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Clinical and radiological outcome evaluation of large diameter head in uncemented total hip arthroplasty

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Abstract

Introduction: Total hip arthroplasty has been in constant change since its inception. Polymethylmethacrylate, a bone cement introduced by Haboush as a mecahanism for achieving rigid initial fixation have lost its popularity due to problems of loosening of stem and cup.

Objective: Evaluation the clinical and radiological outcome of uncemented large diameter head in total hip arthroplasty.

Materials and Method: Out of twenty five hips, twenty four patients were operated upon for large diameter head in total hip arthroplasty in the Department of Orthopedics, Pt. B.D.S. P.G.I.M.S. Rohtak.

Results: The cases studied included patients from age of 21 years to 60 years with an average age of 40.5 years. 14 cases (58.33%) had avascular necrosis of head of femur, 5 cases (20.83%) had osteoarthritis, one patient had rheumatoid arthritis. 15 patients (60%) were operated on left side, while 8 (32%) were operated on right side and 1 (8%) case was operated on both sides. Metal-on-metal THR was done in 8 cases (32%), Metal-on-polyethylene THR was done in 17 cases (68%) and Ceramic-on-ceramic was done in none. Postoperative pain was absent in 15 patients (60%), mild pain was seen in 9 patients (36%) and moderate pain in one patient (4%).

Conclusion: Total hip arthroplasty continues to be an ideal procedure for achieving painless, mobile, stable hip in cases with advanced hip disorders.

Keywords: Total hip arthroplasty, Uncemented, Avascular necrosis, Clinical and radiological outcome

Introduction

The human hip joint is extremely complex as the consequence of the functional demands on it by the body. Its inherent complexity emanates from the function of weight bearing, circumaxial movements and locomotion. Any alteration in the hip joint leads to alteration in the function and bio-dynamics, making the hip joint one of the most complex problems that an orthopaedic surgeon is called upon to study and manage. Artificial joint replacement, the fixation of artificial device to substitute for the kinematic and dynamic functions of the human joint, has become a widely accepted treatment in the orthopaedic surgery, against joint arthritis and the disabling effects of post-traumatic conditions and bone tumor surgery.

Pioneering work done by Charnley in total hip arthroplasty, including the concept of low frictional torque arthroplasty, lubrication, materials, design, and operating room environment. A major advancement was his use of cold-curing acrylic cement (polymethyl methacrylate for fixation of the components.[(1)]

Due to the problem of loosening of the stem and cup based on the alleged failure of cement, press-fit; porous-coated, and hydroxyapatite-coated stems and cups have been investigated to eliminate the use of cement and to use bone ingrowth or on growth as means of achieving durable skeletal fixation.[(2)]

With the advance technology, improve the longevity of implant fixation, problems related to wear of articulating surfaces have emerged. Metal-metal articulations and Ceramic-ceramic are being evaluated because of their low coefficient of friction and better wear characteristics. Highly cross-linked polyethylene has likewise been a topic of intensive investigation. Historically, polyethylene implants have been sterilized by subjecting them to 2.5m rad of gamma radiation or electron beam. By this processes free radicals produce in the material, predisposing the polyethylene to oxidation and rendering it more susceptible to wear. For highly cross-linked polyethylene, cross-linking is accomplished by either gamma radiation at a dose of approximately 10m rad. This promotes recombination reactions between the residual free radicals produced by the radiation, reducing their concentrations to essentially undetectable levels. The resulting polymer is highly resistant to wear and oxidative degradation.[(3)] The objective of present study was evaluation of radiological and clinical outcome of large diameter head in total hip arthroplasty.

Materials and Method

This study was conducted in the outpatien and emergency Department of Orhtopedics, Pt. B.D.S. P.G.I.M.S. Rohtak. Patients presenting to outpatient and emergency department of Pt. B.D.S. P.G.I.M.S. Rohtak between January 2010 to June 2011 were screened for avascular necrosis of hip, osteoarthritis of hip, fracture neck of femur and other disorders of hip. A total of 25 hips on 24 patients were operated upon for uncemented large diameter head in total hip arthroplasty.

Detailed history, clinical examination and radiological examination were carried out in all 24 patients.

Radiological investigations

X – ray Pelvis with both hips – AP
X – ray both hips with thigh – AP & LAT
X – ray chest – PA
X – ray L S Spine – AP & LAT (in selected patients)
X – ray B/L Sacro iliac joints – Oblique (in selected patients)

Patients were evaluated clinically and data recorded on the basis of modified Harris hip score.[4] Patients were admitted forty eight hours prior to surgery for education regarding the rehabilitation program to be followed subsequent to surgery.

Preoperative Planning: This aspect is important in choosing appropriate implants and anticipating unusual needs during the surgery.

In the absence of pelvic obliquity or hip contracture, discrepancy in true and apparent lengths on the two sides would be same. If they are different, restoring equality in true length would result in patient's feeling of newly operated limb being long or short.

On AP radiograph of pelvis with both hips, "tear drop" was marked at medial inferior aspect of quadrilateral plate on both sides and were connected. This line was reference line. Next tip of the lesser trochanter was marked on both sides. Vertical height was measured from this point on lesser trochanter to reference line. The difference in two sides is the true leg length discrepancy, which would be equalized if there was no fixed pelvic obliquity.

I.V prophylactic antibiotic was given twelve hrs prior to surgery and continued till five days postoperative, then switched over to oral antibiotics till the removal of stitch. Just prior to surgery, urinary catheter was introduced in all patients and removed 24 to 48 hours postoperative.

Postoperative: In the immediate postoperative period, the hip is positioned in 15° of abduction. Patient was assessed periodically for the amount of blood collected in suction drain, blood pressure, pulse, any soakage and any need for postoperative blood transfusion.

Check X –ray was done the next day to check the positioning of implant.

Postoperative (day 1)- starting of bedside exercises, hip precautions and weight-bearing status. Initiation of bed mobility and transfer training

Postoperative (day 2)-Initiation of gait training with the use of assistive devices. Continuation of functional transfer training.

Postoperative (days 3-5)- Progression of ambulation on level surfaces the assistive device. Progression of ADL (activities of daily living) training.

Wound was inspected on fifth postoperative day and if healthy, intravenous antibiotics stopped and patient was started on oral antibiotics. Sutures were removed after 12 – 14 days postoperatively and patient was discharged.

Postoperative (day 7 to 4 weeks): Strengthening exercises, Stretching exercises to increase the flexibility of hip muscles. Progression of ambulation distance.

Patient was reviewed at 6 weeks (at 3 months post-operative) and assessed for gait pattern. Patient was instructed to use cane in opposite hand from then onwards. If any abductor weakness was seen, patient was taught abductor exercise to strengthen abductors. Patient was again assessed after 6 months when cane could be discarded.

Hence patient was evaluated after 6 weeks, 3 months, 6 months and 1 year after surgery. Results were evaluated and compared with previous results both clinically and radiographically.

Clinical Evaluation: Patient was evaluated according to Harris hip score which gives points to pain, and function. The scores were compared with pre- operative scores and the scores at the last follow up.

Grading of results based on Harris hip score:

Category	Harris hip Score
Excellent-	91-100
Good-	81-90
Fair-	71-80
Poor-	70 or less

Radiographic Evaluation: Patients were also examined radiographically at discharge and at each follow up visit with AP and lateral views. Evaluation of radiodense line around the femoral and acetabular components and sclerosis around the femoral component were done, their location was identified similar to zones described by DeLee and Charnley[5] for the acetabulum and similar to those described by Gruen et al[6] for the femur.

Fitting of the stem of the femoral component in the femoral canal was considered to be excellent if the AP radiograph showed the stem to be in contact with the cortical bone at some point on both lateral medial and surfaces and the lateral radiograph showed the stem to come within 2 mm of the cortex at 2 of the 3 possible contact points. The fit was considered to be good if the stem was seen to be within 2 millimeters of the cortex medially and laterally on the AP radiograph and it was seen to come within 3 mm of the cortex at two of the 3 possible contact points on the lateral radiograph. The fit was considered to be poor if there was more than 2 mm between the stem and the medial or lateral part of the cortex on the AP radiograph or if there was > 3 mm between the stem and the cortex at 2 of the 3 contact points on the lateral radiograph.

The femoral component was determined to be fixed by ingrowth of bone, by stable fibrous fixation or by unstable fibrous fixation, according to the criteria of Engh et al.[7]

Heterotopic bone when present, was graded according to the classification of Brooker et al.[8]

Localized loss of femoral bone, adjacent to the interface between the femur and proximal part of the femoral prosthesis, was noted.

Vertical subsidence of the femoral component was measured by determination of change in the distance from the superomedial extent of the porous coating to the most proximal point on the lesser trochanter. Subsidence was further checked by measurement of the distance from tip of the greater trochanter to the superolateral border of the femoral component and examined for a superior lucency in the bone there.

Angle of inclination was calculated as per Lewineek et al[9] criteria. The angle was formed by a line joining the two ends of acetabular cup with a horizontal line passing through the proximal tip of the tear drop.

Results

Total of 25 hips in 24 patients was operated for uncemented large head diameter total hip arthroplasty. Following results were obtained. The cases studied included patients from age of 21 years to 60 years with an average age of 40.5 years. Mean age at the time of operation for male was 42.4 years and mean age at the time of operation for female was 35 year.

Present series of 24 patients; 14 cases had avascular necrosis of head of femur, 5 cases had osteoarthritis, one patient had rheumatoid arthritis, one patient had ankylosing spondylitis, one patient had failed osteosynthesis Table 1.

Table 1: Distribution of cases according to diagnosis & sex

Diagnosis	Male	Female	Total
AVN	9 (37.50)	5 (20.83)	14 (58.33)
Osteoarthritis	3 (12.50)	2 (8.33)	5 (20.83)
Rheumatoid arthritis	0	1 (4.16)	1 (4.16)
Ankylosing spondylitis	1 (4.16)	0	1 (4.16)
Old # dislocation of hip	1 (4.16)	0	1 (4.16)
Old hemiarthroplasty with protrusion	1 (4.16)	0	1 (4.16)
Failed osteosynthesis (#Tr)	0	1 (4.16)	1 (4.16)
Total	15 (62.50)	9 (37.50)	24 (100.00)

Side of operation: 15 patients (60%) were operated on left side, while 8 (32%) were operated on right side and 1 (8%) case was operated on both sides.

Prosthesis material: Of total 25 hips, Metal-on-metal THR was done in 8 cases (32%), Metal-on-polyethylene THR was done in 17 cases (68%) and Ceramic-on-ceramic was done in none Table 2.

Table 2: Distribution of hips according to type of prosthesis

Type of prosthesis	No	%
Metal on metal	8	32
Metal on polyethylene	17	68
Ceramic on ceramic	0	0
Total	25	100.00

Postoperative pain: Postoperative pain was absent in 15 patients (60%), mild pain was seen in 9 patients (36%) and moderate pain in one patient (4%) Table 3.

Table 3: Distribution of hips according to post-operative pain grading at final follow up

Pain	No.	%
No pain	15	60
Mild pain	9	36
Moderate pain	1	4
Total	25	100.00

Discussion

Frequent and an unfortunate complication of primary THA was dislocation. Reported incidence ranges from <1-5% with a recent Medicare claims data analysis of 58,521 patients reporting 3.9% dislocation in the first 26 weeks postoperative.[10] Recent advances in implant design allow for use of larger prosthetic heads that more accurately reconstruct native femoral head size and improve head neck ratio. Necessity of larger heads is based on literature that shows a direct relationship between increasing femoral head size and improving implant stability.[11,12, 13]

The present study was a series of a total of 24 cases (25 hips) who were operated with uncemented large diameter head THR during the selected period.

While our study was limited to 25 THR(24 cases), Lombardi et al[14] performed 2020 THR in 1749 cases, Meding et al[15] performed 681 THR in 611 cases.

There were 15 men (62.5%) and nine women (37.5%). Mean age at the time of presentation for men was 42.4 years and for women was 35 years. While mean age of presentation for other series were Berton et al[16] 50 years, and present series 46.20 years.

Most common diagnosis in the present series was avascular necrosis of head of femur (58.33%), followed by osteoarthritis (primary and post traumatic) (20.83%). Studies in the west report Osteoarthritis as the most common diagnosis. (91.42% by Beksac et al[17] and 92% by Meding et al[15]). Avascular necrosis of head of femur is the second most common diagnosis in the western studies (10.78% by Mertl et al[18] and 5% by Meding et al[15]).

Posterolateral approach was used in all patients in present series. Along with posterolateral approach, posterior soft tissue and/ or capsular repair was done. Sierra et al[19] reviewed 150 total hip arthroplasties performed in patients 80 years or older through a

posterolateral approach. They suggested the use of a 32- mm head size in combination with a posterior capsular repair to reduce the incidence of dislocation. In their review, no dislocation occurred when a 32-mm head size was used in association with repair of the posterior capsular structures.

Repair of the posterior capsule was the single most important predictive factor in preventing dislocation. Chivas et al[20] evaluated the role of posterior capsular repair in patients undergoing revision hip arthroplasty using a posterior approach.

They reviewed a total of 79 revision hip arthroplasties in patients using a posterolateral approach followed by posterior capsular repair and identified a 2.5% dislocation rate. Berry et al[11] reported cumulative ten-year rate of dislocation of 6.9% following posterolateral approaches. However rate of dislocation was significantly reduced when larger diameter heads were used in posterolateral approaches.

Average operative time for the present series was 98.20 minutes (range 82 – 127 min). Hummel et al[21] reported average operative time of 129.2 minutes. This difference could be attributed to larger number of patients and higher aged patients included in the latter study. Average blood loss in our series was 353.48 ml and average units of blood transfused was 0.92 units. While Hummel et al[21] reported average blood loss to be 355 ml.

In the current study, out of the 25 hips operated, 18 (72%) were metal-on-polyethylene (MoP) THR and seven (28%) were metal-on-metal (MoM) THR. MoM also allows for the use of large-diameter femoral heads, which leads to an increased head-neck ratio as well as a greater jump distance, which increase stability.[12]

Conclusion

Total hip arthroplasty continues to be an ideal procedure for achieving painless, mobile, stable hip in cases with advanced hip disorders. A continued clinical and radiological evaluation is essential for identifying complicating factors and to undertake necessary measures.

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