric femoral fracture had been treated with a bipolar Bateman-Leinbach prosthesis and who were followed for an average of twenty-eight months. The average patient age was seventy-eight years, and 91% walked prior to discharge. Two patients had a nonunion of the greater trochanter. There were no deep infections, dislocations, acetabular erosions, or cases of stem loosening. Rosenfeld, Schwartz [11] reported good results with the use of the Leinbach prosthesis. Since then there are multiple studies showing good results using this technique. Stern and Goldstein [12] used the Leinbach prosthesis for the primary treatment of 22 intertrochanteric fractures and found early ambulation and early return to the pre fracture status as a definite advantage. Liang *et al* [13] in their study of unstable intertrochanteric fractures concluded hemi prosthesis arthroplasty is an effective method to treat the unstable intertrochanteric fractures in elderly. It can decrease the complications, reduce the mortality, improve the patients living quality, and reduce the burden of the patient's family. Grimsrud *et al* [14] studied 39 consecutive patients of unstable intertrochanteric fractures treated with a cemented bipolar hip arthroplasty. They concluded that these fractures can be treated with a standard femoral stem and cerclage cabling of the trochanters. The technique allows safe and early weight bearing on the injured hip and had a relatively low rate of complications. In our study, the results of the hemiarthroplasty group were significantly better regarding operative time, blood loss, perioperative blood transfusion, and hospital stay. Early postoperative full weight bearing in the hemiarthroplasty group compared with early partial or non-weight-bearing in the internal fixation group was the main reason for significant reduction in post-operative complications such as pressure sores and pulmonary complications. In our series too there was only one case of pressure sores which healed with conservative management. The most serious complication in patients who have had a prosthetic operation on the hip is deep infection; the rate of infection after such an operation has been reported to range from 0 to 3% [15]. The large wound surfaces and the extensive dissection that is needed are factors that facilitate bacterial contamination. In our current study we haven't found any obvious deep infection. Since most of the patients were out of bed on the third day post operatively, and the recumbancy time was minimal, there were no chest complications in our series. Rodop *et al* [16] in a study of primary bipolar hemi prosthesis for unstable intertrochanteric fractures in 37 elderly patients obtained 17 excellent (45%) and 14 good (37%) results after 12 months according to the Harris hip-scoring system. A total of 18 out of 35 patients in our study had a good to excellent result (52.02%). If the patients with a fair result were also included, the percentage goes up to 83.44%. Thus the results of this modality of treatment are definitely promising especially in view of the variable results of osteosynthesis in this group. The opponents of the technique stated increase blood loss, mechanical complications like dislocation, and infection as possible complications as compared to conventional internal fixation. The earliest comparison of internal fixation and hemiarthroplasty was done by Haentjens *et al* [17] showing a significant reduction in the incidence of pneumonia and pressure sores in those undergoing prosthetic replacement. In a comparative study of hemiarthroplasty versus internal fixation, Kayali *et al* [18] reached the conclusion that clinical results of both groups were similar. Hemiarthroplasty patients were

allowed full weight bearing significantly earlier than the internal fixation patients. Broos *et al* [19] concluded that the operative time, blood loss, and mortality rates were comparable between the two groups, with a slightly higher percentage (73% versus 63%) of those receiving a prosthesis considered to be pain free. The functional outcome was comparable between both groups. Stappaerts *et al* [20], found no difference between two groups except a higher transfusion need in the replacement group. In our series the average blood loss was 350 ml with only six patients requiring post-operative blood transfusion and there was no incidence of dislocation. Conflicting reports about postoperative mortality in cases with primary hemiarthroplasty are cited in the literature. Kesmezacar *et al* [21], reported postoperative mortality in 34.2% after a mean of 13 months and in 48.8% after a mean of 6 months in patients treated with internal fixation and endoprosthesis, respectively. Other studies have shown no differences in postoperative mortality in two groups. In present series only 2 patients out of the 37 died (5.4%) within 6 months of surgery due to unrelated causes (both secondary to myocardial infarction). Hardy *et al* [22] reported early weight bearing without excessive collapse in cases with comminuted intertrochanteric fractures fixed with intramedullary nailing. However, there is only one study by Kim *et al* [22] which compares the calcar replacement prosthesis with intramedullary nailing in a prospective study involving two groups of 29 patients. They could not find any significant difference concerning the functional outcomes, but the cut-out rate of the hip screw was 7% in their patients. The rate of dislocation, as reported in the literature, has varied widely aggravated by many factors. In the study of Woo and Morrey [23], there was an increased rate of dislocation of the hip due to abductor weakness and trochanteric non-union. The dislocation rate in our hemiarthroplasty group was zero. The large diameter of the head and self-centering cup that was used in the bipolar arthroplasty might explain the decreased tendency to dislocate, also the reconstruction of abductor mechanism may be the reason for decreased chances of dislocation. Also the surgical technique might decrease the risk of dislocation if proper soft tissue balancing around the hip joint, proper restoration of equal leg length, and proper selection of the neck length, offset and version were performed. The presence of an attached lesser trochanter may preclude accurate adjustment of the proper limb length. This added to the technical difficulty of the operation. To establish a proper limb length, the center of the prosthetic head was adjusted to be in line with the tip of the anatomically repositioned greater trochanter. In our current study one case of non-union along the greater trochanter attachment was encountered in the hemiarthroplasty group. However, the patient could walk in spite of mild to moderate hip pain and lurching gait. This was possibly because of the low functional demand. Similar results were reported by Green *et al* [24] who had two painful hips in their series due to trochanteric non-union and also by Chan and Gill [25] who had one case of greater trochanteric non-union. None of these patients required reoperation. Stern and Angerman [26] reported that all the hips were stable after hemiarthroplasty regardless of whether the greater trochanter was anatomically reduced or just sutured near the prosthesis. Our present study also showed that the cemented mantle used to fix the prosthesis in the femoral shaft was possibly able to transmit the stresses of weight bearing directly to the femoral diaphysis bypassing the postero medial area of the proximal femur. In addition, calcar reconstruction had the potential advantage of improved trochanteric healing,

restoration of bone stock, reestablishment of proper limb length and reduced implant cost. This mechanism was properly efficient for elderly patients with low functional demands. The Cochrane [8] database analysis of relevant studies concluded that there is insufficient evidence to prove that primary arthroplasty has any advantage over internal fixation. However, they also mentioned that there were only two randomized trials studied and both had methodological limitations, including an inadequate assessment of the longer term outcome. Delay in surgery is an important predictor for mortality in patients with proximal femur fracture and also of the postoperative morbidity. In our study however, could not comment on these points because of small sample size and this is one of the limitations of our study. Thus in conclusion, primary hemiarthroplasty does provide a stable, pain free and mobile joint with acceptable complication rate as seen in our study; however a larger prospective randomised study comparing the use of intramedullary devices against primary hemiarthroplasty for unstable osteoporotic fractures will be needed.

5. Conclusion

In the present study there is female predominance for intertrochanteric Fractures. Mean age in this study was 77.1 years. Majority of the patients in our series have grade 2 osteoporosis based on Singh's index. In this study, Evans type 3 and type 4 were taken in to consideration of which type 3 were more common. Post-operative weight bearing was started as soon as possible, averagely it was 4.2 days. Two of the patients in this series expired due to myocardial infarction within 6 months after surgery. Functional results in this group had good to fair outcome. All the patients had limb length shortening with a mean of 1.1cm. According to the results, it is believed that cemented bipolar arthroplasty is of choice in freely mobile elderly patients above seventy years of age with an intertrochanteric femoral fracture. Cemented bipolar hemiarthroplasty is a technically challenging procedure which requires a reasonable learning curve. But a properly performed procedure is a viable option for unstable trochanteric fractures in very elderly osteoporotic patients. Careful restoration of neck length, offset and version maximize stability of the hip joint and increases the durability of the prosthesis. The procedure offered, faster mobilization, rapid return to pre injury level, improved the quality of life and gave a solution in elderly patients with intertrochanteric fractures of the femur. Bipolar hemiarthroplasty reduced the complications of prolonged immobilization, prolonged rehabilitation, marked residual deformities and need for revision surgeries. Postoperative full weight bearing after hemiarthroplasty spares the postoperative complications of non-weight bearing after internal fixation. This also reflects on the functional outcome if the patient survives after the first year postoperatively yet hemiarthroplasty in these cases is a surgically demanding technique. Bad surgical technique may lead to prolonged operative time, high incidence of deep infection, dislocation, and a poor radiological and functional outcome.

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