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A STUDY ON FUNCTIONAL OUTCOME ANALYSIS OF UNCEMENTED TOTAL HIP REPLACEMENT

Orthopaedics

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ABSTRACT

Background: Total hip replacement (THR) is a successful surgical procedure for patients with diseased or damaged hips. Uncemented THR has emerged as a preferred option due to its advantages, including reduced risk of cement-related complications and potential for biological fixation. **Objectives:** To assess and analyze the functional outcome of uncemented THR in patients with hip pathologies. **Methods:** This cohort study was conducted among 51 patients with significant disabling hip pain and moderate to severe functional limitation were enrolled. Patients underwent surgery using cementless extensively porous-coated acetabular cups and hydroxyapatite-coated femoral stems. Post-operative improvement was assessed at 6, 12, and 24 weeks using the Modified Harris Hip Score, X-rays, and evaluation of post-operative complications. **Results:** The study found significant improvement in the mean Modified Harris Hip Score from 45.29 pre-operatively to 77.04 at 6 weeks, 79.55 at 12 weeks, and 81.94 at 24 weeks ($P<0.01$). Excellent outcomes were observed in 5 patients, fair in 8, good in 35, and poor in 3. Post-operative complications included dislocation (5.9%), infection (5.9%), anterior thigh pain (2%), neurological injury (2%), periprosthetic fracture (3.9%), and heterotrophic ossification (3.9%). **Conclusion:** Uncemented THR provides significant functional improvement in patients with hip pathologies, with excellent outcomes observed in a majority of patients. The major pathology attributed to present surgery was arthritis secondary to avascular necrosis. No major complication was reported in the present study. Dislocation and infection were the main post operative complications followed by periprosthetic fracture, heterotrophic ossification, anterior thigh pain and neurological injury. Thus, post-operative complications can occur, emphasizing the need for careful patient selection and surgical technique.

KEYWORDS

Uncemented Total Hip Replacement; Modified Harris Hip Score; Post-operative Complications; Hip Pathologies.

INTRODUCTION

Total hip replacement is considered as one of the most important and successful intervention in the recent era.[1] It is one of the most successful and cost-effective surgical procedures and remains the treatment of choice for long-term pain relief and restoration of function for patients with diseased or damaged hips.[2] Earlier days, hip arthrodesis or resection arthroplasty were the preferred options but since last couple of decades total hip arthroplasty has emerged as successful option with good functional results.[3] Since it was introduced, there has been a steady improvement in the technology associated with it, leading to improved functional outcome and implant survivorship.[1]

The first total hip replacements was performed by Charnley in the 1960s, many different types of prostheses have been used. The traditional method of fixation of an implant to bone involved the use of cement. However, in the 1980s, implant loosening and loss of bone stock, particularly in younger and more active patients, was seen with greater frequency. Osteolysis was once considered a 'cement disease', but now is believed to be a response to wear-debris particles. Therefore, the idea of implanting prostheses without cement and eventually having prostheses that can become part of the living body was most appealing.[2] Thus, total hip arthroplasty (THA) can be roughly classified into two groups: hips that have been cemented and hips that have not. Polymethylmethacrylate (PMMA) is used in cemented THA as a grout to create an interlocking fit between the prosthesis and cancellous bone. Hips without cement rely on the organic attachment of bone to a prosthetic surface layer. By introducing a prosthesis that is marginally larger than the prepared bone-bed, creating compression hoop pressures, and achieving a "press-fit," initial fixation is accomplished."[4]

The success of THRs and the increasing frequency of its use is largely due to the development of the cemented low-friction arthroplasty with its high survival rate. However, the outcomes of other cemented THR prostheses were poor with high and early loosening rate, primarily due to the implant designs and cementing techniques in many cases. The cement itself was considered a cause of loosening leading the term cement disease. The uncemented THR was developed to avoid these problems; however, the early designs had similarly poor outcomes.[5] The advantages of cementless femoral components include a reduced risk of cement related cardiovascular and thromboembolic complications, the possibility of biological fixation, the minimisation of stress shielding of the proximal femur and potential of extended implant survival. The development of circumferentially coated uncemented implants which allow bone to grow in to or on to the prosthesis has led to improved implant survival rate and supports their growing use.[1] Hydroxyapatite (HA) is widely used as a coating for uncemented total hip arthroplasty components. It is generally believed that coating of total hip arthroplasty (THA) components with hydroxyapatite (HA) improves implant ingrowth and long-term stability. Thus, a large number of prostheses designed for uncemented hip arthroplasty are coated with HA.[6]

The primary indication for this procedure is severe pain and the limitation in activities of daily living that it causes. To warrant doing total hip replacement, pain must be refractory to conservative measures such as oral nonsteroidal anti-inflammatory medication, weight reduction, activity restriction, and the use of supports such as a cane.[7] The downsides of uncemented total hip replacement include excessive wear, periprosthetic bone loss, and inadequate initial fixation. The success of total hip replacement is primarily determined by appropriate patient selection, the use of appropriate implants, and the methodological performance of the surgery.[8] The purpose of this study is to assess and analyse the functional outcome of uncemented THR as there are paucity of research related to it.

MATERIALS AND METHOD

This cohort study was conducted in the Department of Orthopaedics at Rohilkhand Medical College and Hospital, Bareilly, over a period of one year from 1st November 2022 to 31st October 2023. Following approval from the institutional ethics committee, the study was carried out in the same department. Written informed consent was obtained from all patients enrolled in the study. Data was collected through a comprehensive evaluation of each patient, including a thorough history, physical examination, and relevant investigations.

The inclusion criteria comprised patients over 18 years old with significant disabling hip pain and moderate to severe functional limitation of daily activities due to various hip pathologies and patients with unilateral or bilateral hip involvement. The exclusion criteria comprised those with active hip joint infection, medical unfitness, neuropathic joint, or previous cemented total hip replacement were excluded. Additionally, patients who were lost to follow-up or had

undergone cemented total hip replacement were not included. The study used various cementless acetabular and femoral components. The cementless acetabular components included trident acetabular shell with poly or alumina ceramic bearing, duralocacetabular shell with poly or ceramic bearing, delta motion acetabular mobile bearing system, trilogy acetabular cup cluster holed or multiholed shell with standard or highly cross linked poly liners, Biolox delta acetabular cup with ceramic bearing and Verilastacetabular cup with ceramic bearing.

Cementless femoral components comprised of accolade stems with tapered wedge stem and proximal body hydroxy apatite & plasma spray coating, corailcementless femoral stem – hydroxyapetite coated collarless stem, acumatch stem with hydroxy apatite & plasma spray coating, M/L taper femoral stem and short modular femoral stems.

The methodology involved noting demographic features, comorbidities, activity level, range of movement, and laterality. All patients underwent surgery using Gibson's posterior approach and anterolateral approach with cementless press-fit extensively porous-coated acetabular cups and hydroxyapatite-coated femoral stems. The study assessed post-operative improvement in patients of various age groups and hip pathologies treated with uncemented total hip replacement at short and long-term follow-up periods of 6, 12, and 24 weeks.

At regular follow-up appointments, patients were evaluated using various parameters, including the Modified Harris Hip Score, X-rays (Pelvis and Hip with Thigh AP view), and assessment of post-operative complications. The X-rays were used to check the implant position, ensuring the femoral stem was not in varus, and to verify the position and fixation of the acetabular and femoral components. Any development of heterotopic ossification was evaluated using x-rays. The post-operative complications assessed included dislocation, infection, loosening, anterior thigh pain, neurological injury (foot drop), limb length discrepancy, and heterotrophic ossification.

The data was entered on a Microsoft Excel spreadsheet and imported into Statistical Package for Social Sciences (SPSS) version 23.0 for Statistical analysis. P value less than 0.05 is considered significant. Data will be analysed by applying Frequency, percentage and mean. Appropriate Statistical test will be applied based on distribution and type of data.

RESULTS

Table 1 shows age group wise distribution of study subjects' results revealed that out of all 51 study subjects 2 subjects were belonged to <20 years of age, 8 subjects belonged to 21-30 years, 11 study subjects belonged to 31-40 years, 9 study subjects belongs to 41-50 years, 15 study subjects belongs to 51-60 years and 6 subjects belonged to >60 years of age. The gender wise distribution of study subjects' results found that 20 female and 31 male participants participated in the study. Table 2 shows distribution of subjects according to post operative complications dislocation was found in 3 subjects, infection was present in 3 subjects, anterior thigh pain in one subject, neurological injury in one subject, periprosthetic fracture in 2 study subjects and heterotrophic ossification in study subjects as post op complication. Table 3 shows distribution of subjects according to limb length discrepancy results revealed that positive discrepancy found in 3 subjects and negative discrepancy found in 2 subjects. Table 4 shows distribution of subjects according to optimal position during radiographic assessment (femoral component) results it was found that neutral position found in 42 participants, 4 study participants valgus and 5 subjects varus positioning. Table 5 shows distribution of subjects according to loosening zone during radiographic assessment (femoral component) results revealed that one subjects had loosening zone 2,3,4 and 2 subjects had loosening zone 3,4,5. Table 6 shows distribution of subjects according to optimal position during radiographic assessment (acetabular component) results revealed that optimal positioning was present among 46 subjects. Table 7 shows distribution of subjects according to loosening zone during radiographic assessment (acetabular component) results revealed that loosening zone was present among 2 study subjects. Table 8 shows pre post comparison of mean modified Harris hip score among subjects results revealed that mean pre-op Harris hip score was 45.29 and post op 77.04 at 6 weeks, 79.55 at 12th week and 81.94 after 24 weeks, it was found statistically significant (P<0.01). Table 9 shows distribution of subjects outcome according modified Harris hip score results revealed that outcome was excellent found in 5 study participants, fair in 8 study participants, good in 35 study subjects and poor in 3 study subjects (graph 1).

Table 1: Age And Gender Wise Distribution Of Study Subjects

Age (years) and gender		Frequency	Percent
Age	<20	2	3.9
	21-30	8	15.7
	31-40	11	21.6
	41-50	9	17.6
	51-60	15	29.4
	>60	6	11.8
Gender	Female	20	39.2
	Male	31	60.8
Total		51	100

Table 2: Distribution Of Subjects According To Post Operative Complications

Complications	No		Yes	
	Frequency	Percent	Frequency	Percent
Dislocation	48	94.1	3	5.9
Infection	48	94.1	3	5.9
Deep vein thrombosis	51	100.0	0	0.0
Anterior thigh pain	50	98.0	1	2.0
Neurological injury/foot drop	50	98.0	1	2.0
Periprosthetic fracture	49	96.1	2	3.9
Heterotrophic ossification	49	96.1	2	3.9

Table 3: Distribution Of Subjects According To Limb Length Discrepancy

Discrepancy	Frequency	Percent
None	46	90.2
Negative discrepancy	2	3.9
Positive discrepancy	3	5.9

Table 4: Distribution Of Subjects According To Optimal Position During Radiographic Assessment (femoral Component)

Optimal Positioning	Frequency	Percent
Neutral	42	82.4
Valgus	4	7.8
Varus	5	9.8

Table 5: Distribution Of Subjects According To Loosening Zone During Radiographic Assessment (femoral Component)

Zone	Frequency	Percent
2,3,4	1	2
none	48	94.1
3,4,5	2	3.9

Table 6: Distribution Of Subjects According To Optimal Position During Radiographic Assessment (acetabular Component)

Optimal Positioning	Frequency	Percent
No	5	9.8
Yes	46	90.2

Table 7: Distribution Of Subjects According To Loosening Zone During Radiographic Assessment (acetabular Component)

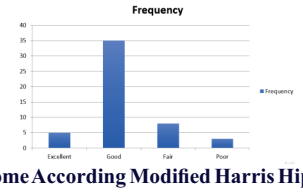
Zone	Frequency	Percent
No	49	96.1
Yes	2	3.9

Table 8: Pre Post Comparison Of Mean Modified Harris Hip Score Among Subjects

Harris hip score at	Mean	Std. Deviation	F value	p value
Pre-OP	45.29	4.94	470.1980	<0.01*
6 weeks	77.04	5.88		
12 weeks	79.55	5.89		
24 weeks	81.94	5.92		

Table 9: Outcome According Modified Harris Hip Score

Outcome	Frequency	Percent
Excellent	5	9.8
Good	35	68.6
Fair	8	15.7
Poor	3	5.9



Graph 1: Outcome According Modified Harris Hip Score

DISCUSSION

Total hip replacement (THR) replaces damaged and worn hip joints with a smooth, artificial prosthesis. It improves the quality of life of people with moderate to severe hip arthritis by relieving pain and functional impairment. The use of uncemented THR is of particular interest because it may offer advantages over cemented THR, such as decreased risk of loosening and improved long-term survival of the implant. Potential disadvantages include increased early femoral loosening and increased risk of femoral fractures.[9] Hence, the present study was undertaken to analyze the functional and radiological outcomes of uncemented total hip replacement.

The present study found that excellent to good outcome was reported in more than one-third of patients (78.4%) with overall improvement of 36.65±0.98 pre-op to post-op of modified Harris hip score in patients with uncemented total hip replacement which provides important insights into the effectiveness and safety of this surgical procedure.

Uncemented THR was introduced to address the poorer results observed with cemented THR in younger patients with higher functional requirements and the registry results confirm that uncemented fixation had a reduced revision rate among inpatients under 65 years of age. Specifically, the uncemented stem has outperformed the cemented variety in this age group, showing a decreased rate of aseptic loosening. Femoral fractures continue to account for a large portion of early revisions with cemented stems. These revisions are most likely related to surgical technique, which may be enhanced by greater exposure to this procedure during surgical training.[10]

The present study enrolled total 51 patients who under uncemented total hip replacement surgery, maximum (29.4%) belonged to 51-60 years age group followed by 21.6% in 31-40 years, 17.6 % in 41-50, 15.7% in 21-30 years, 11.8 % aged > 60 years and minimum number in <20 years age group with 60.8% male and 39.2% female patients. Similarly, in a study by Lakhotia D et al[9] 68% patients were male and 32% were female.

The post operative complications reported in the present study was dislocation and infection each in 5.9% cases followed by periprosthetic fracture and heterotrophic ossification each in 3.9% cases followed by anterior thigh pain and neurological injury each in 2% cases whereas no case of deep vein thrombosis was reported. Similarly, in a study by Lakhotia D et al[9], patients had superficial wound complications at the surgical site managed with debridement and secondary suturing. No patient developed a serious infection.

Resolving limb length discrepancy after total hip arthroplasty (THA) without sacrificing hip stability is one of the intraoperative challenges. In addition to reducing pain, one of THA's main objectives is to restore the hip joint's biomechanics, which allows for normal gait and function by establishing the proper femoral offset and leg length.[11] In the present study, negative limb length discrepancy was seen in 3.9% and positive limb length discrepancy was seen in 5.9% cases. Sathappan SS et al[12] conducted a review of the literature that reported the incidence of LLI after primary THA varies from 1% to 27%, and the mean discrepancy ranges from 3 mm to 17 mm. Careful preoperative measurement and assessment, as well as preoperative and postoperative patient education, are important factors in achieving an acceptable result. However, Clark CR et al suggested that, after total hip arthroplasty, equal leg length should not be guaranteed. Rather, the patient should be given a realistic assessment of what can reasonably be expected.[13]

The Harris hip score (HHS) is a joint specific score that is completed by both the clinician and the patient and consists of 10 items covering domains of pain, function, functional activities, deformity and hip range of motion. The HHS was initially described for assessment of functional outcome after mold arthroplasty for posttraumatic arthritis. The HHS has been used to evaluate functional outcome after per trochanteric hip fracture and intracapsular fracture neck of femur.[40] Modified Harris hip score was found to be statistically significant ($p<0.01$) which improved from pre-op score of 45.29± 4.94 to post-op score of 81.94±5.92 in the present study. 47.05% cases in the present study attributed to arthritis secondary to avascular necrosis, 9.80% secondary to ankylosis spondylitis, 5.88% secondary to tuberculosis, 23.52% cases due to fracture neck of femur and 13.72 % cases to non-union. The results are in concordance with study carried by Wade et al, mean Harris Hip score improved from 36 to 92 and most common etiology was avascular necrosis of hip (56.6%). None of the patients had any major complications. Similarly, in a study by Lakhotia D et al[35] patients had a significant increase in their functional result ($p<0.001$) at the final follow-up, with their modified Harris Hip score improving from a preoperative mean value of 13.28 (0-46) to a postoperative mean value of 88.52 (64-100) and indications for uncemented THR were avascular necrosis, post-traumatic arthritis, and inflammatory arthritis.

In the present study, Harris hip scores of patients showed excellent functional outcome in 9.8%, good in 68.6%, fair in 15.7% and poor in 5.9% cases in uncemented total hip replacement. These results are in consistent with Wade R et al in which 57.14% reported excellent, 37.5% good and 5.35% fair functional outcome. In another alike study by Lakhotia D et al[9], excellent to good results were found in 80% of patients, with only four percent graded as poor and the remaining graded as fair.

Various other studies have reported uncemented THA as a successful procedure with good long term functional outcome. Lettich T et al[14] carried a prospective study among 631 patients (700 hips) who underwent total hip arthroplasty with a follow-up averaged 4.35 years and the study confirmed that the midterm outcome of this implant was excellent, with a low revision rate. There was a significant improvement in functional outcome of these patients as measured by Harris hip score and there were 4 revisions for aseptic loosening of the femoral component in this series, accounting for an overall survivorship of 99.4%.

Another similar study by Vidyadhara S et al[15] with the mean follow-up period of 49 months reported mean Harris Hip Score of 94 at the latest follow-up and reported that the initial clinicoradiological results of uncemented total hip arthroplasty are promising. Another alike study by Rolfson O et al[16] reported uncemented fixation is linked to improved patient-reported outcomes and the variation may also be attributed to non-implant fixation factors like selection bias or performance.

Further, similar to Wade R et al[3], present study also supports that the porous coated uncemented cup with highly crosslinked polyethylene lining and the completely HA coated titanium femoral components can offer long-lasting biological fixation.

This study has some limitations, including the patient cohort's different diagnoses, which could influence the results and introduce confounding variables. In addition, the follow-up is of short duration. Despite its limitations, this study is significant since it presents the results of uncemented total hip arthroplasty in young as well as elderly patients and is prospective in nature.

CONCLUSION

To conclude, the current study found that uncemented total hip replacement reported excellent to good functional and radiological outcome in majority of cases, attributing to more than one-third of patients and lower rate of complications. Modified Harris hip score was found to be statistically significant ($p<0.01$) which improved post-operatively. The overall improvement to 81.94±5.92 post-op score on total 100-point modified Harris hip score was reported offering crucial insights into the efficacy and safety of this surgical procedure.

The major pathology attributed to present surgery was arthritis secondary to avascular necrosis. No major complication was reported in the present study. Dislocation and infection were the main post operative complications followed by periprosthetic fracture, heterotrophic ossification, anterior thigh pain and neurological injury.

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