

## A study of functional outcome of total hip arthroplasty with bone grafting

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### Abstract

The effects of OA on large joints especially the lower extremities result in reduced mobility and marked physical impairment leading to loss of independence and an increase in use of health services. OA also leads to daily living activities and leads to substantial disability and dependence in walking, climbing stairs and rising from a seated position. THR is a successful and effective treatment option when symptoms deteriorate and is at an advanced stage of the disease. Bone grafts can be used in conjunction with cemented all polyethylene cups, cement less implants as well as reinforcement rings and cages. The use of bone grafts and its long-term survival in the acetabulum have been reported to vary from 84% at years to 52% at 25 years. This study used autogenous morselized impaction bone grafting with a cementless press-fitting cup, and the midterm results were excellent to good. Grafting aids in the stable installation of implants and the effective rebuilding of bone stock.

With these fantastic outcomes, total hip arthroplasty with bone grafting can be thought of as offering complete relief, sufficient stability, and an amazing range of motion in extremely painful, refractory hips, provided that it is carried out with careful consideration for patient selection prior to surgery, intraoperative soft tissue balancing, proper overall alignment of the prosthesis, and postoperative patient rehabilitation. Complete hip replacement with bone grafting is a rather safe and certain operation when performed by a qualified professional or guide.

**Keywords:** Arthroplasty; Age-Related Degeneration; Joint Destruction; Limb Lengthening

### 1. Introduction

One of the body's largest weight-bearing joints is the hip joint secondary to knee joint and commonly affected by osteoarthritis(OA).(1) Osteoarthritis is commonly referred to as wear and tear arthritis, age-related arthritis or degenerative joint disease.(2) OA can affecting joint but affects the articular cartilage and surrounding tissues. (3)

OA can be classified in to primary and secondary types. Primary OA is a disease of idiopathic origin (no known cause) and affects multiple joints in elderly population. Secondary OA is monoarticular condition and develops as a result of defined disorder affecting joint articular surface (eg trauma). (4)

The effects of OA on large joints especially the lower extremities results in reduced mobility and marked physical impairment leading to loss of independence and an increase in use of health services. OA also leads to daily living activities and leads to substantial disability and dependence in walking, climbing stairs and rising from a seated position.

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Many factors contribute in development of OA such as age gender, genetics obesity and local joint risk factors. However, the exact aetiology of primary OA is unknown and there is a lack in its diagnosis and treatment. (5,6,7) There are a variety of non-surgical and surgical treatment for management of hip arthritis, depends on the stage of the disease. Along with pharmacological therapy, patients are educated and exercise therapy along with physical activity, particularly in the beginning stages of the disease. Combining these type of therapies had helped delay the need for total hip replacement(THR) for mild to moderate symptoms with a median time of 5.4 years. THR is successful and effective treatment options when symptoms deteriorate and is at an advanced stage of the disease. (8,9)

97.5% of patients reported an improvement in hip pain and function, according to data from the British National Joint Registry (NJR), which has been gathering patient-reported outcomes since 2009 (an increase of 153% from a median of 17 to 43 points as evaluated by the Oxford Hip Score). (10)

Bone grafts can be used in conjunction with cemented all polyethylene cups, cement less implants as well as reinforcement rings and cages. The use of bone grafts and its long term survival in the acetabulum have been reported to vary from 84% at years to 52% at 25 years. (11) A recent series has also showed that using implants with cement or grafting with cementless has a survivorship of 10-20 years. (12)

Reconstructing bone loss within the acetabulum can also be accomplished with porous metal cups and augments composed of trabecular metal. Costs prevent many people from using modular cups and augments, despite their widespread availability. The majority of patients with acetabular abnormalities are younger, and they would require bone stock restoration with the possibility of a future revision in mind.

This study aims to assess clinical and functional outcomes of total hip replacement with bone grafting.

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## 2. Material and method

This study is a prospective study conducted in a Tertiary care centre in Davanagere, Karnataka, including 20 cases from September 2020 to December 2022. The patients will be examined as per the protocol, clinical and laboratory investigations were carried out to get surgical fitness. The inclusion criteria are i. Age- above 18 years and of both genders, ii. CRP-negative, iii. Patients with all indications mentioned for THR and iv. Patients willing for surgery and given informed written consent. The exclusion criteria are i. Active infection, ii. Patients unfit for surgery, iii. Patient not willing for surgery, iv. patients with neurovascular deficit and v. Patients having a compound fracture.

A detailed history of the patient along with the illness, basic demographic details, complaints, duration of the illness, associated co-morbidities were noted. A general and local examination was done. The patients were subjected to blood and radiological investigations. Analgesics, antibiotics, tetanus toxoid blood transfusions are given as and when needed before surgery.

Routine blood investigations are done and all patients are evaluated as per modified Harris Hip score (mHHS) system. The score includes pain, limp, range of movement, distance walked and flexion deformity and associated with other deformities. Thorough clinical examination was done including spine examination and contralateral lower limb examination. The strength of abductor mechanism was determined by Trendelenburg test. Any occult infections like skin lesions, dental carries and urinary tract infections were identified and treated preoperatively.

The patient is subjected to anteroposterior (AP) of pelvis showing proximal femur and lateral view of the hip and proximal femur. In addition, the use of preoperative templating to identify the level of the osteotomy cut, neck length and femoral offset is important in re-establishing hip biomechanics and minimizing LLD. The patient's legs should be internally rotated 15–20° in order to account for femoral neck anteversion and orient the femoral necks parallel to the cassette; therefore, maximizing the projected femoral neck length. X-rays are required to determine bone stock of femur and acetabulum, medullary cavity, LLD, osteophytes, floor of acetabulum, migration of acetabulum, protrusion and for preoperative templating.

The quality of the bone before surgery is a determinant in the selection of the most appropriate implant, optimal method of fixation, the response of the bone to the implant and ultimate success of the arthroplasty. Dorr et al.<sup>152</sup> proposed a radiographic categorization of proximal femurs based on their shape and correlated those shapes with measurements of cortical thickness and canal dimensions. (Fig.38) Type A: Femurs have thick cortices on the AP view and a large posterior cortex seen on the lateral view. The narrow distal canal gives the proximal femur a pronounced funnel shape or –champagne flute appearance.

- The type A femur is more commonly found in men and younger patients and permits good fixation of either cemented or cementless stems.
- Type B: Femurs exhibit bone loss from the medial and posterior cortices, resulting in increased width of the intramedullary canal. The shape of the femur is not compromised and implant fixation is not a problem.
- Type C: Femurs have lost much of the medial and posterior cortex. The intramedullary canal diameter is very wide, particularly on the lateral radiograph. The stovepipe shaped type C bone is typically found in older postmenopausal women and creates a less favourable environment for implant fixation.

Preoperative planning should include the use of templates supplied by the prosthesis manufacturer. In this study, a standardized AP view of pelvis with a 15% magnification was used for templating of all cases. For AP projection, place both extremities in about 15° of internal rotation to position the head and neck parallel to coronal plane. 4 basic steps in the process of templating:

To identify the significant anatomical landmarks in the radiograph, ascertain the quality of radiograph, the identification of various mechanical references, for example, femoral offset, acetabular offset, leg length discrepancy and to optimize the position of the implant so that hip biomechanics are re-established.

Place the acetabular overlay templates on the film and select the size that matches the contour of the patient's acetabulum without excessive removal of subchondral bone. The medial position of the acetabular template is at the teardrop and the inferior margin at the level of the obturator foramen.

Mark the center of the acetabular component on the radiograph this corresponds to the new center of rotation of the hip. The femoral overlay templates on the film and select the size that most precisely matches the contour of the proximal canal and fills it most completely. Make allowance for the thickness of the desired cement mantle if cement is to be used. Select the appropriate neck length to restore limb length and femoral offset. If no shortening is present, match the center of the head with the previously marked center of the acetabulum. If a discrepancy exists, the distance between the femoral head center and the acetabular center should be equal to the previously measured limb-length discrepancy.

Before surgery, the lower limb is washed with germicidal solution twice daily, with skin preparation and shaving in the extremity, perineal area and hemipelvis 10cm proximal to the iliac crest. Pre-operative antibiotics, of piperacillin and tazobactam was administered in the night and morning before surgery and continued for 3 days postoperatively.

Post-operatively, IV antibiotics, were continued for 5 days and followed by oral antibiotics till suture removal. Drain removed on 24-38 hours and the drain tip was sent for culture and sensitivity. Immediate post operative period the hip is positioned at 15 degree using abduction splint to prevent dislocation.

Pre operatively patient is advised about do's and dont's like to avoid strenuous activity and not to sit on floor with cross legged and not to squat and to maintain ideal body weight. Respirometer was done and chest X-ray as well.

Static quadriceps exercise and ankle pump exercises was started on the same day of the surgery and after drain removal, gait training and adductor strengthening exercise was started using walker for balance and stability. 6-12 weeks patients were allowed protected weight bearing. This includes six weeks on walker and another six weeks on either one crutch or one cane. Patients were discharged on 10th or 12th post-operative day after complete staples removal and were advised to use western type toilet, not to adduct or internal rotate the limb, not to sit cross-leg or in squatting position and to use one or two ordinary pillows between the knees when lying on the unoperated side.

Patients were advised for follow up after 1st, 3rd and 6th month and 1 year thereafter. Routine plain radiographs were taken and detailed clinical examination was done. Modified Harris hip scoring system was used for evaluation.

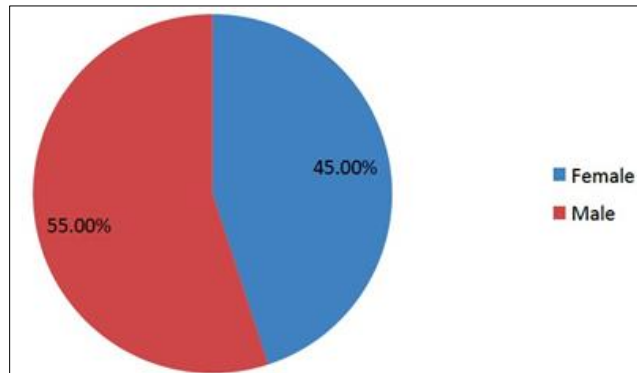
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### 3. Results

20 cases of uncemented total hip replacement surgeries with bone grafting were done in 20 patients for degenerative hip joint diseases.

Twenty patients who had complete hip replacement surgery at a tertiary care institution with bone grafting were included in the current study. Thirty-five percent of the participants were between the ages of forty and fifty. 5 people (or 25%) in the age group of 31 to 40 came next.

11(55%) were male and 9(45%) were females among the 20 participants. (Fig 1)

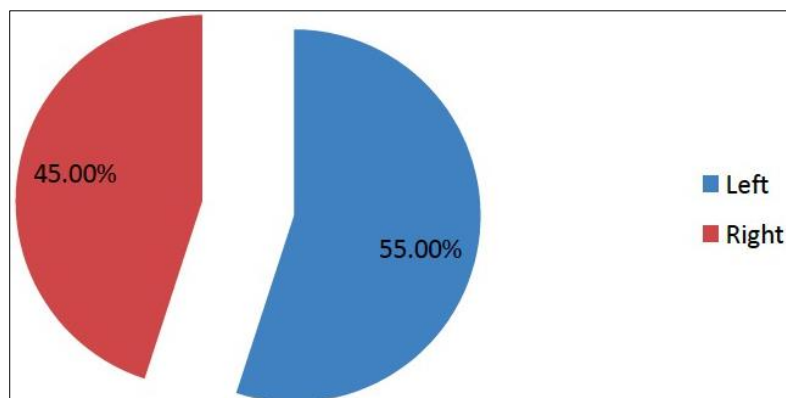


**Figure 1** Distribution of participants based on gender

Majority of cases, 16(80%) were due to avascular Necrosis of femoral head, followed by 2(10%) were from 2' Osteoarthritis of hip with DHS in situ. (Table 1) In the current study, 9 (45%) of the hip replacements were performed on the right side and 11 (55%) on the left. (Fig 2)

**Table 1** Distribution of participants based on diagnosis

Diagnosis	Frequency	Percentage
2' Osteoarthritis of hip with DHS insitu	2	10.0%
Ankylosed Hip with protrusio acetabuli	1	5.0%
Avascular Necrosis of femoral head	16	80.0%
Rheumatoid arthritis of Bilateral hip	1	5.0%
Total	20	100.0



**Figure 2** Distribution of participants based on Side of involvement

In the present study, 3(15%) of participants had co-morbidities, 2(10%) had hypertension and 1(5%) had DM. In the present study, 10(50%) participants had dorr's type B, followed by 9(45%) had dorr's type A. Ninety-five percent of the participants in the current study received uncemented fixation, whereas the remaining participant underwent hybrid fixation.

The majority of them, or 10 (or 50%), were placed on medium-sized stems in the current study. Seven (35%) were then placed on large stems.

In the present study the majority of cases had no complications after surgery. One patient developed dislocation and one patient developed LLD

**Table 2** POST-OPERATIVE mHHS

Post-op mHHS	Number of patients	Percentage (%)	Post op mHHS rate
70-79	1	5	Fair
80-89	6	30	Good
90-100	13	65	Excellent

Pre-operatively, a modified Harris hip score was done. In this study, Pre-operative mHHS ranged from 18 to 56 with a mean score of 40.95. It was poor in all patients, with all the 20 patients having a mHHS score of <70. AFTER OPERATIVE mHHS Post-operative mHHS in this study had a mean score of 90.25 and varied from 73 to 97. Thirteen patients (65%) had post-operative mHHS scores between 90 and 100, good in six (30%), and fair in one patient (5%), with scores between 70 and 79. Following surgery, no unsatisfactory outcome was seen in this study. Post-operative mHHS in this study had a mean score of 90.25 and varied from 73 to 97. Thirteen patients (65%) had post-operative mHHS scores between 90 and 100, good in six (30%), and fair in one patient (5%), with scores between 70 and 79. Following surgery, no unsatisfactory outcome was seen in this study. In this study mean values of Pre op and post op mHHS was more among A type of dorr's and Cup size and head size more among dorr's type C. In study mean values of post op mHHS was more among those with LLD complication. Cup size and head size was more among those with dislocation. Also, in this study, with dorr's type C underwent hybrid type of fixation. Difference observed was not statistically significant. Hybrid fixation was done for medium stem size. Difference observed was not statistically significant.

#### 4. Discussion

One surgical procedure that has a lot of published research on it is total hip replacement. Patients with moderate to severe hip arthritis benefit from improved quality of life due to pain and functional impairment relief. When treating difficult primary hips, bone grafting can be used in conjunction with cementless or cemented all polyethylene cups, as well as strengthening rings and cages.

Acetabulum defects are typically the result of late presentation. Twenty patients who had complete hip replacement surgery at a tertiary care institution with bone grafting were included in the current study.

Five people (or 25%) in the age range of 31 to 40 came next (13) A study by K Adam R et al. found similar results, with participants having mean ages of 38 years for men and 51 years for women.

(14) In a study by Vinjamuri ARS et al., patients, ages ranging from 27 to 82, 53.3 percent were 50 years of age or older. Participants in a study by Schramm et al.[4] had an average age of 47 years.

Hip replacements can be considered for adults of any age, while most are performed on those in the age group 60-80.

(13) In the present study among 20 participants, 11 (55%) were males, remaining 9 (45%) were females. In a study done by Kadam R et al., there was a higher number of male (n = 38) as compared to females (n = 12). (14) In a study done by Vinjamuri ARS et al., the majority were males, with 20 (66.6%) and females, with 10 (33.3%). (15) In a study done by Schramm et al, 56% were males. Both genders are commonly affected by Hip joint problems, but for females due to hormonal support for bone mass delays onset of bone pathologies.

The majority of cases in the current study—16, or 80%—were caused by avascular necrosis of the femoral head, with two cases—or 10%—arising from hip osteoarthritis with DHS in situ. In a (13) research by Kadam R. and colleagues, 13

Osteoarthritis (21%) ankylosing spondylosis (12%) psoriatic arthritis (2%), rheumatoid arthritis (4%), and avascular necrosis (61%), among other types of hip arthritis. According to a study by Alexander et al. (16), AVN head of femur (8.7%) and persistent arthritis (89%), respectively, were the most common indications. Primary osteoarthritis accounted for 70.4% of the indications in a study conducted by Erivan R et al. (17). (16) Osteoarthritis (21%) ankylosing spondylosis (12%) psoriatic arthritis (2%), rheumatoid arthritis (4%), and avascular necrosis (61%), among other types of hip arthritis. The most frequent indication in a research by Alexander et al. (16) was chronic arthritis (89%), which was followed by AVN head of femur (8.7%).

(17) Primary osteoarthritis accounted for 70.4% of the indications in a study conducted by Erivan R et al. Patients who have not responded to conservative or prior surgical treatment for a degenerating hip joint and who experience severe pain that limits their ability to perform activities of daily life might consider total hip arthroplasty (THA). Hip arthroplasty is indicated in cases of pain, low functional level, and failure of conservative treatment.

In the present study, 11 (55%) hip replacement was done on the left side and remaining 9 (45%) on the right side. In a study done by Erivan R et al, 60% of cases of the right hip were involved. (17) Three (15%) of the patients in the current study had comorbidities, two (10%) had hypertension, and one (5%) had diabetes. Twenty percent of individuals in a research by Erivan R et al, had comorbidities of some kind, and diabetes mellitus was frequently seen. (17) Heart disease, hypertension, respiratory disorders, cerebrovascular diseases, diabetes, joint diseases, sensory impairment, and mental health issues are the most prevalent comorbid ailments that affect the aged. In this study, 10 (50%) participants had dorr\_s type B, followed by 9 (45%) had dorr\_s type A. Dorr classification is based on the calcar-to-canal ratio which is defined as the diameter of the femur at the midportion of the lesser trochanter divided by the diameter at a point 10 cm distal. Type A is suitable for cementless femoral stem, type C requires use of cemented stem and type B is intermediate. Limited literature available on this to compare for Hip replacement.

Ninety-five percent of the participants in the current study received uncemented fixation, whereas the remaining participant underwent hybrid fixation. A research by Erivan R et al. found that few people had hybrid fixation and the majority had uncemented fixation (17). For many hip surgeons, the 1980s marked the shift from cement to cementless hip replacements. An alternative method was presented, in which the femoral component was cemented and the acetabular component was cementless. This has been called the hybrid total hip replacement. The clinical results of this approach were excellent in the intermediate term and may have promise for the long term.

The majority of them, or 10 (or 50%), were placed on medium-sized stems in the current study. Seven (35%) were then placed on large stems. The smallest size accounted for 22% of the size 4 in a research by Dundon JM et al. (18) In comparison to females, males had better stem size fitting.

Only 3.82% of guys utilised size 4 stems. It is vital to match the dimensions of the implant closely with those of the femur, as some of the complications resulting from mismatch could be aseptic loosening, improper load distribution and discomfort. Secondary biologic fixation of a hip implant depends to a large extent on the quality of its primary stability. (19,20)

Most of the cases in this study had no post-operative problems. One patient experienced a dislocation, and another experienced LLD. One patient experienced dislocation with the use of uncemented metal implants (Kadam R et al., 13 while a study by Vinjamuri ARS et al. just 3 individuals had (14) had pain in the anterior thigh, but it disappeared after a few months. Typical hip replacement side effects include Common hip replacement problems include joint loosening, blood clots, altered leg length, dislocation, fractures, and infection. In addition to tissue damage and other dangerous problems, metallosis—a type of metal poisoning—may also strike people with metal-on-metal hip replacements. Periprosthetic fractures and heterotrophic ossification are also observed in cases of hybrid total hip replacement.

In this study mean values of pre operative HHS was 40.85 and post operative HHS 88.2. Knahr et al. (15) considered Harris Hip Score as the best mean of objective evaluation of result of Total hip arthroplasty. Harris hip score is a preoperative and postoperative scoring system designed to assess patients improvement, both objectively and subjectively. In a study done by Schramm et al., (16) 84% had good or excellent values, 14% had fair values and only 2% had poor values post operatively. In a study done by Sharkey PR et al., 79% had good or excellent HHS values and 20% had fair or poor HHS values. (17)

In present study mean values of HHS post operatively was 88.2. In a study done by Schramm et al., (16) mean values were 88. In a study done by Siebold et al., (18) mean values were 94.3. Standard Harris Hip Score (HHS) is a validated tool to measure the functional status of an individual and has been traditionally used to assess the condition of a patient

with hip pathologies. Harris hip score in its standard form includes a physician's physical examination component which has a high inter-observer variability.

In the present study complications were seen among uncemented type of fixation. Difference observed was not statistically significant. Cementless implant is dependent on bone ingrowth and biological stabilization process which is slow in elderly patients as they have limited reserves.

Young patients often have a small diaphyseal diameter which would require use of a smaller sized stem, if cementing, to accommodate adequate cement mantle. However, this is not the problem with the normal and wide femoral canal of the adult and elderly patients. (19)

In present study mean values of post operative HHS was 72 among those who developed dislocation. In a study done by Peter Aldinger et al.(20) High rate of Cup loosening and low Harris hip score was observed. The Harris Hip Scale (HHS) was developed for the assessment of the results of hip surgery, and is intended to evaluate various hip disabilities and methods of treatment in an adult population. The original version was published in 1969. The HHS is an outcome measure administered by a qualified health care professional, such as a physician or a physical therapist. (21)

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## 5. Conclusion

Over the last forty years, total hip replacement has completely changed how arthritic hips are treated. A solid implant fixation and the restoration of joint mechanics for a long-lasting, functional arthroplasty are the main objectives. In certain cases, bone grafts can assist the surgeon in achieving these objectives when the bone stock is inadequate. Preserving or replenishing the bone reserve surrounding the arthroplasty is a secondary objective.

This study used autogenous morselized impaction bone grafting with a cementless press-fitting cup, and the midterm results were excellent to good. Grafting aids in the stable installation of implants and the effective rebuilding of bone stock.

With these fantastic outcomes, total hip arthroplasty with bone grafting can be thought of as offering complete relief, sufficient stability, and an amazing range of motion in extremely painful, refractory hips, provided that it is carried out with careful consideration for patient selection prior to surgery, intraoperative soft tissue balancing, proper overall alignment of the prosthesis, and postoperative patient rehabilitation. Complete hip replacement with bone grafting is a rather safe and certain operation when performed by a qualified professional or guide.

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## Compliance with ethical standards

### *Disclosure of conflict of interest*

No conflict of interest to be disclosed.

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