ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Prospective Study On Clinical Results Of Total Hip Arthroplasty.

D Thirumalai Pandiyan[1]*, S Sivabharathi[2], S Kumaravel[3].

[1]Associate Professor, Department of Orthopaedics, Thanjavur Medical College Hospital, Tamil Nadu, India.
[2]Junior Resident, Department of Orthopaedics, Thanjavur Medical College Hospital, Tamil Nadu, India.
[3]Professor, Department of Orthopaedics, Thanjavur Medical College Hospital, Tamil Nadu, India.

ABSTRACT

Total hip replacement aims mobility and pain relief while maintaining stability of hip joint. 27 patients were included with a mean age of 48 ±12.20 years at the time of surgery. Out of which non-union fracture neck of femur were -56% and Arthritis patients were -44%. 17 patients underwent uncemented Total Hip Arthroplasty whereas 10 patients underwent Cemented Total Hip Arthroplasty. The mean total pre-operative Harris Hip score was 31.8, which significantly improved post operatively to a mean score of 83.9. Total hip Arthroplasty with or without cement provides with good clinical and functional results. Better pre-disease mobility in neck of femur fracture patients prior to the surgery has reflected in better objective outcome post operatively in these cases. The patients with painful chronic arthritis, stated to have experienced better subjective pain relief following total hip arthroplasty. However, long-term studies must be done to assess the risk both clinically and radiologically that may impact the clinical result and implant longevity.

Keywords: Hip Arthroplasty, radiology, clinical.

https://doi.org/10.33887/rjpbcs/2023.14.5.5

Corresponding author

ISSN: 0975-8585

AIM

The purpose of this study is to assess the clinical outcomes following total hip arthroplasty with Subjective measures and radiological assessment.

INTRODUCTION

Total hip replacement refers to replacement of a diseased or damaged hip joint with an artificial head of femur and acetabulum. The goals of total hip replacement are to provide mobility and to relieve the pain and deformity while maintaining stability of hip joint. Total hip replacement can either be uncemented or cemented. Sir john Charnley pioneered the concept of total hip replacement, that has evolved as an effective surgery, used widely around the world for treatment of a spectrum of hip pathologies.

It is a highly cost-effective procedure. Evaluation of outcome is important to determine the durability of the procedures like total hip replacement (THR). This study is undertaken to assess the important clinical and radiological outcomes of the total hip arthroplasty.

Total hip prosthesis is expected to perform a mechanical function by transmission of weight load and also transmission of motion. Not only must low frictional resistance be maintained between a joint but also the torsional force transmitted from the prosthetic femoral head to the socket must be resisted for a successful arthroplasty. Prosthetic components of total hip arthroplasty must withstand several years of cyclical loading that is equal to 3 to 5 times the weight of the body and at times 10 to 12 times while jogging and running. Increased physical activity and increased body weight will add to the loosening, and hence hip replacement patient should not do these activities.

Review Of Literature

John Charnley [1] created the concept of low friction arthroplasty with regards to 3 distinct ideas:

- The idea of low friction torque arthroplasty;
- Use of acrylic cement to fix components to bone;
- Introduction of high-density polyethylene as a bearing material.

Charnley's low friction arthroplasty had a 77-81% good clinical results at 25 years follow-up. Charnley noticed that copying joint anatomy would only lead to failure, so he devised a system based on a steel ball (size 22,25 mm), rolling on a polytetrafluoroethylene (PTFE/Teflon) acetabular cup.

Following this, Muller increased the size of the femoral head up to 32 mm, thus increasing the ROM up to 106°. Most of the Teflon hips were experiencing aseptic loosening and osteolysis so, Charnley found a ultrahigh molecular weight polyethylene (UHMWPE) [2].

In the 1950s' he introduced the PMMA (poly methyl methacrylate) bone cement. Charnley's article "Anchorage of the femoral head Prosthesis to the Shaft of the Femur" from 1960 stated some of the basic principles, such as medullary reaming of the femur prior to cementing and stem fixation [1].

In 1970's France, surgeons started using the fixation of a femoral stem with 2 points for support (from cortex to cortex) with a thin cement mantle and the intensive broaching of the femoral canal in contrast to the idea that the femoral stem should be coated by a thick cement mantle and enough cancellous bone for support.

This concept was capitalized by Kerboull [4] which led to the development of Charnley Kerboull stem. Langlais*et al*. defined the "French paradox" [5] a phenomenon of two seemingly contradictory cementing concepts leading to good outcomes.

The pioneer of the uncemented total hip technique was Ring [3], in the 60's who used screws on the acetabular component and a valgus placement of the implant in order to achieve fixation. The porous coated stem was deviced in order to allow bony ingrowth and successful integration of the implant.

At first, the stems were coated all around, causing a rigid implant and high levels of thigh pain. As a result, the stems were coated only on the metaphyseal region, insuring a more stable construct. This led to the modern uncemented stem implants: anatomical, tapered and cylindrical.

In the recent decades, the assessment of outcomes after THA has shifted from focusing on success or failure of the implant to effective pain relief, improvements in physical functioning, and quality of life.

In 1998, Young-Hoo Kim [6] et al performed a prospective study in Primary Total Hip Arthroplasty with a Cementless Porous-Coated Anatomic Total Hip Prosthesis. Improvement measured by Harris Hip Score, gave excellent results in 65% and The overall rate of revision was 15 %. At 11 years, 81 hips (70%) showed definite wear of the polyethylene liner.

In 2005, Shetty et al[7] describe the survival of 134 consecutive JRI **Furlong** hydroxyapatite-coated uncemented total hip replacements. None of the cups was revised, giving a 99% survival at 13 years.

In 2013, Kristi Elisabeth hinerket al [8] looked into recovery of physical functioning in patients during the first year after THA and to prognosticate postoperative walking distance outcomes from preoperative measures. Younger age, male sex, and better scores of walking distance and hip flexibility before surgery predicted better score in walking distance at both 3 and 12 months after surgery.

In 2016, Roland P. Walker et al [9] did a systematic review and meta-analysis to assess whether THA in patients aged 30 years or less provides significant functional improvement. The results show vital functional improvement measured by Harris Hip Score. The revision rate of 5% at 8.4 years is comparable to the general THA population.

In 2019, Tubaguler et al [10] assess early changes in physical activity and function after total hip arthroplasty (THA) using both subjective and objective methods, and to identify predictors of outcomes of THA. Suggested age and baseline 6 minute walking test scores were correlated with physical capacity after THA.

A technique to position the correct anatomic position of the acetabulum in deformed hips and to evaluate any change of position of the acetabular component after THA based on radiographs came about by Ranawat [11] and colleagues.

The Acetabular component screws do not protrude above the inner surface of the titanium shell, it will interfere with polyethylene liner insertion. The screws are inserted in the safe zone quadrant of Wasielewski [12].

MATERIALS AND METHODS

A prospective study was done in patients undergoing total hip replacement from June 2019 to March 2022 at the Department of Orthopaedics and Traumatology, Thanjavur Medical College Hospital. Consecutive patients were included in the study.

Inclusion Criteria

- Age more than 18yrs,
- Old non-union neck of femur fracture,
- Arthritis hip.

Exclusion Criteria

- Age less than 18 years,
- Evidence of Infection,
- Neurological disease or history of sciatica with neurological signs,
- Previous Total hip arthroplasty of same hip.
- Diagnosis included chronic arthritis secondary to primary osteoarthritis, avascular necrosis, inflammatory conditions namely Ankylosing spondylitis, Rheumatoid arthritis.

- Posterior Moore's approach [14]was used in all the patients.

Clinical Assessment

The functional outcome of hip surgery is assessed using Harris Hip Score, limb length discrepancy, Trendelenburg test, Rivermead visual gait analysis and Radiological assessment by Acetabular inclination, Anteversion, vertical and horizontal offset ratio of femur. Clinical records from hospital charts were evaluated for complications such as wound drainage, hematoma, dislocation, infection, deep venous thrombosis, pulmonary embolus, neurologic and vascular problems.

RESULTS

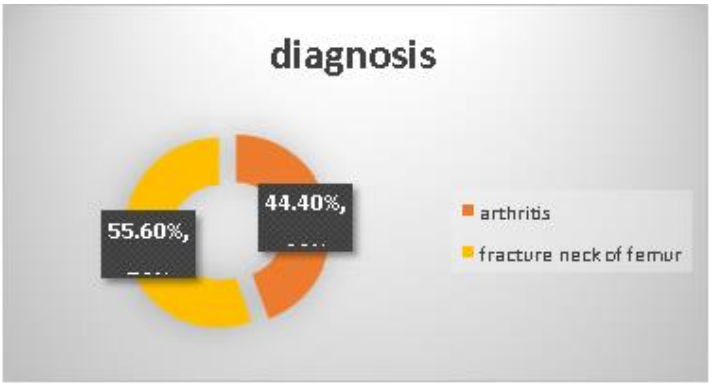
30 patients were included in the study 3 patients had insufficient follow up evaluation and were excluded from the study after initial assessment. Observation of 27 patients for the follow up periods of one year after total hip arthroplasty, The following observations were made.

Table 1

S.no	Variables	Frequency (27)	Percent (%)
1.	**Age group(years)**		
	20-40	8	29.6
	41-60	15	55.6
	>60	4	14.8
2.	**Gender**		
	Female	7	25.9
	Male	20	74.1

Among the study populations, age ranged from 23 to 70 years with mean age 48 years of age and SD-12.20. Maximum cases were in 4th and 5th decades of life. More than 70% of the study populations were male.

Chart 1: Frequency distribution of diagnosis



Implant

Table 2: Frequency distribution of implant

S.no	Implant	Frequency(27)	Percent(%)
1.	Cemented	10	37
2.	Uncemented	17	63

ISSN: 0975-8585

Limb length discrepancy

Table 3: Frequency distribution of limb length discrepancy pre operative andpost operative

S.no	Variables	Frequency(27)	Percent (%)
1.	**Limb lengthdiscrepancy Pre operative** (incms)		
	0.4-0.8	15	55.6
	0.9-1.2	1	3.7
	1.3-1.8	6	22.2
	1.9-2.4	5	18.5
2.	**Limb lengthdiscrepancy Post operative** (in cms)		
	Less than or equal to 0.5	6	22.2
	0.6-1.0	1	3.7
	Nil discrepancy	20	74.1

Harris hip score

Table 4: Frequency distribution of harris hip score

S.no	Variables	Frequency (27)	Percent (%)
1.	**HHS pre operative**	Mean-31.8SD-7.85	
	<70	27	100
2.	**HHS 3 weeks aftersurgery**	Mean-53.92SD-6.81	
	<70	27	100
3.	**HHS 6 weeks aftersurgery**	Mean-65.81SD-6.17	
	<70	21	77.8
	70-79	6	22.2
4.	**HHS 3 months aftersurgery**	Mean-75.15 SD 7.18	
	<70	7	25.9
	70-79	12	44.4
	80-89	8	29.6
5.	**HHS 6 months aftersurgery**	Mean-79.25SD-6.81	
	<70	2	7.4
	70-79	14	51.9
	80-89	10	37
	90-99	1	3.7
6	**HHS 1 year after surgery**	Mean-83.9SD-6.81	
	<70	1	3.7
	70-79	5	18.5
	80-89	14	51.9
	90-99	7	25.9

Harris hip score outcome after 1 year of surgery

Table 5: Frequency distribution of HHS outcome

S.no	HHS outcome	Frequency (27)	Percent (%)
1.	Excellent	7	25.9
2.	Good	14	51.9
3.	Fair	5	18.5
4.	Poor	1	3.7

Among the study populations, The Harris Hip score is graded as follows:

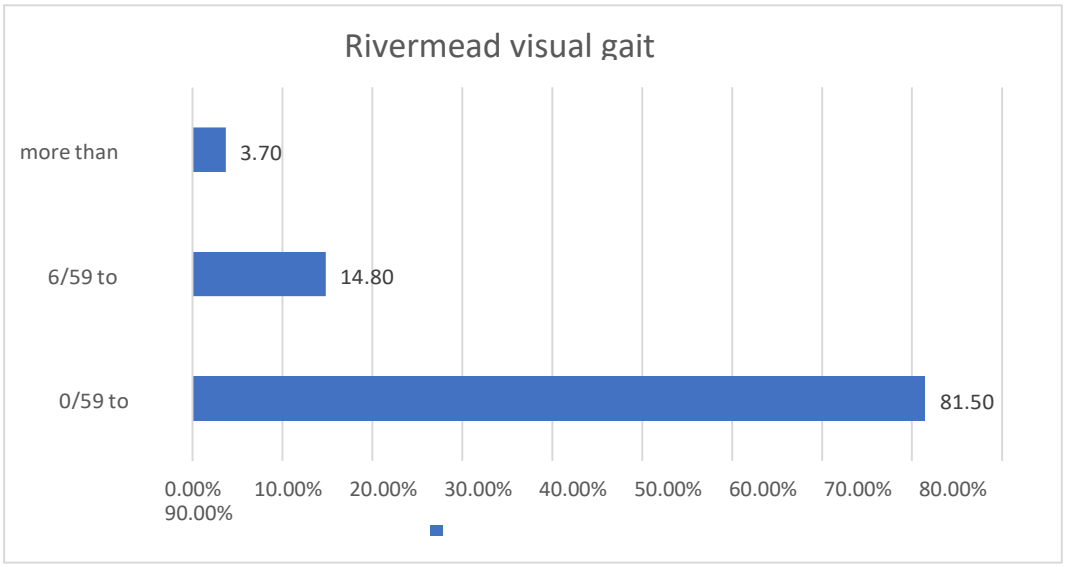
Score < 70 – Poor, 70-79 – fair, 80 – 90 – good, 90-100 – Excellent. HHS score preoperative and after 3 weeks follow up were poor, more than 50% had good HHSafter one year follow up of surgery.

ISSN: 0975-8585

Rivermead visual gait score

Among the study populations, more than 80% patients had visual gait score lessthan or equal to 5/59.

Chart 2: Frequency distribution of rivermead visual gait score



Trendelenburg sign

Table 6: Frequency distribution of Trendelenburg sign

S.no	Trendelenburg sign	Frequency (27)	Percent (%)
1.	Negative	24	88.9
2.	Positive	3	11.1

Among the study populations, nearly 90% had negative Trendelenburg sign

Femoral offset ratio

Table 7: Frequency distribution of femoral offset ratio

S.no	Femoral offsetratio	Frequency(27)	Percent (%)
1.	Vertical		
	<1.0	1	3.7
	1.0-1.10	24	88.9
	>1.10	2	7.4
2.	Horizontal		
	<1.0	5	18.5
	1.0	22	81.5

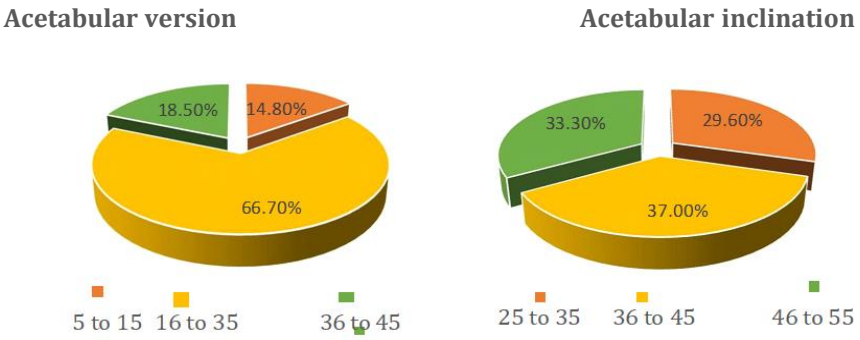
Among the study populations, more than 80 percent had better vertical andhorizontal offset.

Acetabular version, Acetabular inclination

Among the study populations, nearly 3/4th of them had 16° to 35° acetabularversion.

ISSN: 0975-8585

Chart 3: Frequency distribution of acetabular version , inclination



Inferential statistics using chi square test and fisher exact test

Diagnosis versus implant

Table 8: Diagnosis versus implant

S.no	Diagnosis	Implant		Total
		Cemented	Uncemented	
1	Chronic Arthritis	5,41.7%	7,58.3%	12,100%
2	Fracture neck offemur	5,33.3%	10,66.7%	15,100%

p value-0.706 (p value <0.05 significant) p value derived from Chi square test andFisher exact test. Among the study populations (27), more than 65% of the patient with fracture neck of femur had uncemented implant.

Diagnosis versus preoperative HHS

Table 9: Diagnosis versus pre operative HHS

S.no	Diagnosis	HHS pre operative				Total	
		<70	70-79	80-89	90-99		
1.	Chronic Arthritis	12,100%	0	0	0	12,	100%
2.	Fracture neck offemur	15,100%	0	0	0	15,	100%

Diagnosis versus HHS

Table 10: Diagnosis versus HHS

S.no	Diagnosis	HHS after one year follow up				Total
		<70	70-79	80-89	90-99	
1.	Chronic Arthritis	0	2,16.7%	7,58.3%	3,25%	12,100%
2.	Fracture neck offemur	1,6.7%	3,20%	7,46.7%	4,26.7%	15,100%

p value -1.000(p value <0.05 significant) p value derived from Chi square test and Fisher exact test. Among the study populations (27), nearly 60% of the arthritis patients had HHS after one year follow up were 80-89.

ISSN: 0975-8585

Implant versus HHS

Table 11: Implant versus HHS pre operative

S.no	Implant	HHS pre operative				Total	
		<70	70-79	80-89	90-99		
1.	Cemented	10,100%	0	0	0	10,	100%
2.	Uncemented	17,100%	0	0	0	17,	100%

(p value <0.05 significant) p value derived from Chi square test and Fisher exacttest.

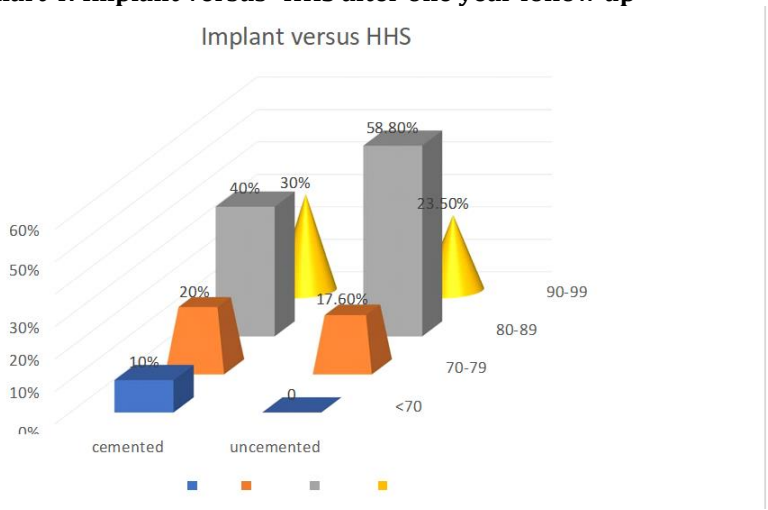
Implant versus HHS after one year follow up

Table 12: Implant versus HHS after one year follow up

S.no	Implant	HHS after one year follow up				Total	
		<70	70-79	80-89	90-99		
1.	Cemented	1,10%	2,20%	4,40%	3,30%	10,	100%
2.	Uncemented	0	3,17.6%	10,58.8%	4,23.5%	17,	100%

p value -0.638(p value <0.05 significant) p value derived from Chi square testand Fisher exact test. Among the study populations (27), nearly 60% of the uncemented implant patients had 80-89 HHS .

Chart 4: Implant versus HHS after one year follow up



Diagnosis versus RMVG score

Table 13: Diagnosis versus RMVG score

S.no	Diagnosis	RMVG score			Total
		0/59-5/59	6/59-10/59	>10/59	
1.	Arthritis	11,91.7%	1,8.3%	0	12, 100%
2.	Fracture neck offemur	11,73.3%	3,20%	1,6.7%	15, 100%

p value -0.605(P value <0.05 significant) p value derived from Chi square test and Fisher exact test.Among the study populations (27), arthritis patients had RMVG score 91.7% of (0/59-5/59).

ISSN: 0975-8585

Implant versus RMVG score

Table 14: Implant versus RMVG score

S.no	Implant	RMVG score			Total
		0/59-5/59	6/59-10/59	>10/59	
1.	Cemented	8,80%	1,10%	1,10%	10,100%
2.	Uncemented	14,82.4%	3,17.6%	0	17,100%

p value -0.537(P value <0.05 significant) p value derived from Chi square test and Fisher exact test. Among the study populations (27), more than 80% of the uncemented implant patients had RMVG score of 0/59 to 5/59.

CASE ILLUSTRATION

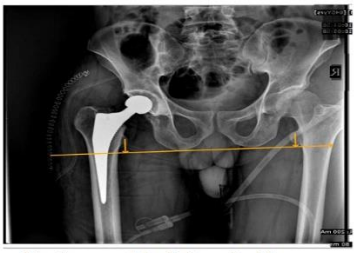
CASE 1

Patient Details	38 yrs old Male					
Diagnosis	Right side Avascular necrosis of hip					
Procedure	Uncemented Total Hip Arthroplasty					
Complications	NIL					
Limb Length Discripency	PRE OP: 0.5 CM			POST OP: NIL		
Trendelenberg Sign	NEGATIVE					
Harris Hip Score	**PREOP**	**3 WEEKS**	**6 WEEKS**	**3 MONTHS**	**6 MONTHS**	**1 YEAR**
	26	62	78	86	88	93
Outcome	EXCELLENT					
Rivermead Visual Gait Score	0/59					

Pre operative x-Ray

Post operative X-Ray

Pre op Limb length discrepancy 0.5 cm



Post op no Limb length discrepanc

Femoral Offset ratio 1

ISSN: 0975-8585

Sitting

Single leg stance

Straight leg rising test

Hip flexion

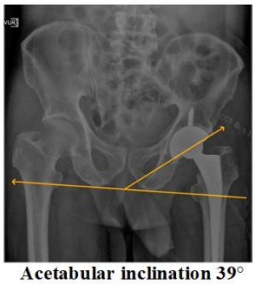
Hip abduction and external rotation

ISSN: 0975-8585

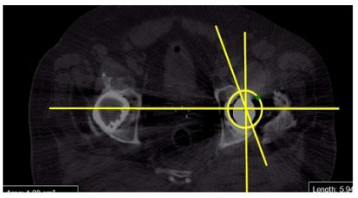
CASE 2

Pre operative x-Ray

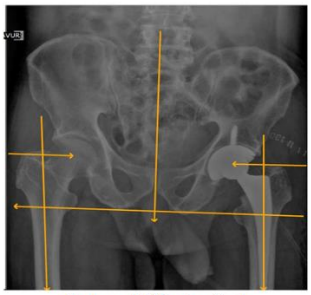
Post operative X-Ray



Acetabular inclination 39°



Acetabular Version 17°



Femoral Offset ratio 1

Patient Details	26 yrs old Male					
Diagnosis	Chronic Arthritis hip Right side					
Procedure	Uncemented Total Hip Arthroplasty					
Complications	NIL					
Limb LengthDiscripency	PRE OP: 0.4 CM			POST OP: NIL		
TrendelenbergSign	NEGATIVE					
Harris Hip Score	**PREOP**	**3 WEEKS**	**6 WEEKS**	**3 MONTHS**	**6 MONTHS**	**1 YEAR**
	36	58	71	84	89	92
Outcome	EXCELLENT					
RivermeadVisual Gait Score	3/59					

ISSN: 0975-8585

Clinical Pictures

Sitting

Single leg stance

Straight leg rising test

Hip flexion

Hip abduction and external rotation

DISCUSSION

"There are various methods of treatment of proximal femur fractures, both replacements [17] and fixations [18].

THR is one of the most successful and cost-effective Orthopaedic procedures and remains the treatment of choice for long term pain relief and functional restoration in patients with diseased or damaged hips. The functional outcome of THR depends on various factors; patients' profile, surgical technique, and the implants used, all of which have roles to play in the ultimate quality of life.

In our study, 20% of the patients were found to be in the 50 years and above age group, with age ranging from 23 to 70 years and Maximum cases were in 4th and 5th decades of life. The mean age of our study was comparable with study of Unger AS et al [20] where the mean **age** was 39.9 years with range of 14 72 years. However, in our study there were no statistically significant between age and functional outcome of the patients. Singling out the primary indication of the procedure is difficult, but reports of Eftekhar [21] and Harkess [22] document the arthritis group to be the most common indication.

In our study Non union neck of femur was the most common indication for replacement followed by avascular necrosis of hip 26%. We used Harris hip score(15) to assess the functional outcome in our study which is the most widely used scoring system for evaluating hip Arthroplasty. Excellent and good pain relief and function were obtained in 78% of patients which is comparable to study of RC Siwach et al [23] in which excellent or good outcome was achieved in 75% patients and Chandrasekhar et al [24] where 84 % had excellent results.

The mean total pre-operative Harris Hip score was 31.8, which improved post operatively to a mean score of 83.9. There was statistically significant improvement in postoperative Harris hip score.

In our study mean Pre op Harris Hip score and mean post-operative Harris hip score in cemented THR was 30.5 and 82.7 which was comparable with Wixson et al [25] which is 42 and 90 and Sandesh Reddy Yaratapalli et al(26) which is 36 and 88. The mean Pre op Harris Hip score and mean post-operative Harris hip score in uncemented THR was 32.5 and 84 which were comparable to Wixson et al [25]. However, there was no statistical significance found between the type of Arthroplasty and functional outcome scores.

Another factor that may be of important in determining the outcome of Arthroplasty the Indication of total hip Arthroplasty. In our study all the patients of arthritis hip had good outcome compared to neck of femur fracture patients. These results are comparable with the study of Jakub et al [27] as they concluded that function outcome of total hip Arthroplasty is more in osteoarthritis as compared to Fracture neck of femur. In our study we found that there was statistical significance between the indication of surgery and final outcome.

In a study conducted by Divyanshu Goyal [28] reported there was no significant difference between cemented and cementless group at 2 years' follow-up. In our study the results in the two procedures are similar.

In total hip arthroplasty one ideally aims to restore the anatomic geometry of the hip. The clinical and biomechanical significance of leg length discrepancy following total hip arthroplasty is frequently debated. In primary hip arthroplasty the leg length discrepancy has been shown subsequently to vary from 1 mm to 15.9 mm, with this being clinically symptomatic with shortening in excess of 10 mm, and lengthening in excess of 6 mm . Friberg has shown a significant correlation between leg length discrepancy and both chronic low back pain and hip symptoms [29].

According to Jasty et al [30] preoperative LLD of more than 2 cm presents social problems. Also Lai et al [31] found that patients with equal leg length following total hip arthroplasty walked faster and had better symmetrical gait parameters, as compared to untreated patients with leg length discrepancy .

In our study more than 0.6-1 cm shortening was present in 3.7% of cases which was managed with footwear correction in the form of shoe raise which is better than from findings of Ganeshan et al [32] showing 1- 1.5 cm shortening in 13% case.

In our study we assessed gait visually using the Rivermead visual gait assessment form for comparing the gait following total hip replacement. Among the study populations, arthritis patients had RMVG score 91.7% of (0/59-5/59). And more than 80% of the uncemented implant patients had better RMVG score of 0/59 to 5/59.

However, there was no statistical significance found between the type of Arthroplasty and indication for surgery. Though there is better scores in the uncemented group compared to the cemented, which is statistically insignificant. And also better results in arthritis hip compared to fracture neck of femur.

In our prospective study 3 patients had Trendelenburg test positive due to weak abductors. Baker [33] (1989) and Weale [34] (1996) studied Nerve palsy or injury and compared the posterior approach to direct lateral one. They found post op nerve injuries are less with posterior approach.

Acetabular component positioning is crucial to a successful total hip arthroplasty. In our study nearly 3/4th of them had 16* to 35* acetabular version , one patient had -5* Retroverted cup got post op

dislocation. This was comparable with Lewinnek et al [33]. suggested acetabular components to be positioned in 15±10 degrees of anteversion and 40±10 degrees of inclination based on 9 dislocations.

Among the study populations, more than 80 percent of patients have better femoral offset ratios. Bjarnason et al [35]. found a stronger correlation between femoral and global offset when compared to acetabular and global offset, suggesting that femoral offset alone may be a fair approximation of global offset.Clement et al. showed that femoral offset was more predictive of greater postoperative outcomes than global offset, independently. It is evident that Femoral offset has an effect on both functional and clinical patient reported outcomes. Setting a target Femoral offset during preoperative planning should help facilitate reconstruction of the optimal Femoral offset.

Limitations of our study are: smaller sample size and short term follow-up.

CONCLUSION

In conclusion, Total hip Arthroplasty with or without cement provides with good clinical and functional results. Our study proposes that the Total Hip Replacement can furnish adequate clinical and radiographic outcomes after short term duration of follow-up. However, successive long-term studies must be performed in order to make clear, the progression of Osteolysis that may impact the clinical result and implant longevity. Though the study was not without complications, the all-inclusive functional and clinical outcome showed good results.

REFERENCES

[1] Charnley J. Anchorage of the femoral head prosthesis to the shaft of the femur. J Bone Joint Surg Br 1960;42B:28-30

[2] Paul Fenton MRCS, Ashok Rampurada MRCS Ed, Ford Qureshi FRCS. Bone cement, its history, its properties and developments in its use. 2009. Available from: http://usmorthopaedic.wordpress.com/2009/08/24/ bone-cement

[3] Ring PA. Total replacement of the hip. Clin Orthop Relat Res 1970;72:161-8.

[4] Kerboull L, Hamadouche M, Courpied JP, Kerboull M. Long-term results of Charnley-Kerboull hip arthroplasty in patients younger than 50 years. Clin Orthop Relat Res 2004;418:112-8.

[5] Langlais F, Kerboull M, Sedel L, Ling RS. The 'French paradox.'. J Bone Joint Surg Br 2003;85:17-20.

[6] Kim YH, Kim JS, Cho SH. Primary total hip arthroplasty with a cementless porous-coated anatomic total hip prosthesis: 10- to 12-year results of prospective and consecutive series. J Arthroplasty 1999;14(5):538-48.

[7] Shetty AA, Slack R, Tindall A, James KD, Rand C. Results of a hydroxyapatite-coated (Furlong) total hip replacement: a 13- to 15-year follow-up. J Bone Joint Surg Br 2005;87(8):1050-4. doi: 10.1302/0301-620X.87B8.16011. PMID:16049237.

[8] Heiberg KE, Ekeland A, Bruun-Olsen V, Mengshoel AM. Recovery and prediction of physical functioning outcomes during the first year after total hip arthroplasty. Arch Phys Med Rehabil 2013;94(7):1352-9.

[9] Walker Roland P, et al. Functional outcomes of total hip arthroplastyin patients aged 30 years or less : A systematic review and meta-analysis. In: Hip International 2016; 26(5):424-431.

[10] Güler T, Sivas F, Yurdakul FG, Çelen E, Utkan A, Başkan B, Bodur H, Özkurt B. Early improvement in physical activity and function after total hip arthroplasty: Predictors of outcomes. Turk J Phys Med Rehabil 2019;65(4):379-388.

[11] Ranawat CS, Dorr LD, Inglis AE. Total hip arthroplasty in protrusion acetabuli of rheumatoid arthritis. J Bone Joint Surg Am 1980; 62(7):1059-1065

[12] Charnley J. Total hip replacement by low-friction arthroplasty. Clin Orthop Relat Res 1970; (72):7-21.

[13] Wasielewski RC, Cooperstein LA, Kruger MP, Rubash HE. Acetabular anatomy and the transacetabular fixation of screws in total hip arthroplasty. J Bone Joint Surg Am 1990 Apr;72(4):501-8. PMID: 2324135.

[14] Moore AT. The self-locking metal hip prosthesis. J Bone Joint Surg Am 1957;39-A: 811-27.

[15] Harris WH. Traumatic arthritis of the hip after dislocation and acetabular fractures: treatment by Mold arthroplasty. An endresult study using a newmethod ofresult evaluation. J Bone Joint Surg [Am] 1969;51-A:737–55.

[16] Lord SE, Halligan PW, Wade DT. Visual gait analysis:the development of a clinical assessment and scale. Clin Rehabil 1998; 12; 107.
[17] Kumaravel S. Primary Cemented Hemiarthroplasty Gives Predictable Early Mobility in Inter-Trochanteric Fractures of Elderly. Res J Pharm Biol Chem Sci 2015;6(2): 1550- 61.
[18] Sivasenthil A Kumaravel S Kirubha Shankar V The. Effectiveness of Biological Fixation of Proximal Femoral Fractures Using Angle Stable Implant Pf-LCP in Restoring Function and Bone Union - A Study on 56 Cases. IOSR Journal of Dental and Medical Sciences 21(4): 49-54
[19] Murray DW. The definition and measurement of acetabular orientation. J Bone Joint Surg [Br] 1993;75-B:228–232
[20] Unger AS, Inglis AE, Ranawat CS, Johanson NA. Total hip arthroplasty in rheumatoid arthritis. A long-term follow-up study. J Arthroplasty 1987;2(3):1917.
[21] Eftekhar NS. Total hip replacement using principles of low-friction arthroplasty: The Hip. Surgery of the musculoskeletal system, Edited by CM Evarts,Vol.3: Churchill Livingston, 1983.
[22] Harkess JW. Arthroplasty of hip., Campbells Operative Orthpeadics, Edited by AH Crenshaw, 8th edition, Vol. 1: CV Mosby Company, St. Louis, Washington DC,Torto,1982.
[23] RC Siwach, Virender Singh Kadyan, SS Sangwan, and Rajiv Gupta A retrospective study of total hip arthroplasty Indian J Orthop 2007 Jan- Mar;41(1):62–66.
[24] Chandra Sekhar, Ankur Mittal, Ramprasad Rallapalli, Biju R, Siva Prasad Y. Evaluation and Outcome of Total Hip Replacement in Adults with Arthritis. IOSR Journal of Dental and Medical Sciences 2015;14(4):65-72.
[25] Wixson RL, Stulberg SD, Mehlhoff M; Total hip replacement with cemented, uncemented, and hybrid prostheses. A comparison of clinical and radiographic results at two to four years. J Bone Joint Surg Am 1991;73:257-70.
[26] Y.R.Sandesh, G.G.Ram, P. Kunal, H. Giriraj, V.V.Phagal; Functional and radiological outcomes of total hip replacement in non traumatic indications. Int J Curr Microbiol App Sci 2014;3(3):153-158.
[27] Jakub Szczesiul, Marek Bielecki. A Review of Total Hip Arthroplasty Comparison in FNF and OA Patients. Advances in Orthopedics 2021; Article ID 5563500. https://doi.org/10.1155/2021/5563500
[28] Goyal D, Bansal M, Lamoria R. Comparative study of functional outcome of cemented and uncemented total hip replacement. J Orthop Traumatol Rehabil 2018;10:23-8
[29] Friberg O. Clinical symptoms and biomechanics of lumbar spine and hip joint in leg length inequality. Spine 1983; 8: 643-51
[30] Jasty M, Webster W, Harris W. Management of limb length inequality during total hip replacement. Clin Orthop Relat Res 1996;333:165–71.
[31] Lai KA, Lin CJ, Jou IM, Su FC. Gait analysis after total hip arthroplasty with leg-length equalization in women with unilateral congenital complete dislocation of the hip-comparison with untreated patients. J Orthop Res 2001; 19: 1147-52.
[32] G. Ram, B. Thamodaran, T. Ashok, S. Perumal and V.Varthi. Analysis of Functional and Radiological Outcome of Total Hip Replacements in Rheumatoid and Osteoarthritis Patients. Open Journal of Rheumatology and Autoimmune Diseases 2013;3(4):246-250.
[33] Baker AS, Bitounis VC. Abductor function after total hipreplacement. An electromyographic and clinical review. J Bone Joint Surg 1989;71- B:47-50.
[34] Weale AE, Newman P, Ferguson IT, Bannister GC. Nerve injury after posterior and direct lateral approaches for hip replacement. A clinical and electrophysiological study. J Bone Joint Surg 1996;78-B: 899–902.
[35] Bjarnason JA, Reikeras O. Changes of center of rotation and femoral offset in total hip arthroplasty. Ann Transl Med 2015;3(22):355. doi:10.3978/j.issn.2305- 5839.2015.12.37.