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Primary modular straight stem cemented prosthetic replacement for unstable, comminuted intertrochanteric fracture in the elderly with severe osteoporosis

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ABSTRACT

Background: The increasing number of hip fractures in the elderly, with the subset of unstable, comminuted intertrochanteric hip fractures is extremely relevant as the treatment is hampered by unsuccessful fixations and high complication rates. Osteoporosis and fracture geometry are two factors responsible for the failure of fixation in such fractures, upon which the surgeon has no control. Hence newer methods of fixation or treatment have to be opted for. The objective of the study was to evaluate the functional outcome of primary modular cemented prosthetic replacement for unstable, osteoporotic intertrochanteric fractures in a selected group of patients.
Methods: A total of 34 patients with type II and type III unstable intertrochanteric fractures were treated with primary modular cemented bipolar prosthesis and followed up in Pushpagiri Institute of Medical Sciences and Research Centre, Tiruvalla.
Results: After surgery 94.12% patients regained walking capacity. The functional outcome at the time of discharge was fair to excellent in 88.24% of cases. The complications were few and the major benefit was early ambulation of patients and return to pre-fracture level of activity.
Conclusions: Primary modular bipolar straight stem cemented prosthetic replacement is probably the best option for treatment in previously independently ambulant, elderly osteoporotic patients with unstable, comminuted intertrochanteric fracture of femur.

Keywords: Unstable, Comminuted, Intertrochanteric fracture, Osteoporosis, Modular cemented prosthesis

INTRODUCTION

Intertrochanteric fractures commonly occur in the elderly females. Prolonged recumbence in such cases has an adverse outcome not only in terms of patient function, but also in terms of their survival. The most important goal of treatment is an early restoration of function, which implicates an immediate, unrestricted weight bearing. Green et al observed in 1987 that morbidity and mortality in such patients would equal those treated conservatively with traction, if the surgery performed did not permit early weight bearing.[1]

While relative consensus exists about the treatment of femoral neck fractures in elderly patients, debate continues about the most appropriate treatment for unstable intertrochanteric fractures, especially in elderly patients with osteoporosis. Despite advances in internal fixation, fixing the unstable comminuted fractures in these patients still carries a high risk of failure. Elderly patients are often unable to co-operate with partial weight bearing; hence the primary stability of the device is crucial in allowing an early mobilization and preventing the cardio-pulmonary complications. Reports show that

stability of the cemented prosthesis complex is significantly greater than any nail-reduction complex.[2]

Early weight bearing and mobilization, and rapid return of patients to their pre-fracture status constitute the basis of primary cemented arthroplasty. While primary arthroplasty is a standard procedure for intracapsular fracture of neck of femur, little support extends to applying this procedure in the intertrochanteric fractures. Vidal et al were the first to propose primary arthroplasty in treating trochanteric fractures towards the end of 1970's.[3] Many studies have reported satisfactory results using unipolar/bipolar prostheses. Stern and Angerman reported their results in comminuted inter-trochanteric fractures treated by inserting Leinbach (calcar replacement) prosthesis.[4] Primary arthroplasty is however a technically challenging procedure; all loose fragments including the greater and lesser trochanters have to be attached before cementing the stem. Also, while using a conventional unipolar/ bipolar prosthesis the head obstructs the view of the surgeon during reconstruction.

So we chose to use the modular prosthesis, where the stem is first fixed, and proper replacement of the other pieces can be done without hindrance to view by the femoral head, as occurs in case of unipolar/ bipolar prosthesis. Here only the appropriately sized neck and head are used to make up the length and off set. Also here we have the option of choosing from three different sizes of stem, three different neck lengths and different head sizes. Such a study using modular bipolar prosthesis in intertrochanteric fractures of the osteoporotic elderly patients has never been reported in the available literature.

The purpose of this study is to analyse the role of straight stem cemented prosthesis system in cases of unstable, comminuted intertrochanteric fracture in the elderly with severe osteoporosis.

METHODS

A prospective study of 34 patients was undertaken from January 2004 to July 2006 in the Department of Orthopaedics of Pushpagiri Institute of Medical Sciences and Research Centre, Tiruvalla, Kerala, to evaluate the functional outcome following primary modular bipolar cemented prosthetic replacement for the unstable, comminuted, intertrochanteric fractures in elderly patients with osteoporosis.

Patients with physiological and chronological age of 75 years or above, patients with unstable comminuted intertrochanteric fracture (modified Evans-Jensen Type II (3 part) and Type III (4 part)) and patients ambulant prior to fracture were included in the study.

Patients of physiological and chronological age below 75 years, patients with stable intertrochanteric fracture (modified Evans- Jensen Type I (2 part)), patients non-ambulant prior to fracture, patients with previous ipsilateral hip surgeries and osteoarthritis of hip joint were excluded from the study.

Afetr getting informed consent from all the patients, the pre-injury ambulatory status of the patients was assessed with mobility score system of Parker and Palmer.[5] All patients were assessed by plain X-ray AP view and a cross table lateral view of the involved proximal femur. Fractures were classified according to modified Evans-Jensen classification.[6]

Implants

The prostheses (Figure 1) used were modular, straight stem, bipolar, endo-prostheses (Bimod Modular Hip System INOR). They are available with stem lengths 137 mm (small), 142 mm (medium) and 147 mm (large). They are not designed to replace calcar. Bipolar XL heads were used, diameters of which range from 39 to 51 mm (with 2 mm increments); neck sizes available are short (0 mm), standard (5 mm), and long (8 mm).

Figure 1: Modular straight stem bipolar prostheses and accessories.

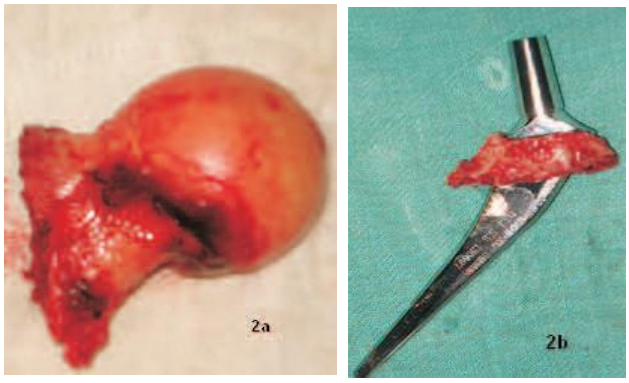

Figure 2: (a) Head, neck, trochanter removed; (b) modular stem with calcar.

Operative technique

Surgical procedure: A straight lateral incision was put centred over the tip of the posterior border of greater

trochanter, gluteus maximus and tensor fasciae latae are retracted, trochanteric bursa incised, and gluteus medius separated. The knee was flexed; hip internally rotated and extended, and short external rotators divided to visualize the posterior capsule. The fracture fragments were exposed, capsule opened in line with femoral neck, and the head, neck and trochanteric fragment removed as a single piece (Figure 2).

Reconstruction of the calcar femorale was done wherever possible by cutting it from the head using Gigli saw. The calcar was broached and placed on the selected stem before cementing the stem to the shaft of femur.

The femoral canal was prepared using bimod rasp, and the prosthesis stem was cemented in place using standard cementing techniques. In severe comminution, cerclage wires were used to augment fixation. Greater trochanter was stabilized with 18 gauge wires or non-absorbable prolene sutures. Trial neck and head of appropriate size was placed on the fixed stem and trial reduction performed, followed by the appropriate sized prosthesis.

Any debris from acetabulum was removed and the joint reduced. Stability was confirmed by putting the hip through a full range of motion. Saline wash was given, capsular incision closed, trochanteric bursa and muscles sutured back, and fascia lata and skin closed in layers. Suction drain was used in all patients for 48 to 72 hours.

Post-operative protocol: All the patients received prophylactic antibiotics, IV for the first five days, followed by orally until suture removal. In the immediate post-operative period the limb was kept in 30 to 40 degrees abduction.

Active and passive movements were encouraged from the first postoperative day itself; bed to chair was done on second day; patient made to stand and take a few steps using walker on third day and gait training with full weight bearing on the operated side under the supervision of an expert physiotherapy team by fourth day. Sutures were removed by tenth to twelth day, and patient discharged on being able to get out of bed and walk over level surface.

The data obtained in the study was analysed using Microsoft excel and presented in number and percentages.

RESULTS

There were a total of 34 patients with unstable intertrochanteric fracture, treated with primary modular cemented bipolar prosthesis. Table 1 presents the demographic and clinical characteristics of patients. The age of the patients ranged from 75 to 95 with a mean age of 83.4 year. Of the total 34 patients 05 were male (14.71%) and 29 female (85.29%). Frequency of involvement of right and left femurs were looked for; right was involved in 22 (64.70 %) and left only in 12 (35.29 %) patients. All the studied fractures were classified according to the modified Evans-Jensen classification. Of the total 34 patients, 22 (64.70%) had Type II [3 part] fracture with Type IIA in 14 (41.18%) and Type IIB in 8 (23.53%). Twelve patients (35.29%) had Type III [4 part] fracture.

Table 1: Demographic and clinical findings of the study participants (n=34).

Variable	No. of patients (N)	Percentage (%)
Age in years		
75-80	14	41.17
81-85	8	23.52
86-90	6	17.65
91-95	6	17.65
Sex		
Male	5	14.71
Female	29	85.29
Side of involvement of femur		
Right	22	64.7
Left	12	35.29
Types of fractures according to the modified Evans-Jensen classification		
Type IIA	14	41.18
Type IIB	8	23.53
Type III	12	35.29

Associated injuries: Two patients had other injuries as well; one had a head injury with subdural hygroma, managed conservatively by our Neurosurgeon. The other had a fracture of proximal humerus (right), managed using a shoulder immobilizer.

Co-morbidities were present in 26 patients (76%), of which the most frequent (Table 2) were hypertension (64%) and diabetes mellitus (52.9%).

Table 2: Co-morbid conditions present in the patients.

Co-morbidities	No. of patients (N)	Percentage (%)
Hypertension	22	64.70
Diabetes mellitus	18	52.94
Coronary artery disease	4	11.76
Bronchial asthma	2	5.88
Hemiparesis	1	2.94

All patients were treated with modular bipolar cemented prostheses replacement. In six patients with Type III fracture, cerclage wire also was used to stabilize the calcar fragment. Bone cement was used for fixation of the femoral stem in all patients.

The mean operative time was 96 minutes (range 82 to 124). The average number of units of blood transfusion was 1.9 units. In 32 patients (94.12%) full weight bearing

ambulation could be started in 5½ days. In the patient with fracture of humerus, and in the patient with subdural hygroma, weight bearing got delayed by one month. Duration of hospitalization varied from 15 to 27 days (average 18). All the patients with co- morbidities had to stay longer.

Figure 3 (A-D): Radiographic follow up of a patient.

Follow up

The follow up period ranged from six weeks to 29 months, with an average of 19½ months. Regular evaluations were performed at six weeks, and three, six and twelve months, and yearly thereafter. One patient expired two months after surgery following myocardial infarction. Three patients passed away within a year of surgery due to co-morbid conditions, but were ambulant until the terminal stages. One patient got bedridden due to general debility and co-morbidities at a follow up 18 months, but she had no complaints related to the hip. Follow up of two patients was lost after two years. Ambulatory status was assessed with mobility score of Parker and Palmer, and was compared to the pre-injury status.

Roentgenographic follow up: Evaluation was done for signs of fracture healing, migration, loosening, wears, or implant failure at six weeks, three and six months (Figure 3). It showed callus incorporating the bone fragments, even though they were not fixed to the prosthetic component. The bony envelope was responsible for the absent mobility at the site. There was no evidence of any loosening, migration, or acetabular erosion.

The average pre-injury score was 6.8 (range 4 to 9) as assessed by Parker and Palmer scale. The average

postoperative mobility score at six weeks follow up was 5.4, and at sixteen weeks was 6.2 (range 4 to 9). The comparison of pre-injury and post-operative mobility score suggest that nearly all patients were able to return to their pre-injury ambulatory status without any delay. The final functional outcome (Table 3) was graded by Harris hip scoring system (HSS).

Table 3: Functional outcome of the ambulant patients as per HSS (n=34).

Outcome	No. of patients (N)	Percentage (%)
Excellent	4	11.76
Good	10	29.41
Fair	16	47.06
Poor	4	11.76

The commonest complication was shortening of the limb noted in six patients (18.75%). Average shortening was only 1.3 cm; as this is considered minimal, no intervention was required to be done (Table 4).

Table 4: Complications following the prosthetic management.

Complication	No. of patients (N)	Percentage (%)
Shortening	6	17.65
Respiratory infection	4	11.76
Bed sore	2	5.88
Anterior thigh pain	4	11.76

DISCUSSION

Inter-trochanteric fractures of femur are common in elderly people with weak bone structure, and most of them are communited and unstable. The ideal implant for the treatment of unstable intertrochanteric femoral fractures is still a matter of debate. The dynamic devices popularized as sliding screw/ side plate, telescoping nail, dynamic hip screw, and sliding hip screw are currently in wide use as reliable methods of internal fixation, even though the operative technique is not always easy. The poor mechanical properties of the porotic bone in the elderly patients do not usually provide firm fixation for the screws. Surgical failure due to loosening has been documented by disengagement and intrapelvic protrusion of the sliding screws, and the cutting out of side plate screws. Various implants like trochanteric stabilization plates and Medoff plate have been tried to prevent these complications.

Few surgeons prefer prosthetic replacement to standard internal fixation supplemented with bone cement. There are advantages and disadvantages to each option.[7] While primary arthroplasty is a standard procedure for femoral neck fractures, little evidence is available regarding its application in intertrochanteric fractures.[8,9] They have primarily been used as a salvage procedure in cases of failure of internal fixation.[10] Calcar replacement type of prosthesis and cemented bipolar prosthesis have been reported to be useful in such fractures in the elderly. Haentjen et al in their study of bipolar prosthesis compared with internal fixation noted that octogenarians will usually bear weight on the involved limb as much as their psychomotor abilities will allow, and the patients in the arthroplasty group were able to walk with full weight bearing without fear of losing their balance.[11] Similar findings were noted in our study as well, and rehabilitation was easier. In another study Haentjen et al also strongly suggest that early mobilization with full weight bearing has to be the objective of treatment.[12] They also propose that older patients with severe osteoporosis or comminution, and non-unions could benefit better from bipolar prosthetic replacement in intertrochanteric fractures

To the best of our knowledge, the use of modular bipolar cemented straight stem prosthesis as primary treatment in the elderly osteoporotic has not been reported in the available literature. Fixation of the modular prostheses with cement allows immediate full weight-bearing; availability of different neck lengths due to the modularity of the implant allows improved equalization of limb lengths and stability of the hip joint; long stems are useful in treating the distal disease; and the survival of these prostheses is excellent over the shortened life span of these patients.[13]

Infection may occur after either arthroplasty or internal fixation, but the risk is highest in patients who require an arthroplasty after internal fixation has failed. The rate of infection in one study of femur with a pathological fracture that had been treated with arthroplasty was one to three percent.[14] In the present study with bipolar prosthesis we did not encounter any episode of deep sepsis until the last follow up.

The mean operative time in the present study was 96 minutes (range 82 to 124). This was slightly longer than the time of 69 minutes (35 to 130) reported in Chan et al series.[8] The age, gender, pre-fracture health status and social dependency before fracture are also important factors determining functional recovery after hip fracture. Direct comparison of these with other studies is difficult.

In our study 94.12 % patients regained walking capacity after surgery. We had 41.17% good to excellent, 47.06 % fair, and only 11.76 % poor results as per the Harris hip score system for functional evaluation. Using mobility score of Parker and Palmer we found that nearly all patients were able to return to their pre-injury ambulatory status without delay. This proves that our surgical technique permits a more rapid recovery with immediate weight-bearing, and maintenance of a good level of function, with little risk of mechanical failure.

Roentgenographic follow up in our study showed new bone formation incorporating the bone fragments, even

though they were not fixed to the prosthesis. Haentjens et al reported similar findings.[12] They state that new bone formation takes place in the medial and posterior aspects of femur, which bear the load in compression.

The rate of dislocation, as reported in literature varies between zero and seven percent, but we did not have even a single dislocation of the modular prosthesis.[15] Dislocations usually occur due to faulty version or length of stem. The maximum shortening in our study was only 1.3 cm, which can be considered insignificant.

Advantages of modular bipolar prosthesis

- Reconstruction of calcar and the greater trochanter fragment is easier with this technique than with ordinary bipolar or unipolar prosthesis.
- Prosthesis length can be corrected to a certain extent using proper neck length, thus preventing limb length discrepancy.
- Conversion to a total hip is possible, in case of acetabular erosion in follow up.
- No unusual medical or surgical complications were encountered in this study compared with other published reports on internal fixation and endoprosthetic replacement.

Limitations of the study

- It included only a limited number of patients
- Follow up period was relatively short. Potential long-term problems like loosening, acetabular erosion and stem failure need longer follow up
- A control group treated with sliding hip screw was not considered
- Cost effectiveness of the surgical intervention was not addressed.

CONCLUSION

Primary modular straight stem cemented bipolar prosthetic replacement is a viable option for treatment in previously independently ambulant, elderly osteoporotic patients with unstable, comminuted intertrochanteric fracture. The patients' rapid return to pre-fracture level of activity significantly reduces the incidence of complications related to immobility as well. Early walking with full weight bearing is the major benefit and goal of the procedure.

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