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COMPARISON OF CONVENTIONAL HEAD AND LARGE HEAD IN TOTAL HIP ARTHROPLASTY

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ABSTRACT

The size of the femoral head, the ratio of head and neck diameters, and the shape of the neck of the femoral component have a substantial effect on the range of moof the hip, the degree of impingement between the neck and rim of the socket, and the stability of the articulation. Limb length discrepancy was found in 11 hips (44%). Range of motion was good in 15 (60%) cases and mild restriction was seen in 10 cases (40%). Of total 25 hips, none had inclination less than 35°, five hips (20%) had inclination of 36 - 45°, 19 hips (76%) had inclination of 46 - 55° and one hip(4%) had inclination of ≥ 56°. Harris hip score at final follow up was, 14 cases (56%) had excellent results, 10 cases (40%) had good results and one (4%) had fair result.Lower dislocation rate and better range of motion in majority of the cases reinforces the advantage of large diameter head total hip arthroplasty.

KEYWORDS : Total hip arthroplasty, Avascular necrosis, Limb length discrepancy, Range of motion

The size of the femoral head, the ratio of head and neck diameters, and the shape of the neck of the femoral component have a substantial effect on the range of motion of the hip, the degree of impingement between the neck and rim of the socket, and the stability of the articulation. This impingement can lead to dislocation, accelerated polyethylene wear, acetabular component loosening, and liner dislodgment or fracture. The introduction of advanced bearing surfaces has allowed the use of larger head sizes than those traditionally used in the past (Cuckler et al.,1995).

Conventional total hip prostheses consist of a 28mm metal head and a polyethylene cup. Polyethylene wear debris can however lead to osteolysis, bone loss, aseptic loosening and eventually failure of the implant, especially in high demand young patients. But, wear and osteolysis have become foremost concerns in primary THA in the recent decade (Amstutz et al.,1992). Metal-on-metal (MM) THA is an alternative to overcome polyethylene wear induced prosthetic failure. The MM wear rate is reported to be 20 to 100 times lower than conventional wear rates. Metal-on-metal wear rate is also influenced by the size of articulation and its clearance (i.e. difference between radius of the head and the shell). Larger heads show lower wear rates provided they have a low clearance (Dumbleton et al., 2005). Other advantages of large diameter heads seem to be increased range of motion and reduced number of dislocations.

Alumina ceramic has many properties that make it desirable as a bearing surface in hip arthroplasty. Because of its high density, implants have a surface finish smoother than metal implants. The hydrophilic nature or ability to absorb moisture, of ceramic promotes lubrication. Ceramic is harder than metal and more resistant to scratching from third-body wear particles. The linear wear rate of alumina-on-alumina has been shown to be 4000 times less than cobalt-chrome alloy-on-polyethylene. Impingement between the femoral neck and rim of the ceramic acetabular component creates problems unique to this type of articulation. Impact loading of the rim can produce chipping or complete fracture of the acetabular bearing. Repetitive contact at extremes of motion also can lead to notching of the metal femoral neck by the harder ceramic and initiate failure through this relatively thin portion of the implant (D' Antonio et al., 2005). But ceramic-on-ceramic arthroplasties may be more sensitive to implant malposition than other bearings. So-called stripe wear has been reported on retrieved ceramic heads. This term describes a long, narrow area of damage resulting from contact between the head and the edge of the ceramic liner. Microseparation of the implants during the swing phase of gait is a recognized phenomenon. Edge loading at heel strike has been proposed as a cause of the stripe wear (Hrlmer et al.,1993).

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Large diameter heads are emerging as a valuable tool in the arsenal against the dislocation in THAs. In last 5 years gamma sterilized in air and gamma sterilized in nitrogen Ultra High Molecular Weight Polyethylene (UHMWPE) have been supplanted by highly cross linked polyethylene. Early laboratory and clinical studies have shown even greater improvement in wear characteristics (Shimmin A et al.,2005)

In order to overcome the potential drawbacks of femoral neck fractures, loosening, late osteonecrosis and dislocations seen with conventional THAs, it is now possible to take advantage of articulations with large heads mated to a standard femoral component (Muratoglu et al.,2001). The purpose of this study was to comparison of conventional head and large head in total hip arthroplasty.

MATERIALS AND METHODS

This study was conducted in the Department of Orhtopaedics, Pt. B.D.S. P.G.I.M.S. Rohtak. Patients presenting to outpatient department 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.

Investigations Common to All Patients

Hb, TLC, DLC, Urine routine examination, B Sugar B Urea S Electrolytes S Creatinine ECG ESR

Special Investigation (in Selected Patients)

RA Factor PFT HLA B27 RA Factor PFT HLA B27

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 (Harris et al.,1969).

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

Preoperative Planning

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

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.

Preoperative Regime

Parts were shaved and cleaned 48 hours before surgery, nails were cut short. Intra-venous prophylactic antibiotic was given 12 hours prior to surgery and continued till 5 days postoperative.

Postoperative Regime

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)

Initiation of bedside exercises - Such as ankle pumps, quadriceps sets, and gluteal sets.

Review of hip precautions and weight-bearing status.

Initiation of bed mobility and transfer training - Bed to/from chair.

Postoperative (Day 2)

Initiation of gait training with the use of assistive devices, such as crutches and a walker.

Continuation of functional transfer training.

Drains were removed between 24 and 48 hours after surgery.

If patient had fever after 48 hours, injectable

antibiotics were continued till results of blood cultureand urine culture and sensitivity, chest X ray, hemogram, erythrocyte sedimentation rate and peripheral smear for malarial parasites were available.

Postoperative (Days 3-5)

Progression of ROM and strengthening exercises to the patient's tolerance.

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. If any discharge was seen on expressing the wound, it was sent for pus culture and sensitivity and injectable antibiotics continued until results were available. Sutures were removed after 12 14 days postoperatively and patient was discharged.

Postoperative (day 7 To 4 Weeks)

Strengthening exercises - For example, seated leg extensions, knee bends.

Stretching exercises to increase the flexibility of hip muscles.

Progression of Ambulation Distance.

Progression of independence with ADL.

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 radiolographically.

CLINICAL EVALUATION

Patient was evaluated according to Harris hip score which gives points to pain, and function. Function was assessed in terms of gait, activities, deformities and range of motion. 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 anteroposterior and lateral views. Radiodense line around the femoral and acetabular components and sclerosis (at least 3 mm thick) around the femoral component were evaluated, their location was identified similar to zones described by (DeLee and Charnley 1976) for the acetabulum and similar to those described by (Gruen et al., 1979) for the femur.

The fit of the stem of the femoral component in the femoral canal was considered to be excellent if the anteroposterior radiograph showed the stem to be in contact with the cortical bone at some point on both medial and lateral surfaces and the lateral radiograph showed the stem to come within two millimeters of the cortex at two of the three possible contact points (proximal and anterior, distal and anterior, and posterior). The fit was considered to be good if the stem was seen to be within two millimeters of the cortex medially and laterally on the anteroposterior radiograph and it was seen to come within three millimeters of the cortex at two of the three possible contact points on the lateral radiograph. The fit was considered to be poor if there was more than two millimeters between the stem and the medial or lateral part of the cortex on the anteroposterior radiograph or if there was more than three millimeters between the stem and the cortex at two of the three contact points on the lateral radiograph.

Loss of density proximally and rounding of the proximal aspect of the medial side of the femoral neck were determined by study of sequential radiographs and were evaluated for progression. 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., 1988).

Heterotopic bone, when present, was graded according to the classification of (Brooker et al., 1973). 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.

Vertical migration of the acetabular component

was determined by measurement of the change in the vertical distance from a horizontal line drawn through the inferior aspect of both teardrops to a horizontal line drawn through the center of the spherical acetabular component, with the use of a template with a series of concentric circles. Horizontal migration of acetabular component was determined by measurement of change in the horizontal distance from a vertical line drawn through the center of teardrop to a vertical line drawn through the center of the acetabular component, again with the use of a template with a series of concentric circle.

RESULTS AND DISCUSSION

The cases studied included patients from age of 21 years to 60 years with an average age of 40.5 years.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. Of total 25 hips, Metal-on-metal THR was done in 8 cases (32%), Metal-on-polyethylene THR wass 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%).

Limb length discrepancy was found in 11 hips (44%). Of the 11 hips three hips (12%) had limb length discrepancy of less than 2 cm, of which two had limp. Eight hips (32%) had limb length discrepancy of more than 2 cm and of whom all the eight hips had limp. 14 hips (56%) had no limb length discrepancy, of whom one (4%) had limp Table 1.

Table 1 : Distribution according to post-operative limb length discrepancy & limping

Leg length discrepancy	Limping		Total (%)
	Yes (%)	No (%)	
No discrepancy	(4)	13 (52)	14 (56)
< 2 cm	2 (8)	1 (4)	3 (12)
≥ 2 cm	8 (32)	0	8 (32)
Total	11 (44)	14 (56)	25 (100.00)

Range of motion was good in 15 (60%) cases and mild restriction was seen in 10 cases (40%) table 2.

Table 2 : Distribution of hips according to range of motion

Range of motion	Number	%
Good	15	60
Mild restriction	10	40
Moderate restriction	0	0
Total	25	100.00

Of total 25 hips, none had inclination less than 35°, five hips (20%) had inclination of 36 - 45°, 19 hips (76%) had inclination of 46 - 55° and one hip (4%) had inclination of ≥ 56° table 3.

Table 3 : Distribution of hips according to acetabular cup inclination

Cup inclination (degrees)	Number	%
≤35	0	0
36-45	5	20
46-55	19	76
≥56	1	4
Total	25	100.00

Table 4 : Distribution of hips according to stem position

Stem Position	**Number**	**%**
Central	22	88
Varus	3	12
Valgus	0	0
Total	25	100.00

Harris hip score at final follow up was, 14 cases (56%) had excellent results, 10 cases (40%) had good results and one (4%) had fair result table 5.

Table 5 : Distribution of hips according to harris hip score at final follow up

Harris Hip Score	**Result**	**Number**	**%**
91-100	Excellent	14	56
81-90	Good	10	40
71-80	Fair	1	4
70 or less	Poor	0	0
	Total	25	100.00

Limb length discrepancy in the present series was found in 11 hips (44%).. All of these patients responded to shoe raise. 14 hips (56%) had no limb length discrepancy, of whom one (4%) had limp, which was attributed to hip pain in the absence known etiology Ideally, the leg lengths should be equal after total hip arthroplasty, but leg length is difficult to determine accurately at the time of surgery. Overlengthening is more common than a residually shortened leg, and a lengthened limb is more poorly tolerated. Lengthening may result from insufficient resection of bone from the femoral neck, from use of a prosthesis with a neck that is too long, or from inferior displacement of the center of rotation of the acetabulum.

In a more recent series of 65 patients, Edeen, Sharkley, and Alexander found an average lengthening of 9.7 mm; more than half of patients with lengthening were disturbed.

No other complications were documented in our series. Lower complication rate in present study, emphasizes the importance of preoperative planning, operative execution. Where in every aspect of it has significant role in outcome of procedure.

Of the 25 cases who were operated upon, 15 hips (60%) had good range of motion and 10 hips (40%) had mild restriction of range of motion. This was correlated to pain at hip, which could have been the reason for mild restriction of motion in 10 hips. Though patients did not have limitation of their ADL (activities of daily living).

In the present series the mean angle of inclination of acetabular cup was 48.21°. Of these none were placed at < 35°, in five hips (20%) cup was placed at 36-45°, in 19 cases (76%) cup had an inclination of 46-55° and one hip had cup inclination >56°. The high inclination in one case was correlated to the disturbed anatomy of hip joint and altered bony

HARRIS HIP SCORE

In our series the mean preoperative harris hip score was 38.94 and the mean harris hip score at final follow up was 90.50, of which 56% were graded as excellent, 40% were good and 4% were fair. While the mean harris hip score for other studies were,

Table 6 : Harris hip score

Name of study	Harris hip score	
	Preoperative	At final follow up
Siwach et al (2007)	44	83.5
Mertl et al (2010)	49.3	91.6
Meding et al (2012)	51	93
Present series	38.94	90.50

land marks for proper placement of cup peropaeratively, as it was revision hip surgery. While mean cup inclination of other studies were, 49.2°and 40.1° by Berton et al., 2010. Bolland et al., 2011 respectively. No periacetabular osteolysis was seen. This was attributed to shorter duration of follow up (Table 6).

In our series, 22 hips (88%) had central placement of femoral stem and three stems were placed in varus position. Although varus placement of stem did not have any untoward effect on gait or range of motion. No periprosthetic zones of osteolysis were identified.

CONCLUSION

Lower dislocation rate and better range of motion in majority of the cases reinforces the advantage of large diameter head total hip arthroplasty, especially in young and active patients.

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