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ORIGINAL RESEARCH

Short Term Outcome of Large Diameter Head In Uncemented Total Hip Arthroplasty 10 Years Outcome Evaluation

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ABSTRACT

Background: The normal mechanical function of the hip is substantially altered by a variety of disorders. The surgical treatment of such conditions, particularly by hip replacement offers an opportunity not only to replace the articular surface of joint, but also to improve the long term mechanical function by decreasing the load on the joint. **Objective:** To evaluate short term outcome of large diameter head in uncemented total hip arthroplasty.

Materials and Methods: This study was done in the outpatien and emergency Department of Orthopaedics, Pt. B.D.S. P.G.I.M.S. Rohtak. Duration of study period was from January 2010 to June 2020**.**

Results: 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: Metal-on-polyethylene, Total hip arthroplasty, uncemented, avascular necrosis.

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INTRODUCTION

The mechanics of the hip joint and the magnitude of force generated in the process of unipedal stance, bipedal progression and various day-to-day activities render the hip joint, an extremely complicated engineering design. 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.

The complexity is further enhanced by the various conditions affecting the hip joint ranging from congenital, through traumatic, infective, degenerative to paralytic and other conditions, considering these facts, it is not surprising that an extraordinary number of procedures have been described in the literature for the reconstruction of the hip.

Due to the important kinematics and load bearing function of hip and the high number of patients suffering from degenerative hip conditions, the first and the main efforts in artificial joint replacement were focussed on this point.

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.

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 ongrowth as means of achieving durable skeletal fixation.[1]

Total hip arthroplasty has been in constant change since its inception. Polymethylmethacrylate, a bone cement introduced by Haboush as a mecahanism for achieving rigid initia fixation have lost its popularity due to problems of loosening of stem and cup. Materials involved in fixation of the implant to bone have also evolved. The choices are press-fit, porous coated and hydroxyapatite coated stems and cups. They are being investigated as ways to eliminate the use of cement and use bone ingrowth as a means for achieving durable skeletal fixation.

Charnley did pioneering work in all aspects of total hip arthroplasty, including the concept of low frictional torque arthroplasty, surgical alteration of hip biomechanics, lubrication, materials, design, and operating room environment. A major advancement was his use of cold-curing acrylic cement (polymethyl methacrylate [PMMA]) for fixation of the components. With long-term follow-up studies of 10 years it became apparent that implant breakage, trochanteric nonunion, loosening, wear, and periprosthetic bone loss were substantial problems.[2]

Initially, bone cement was used to fix the articulating surfaces of the THA to the bony ends. But high rates of the loosening of the implants, especially the acetabular components led to a change in the technique of fixation of implants. In response 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 as ways to eliminate the use of cement and to use bone ingrowth or ongrowth as means of achieving durable skeletal fixation.[1]

As technological advances improve the longevity of implant fixation, problems related to wear of articulating surfaces have emerged. Ceramic-ceramic and metal-metal articulations are being evaluated because of their low coefficient of friction and superior 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 either electron beam or gamma radiation. These processes produce free radicals 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 or electron beam radiation at a dose of approximately 10m rad. This step 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. Although the process of cross-linking can improve resistance to wear, it can diminish other material properties of polyethylene, including lower fracture toughness and tensile strength. Concerns have been raised over the potential for fatigue, delamination, and implant fracture when a thin liner is used to accommodate a large-diameter head.[3]

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MATERIALS & METHODS

This study was done in the Outpatient and Emergency Department of Orthopedics, Pt. B.D.S. P.G.I.M.S. Rohtak. A total of 25 hips on 24 patients were operated upon for uncemented large diameter head in total hip arthroplasty. Duration of study period was from January 2010 to June 2020. Ethical clearance was obtained from the institutional ethical committee for the present study. Informed consent was taken from the study subjects.

Detailed history, clinical examination and radiological examination were carried out in all 24 patients. Salient features included:-

History

1. Pain :- Site, severity, mode of onset, character, diurnal variation, radiation, aggravating and relieving factors.
2. Deformity:- Mode of onset, progressive or static, Disability due to deformity.
3. Limitation of movement:- Progressive or static.
4. Constitutional features:- Fever, anorexia, burning micturition, night sweating.
5. Other complaints:- Backache, wrist pain.
6. Family history
7. Personal history

Necessary radiological investigations was done

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

Preoperative Planning

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 12 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.

Radiographic Evaluation

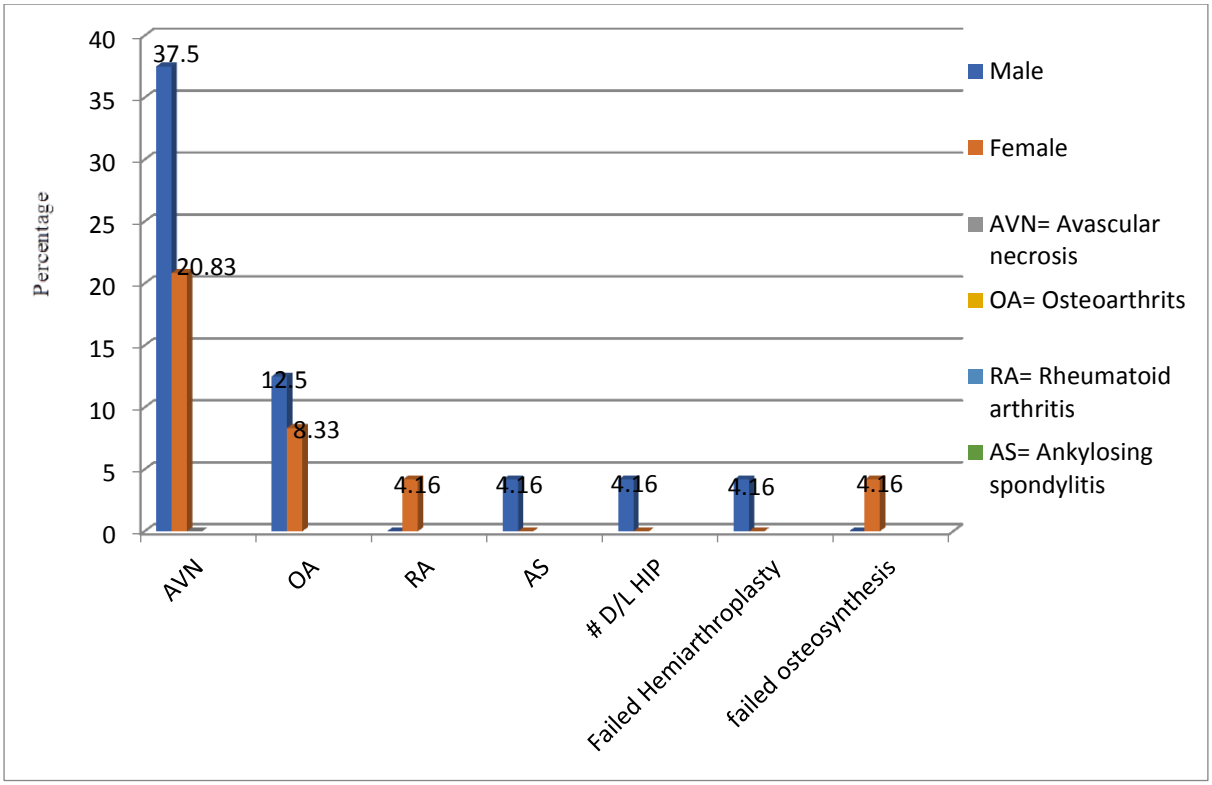
Patients were also examined radiographically at discharge and at each follow up visit with AP and lateral views. Evaluation of radio dense line around the femoral and acetabular components and sclerosis around the femoral component were done, their location was identified similar to zones described by De Lee and Charnley [4] for the acetabulum and similar to those described by Gruen et al[5] for the femur.

RESULTS

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.

Table 1: Distribution of cases according to age & sex

Age (in years)	Male	Female	Total
19-28	1 (4.16)	1 (4.16)	2 (8.33)
29-38	3 (12.50)	1 (4.16)	4 (16.66)
39-48	4 (16.66)	0	4 (16.66)
49-58	6 (25.00)	5 (20.83)	11 (45.83)
59+	1 (4.16)	2 (8.33)	3 (12.50)
Total	15 (62.50)	9 (37.50)	24 (100.00)



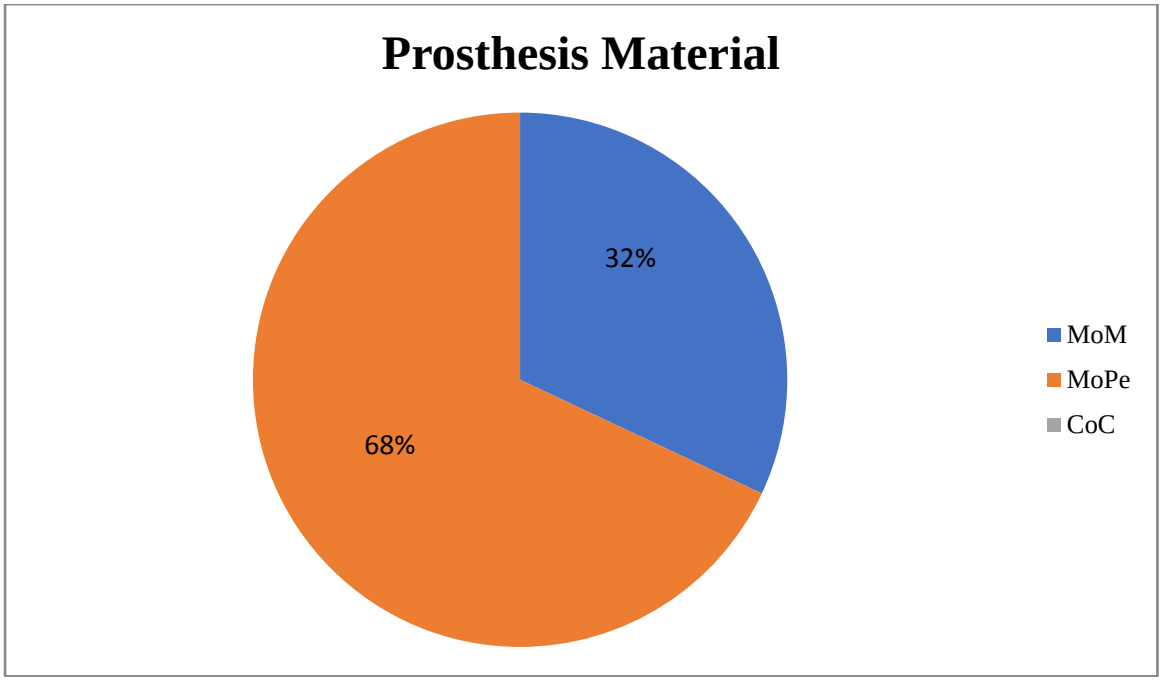
Present series of 24 patients; 14 cases had avascular necrosis of head of femur, 5 cases had osteoarthritis, one patient had rheumatoid arthritis, one patient had ankylosing spondylitis, one patient had failed osteosynthesis. one was case of operated case of fracture dislocation hip and one was operated case of hemiarthroplasty with protrusion.

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.

Table 2: Distribution of hips according to side of operation

Side of operation	No.	%
Right	8	32.00
Left	15	60.00
B/L	1	4.00 + 4.00
Total	25	100.00

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.



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: 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

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%). Other diagnosis were, one case each of rheumatoid arthritis, ankylosing spondylitis, old fracture dislocation of hip, old case of hemiarthroplasty with protrusion in to acetabulum and a case of failed osteosynthesis in fracture trochanter. Studies in the west report Osteoarthritis as the most common diagnosis. (91.42% by Beksac et al[6], 81.37% by Mertl et al[7], 80% by Lombardi et al[8] and 92% by Meding et al[9]). Avascular necrosis of head of femur is the second most common diagnosis in the western studies (2.85% by Beksac et al[6] , 10.78% by Mertl et al[7], 9% by Lombardi et al[8] and 5% by Meding et al[9]). In our series, the difference in diagnosis might suggest high rate of osteoarthritis and a low rate of avascular necrosis of head of femur in western studies.

Table 4: Comparison of different studies with present study

Name of study	Diagnosis		
	Osteoarthritis	AVN	Rheumatoid arthritis
Beksac et al[6] (2009)	91.42%	2.85%	--
Mertl et al[7] (2010)	81.37%	10.78%	0.98%
Lombardi et al[8] (2011)	80%	9%	1%

Meding et al [9] (2012)	92%	5%	<1%
Present series	20.83%	58.33%	4.16%

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[10] 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[11] 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[12] 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[13] 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[14] 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. Lombardi et al[8] reported, MoM in 1635 (81%) hips, metal-on-polyethylene (MoP) in 337 (17%) hips, and ceramic-on-polyethylene (CoP) in 48 (2%) hips. As the age of patients included in this series were younger as compared to western studies and also the financial constraints of the patients, did not allow to take the advantage of latest designs and technologies in prosthesis for this study. The mean size of the head of femoral component was 42.99 mm and that of acetabular component was 53.33 mm. While the mean size of femoral head was 46 mm and 52 mm for acetabular cup as reported by Bolland et al.[15]

Advances in implant design, manufacturing techniques and tolerances, and metallurgical considerations have allowed development of second-generation metal-on-metal (MoM) implants, which represent an improvement over historical designs. MoM articulations provide reduction in wear and osteolysis and allow a femoral head size that closely resembles the patient's native anatomy.[13] Because the neck of a femoral component is much smaller than the native human femoral neck, matching head size markedly improves head/ neck ratio, a benefit in younger patients and those with a high-demand lifestyle. Increased volumetric polyethylene wear has previously limited femoral head size to 32 mm or less. MoM is a bearing surface with earlier designs that were prone to failure as a result of poor designs with inadequate engineering and manufacturing processes. Recent designs have corrected these insufficiencies and have made available a bearing surface that has very little wear and subsequent osteolysis. [16,17] 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.[18, 19]

CONCLUSION

The overall results of the procedure were very encouraging. Still the present study had limitations. Due to a shorter follow up as compared to other studies, it would be unfair to compare these results with classical studies. The smaller sample size could also account for statistical differences observed in this series.

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