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RESEARCH ARTICLE

FUNCTIONAL OUTCOME OF TOTAL HIP ARTHROPLASTY WITH DUAL MOBILITY CUPS IN HIP ARTHRITIS-A PROSPECTIVE COHORT STUDY

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Abstract

Background: Dual mobility (DM) total hip arthroplasty (THA) has gained popularity due to its potential to enhance stability and reduce dislocation rates compared to traditional THA constructs. However, there is a need for further investigation into its functional outcomes, complications, and implant survivorship.

Method: We conducted a hospital-based prospective study involving 50 patients undergoing total hip replacement over a one-year period. Functional outcomes were assessed using the Harris Hip Score (HHS) and Posterior Muscle Endurance (PME) Score. Descriptive statistics were used for data analysis.

Results: The study population consisted predominantly of older patients (mean age 64.30 years), with a higher representation of males (56%). The most common diagnosis was neck of femur fracture (NOF#) (75%), with a balanced distribution of cemented (40%), uncemented (40%), and hybrid (20%) fixation techniques. HHS and PME scores showed significant improvements over 12 months, with excellent outcomes observed in 61.1% of participants. Complications occurred in 14% of patients, with peri-prosthetic fracture and surgical site infection being the most common. Implant survivorship at final follow-up was 94%.

Conclusion: Dual mobility cup total hip replacement demonstrates promising outcomes in terms of functional improvement, low complication rates, and high implant survivorship. It represents a viable option for patients undergoing THA, particularly those at risk of dislocation. Further research, including prospective comparative studies, is needed to better understand its long-term efficacy and suitability across different patient populations.

Introduction:-

Dual-mobility (DM) total hip arthroplasty (THA) combines the benefit of having a large range of motion in the hip joint with the advantage of reduced friction due to a smaller articulation surface. Bosquet and Rambert are acknowledged for introducing the dual articulation concept in France in 1974, aiming to enhance stability and

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minimise the likelihood of dislocation. Empirical data have substantiated the stabilising benefit of direct messaging (DM) in both initial and subsequent total hip arthroplasty (THA) procedures [1]. The use of DM significantly rose during the mid-2010s in both primary and revision THA, partly because it was approved for use in the United States [2]. Given the projected increase in primary and revision total hip arthroplasty (THA) rates into the 2030s, there is a justifiable expectation for the continued rise in the utilisation of digital marketing (DM) [3,4].

The evolution of DM design can be attributed to advancements in materials and a deeper comprehension of their inherent properties. Initially, it was believed that the construct had two articulations. However, new designs have recognised the significance of a third articulation between the femoral neck and polyethylene liner [5]. Studies have demonstrated that ultra-high-molecular-weight polyethylene can decrease the amount of particulate wear in total hip arthroplasty [6]. The enhanced durability of these wear characteristics may be particularly significant in DM due to the numerous joint movements involved. While the introduction of modular DM enables surgeons to enhance acetabular fixation with screws, the presence of micromotion between the metal liner and acetabular shell can result in the generation of metallic wear debris and subsequent metallosis.

Contemporary DM designs have shown convincing results in both clinical and economic studies. The systematic review conducted by Darrith et al [7] found that both primary and revision cases of DM had satisfactory outcomes with high survival rates. Through an analysis of 46 articles, Donovan et al [8] concluded that DM has led to a decrease in dislocation rates after primary THA. The fiscal profile of DM has also attracted attention. Epinette et al [9] showed significant cost savings with DM compared to traditional fixed bearing constructs in primary THA. The clinical and economic findings have demonstrated the short-term effectiveness of DM.

There is a growing push for the utilisation of DM in a broader range of patients, with some proponents arguing for DM to become the standard primary total hip construct [10]. In the past, DM was recommended for cases with a high likelihood of dislocation, such as older patients, spinopelvic issues, neurological problems, and revision surgeries. Despite initial warnings against regular use of DM in young adults, the authors acknowledged the possibility of better outcomes with innovative modifications to the implant [11]. Additional inquiry is required to ascertain if the regular utilisation of DM in younger individuals is substantiated by collective data.

The aim of our study was to examine Functional outcome of TOTAL HIP ARTHROPLASTY with dual mobility cups in hip arthritis. This assessment included the documented clinical outcomes metrics, rates of revision, and implant survivorship.

Methodology:-

This is a hospital-based prospective study involving 50 patients diagnosed with conditions necessitating total hip replacementover a period of 1 year . A study was conducted on patients who underwent a dual mobility cup procedure during the study period at tertiary care hospital for a period of 12 months. The functional outcome was evaluated using the Harris Hip Score and PMA Score. Descriptive statistics were used to analyze the data.

Inclusion Criteria

Patients of age 18 years and above of either sex. Patients diagnosed clinically and radiologically with below condition:

1. Primary and secondary osteoarthritis of hip.
2. Failed fixation of proximal femur fracture.
3. Femur head necrosis.
4. Femur neck fracture in elderly who are not ideal for osteosynthesis.
5. Rheumatoid arthritis of hip.
6. Ankylosing spondylitis of hip.
7. Willingness and written informed consent of the patient to participate in the study.

Exclusion criteria

1. Patients with Tumor pathology.
2. Non ambulatory patients.
3. Patients with cerebrovascular accidents.
4. Patients unfit for surgery.
5. Not willing to participate in the above study.

Patients who meet the inclusion criteria will be included in the study after providing written informed consent. The study will document demographic data, historical information, clinical examination findings, and details of investigations and interventions in a structured format. Patients were monitored at 6 weeks, 3 months, 6 months, and 1 year. Evaluation criteria Clinical Performance assessed using the HARRIS HIP Score at 1 year postoperative. Clinical Performance - PMA Score assessed 1 year after surgery.

Surgical procedure

1. All surgeries were conducted electively with standard aseptic measures. The procedures were carried out under either spinal with epidural or general anesthesia.
2. Position the patient laterally on the unaffected side. The skin on the hip was cleaned with povidone-iodine.
3. Approach: Moore's Approach (Southern Exposure)

a. The acetabulum is prepared by removing the remaining ligamentum teres and soft tissue. Serial reaming is then performed at right angles and at a forty-five-degree angle until punctate bleeding is observed. The transverse acetabular ligament (TAL) is used to maintain the cup in the correct abduction and anteversion angle.

b. After preparing the acetabulum, the femoral medullary cavity is readied using a broach for the prosthesis insertion. Long femoral neck is removed with an oscillating saw. A prosthesis is inserted into the femoral canal at an angle of approximately 10-15 degrees of anteversion and secured in place in the femur using either cement or a cementless method, depending on the type of stem. The tripolar femoral head is placed into the neck, and the prosthesis is reduced through gentle traction and rotator movements.

Image 1:- Modular dual mobility implant design.

c. After suturing the capsule the external rotators are sutured back and the wound is closed.

Postoperative management

1. Pharmacological prophylaxis for preventing DVT according to ACCP guidelines Intramuscular pain relievers were administered based on the patient's cooperation; intravenous antibiotics were administered (2 doses - one before the operation and one after).
2. An X-ray was taken 48 hours later. Patients engaged in dynamic quadriceps exercises while standing with the support of a walker on the first or second day. They were permitted to bear full weight and walk with the assistance of a walker based on their pain tolerance, and were motivated to continue walking thereafter. Cross-legged sitting and squatting were prohibited.
3. Patients were monitored at 1-month, 3-month, 6-month, and 9-month intervals to assess functional outcome using the modified Harris hip scoring system and PME scoring system. Radiographs of the hip were taken at each follow-up for radiological analysis.

Result:-

Table1: Age Distribution of Patients Studied

Age in years	No. of patients	%
51-60	15	**30.0**
61-70	28	**56.0**
>70	7	**14.0**
Total	50	**100.0**
Mean±SD:64.30±7.44		

The age distribution of patients in Table 1 reveals a predominantly older demographic, with 56% falling within the 61-70 age range, followed by 30% between 51-60 years, and 14% over 70 years old. The total sample consists of 50

patients, with a mean age of 64.30 years and a standard deviation of 7.44. This distribution underscores the study's focus on an older population, with implications for understanding age-related health conditions and treatment outcomes.

Table 2:- Gender Distribution of Patient Studied.

Gender	No. of patients	%	Mean age ±SD
Female	22	45.0	**65.56±8.52**
Male	28	56.0	**63.28±6.67**
Total	**50**	**100.0**	**64.30±7.44**

Table 2 presents the gender distribution of patients studied, indicating a slightly higher representation of males (56%) compared to females (45%). The mean age for females is 65.56 years with a standard deviation of 8.52, while for males, it is 63.28 years with a standard deviation of 6.67. The overall mean age for the entire sample is 64.30 years, with a standard deviation of 7.44. This distribution provides insight into the gender balance within the study population and highlights potential variations in age among male and female patients.

Table 3:- Distribution of the Patient According to Diagnosis.

Diagnosis	No. of patients	%
NOF#	38	**75.0**
Secondary arthritis	7	**14.0**
Failed fixation no fit#	5	**10.0**
Total	**50**	**100.0**

Table 3 displays the distribution of patients according to diagnosis, with the majority (75%) diagnosed with NOF#, followed by 14% with secondary arthritis and 10% with failed fixation no fit#. This breakdown provides valuable insight into the primary conditions afflicting the patient population under study, emphasizing the prevalence of NOF# as the predominant diagnosis.

Table 4:- Fixation technique used distribution of patients studied.

Implant	No. of patients	%
Cemented	20	40.0
Hybrid	10	20.0
Un cemented	20	40.0
Total	50	100.0

Table 4 illustrates the distribution of patients studied based on the fixation technique used, showing that 40% received a cemented implant, while another 40% received an uncemented implant. The hybrid technique was utilized in 20% of cases. This breakdown provides insight into the various approaches employed for fixation, highlighting a balanced distribution between cemented and uncemented implants, with a smaller proportion undergoing hybrid fixation.

Table 5:- HHS Among Study Participant at Different Time Interval.

HHS	Min-Max	Mean ±SD	Difference	t value	P value
1month	46.70-87.00	63.89±12.91	-	-	-
3 months	52.50-93.65	72.23±13.73	-8.342	-8.750	<0.001**
6 months	63.50-94.70	79.90±10.21	-16.992	-13.376	<0.001**
9 months	71.65-97.50	86.28±7.72	-23.381	-15.482	<0.001**
12months	85.00-97.50	90.39±4.07	-27.481	-12.393	<0.001**

Table 5 presents the Hip Harris Score (HHS) measurements over multiple time points following treatment. At 1 month, the HHS ranged from 46.70 to 87.00, with a mean of 63.89 and a standard deviation of 12.91. Subsequent assessments at 3, 6, 9, and 12 months show improvements in HHS, with mean scores of 72.23, 79.90, 86.28, and 90.39, respectively. The standard deviations also decrease over time, indicating reduced variability in scores. The differences between consecutive time points, along with corresponding t-values and p-values, demonstrate

statistically significant improvements in HHS from baseline to each subsequent follow-up, highlighting the efficacy of the treatment intervention.

Table 6:- PME Score Among Study Participant at Different Time Interval.

PME	Min-Max	Mean ±SD	Difference	t value	P value
1month	7.00-14.00	12.26±1.97	-	-	-
3 months	8.00-16.00	12.89±1.85	-0.632	-3.076	0.007**
6 months	10.00-17.00	14.78±1.66	-2.389	-14.524	<0.001**
9 months	12.00-17.00	15.33±1.19	-2.944	-11.255	<0.001**
12months	13.00-17.00	15.72±1.02	-3.333	-11.902	<0.001**

Table 6 displays the Posterior Muscle Endurance (PME) scores measured at various time points following treatment. At 1 month, the PME scores ranged from 7.00 to 14.00, with a mean of 12.26 and a standard deviation of 1.97. Subsequent assessments at 3, 6, 9, and 12 months reveal improvements in PME scores, with mean scores of 12.89, 14.78, 15.33, and 15.72, respectively. The standard deviations also decrease over time, indicating reduced variability in scores. The differences between consecutive time points, along with corresponding t-values and p-values, demonstrate statistically significant improvements in PME scores from baseline to each subsequent follow-up, indicating the positive impact of the treatment intervention on posterior muscle endurance.

Table7:- Post Surgery Complications Among Study Participant.

	No. of patients(n=50)	%
No complication	43	86.0
complication	7	14.0
Types of complication		
Peri prosthetic fracture(van AL)	3	6.0
Surgical site infection	2	4.0

Table 7 presents the occurrence of complications among the patient cohort studied. Out of 50 patients, 86% experienced no complications, while 14% encountered complications. Among those with complications, the types reported include peri-prosthetic fracture (6%) and surgical site infection (4%). This breakdown provides insight into the incidence and nature of complications associated with the treatment intervention, highlighting the majority of patients who did not experience adverse events.

Table 8:- Implant survivorship.

Implant survivorship	No. of patients(n=50)	%
No. of patients in the study	50	**100.00**
No .of patient at final follow up	45	**90.0%**
Implant survival	**47**	**94%**

Table 8 outlines the implant survivorship data for the study cohort. Initially, there were 50 patients enrolled in the study. At the final follow-up, 45 patients remained, indicating a retention rate of 90%. The implant survival rate at the final follow-up was 94%, with 47 implants still functioning effectively. This information provides valuable insights into the long-term performance and durability of the implants used in the study, indicating a high level of success in terms of implant retention and functionality.

Discussion:-

Total hip arthroplasty is conducted approximately 1.5 million times annually on a global scale. It is a highly successful procedure, although some concerns still persist. A disease or fracture affecting the hip joint may necessitate the replacement of the ball-and-socket joint through a total hip replacement (THR).This procedure is widely practiced and successful, as evidenced by the growing number of surgeries performed worldwide each year. Various types of total hip replacements (THR) are currently utilized, differing in materials, geometries, mobility options, and other factors. We assessed the functional outcome and surgical results in patients who underwent total hip arthroplasty using dual mobility components. The text is minimal. The results were analyzed and observations were made. Among the twenty patients, one was lost to follow-up and one died two days after the surgery due to acute renal failure. This study was compared to analogous studies conducted by other authors. The study assessed functional outcome using the Harris Hip Score and PME score, which evaluate the level of function post-surgery through a series of daily activities.

The HARRIS HIP Score (HHS) demonstrated a steady increase from 46.7 to 87.0 with a mean of 63.89 in the first month, and from 85.0 to 97.5 with a mean of 90.39 at the conclusion of the study. 61.1% of participants demonstrated an excellent outcome at the end of the study, while 38.9% showed a good outcome. The PME score consistently improved from 7 to 14 with a mean of 12.26 in the first month and from 13 to 17 with a mean of 15.72 at the end of the study.
By the end of the study, all patients demonstrated an excellent PME score outcome.
A study on Unconstrained Tripolar Implants for primary total hip arthroplasty in high-risk patients included 167 cases. The mean preoperative HHS improved from 39.6 to 83.4 at the latest follow-up. A study conducted by R. A Rasheed et al. [12]included 31 patients (32 hips) with displaced femoral neck fractures who were hospitalized at El Hadara University Hospital in Alexandria, Egypt. The average HHS increased from 79.04+/-7.9 at 12 weeks to 92.8+/-11.1 at the 1-year follow-up period. Dual mobility cup total hip replacement is considered a suitable treatment method for displaced femoral neck fractures in active middle-aged patients in Egypt. It offers pain relief and good function without compromising stability. A study conducted by G. Canton, A. Moghnie, M. Cleva, et al.[13] on Dual mobility total hip arthroplasty for the treatment of femoral neck fractures revealed that Harris Hip scores had a mean value of 81.22 (range 54.60-97.02). They determined that Dual mobility total hip arthroplasty resulted in good clinical outcomes, low complications, and very low dislocation rates for treating neck of femur at longer follow-up.

Our study found that the HHS and PME scores were comparable in patients under 60 years old and those over 60 years old ($P > 0.005$). Additionally, at the 12-month mark, the HHS and PME scores were similar across different diagnoses ($P > 0.005$). A study conducted by Sarunas Tarasevicius et al. [14]found that dual-mobility total hip arthroplasty (THA DMCs) have a high incidence of loosening, osteolysis, and cup loosening in younger patients and those with childhood disease sequelae, based on a median follow-up time of 2.5 years.

They discovered that surgery for conditions other than osteoarthritis (OA) had a higher chance of needing revision. This implies that using dual articular cups could be an option for non-OA patients, such as those undergoing total hip arthroplasty (THA) for femoral neck fractures.
Our study found that the Cemented, Cement-less, Hybrid technique of implantation resulted in similar HHS and PME scores after 12 months ($P>0.005$). Additionally, the final follow-up showed that both male and female participants had similar HHS scores ($P>0.005$).

Divyanshu Goyal et al.[15] conducted a randomized comparative observational study in a hospital setting to compare the functional outcomes of cemented and un cemented total hip replacements. They followed 25 patients in each group for 2 years and found that cemented fixation resulted in better short-term clinical outcomes, including improved pain management and early pain-free full weight bearing. One patient experienced a peri-prosthetic fracture (Vancouver AL) during the broaching of the proximal femoral medullary cavity in a dual mobility total hip replacement with a press-fit un cemented stem. The fracture was repaired using stainless steel wire. Another patient developed a surgical site infection at the operative site, which was treated with standard dressing and antibiotics based on the culture report. patient died after surgery, while another patient exhibited new bone formation at the femoral side and lysis around the acetabular component on radiological imaging. 86% of the patients did not experience any complications associated with total hip arthroplasty. A systematic review of comparative studies on dual-mobility constructs in primary and revision surgeries. sum In primary total hip arthroplasty, the dislocation rate was significantly lower at 0.9% in the dual-mobility group compared to 6.8% in the control group ($p<0.001$) after an average follow-up of 7.6 years. The control group had odds ratios of 4.06 ($p<0.001$) for dislocation, 1.18 ($p=0.87$) for revision, 2.97 ($p=0.04$) for revision due to dislocation, 1.67 ($p=0.57$) for infection, 0.6 ($p=0.53$) for fracture, and 1.21 ($p=0.81$) for aseptic loosening in comparison to the dual-mobility group.

In our study, the implant survivorship rate was 94% at the conclusion of the final follow-up. The study by Chahine Assi7 et al.[16] on the outcomes of dual mobility cups in a young Middle Eastern population found a 100% survival rate of DMC implants in a 60-month follow-up.

In a study conducted by B. Darrith et al.,[17] a systemic review was performed on the outcomes of dual mobility components in total hip arthroplasty. The study included 10,783 primary dual mobility THAs, and the overall survivorship of the acetabular and dual mobility components was 98.0% at a mean follow-up of 8.5 years.

Conclusion:-

Dual mobility cup total hip replacement is a suitable approach for patients scheduled for Total Hip Arthroplasty as it offers pain relief and good function while maintaining stability.

The utilization of dual mobility cup in total hip arthroplasty is increasing and has demonstrated good to excellent results in the short-term follow-up, compared to conventional total hip replacement. High-quality, prospective, comparative studies are required to further assess the use of dual mobility components in total hip arthroplasty.

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