Total hip arthroplasty for failed aseptic Austin Moore prosthesis

Pradeep Bhosale, Ashish Suryawanshi, Amber Mittal

ABSTRACT

Background: Though Austin Moore (AM) replacement prosthesis has fairly good short term results for intracapsular femoral neck fractures in the elderly, it still is a compromised option and has a high failure rate in the long run. The objective of the present retrospective study is to analyze the functional outcome, assess survivorship of revision total hip arthroplasty (THA) at mid to long term followup, and evaluate intraoperative difficulties faced during conversion of failed aseptic AM prosthesis to cemented THA.

Materials and Methods: Eighty-nine cemented THA surgeries for failed AM prosthesis were performed between 1986 and 2005. AM failures were classified into seven groups on the basis of mode of failure. Infected failures were excluded from the study. There were 35 men and 54 women in the study group. The mean age was 68 years (range 57–91 years). Mean followup was 8 years (range 5–13 years).

Results: Average Harris Hip Score improved from 65 preoperatively (range 42–73) to 87 (range 76–90) at 1 year postoperatively and to 86 (range 75–89) at the last followup. The overall complication rate was 4.5%.

Conclusion: Conversion THA is an excellent treatment strategy for symptomatic failed AM hemiarthroplasty in terms of pain relief and restoration of function and mobility as near as possible to the preinjury level. Also, hemiarthroplasty should not be used in physically active patients, even in elderly individuals. Careful patient selection for hemiarthroplasty versus THA is vital and may decrease the incidence of complications and ameliorate the outcomes in the treatment of intracapsular femoral neck fractures.

Key words: Austin Moore prosthesis, hemiarthroplasty, total hip arthroplasty

INTRODUCTION

Austin Moore prosthesis, historically, has served as a good implant over the years in the management of femoral neck fracture in elderly. There are many case reports of these actually lasting a long time (>20 years).1-3 The disadvantages of AM prosthesis are relatively poor outcomes in active patients secondary to poor femoral fixation and a marked potential for acetabular erosion.1-3 Therefore, at this time, the indication for a Moore’s arthroplasty should be reserved for very limited or nonambulatory, low-demand patients.1-3 However, because of less cost and good short term results, its widespread use in improperly selected patients leads to large number of failures with this type of prosthesis.

According to Lunceford,4 improper placement of the prosthesis and the resulting biomechanical disturbances within the hip joint (excessive elongation or shortening of the extremity or improper rotation of the implant) are responsible for failure of hemiarthroplasty. Inadequate calcar seating, insufficient residual femoral neck length, insufficient metaphyseal fill, and errors in sizing the prosthesis are all associated with early failure of the AM hemiarthroplasty.5

Linas et al.6 reported that after femoral neck fractures, there is a tendency of the femoral neck to resorb, allowing the hemiarthroplasty to sink into the medullary canal to the level of the lesser trochanter. Conversion total hip arthroplasty (THA) for failed AM prosthesis, therefore, may be more challenging and should be done with a great deal of caution to prevent intraoperative complications.7

The objective of the present study is to analyze the functional outcome, assess survivorship of revision THA at mid to long term followup, and evaluate intraoperative...
difficulties faced during conversion of failed aseptic AM prosthesis to cemented THA in a tertiary care center.

**MATERIALS AND METHODS**

Ninety-one cemented THA surgeries for failed aseptic Austin Moore (AM) prosthesis were performed at our institute between 1986 and 2005. Two patients lost to follow-up and were excluded from the analysis. There were 35 men and 54 women. The mean age was 68 years (range 57–91 years). All patients had displaced intracapsular femoral neck fracture as the indication for primary surgery. Mean time to failure since primary surgery was 58 months (range 1-144 months). Mean preoperative Harris Hip Score (HHS) was 65. Thirty patients were community ambulators, 34 were homebound, and 25 were bedridden. Preoperative clinical evaluation (discharging sinus, swelling, redness, warmth, etc.) laboratory investigations in form of complete blood count, erythrocyte sedimentation rate (ESR), and C-reactive protein (CRP) were measured to exclude infection. All the patients were operated in lateral decubitus position using posterolateral approach.

We found that the difficulties were mainly encountered during three major surgical steps: Exposure, dislocation of prosthesis, and extraction of prosthesis.

During exposure, when external rotators and capsule were difficult to identify (because of prior surgery), the scar tissue was elevated “en masse” from the intertrochanteric ridge posteriorly to prevent sciatic nerve injury. Before dislocating, femur was lateralized with bone hook and scar tissue was released meticulously from all around the prosthesis. Then, the prosthesis was dislocated posteriorly by flexing, adducting, and internally rotating the hip, checking synchronous motion of femur with prosthesis to avoid periprosthetic fractures. The anterior capsule, any scar tissue, and osteophytes were removed at this stage. Before extraction, the piriform fossa and the proximal periprosthetic area were cleared of any bone and fibrous tissue using bone nibblers and thin osteotomes so as to visualize prosthesis extraction holes. Then, the prosthesis was extracted using devices like bone hook, universal extractor, etc. In a few cases, cortical erosion and false tract [Figure 1] were found for which we first used an interlock nailing guide wire to negotiate false tract and then femoral reaming was done over guide wire using cannulated flexible reamers. Fiberoptic headlight was used to visualize the fibrous membrane and slightly angled curettes and metal bristle roller brush were used to remove it. Femoral and acetabular preparation and cementing were done using standard techniques. The results were evaluated using Harris Hip Score recorded preoperatively, at 1 year, and at each followup visit. Mean followup duration was 8 years (range 5-13 years). For statistical analysis, paired t-test was used to evaluate possible statistical differences of preoperatively and postoperatively values. Statistical significance was set at $P<0.05$.

We have categorized AM prosthesis failures into seven groups on the basis of mode of failure [Table 1].

Group 1 ($n=6$): The patients had periprosthetic fractures [Figure 2] often involving calcar for which we used longer femoral stem bypassing the fracture site by at least two cortical diameters or 5 cm, whichever was more. It was augmented with cerclage wiring and bone graft (auto or allograft).

Group 2 ($n=8$): The patients had implant breakage. We removed broken implants, either endofemoral ($n=5$) or transfemoral ($n=2$). In one patient, we pushed the broken implant distally so that it could act as cement restrictor. One of the revised patients had a broken stem and a dislocated Austin Moore prosthesis head [Figure 3] which was removed through endofemoral approach. In transfemoral approach, opening in the medullary canal by creating a posterolateral bony lid which remains attached to the surrounding soft tissues (extended transfemoral osteotomy) was done to extract the broken implant and long stem prosthesis was used to bypass the cortical defect.

Group 3 ($n=36$): The patients had calcar resorption often associated with shortening. In all these patients, prostheses were loose and often associated with fibrous tissue formation which was removed using fiberoptic light. We did augmentation of calcar with bone graft [Figure 4] to restore the limb length (vertical offset).

Group 4 ($n=19$): The patients had protrusion acetabuli [Figure 5] which was treated with impaction bone grafting (autogenous iliac crest bone graft preferred over allograft) using impactor and reverse reaming. In severe cases, we used antiprotrusion cages ($n=3$). The outer wall of the ilium is exposed for several centimeters above the bone defect,

| Table 1: Classification of Austin Moore prosthesis failures |
|----------------|----------------|
| Groups        | Type of failure | Number of patients |
| Group 1       | Periprosthetic fractures | 6 |
| Group 2       | Implant breakage    | 8 |
| Group 3       | Calcar resorption  | 36 |
| Group 4       | Protrusion         | 19 |
| Group 5       | Instability        | 6 |
| Group 6       | Improper positioning of AM prosthesis | 2 |
| Group 7       | Painful hip (no obvious cause) | 12 |
| Total         |                  | 89 |
and the residual bone surfaces are roughened with a burr, reamers, or an osteotome. Morsellized pieces of bone graft are then packed into bone defects, leaving room for the antiprotrusion cages.

Group 5 (n=6): The patients had instability [Figure 6] as demonstrated by telescoping of prosthesis in femoral canal during traction views. These were the patients where synchronous motion of femur with prosthesis was observed.

Figure 1: (a) Lateral radiographs of the prosthesis showing false tract posteriorly in the shaft of femur. (b) Bypassing the false tract with cannulated reamers over guide wire

Figure 2: (a) X-rays of right hip showing periprosthetic fracture of the femur which was (b) managed using long stem cemented total hip arthroplasty augmented with cerclage wiring and bone graft

Figure 3: (a) Radiograph showing broken AM prosthesis at the junction of neck and stem with dislocation of head or prosthesis which was (b) managed successfully with cemented total hip arthroplasty as shown in the 8 year postoperative radiograph
while dislocating prosthesis so as to avoid periprosthetic fracture.

Groups 6 (n=2) and 7 (n=12): The patients often had either proximal calcar gap or tight fit between prosthesis head and acetabulum. These were the patients where care had to be taken while dislocating prosthesis head so as to avoid acetabular and femoral fracture.

**RESULTS**

Average HHS improved from 65 preoperatively (range 42–73) to 87 (range 76–90) at 1 year followup and to 86 (range 75–89) till the last followup [Table 2]. Mean followup duration was 8 years (5–13 years). Harris Hip Scores were affected by the indication for conversion arthroplasty. The *P* values of all the groups were less than 0.001, which suggests highly significant results except in group 6 where the *P* value was more than 0.05 which may be because of only two patients in that group. The overall complication rate was 4.5%. Deep infection occurred in two patients, which required two stage revision surgery. Loosening occurred in two patients after 10 years followup. Revision was subsequently performed in both these patients. Our 5 patients had limb length discrepancies (<2.5 cm). The mean leg length discrepancy was 12 mm (range 5–20 mm). Six patients had persistent groin pain. Heterotopic ossification

| Groups   | Number of patients | Preoperative | 1 year followup | Last followup | *P* value |
|----------|--------------------|--------------|-----------------|---------------|-----------|
| Group 1  | 6                  | 42           | 76              | 75            | <0.001 HS |
| Group 2  | 8                  | 50           | 78              | 78            | <0.001 HS |
| Group 3  | 19                 | 68           | 89              | 88            | <0.001 HS |
| Group 4  | 19                 | 65           | 86              | 86            | <0.001 HS |
| Group 5  | 6                  | 73           | 89              | 87            | <0.001 HS |
| Group 6  | 2                  | 72           | 84              | 84            | <0.001 HS |
| Group 7  | 12                 | 69           | 90              | 89            | <0.001 HS |
| Total    | 89                 | 65           | 87              | 86            |           |
Failed AM prosthesis in our study has been attributed to non-modularity of AM prosthesis stem, inadequate lateralization of stem, poor interphase between metal and cartilage, calcar loading with poor AM fixation, implant bone instability, and poor soft tissue balancing (intraoperative observation of joint laxity with shuck test).

Several studies have been published concerning the results following total hip replacement in failed hemiarthroplasty. Amstutz and Smith\textsuperscript{20} noted very high incidence of intra- as well as postoperative complications. Intraoperative femoral fractures (n=5), perforations of the medial femoral cortex (n=2), instability (n=2), infection (n=2), deep venous thrombosis (n=3), progressive loosening (n=6) out of 41 patients. Amstutz and Smith\textsuperscript{20} and Sarmiento and Gerard\textsuperscript{21} reported significant improvement in pain after conversion of failed endoprosthesis to THA. The d’Aubigne and Postel rating for pain improved from 3.3 to 7.9 after conversion of failed endoprosthesis in the series of Amstutz and Smith.\textsuperscript{20} Sarmiento and Gerard\textsuperscript{21} also reported improvement from 2.8 to 5.78 using the same scoring system. Llinas \textit{et al.}\textsuperscript{6} conducted a larger study with longer followup (mean 87 months) and they had a 6% revision rate which is comparable to the 5% revision rate for primary total hip in the same study for a similar period. Cossey and Goodwin\textsuperscript{22} reported 46 patients who had conversion arthroplasty with 1 year followup; they had no loosening, no dislocation, two patients had superficial infection, and three patients had died at the time of the final followup. Llinas \textit{et al.}\textsuperscript{6} concluded that conversion arthroplasty had a higher rate of early loosening of the femoral component than after a primary THA, and this statement was supported by the results of Amstutz and Smith.\textsuperscript{20}

Sierra and Cabanela\textsuperscript{7} in a larger series of 132 hemiarthroplasties that were converted to THA reported major complications in 45% including loosening in 10%, femoral fractures in 9%, and dislocations in 9.8%, after a mean followup of 7.1 years. Hammad and Abdel-Aal\textsuperscript{23} reported no loosening in 47 patients of conversion THA after an average followup of 44 months. The reasons they stated were better cementing technique and stem design.

Our study showed significant improvement in HHS following conversion arthroplasty, as found in previous studies. However, overall complication rate was significantly lower than most of the studies. Also, mean followup duration in our study, 8 years (range 5–13 years), was considerably higher than that reported in almost all studies.

Deep infection occurred in two patients, which required two stage revision surgery. Loosening occurred in two patients after 10 years followup. Revision was subsequently performed in both these patients.

Preoperative planning is essential in conversion THA. Assessment of acetabular and femoral bone quality, presence of endosteal cortical shell, and status of the greater trochanter are all important. Knowledge of the prior approach, range of motion, and power of the abductors are essential in planning the procedure. It may be necessary to plan ahead for a trochanteric osteotomy or trochanteric slide as proposed by Glassman \textit{et al.}\textsuperscript{24} According to our experience, the following intraoperative steps should be considered during conversion arthroplasty:

\textit{En masse} removal of scar tissue (capsule and external rotators’ distinction often difficult) from the intertrochanteric ridge posteriorly. Avoid inadvertent damage to the sciatic nerve during removal of scar tissue. Lateralization of femur with bone hook and release of scar tissue meticulously from all around the prosthetic prior to dislocation. Dislocate the prosthesis posteriorly by flexing, adducting, and internally rotating the hip, checking synchronous motion of femur with prosthesis to avoid periprosthetic fractures (especially in cases when there is movement between the femur and the prosthesis). In cases with a proximal calcar gap and in cases with a tight fit between prosthetic head and the acetabulum, care has to be taken to avoid fracturing the acetabulum and the femur during dislocation of the prosthetic head. Remove the anterior capsule, and any scar tissue and osteophytes to prevent retroversion of the cup. Clearance of the piriform fossa and the proximal periprosthetic area of bone and fibrous tissue in order to visualize the extraction

\textit{Discussion}

Elderly patients with intracapsular femoral neck fractures commonly have been treated with AM prosthesis. It has been associated with a poor quality of life in the long term, with a very high incidence of groin and thigh pain in physically active elderly patients, largely as a consequence of acetabular cartilage degeneration and stem loosening, respectively.\textsuperscript{8,10} The percentage of unsatisfactory results quoted in literature is variable, ranging from 13%,\textsuperscript{11} 15%,\textsuperscript{12} 29%,\textsuperscript{13} and 34%\textsuperscript{14} to 48%\textsuperscript{15} in Western series and from 9%\textsuperscript{16} and 35%\textsuperscript{17} to 36%\textsuperscript{18} in Indian series. Norrish Alan\textsuperscript{19} reported the prosthesis survivorship of 94% (90–96%) at 5 years and only 83% (65–94%) at 12 years in an 8-year followup study.

Failure of AM prosthesis in our study has been attributed to non-modularity of AM prosthesis stem, inadequate lateralization of stem, poor interphase between metal and cartilage, calcar loading with poor AM fixation, implant bone instability, and poor soft tissue balancing (intraoperative observation of joint laxity with shuck test).

Removal of scar tissue (capsule and external rotators’ distinction often difficult) from the intertrochanteric ridge posteriorly. Avoid inadvertent damage to the sciatic nerve during removal of scar tissue. Lateralization of femur with bone hook and release of scar tissue meticulously from all around the prosthetic prior to dislocation. Dislocate the prosthesis posteriorly by flexing, adducting, and internally rotating the hip, checking synchronous motion of femur with prosthesis to avoid periprosthetic fractures (especially in cases when there is movement between the femur and the prosthesis). In cases with a proximal calcar gap and in cases with a tight fit between prosthetic head and the acetabulum, care has to be taken to avoid fracturing the acetabulum and the femur during dislocation of the prosthetic head. Remove the anterior capsule, and any scar tissue and osteophytes to prevent retroversion of the cup. Clearance of the piriform fossa and the proximal periprosthetic area of bone and fibrous tissue in order to visualize the extraction
holes of the prosthesis. In cases where bone plugs have been formed in the extraction holes, thin osteotomes should be used to remove the bone plugs. Failure to do so may lead to a periprosthetic fracture while extracting the prosthesis. Extract the prosthesis using devices like bone hook, universal extractor, etc. applying gentle force only in the direction of medullary canal. In a case of cortical erosion and a false tract, a guide wire for an interlocking nail should be used to avoid the false tract. Reaming should then be performed using cannulated flexible reamers. Use fiberoptic headlight to visualize the fibrous membrane and slightly angled curettes and a metal bristle roller brush to remove the membrane. Remnants of such a membrane may compromise the fixation of the subsequent cemented prosthesis by decreasing the total area of bone available for cement interdigitation, preventing intimate contact between cement and bone, and also by increasing the rate of endosteal bone resorption. Fragments of such fibrous membrane are metabolically very active, producing prostaglandin E2, collagenase, and interleukin 1b, all of which may contribute to resorption of adjacent bone.\textsuperscript{25-27}

In case of implant breakage, the broken stem can be extracted in two ways, either endofemoral or transfemoral. Endofemoral extraction can be accomplished anterogradely (using special extraction instruments) or retrogradely (when anterograde approach fails). A retrograde technique requires establishment of a standard retrograde femoral nailing portal and intramedullary rods to push the broken stem proximally. Sometimes, a broken implant can be pushed distally so as to act as cement restrictor. However, endofemoral approach is tedious and time consuming. Special instruments (like extraction hook, hollow mill, carbide drill, extraction cork screw) are needed when using this approach and such a technique always carries a risk of cortical perforation. The transfemoral approach includes sliding trochanteric osteotomy, extended trochanteric osteotomy, or distal fenestration of the femoral cortex to remove the broken implant. However, transfemoral approach requires bypassing the osteotomy by the new longer femoral stem with at least two canal diameters. Other methods like metal cutting ones have the risk of metallosis. Augment calcar with bone graft so as to restore the limb length (vertical offset) in cases of calcar resorption.

It should be noted that the results after use of THA in displaced femoral neck fractures have been presented in several reports. Dorr \textit{et al.}\textsuperscript{28} reported no difference in results between cemented THA and cemented hemiarthroplasty, but the results associated with uncemented hemiarthroplasty were poor after a minimum duration of followup of 2 years. Function improved with time after THA but not after hemiarthroplasty.

Gebhard \textit{et al.}\textsuperscript{29} demonstrated superior longevity of THA when compared with hemiarthroplasty with and without cement in 166 cases of displaced femoral neck fractures. The revision rate was 2.2\% after THA, 7.9\% after hemiarthroplasty with cement, and 13\% after hemiarthroplasty without cement. Pain was the main reason for revision in hemiarthroplasty group.

\textit{Lee et al.}\textsuperscript{30} reported their experience with primary THA in patients with femoral neck fractures. Their survivorship analysis showed a probability of survival of the prosthesis without revision of 95\% at 5 years, 94\% at 10 years, and 89\% at 15 years.

Conversion of endoprostheses to THA is challenging. Special attention should be given to the greater trochanter and to the femoral shaft to prevent intraoperative fractures. The incidence of perioperative complications in this subgroup of elderly individuals is high. When compared with primary THA after femoral neck fractures, patients having conversion from endoprostheses to THA fare worse at long term followup.\textsuperscript{6,7,20}

Keating \textit{et al.}\textsuperscript{31} and Blomfeldt \textit{et al.}\textsuperscript{32} reported increased pain and reduced walking ability after hemiarthroplasty compared with THA and this is in agreement with a previous review of the literature on outcomes and cost-effectiveness after surgical treatment of displaced femoral neck fractures.\textsuperscript{33}

The results from the Swedish Hip Arthroplasty Registry\textsuperscript{34} have shown a probability for implant survival for primary THA in patients with hip fractures that is comparable with those in patients with osteoarthritis or rheumatoid arthritis. This suggests that primary THA in these elderly patients will survive their remaining lifespan, provided there are no early complications. This is in contrast to the hemiarthroplasty group, where there is a potential risk for deteriorating hip function, especially in the most active patients and in those with the longest life expectancy.\textsuperscript{31}

According to our experience, it seems reasonable to conclude that conversion arthroplasty is an excellent treatment strategy for symptomatic failed AM hemiarthroplasty in terms of pain relief and restoration of function and mobility as near as possible to the preinjury level. As to the primary treatment, there are reports in the literature showing that hemiarthroplasty should not be used in physically active patients, even in elderly individuals.\textsuperscript{31} Careful patient selection for each type of arthroplasty (hemi versus total) after femoral neck fractures may decrease the incidence of complications and ameliorate the outcomes in the treatment of femoral neck fractures.
References

1. Klenerman L, Marcuson RW. Intracapsular fractures of the neck of the femur. J Bone Joint Surg Br 1970;52:514-7.
2. Clayer M, Bruckner J. The outcome of Austin-Moore hemiarthroplasty for fracture of the femoral neck. Am J Orthop 1997;26:681-4.
3. Emery RJ, Broughton NS, Desai K, Bulstrode CJ, Thomas TL. Bipolar hemiarthroplasty for subcapital fracture of the femoral neck: A prospective randomized trial of cemented Thompson and uncemented Moore stems. J Bone Joint Surg Br 1991;73:322-4.
4. Lunceford EM Jr. Use of the Moore self-locking Vitallium prosthesis in acetabular fractures. J Bone Joint Surg Am 1965;47:832-41.
5. Weinrauch P. Intra-operative error during Austin Moore Hemiarthroplasty. J Orthop Surg (Hong Kong) 2006;14:249-52.
6. Llinas A, Sarmiento A, Ebrahimzadeh E, Gogan WJ, Mc Kellop HA. Total hip replacement after failed hemiarthroplasty Or mould arthroplasty. Comparison of results with those of primary replacement. J Bone Joint Surg 1991;73:902-7.
7. Sierra RJ, Cabanela ME. Conversion of failed hip hemiarthroplasties after femoral neck fractures. Clin Orthop 2002;399:129-39.
8. Squires B, Bannister G. Displaced intracapsular neck of femur fracture in mobile independent patients: Total hip replacement or hemiarthroplasty. Injury 1999;30:345-8.
9. Gingras M, Clarke J, Evarts CM. Prosthesis replacement in femoral neck fracture. Clin Orthop Relat Res 1980;152:147-52.
10. Gowen M, Wood DD, Ihrie EJ, McGuire MK, Russell RG. An interleukin 1 like factor stimulates bone resorption in vitro. Nature 1983;306:378-80.
11. Andersson G, Nielsen JM. Results after arthroplasty of the hip with Moore's prosthesis. Acta Orthop Scand 1972;43:397-410.
12. D'Arcy J, Devas M. Treatment of fractures of the femoral neck by replacement with a Thompson prosthesis. J Bone Joint Surg 1976;58:729-86.
13. Moore AT. The self-locking metal hip prosthesis. J Bone and Joint Surg 1957;39:811-27.
14. Salvati EA, Wilson PD. Long term results of femoral-head replacement. J Bone Joint Surg 1973;55:516-24.
15. Jensen JS, Holstein P. A long-term follow-up of Moore Arthroplasty in femoral neck fractures. Acta Orthop Scand 1975;46:764-74.
16. Saxena PS, Saraf JK. Moore prosthesis in fracture neck of femur. Indian J Orthop 1978;12:138.
17. Jadhav AP, Kulkarni SS, Vaidya SV, Divekar MM, Suralkar SP. Results of Austin Moore replacement. J Postgrad Med 1996;42:33-8.
18. Kumar R, Singh T. Early results of prosthetic replacement in old neglected cases of fracture neck femur. Indian J Orthop 1980;14:1.
19. Norrish AR, Rao J, Parker MJ. Prosthesis survivorhip and clinical outcome of the Austin Moore hemiarthroplasty: An 8-year mean follow-up of a consecutive series of 500 patients. Injury 2006;37:734-9.
20. Amstutz HC, Smith RK. Total hip replacement following failed femoral hemiarthroplasty. J Bone Joint Surg Am 1979;61:1161-6.
21. Sarmiento A, Gerard FM. Total hip arthroplasty for failed endoprostheses. Clin Orthop 1978;137:112.
22. Cossey A, Goodwin M. Failure of Austin Moore hemiarthroplasty: Total hip replacement as a treatment strategy. Injury 2002;33:19-21.
23. Hammad A, Abdel-Aal A. Conversion total hip arthroplasty: Functional outcome in Egyptian population. Acta Orthop Belg 2006;72:549-54.
24. Glassman AH, Engh CA, Bobyn JD. Proximal femoral osteotomy as an adjunct in cementless revision total hip arthroplasty. J Arthroplasty 1987;2:47-63.
25. Goldring S, Schiller A, Roelke M, Rourke CM, O'Neil DA, Harris WH. The synovial like membrane at the bone-cement interface in loose total hip replacement and its proposed role in bone lysis. J Bone Joint Surg 1983;65:575-84.
26. Goodman S, Fornasier V, Kei J. The effects of bulk versus particulate ultra-high molecular weight polyethylene on bone. J Arthroplasty 1988;3 suppl:S41-6.
27. Gown M, Wood DD, Ihrie EJ, McGuire MK, Russell RG. An interleukin 1 like factor stimulates bone resorption in vitro. Nature 1983;306:378-80.
28. Dorr LD, Glousman R, Hoy Al, Vanis R, Chandler R. Treatment of femoral neck fractures with total hip replacement versus cemented and noncemented hemiarthroplasty. J Arthroplasty 1986;1:21-8.
29. Gebhard JS, Amstutz HC, Zinar DM, Dorey FJ. A comparison of total hip arthroplasty and hemiarthroplasty for treatment of acute fracture of the femoral neck. Clin Orthop Relat Res 1992;282:123-31.
30. Lee PB, Berry Di, Harmsen WS, Sim FH. Total hip arthroplasty for the treatment of an acute fracture of the femoral neck: Long term results. J Bone Joint Surg 1998;80:70-5.
31. Keating JF, Grant A, Masson M, Scott NW, Forbes JF. Randomized comparison of reduction and fixation, bipolar hemiarthroplasty, and total hip arthroplasty: Treatment of displaced intracapsular hip fractures in healthy older patients. J Bone Joint Surg Am 2006;88:249-60.
32. Blomfeldt R, Törnkvist H, Eriksson K, Söderqvist A, Ponzer S, Tidermark J. A randomised controlled trial comparing bipolar hemiarthroplasty with total hip replacement for displaced intracapsular fractures of the femoral neck in elderly patients. J Bone Joint Surg Br Feb 2007;89:160-5.
33. Iorio R, Healy WL, Lemos DW, Appleby D, Lucchesi CA, Saleh KJ. Displaced femoral neck fractures in the elderly: Outcomes and cost effectiveness. Clin Orthop 2001;383:229-42.
34. The Swedish National Hip Arthroplasty Registry. 2006. Available from: http://www.jsu.orthop.gu.se/ [Last cited on 2011 July 13].

How to cite this article: Bhosale P, Suryawanshi A, Mittal A. Total hip arthroplasty for failed aseptic Austin Moore prosthesis. Indian J Orthop 2012;46:297-303.

Source of Support: No benefits in any form have been received from a commercial party related directly or indirectly to the subject of this article. Conflict of Interest: None.
