

## “Evaluation of patient satisfaction after total hip arthroplasty”

Dev Krishan Sharma<sup>1,\*</sup>, Pramod P Neema<sup>2</sup>

<sup>1</sup>Resident, <sup>2</sup>HOD, Dept. of Orthopaedics, Unique Super Speciality Centre, Indore, Madhya Pradesh

\*Corresponding Author:

Email: devks@yahoo.com

### Abstract

**Background:** Nowadays Total Hip Arthroplasty is the final treatment option provided to patients with unsalvageable, severely arthritic, painful and deformed hips. Arthroplasty has evolved over a period of many years.<sup>(1-5)</sup> Total Hip Arthroplasty is a very successful and a low risk treatment option. It is a safe and cost effective treatment for alleviating pain and restoring physical function in patients unresponsive to non-surgical modalities of treatment. Though the success story of Total Hip Replacement Arthroplasty is well known to us question remain whether patient are satisfied or not.<sup>(6-8)</sup> However, 7 to 15% of patients are dissatisfied after surgery.<sup>(9-11)</sup> Till date important technical progresses have already been made in THA, so future progress in this field might not significantly impact patient satisfaction. An emerging area of research lies in the identification of determinants of patient satisfaction which may offer new improvement perspective in quality care and helps in increment in patient satisfaction level.<sup>(7)</sup> Therefore present study was conducted to evaluate patient satisfaction after THA with the help of HHS, JOA and SF-36 score.<sup>(12-18)</sup>

**Material and Method:** The study was conducted in Department of Orthopaedics and Traumatology at USSC, Indore from July 2015 to June 2016. The results of 51 consecutive Total Hip Replacement that was performed during above period was reviewed and studied. Informed consent was taken from all patients. Clearance of ethical committee of the institute was taken. Evaluation done pre operatively and post operatively at 1 month, 3 months and at 6 months with the help of Harris Hip Score, JOA score and SF-36 and evaluated various parameters and correlation between them for patient satisfaction.

**Results:** In this study group, the analysis was undertaken to determine the relation or relatedness between the scoring systems. When comparing the post-operative six month follow-up of different scoring systems it was found that SF-36 was correlated with JOA with a Pearson's correlation coefficient of 0.711, which was significant at the 0.01 level (two tailed), followed by HHS and SF-36 ( $r=0.672$ , at 0.01 level) and HHS and JOA ( $r = 0.431$ , at 0.05 level of significance).

**Conclusion:** The post-operative follow-up of different scoring systems revealed that SF-36 was correlated with JOA with a Pearson's correlation coefficient of 0.711, followed by HHS and SF-36 ( $r=0.672$ ) and HHS and JOA ( $r = 0.431$ ). The moderate to low correlation between different scoring systems indicate the unique areas that these systems evaluate; hence any of the scoring systems used cannot be used to replace the other. However using them (at least two) in conjunction appears to be more useful.

**Keywords:** THA, THR, Patient satisfaction score, Harris Hip Score, SF-36 score, JOA score, MOS study.

### Access this article online

**Website:**

[www.innovativepublication.com](http://www.innovativepublication.com)

**DOI:**

10.5958/2395-1362.2016.00039.6

### Introduction

Nowadays Total Hip Arthroplasty is the final treatment option provided to patients with unsalvageable, severely arthritic, painful and deformed hips. Arthroplasty has evolved over a period of many years. The modern era began in the 1960s. The effort of the pioneers Glucks, Smith, Petersen, MacKee and Farrar, Sir John Charnley and others opened the doors to most successful operative procedure.<sup>(1-5)</sup>

Total Hip Arthroplasty is a very successful and a low risk treatment option. It is a safe and cost effective treatment for alleviating pain and restoring physical function in patients unresponsive to non-surgical modalities of treatment. Though the success story of Total Hip Replacement Arthroplasty is well known to us, questions remains which material and implant design are

most effective for patient specific population and which surgical technique is optimal for a successful outcome.<sup>(6-8)</sup>

Total Hip Arthroplasty (THA) has been thought of as one of the best treatment for last stage coxarthrosis. Superior post-operative results are usually obtained when it is compared with other joint reconstruction techniques. It provides excellent pain relief and improves functional status and wellbeing. However, 7 to 15% of patients are dissatisfied after surgery.<sup>(9-11)</sup>

Important technical progresses have already been made in THA, so future progress in this field might not significantly impact patient satisfaction. An emerging area of research lies in the identification of determinants of patient satisfaction, which may offer new improvement perspective in quality care and helps in increment in patient satisfaction level.<sup>(7)</sup>

Various parameters have been considered as possible predictors of health related quality of life outcomes after Total Hip Arthroplasty in patient with arthritis. There are many studies that have evaluated the outcomes of Total hip arthroplasty using Japanese Orthopaedics Association Hip Score (JOA Hip Score), Harris Hip Score but these tools are designed to reflect

the view point of health care provider rather than patient. It is necessary to assess the quality of life (QOL) from viewpoint of patient through SF-36 score and others.<sup>(12-18)</sup>

The research was conducted at USSC Indore; Our Institute is a pioneer arthroplasty center of central India. Hence, observing the large number of cases being operated in our center, thus study was conducted to assess the satisfaction level of our patients, whether it reached international level or not.

### Material and Method

The study was conducted in Department of Orthopaedics at USSC, Indore from July 2015 to June 2016. The results of 51 consecutive Total Hip Replacement that was performed during above period, reviewed and studied.

#### Inclusion Criteria

1. Unilateral cases of hip disease with the other hip and knee normal or with successful replacement.
2. Bilateral hip symptomatic with normal knee or previously replaced knee.
3. Patients willing to participate in study and given consent for regular follow up.

#### Exclusion Criteria

1. Revision Arthroplasty cases.
2. Previous hip Osteosynthesis.
3. Associated knee pathology.
4. Patients with BMI more than 40.
5. Patient not willing for regular follow-up

### Data Collection and Method of Statistical Analysis

The questionnaires were conducted with informed consent of the patients. Total Items Used to Measure Patient Satisfaction With the help of Questionnaires in JOA, SF-36 and HHS are Recorded pre operatively and post operatively at 1month, 3 months and 6 months level.<sup>(12-18, 19-34)</sup>

In JOA score sheet Questionnaire mainly pain, movement and mental function scoring evaluation were performed.<sup>(18)</sup>

In SF-36 score sheet Questionnaire physical function, role limitation due to physical health, role limitation due to emotional problems, energy and fatigue, emotional well-being, social functioning, pain, general health, the quality of life in terms of patient satisfaction, evaluation was done using the SF 36 Score and the score was graded as follows: The SF-36 consists of eight scaled scores, which are the weighted sums of the questions in their section. Each scale is directly transformed into a 0-100 scale on the assumption that each question carries equal weight. The lower the score more is the disability. The higher the score the less disability i.e., a score of zero is equivalent to maximum disability and a score of 100 is equivalent to no disability.<sup>(24-28)</sup>

The health related quality of life was evaluated by using SF-36 questionnaire which consist a set of 36

questions, the items of similar nature clubbed together in eight sections. The eight sections are: physical function, role limitation due to physical health, role limitation due to emotional problems, energy and fatigue, emotional well-being, social functioning, pain and general health.

In HHS score items included are pain, limp, support, distanced walk, stairs, put on shoes and shocks, sitting, enter public transport, flexion contracture, leg length discrepancy, absence of deformity, range of motion scale. The clinical evaluation was done using the Harris Hip Score.

Statistical Analysis was done using SPSS ver. 16.10 software; Descriptive statistics were obtained for mean, standard deviation and other relevant parameters. Mean co-relation between scores at pre-operative and post-operative levels were evaluated using Student's T-test. Inter-correlation between preoperative and postoperative scores at six months level was evaluated to test the efficacy of the surgery. Different scoring systems were compared using correlation matrix.

### Results

In this study, cohort of 51 patients were included randomly those came for total hip replacement and fulfilled inclusion criteria. This study was mainly done to evaluate function outcome after THR and to assess patient satisfaction level after replacement surgery for which Harris Hip Score, Japanese Orthopaedic Association Hip Disease Evaluation Questionnaire and Sf-36 Questionnaire were evaluated pre operatively and post operatively at 1, 3 and 6months. Following results are obtained; the minimum age of operated patient was 17 while the maximum age was 74 years. The highest frequency was recorded for age 50 years with 11.8% incidence. Enrolled patients in this study belonged mostly to 40-60 age group. Mean age was 46.22. Male had predominance in the study group, Out of 51 patients 29 were male (56.9%) and 22 were female (43.1%).

Incidence of right side affection of the disease was much higher. In this study cohort, out of total 51 cases 31 were suffering from idiopathic avascular necrosis of femoral head was found the most common cause for the surgery as diagnosed, Followed by secondary osteoarthritis, primary OA, RA, AS and post infective arthritis.

It is observed in this study that the most common surgical approach was posterior. 27 out of 51 patients were operated by posterior approach followed by antero-lateral, lateral approach.

Limb Length Discrepancy improved significantly post operatively. Out of the 51 patients studied 50 had LLD pre-operatively and Post operatively this figure reduced to 22 and in 2 patients Lengthening was observed. Remaining 29 patients showed complete amelioration of LLD.

In this series a total of 64 hips were operated in 51 patients, out of which 58 hips in 45 patients were uncemented, 3 were hybrid and 3 hips were cemented in 3

patients each. Male predominance was seen in un-cemented group and female predominance was seen in cemented and hybrid implant group.

Neutral and in cemented group out of 3 patient’s cup placement is vertical in 2 patients and Neutral in 1.



Case 1 (X-Rays) Pre-Operative



Case 1 (X-Rays) Post-Operative



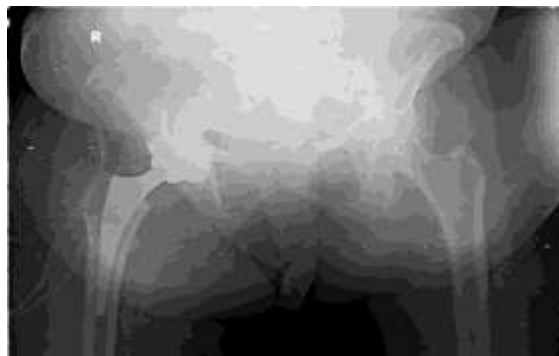
Case 2 (X-Rays) Pre-Operative



Case 2 (X-Rays) Post-Operative



Case 3 (X-Rays) Pre-Operative



Case 3 (X-Rays) Post-Operative

In this series a total of 64 hips were operated in 51 patients, out of which cup placement in 51 hips were Neutral, 7 were Vertical in un-cemented group. In Hybrid group cup placement in All 3 patients were

In this series a total of 64 hips were operated in 51 patients, out of which in 48 hips i.e., 75% femoral stem placement were central, 10 i.e., 16% were Valgus and 6 i.e., 9% hips were Varus. Stable implant placement found in all patients. (X-Rays: case 1, 2 and 3)

## Comparative Mean Score

**Table 1: Comparative mean scores**

S No	Scoring Methods	Pre-op	Post-op 1M	Post-op 3M	Post-op 6M (final follow up)
1	HHS	28.51	58.82	82	93.45
2	JOA	38.92	58.68	73.16	73.16
3	SF-36	20.03	38.39	64.69	83.80

Evaluated HHS score done at pre-operative level and follow up at 1 month, 3 months and 6 months plotted graphically. The survey shows a gradual improvement in the HHS scores through various temporal points of evaluation. The descriptive parameters for the various components evaluated in HHS survey revealed the total mean score for 51 patients at preoperative level which was 28.51 which postoperatively at six months improved to 93.45. The highest percentage (61.60) improvement was recorded for RMS (range of motion scale), followed by support, sitting, distanced walk, pain, limp, stairs, absence of deformity and public transport usage. Paired sample t-test was performed to compare the mean differences of various pairs of data i.e., preoperative analysis with post-operative scores at six month stage. The Mean difference was found to be 64.871 with a standard deviation of 11.451. The difference was significant at 95% level of confidence. The paired sample correlation was however positive 0.019 which was non-significant ( $p = 0.918$ ) at 95% CI. Significant correlation was obtained in inter-alia postoperative evaluations at one month, three months and six months level. The high score at six month postoperative evaluation shows that patients were highly satisfied with the outcome of the surgery performed. (Table 1)

Mean JOA score in postoperative follow up showed a regular upward improvement from preoperative to postoperative (3 month) levels, which did not improve any further at six months level. The mean JOA score at preoperative level was 38.92, which improved to 58.68, 73.16 and 73.16 at one month, three months and six months stages respectively. Descriptive statistics for various JOA parameters included the number of cases, range, range minimum, range maximum, mean, standard deviation, variance, skewness and kurtosis of the data obtained. The total mean score for 51 patients at preoperative level was 38.92 which postoperatively at six months improved to 73.16. The highest percentage (59.16) improvement was recorded for pain, followed by movement and mental health perception.

Paired sample t-test was performed to compare the mean differences of various pairs of data i.e., preoperative analysis with post-operative scores at six month stage. The Mean difference was found to be 58.581 with a standard deviation of 10.993. The difference was significant at 95% level of confidence. The paired sample correlation was however negative at -0.365 which was marginally significant ( $p = 0.044$ ) at

95% CI. Significant correlation was however obtained in inter-alia postoperative evaluations at one month, three months and six months level.

Mean SF-36 score (serial follow-up mean scores) in postoperative follow up showed a regular upward improvement from preoperative to postoperative levels. The mean SF-36 score at preoperative level was 20.03, which improved to 38.39, 64.69 and 83.80 at one month, three months and six months stages respectively. The descriptive parameters for the various items evaluated in SF-36 included the number of cases, range, range minimum, range maximum, mean, standard deviation, variance, skewness and kurtosis of the data obtained. The total mean score for 51 patients at preoperative level was 20.03 which postoperatively at six months improved to 83.80. The highest percentage (46.51) improvement was recorded for role limitation due to physical health, followed by role limitation due to emotional problem, energy and fatigue, emotional wellbeing, social function, pain score, physical function and general health score. Paired sample t-test was performed to compare the mean differences of various pairs of data i.e., preoperative analysis with post-operative scores at six month stage. The Mean difference was found to be 64.417 with a standard deviation of 16.023. The difference was significant at 95% level of confidence. The paired sample correlation was however negative at -0.205 which was non-significant ( $p = 0.268$ ) at 95% CI. Significant correlation was however obtained in inter-alia postoperative evaluations at one month, three months and six months stages.

The correlation study of different scoring systems at various levels was undertaken to determine the relation or relatedness between the scoring systems. When comparing the post-operative six month follow-up of different scoring systems it was found that SF-36 was correlated with JOA with a Pearson's correlation coefficient of 0.711, which was significant at the 0.01 level (two tailed), followed by HHS and SF-36 ( $r=0.672$ , at 0.01 level) and HHS and JOA ( $r = 0.431$ , at 0.05 level of significance).

Among the three scoring systems used for the postoperative follow-up, SF-36 appears to be most suited to evaluate the patient satisfaction level, whereas the other two systems namely JOA and HHS are definitely aligned from the healthcare provider's perspective of receiving a feedback. This study has been successful in delineating a relation between the scoring systems and

SF-36 appears to be correlated to an extent of 71% with JOA scoring system. Despite this high correlation it is difficult to recommend either one as a replacement of other. This study suggests, it is important to use at-least two scoring systems in synergy to obtain a more comprehensive follow-up result evaluation, thus keeping both the patient’s perspective as well as healthcare provider’s perspective.

**Discussion**

Total Hip Replacement has evolved as a result of many improvements in design of Femoral Head prosthesis, the availability of suitable components, materials and manufacturing techniques, a better understanding of Hip mechanics and the need for resurfacing the acetabulum.

Advanced Avascular Necrosis in young age group is a big challenge that confronts the orthopaedic surgeon today. Research continues to improve results especially in young patients. It is also very well observed in this study that out of 51 patients 31 were diagnosed as AVN.

In our set-up, the population catered is not financially sound. Irrespective of all clinical indications the Cost of Implant becomes the predominant factor. The

cost of Un-cemented implants being 4-5 times higher than Cemented Hip System The main drawbacks of un-cemented THR is that it is expensive and average expenditure, being Rs. 1.5 lacks -for implants plus cost of medications and hospital expenditure but now due to improvement in health care facility, availability of insurance facility for health, government funding for poor patient un-cemented implant were easily available and the number of un-cemented surgery is increasing as compared to cemented one which shows changing trends in this study group out of 64 hips operated 58 hips were un-cemented.

Important technical progresses have already been made in THA, so future progress in this field might not significantly impact patient satisfaction. An emerging area of research lies in the identification of determinants of patient satisfaction, which may offer new improvement perspective in quality care and helps in increment in patient satisfaction level.<sup>(7)</sup>

For clinical evaluation the Harris Hip Score was used and compared with JOA and SF-36 scores at final follow up at six months level and it is found that mean score improvement at compare to Pre-op was 28.50 to 93.45 in HHS, 38.9 to 73.16 in JOA and 20.03 to 83.80 in SF-36.

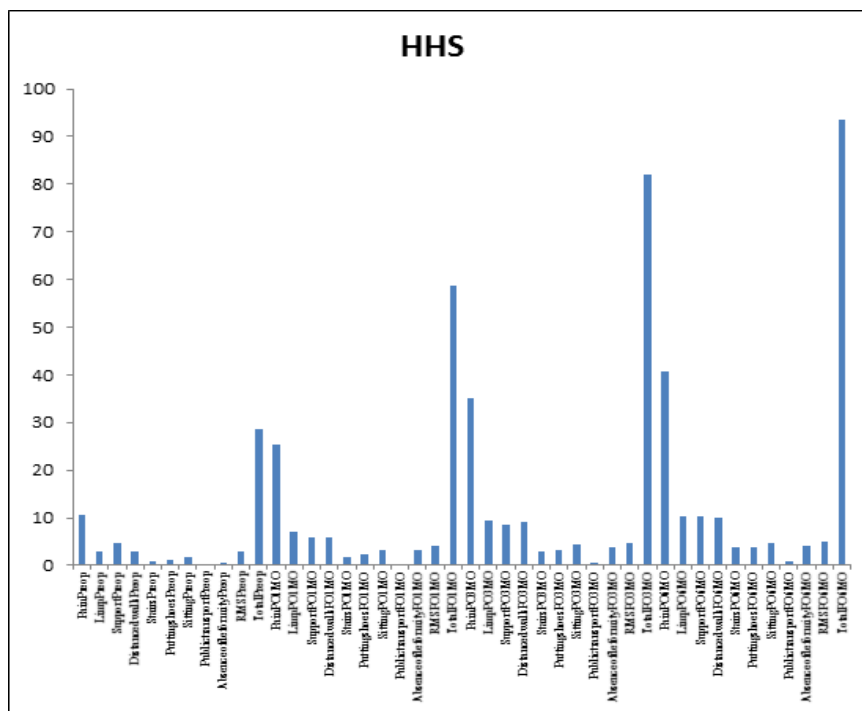


Fig.: 1

The mean average HHS score at the final follow-up was found to be 93.45 in this series. The highest percentage (61.60) improvement was recorded for RMS (range of motion scale), followed by support, sitting, distanced walk, pain, limp, stairs, absence of deformity and public transport usage. (Fig. 1)

The HHS score more than 90 present in 22 patients and between 80 to 90 in 9 patients out of 31 those six months follow up present in the series of 51 patients studied indicate excellent to good outcome of surgery in all patients.

22 out of 31 cases were graded as Excellent and 9 was graded as Good surgical outcomes as per H.H.S.

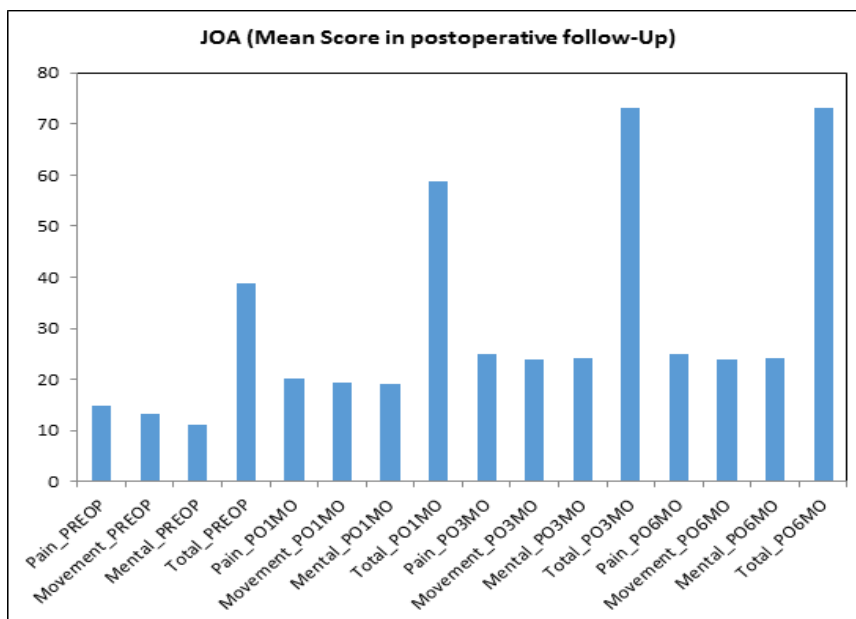


Fig. 2

In JOA analysis the total mean score for 51 patients at preoperative level was 38.92 which postoperatively at six months improved to 73.16. The highest percentage (59.16) improvement was recorded for pain, followed by movement and mental health perception. Which was similar to results was found in the study of Fukui k et. al.,<sup>(18)</sup> they found improvement for pain subscale was significantly higher than that of movement and mental subscale. Preoperative scores on the JHEQ movement and mental subscales were positively correlated to scores on the same subscales at six months after surgery and also state that most predictable aspect of THA is pain relief, preoperative hip ROM and mental status influence 6 month postoperative outcomes. It was very well

appreciated in this study that scores are stable at six month follow up in JOA score scale and significant improvement was recorded for pain, followed by movement and mental health perception.(Fig. 2)

Similar results are observed by Jill Dawson, Ray Fitz Patric and others<sup>(34)</sup> in his study they concluded the disease specific questionnaire, the oxford hip score, and a general state of health questionnaire, SF 36, performed similarly in assessing outcomes of total hip replacement except that the disease specific questionnaire resulted in a higher completion rate and greater responsiveness in some section. On the other hand the general health questionnaire drew attention to broader problem of physical function not considered by the oxford hip score.

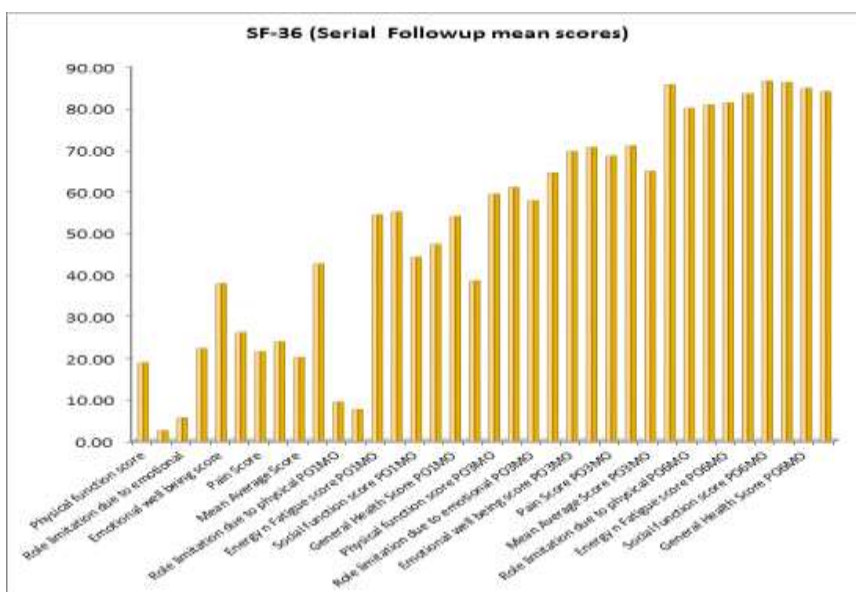


Fig. 3

In this study the SF 36 total mean score for 51 patients at preoperative level was 20.03 which postoperatively at six months improved to 83.80. The highest percentage (46.51) improvement was recorded for role limitation due to physical health, followed by role limitation due to emotional problem, energy and fatigue, emotional wellbeing, social function, pain score, physical function and general health score. (Fig. 3)

In this study group, the analysis was undertaken to determine the relation or relatedness between the scoring systems. When comparing the post-operative six month follow-up of different scoring systems it was found that SF-36 was correlated with JOA with a Pearson's correlation coefficient of 0.711, which was significant at the 0.01 level (two tailed), followed by HHS and SF-36 ( $r=0.672$ , at 0.01 level) and HHS and JOA ( $r = 0.431$ , at 0.05 level of significance).

### Conclusion

The study was conducted to determine whether the patient was satisfied or not after total hip replacement surgery & to identify the correlation between Harris, JOA and SF-36 scoring system for the patient after surgery to judge satisfaction level as well as comparison and correlation between HHS, JOA and SF-36 scoring system whether they are associated with patient satisfaction level or not.

In this study series clinical evaluation of results of surgery was done with the Harris Hip Score and compared with JOA and SF-36 scores at final follow up at six months level and it is found that mean score improvement as compare to Pre-op was 28.50 to 93.45 in HHS, 38.9 to 73.16 in JOA and 20.03 to 83.80 in SF-36. The mean average HHS score at the final follow-up was found to be 93.45. The HHS score was more than 90 in 22 patients and between 80 to 90 in 9 patients out of 51 patients studied indicate excellent to good outcome of surgery in all patients.

In HHS score the highest percentage (61.60) improvement was recorded for RMS (range of motion scale), followed by support, sitting, distanced walk, pain, limp, stairs, absence of deformity and public transport usage. In Case of SF-36 the highest percentage (46.51) improvement was recorded for role limitation due to physical health, followed by role limitation due to emotional problem, energy and fatigue, emotional wellbeing, social function, pain score, physical function and general health score. In case of JOA the highest percentage (59.16) improvement was recorded for pain, followed by movement and mental health perception.

The post-operative follow-up of different scoring systems revealed that SF-36 was correlated with JOA with a Pearson's correlation coefficient of 0.711, followed by HHS and SF-36 ( $r=0.672$ ) and HHS and JOA ( $r = 0.431$ ). The moderate to low correlation between different scoring systems indicates the unique areas that these systems evaluate; hence any of the scoring systems used cannot be used to replace the other.

However using them (at least two) in conjunction appears to be more useful.

The study was observational; thus, it is difficult to apply its conclusions directly to clinical practice. A prospective, randomized trial with stratification of baseline scores will be necessary to confirm the association between Harris, Japanese and SF-36.

We evaluated patient satisfaction after a short duration of follow up that is only up to 6 months; thus, this study evaluated only correlations. More frequent measurements to evaluate temporal changes and long-term follow-up data could reveal the relationship between scores and the temporal nature of their relationship.

### References

1. Chanley J. Surgery of the hip-joint: present and future developments. *Br Med J* .1960 Mar 19;1(5176)(1):821-826.
2. Charnley J. Arthroplasty of the hip: a new operation. *Lancet*. 1961 May 27;1(7187):1129-3.
3. McKee GK, Watson Farrar J. Replacement of arthritic hips by the McKee-Farrar prosthesis. *J Bone Joint Surg Br*. 1966 May;48(2):245-59.
4. Smith Petersen MN. Evolution of mouldarthroplasty of the hip joint. *J Bone Joint Surg Br*.1948; 30-B:59-75.
5. Charnley J. The long term results of low friction arthroplasty of the hip performed as a primary intervention. *J Bone Joint Surg Br*. 1972 Feb;54(1):61-76.
6. Charnley J, Cupic Z. The nine and ten year results of the low friction arthroplasty of the hip. *Clin Orthop Relat Res*. 1973 Sep;(95):9-25.
7. Jone CA, Beaupre LA, Jonston DW et al: Total joint arthroplasties: Current concepts of patient outcomes after surgery. *Rheum Dis Clin North Am*. 2007 Feb;33(1):71-86.
8. Uchida A, Nade SM, McCartney ER, Ching W. The use of ceramics for bone replacement: a comparative study of three different porous ceramics, *J Bone Joint Surg Br*. 1984 Mar;66(2):269-75.
9. Semlitsch, M., Panic, B. Tenyears of experience with test criteria for fracture—proof anchorage of stems of artificial hip joints. *Eng. Med*. 1983;12:185-198.
10. Schmalzried TP, Peters PC, Maurer BT, et al. Long duration metal-on-metal total hip arthroplasties with low wear of the articulating surfaces. *J Arthroplasty* 1996;11:322.
11. J Rose RM, Nusbaum HJ, Schneider H, Ries M, Paul I, Crugnola A, Simon SR, Radin EL. On the true wear rate of ultrahigh-molecular-weight polyethylene in the total hip prosthesis. *J Bone Joint Surg Am*. 1980;62(4):537-549.
12. Shields R, EnloeL, Leo K. Health related quality of life in patients with total hip or knee replacement. *Arch Phys Med Rehabil*. 1999 May;80(5):572-9.
13. Grissom SP, Dunagan L. Improved satisfaction during inpatient rehabilitation after Hip and Knee Arthroplasty: a retrospective analysis. *J Phys Med Rehabil Am*. 2001 Nov;80(11):798-803.
14. Harris WH. Traumatic arthritis of the hip after dislocation and acetabular fractures: treatment by mold arthroplasty. An end-result study using a new method of result evaluation. *J Bone Joint Surg Am*. 1969 Jun;51(4):737-55.
15. McGregor AH, Rylands H, Owen A, Dore CJ, Huges SP. Does preoperative hip rehabilitation advice improve

- recovery and patient satisfaction? *Journal of Arthroplasty*.2004 Jun;19(4):464-8.
16. Fielden JM, Scott S., Horne JG. An investigation of patient satisfaction following discharge after total hip replacement surgery. *Orthop Nurs*.2003 Nov-Dec;22(6):429-36.
  17. Boutron, S. Poiraudau, J-F Ravaud, G Baron, M Revel, R Nizard, M. Dougados, PhRavoud: Disability in adults with hip and knee arthroplasty: A French national community based survey. *Ann Rheum Dis* 2003;62:748–754.
  18. Fukui K, Kaneuji A, Sugimori T et al. Clinical assessment after total hip arthroplasty using the Japanese orthopaedic association hip disease evaluation questionnaire.2015 Oct;12 (suppl 1):p S31-S36.
  19. Nilsson A, Bremander A. Measures of Hip Function and Symptoms. *Arthritis Care & Research* 2011 Nov; 63(S11):p S200 –S207.
  20. Kuribayashi M, Takahashi KA, Fujioka M, et al. Reliability and validity of the Japanese Orthopaedic Association hip score. *J Orthop Sci*.2010 Jul;15(4):452-8.
  21. Matsumoto T, Kaneuji A, Hiejima Y et al. Japanese Orthopaedic Association Hip Disease Evaluation Questionnaire (JHEQ): a patient-based evaluation tool for hip-joint disease. The Association. Subcommittee on Hip Disease Evaluation of the Clinical Outcome Committee of the Japanese Orthopaedic. *J Orthop Sci*. 2012 Jan;17(1):25-38.
  22. Seki T, Hasegawa Y, Ikeuchi K, et al. Reliability and validity of the Japanese Orthopaedic Association hip disease evaluation questionnaire (JHEQ) for patients with hip disease. *J Orthop Sci*. 2013 Sep;18(5):7827.
  23. Ware JE, Scherbourne CD. The MOS 36-item short form health survey (SF-36) I: Conceptual framework and item selection. *Med Care* 1992;30:473-483.
  24. Quintana JM, Escobar A, Aguirre U et al, Iratxe Lafuente and Juan C. Arenaza Predictors of Health related quality of life change after total hip arthroplasty. *Clin Orthop Relat Res*. 2009 Nov;467(11):2886–2894.
  25. Alonso J, Preito L, Anto JM. [The Spanish version of the SF-36 Health Survey (the SF-36 health questionnaire): an instrument for measuring clinical results. *Med Clin (Barc)*. 1995;104:771-776.
  26. Quintana JM, Escobar A, Bilbao A, Arostegui I, Lafuente I, Vidaurreta I. Responsiveness and clinically important differences for the WOMAC and SF-36 after hip joint replacement *Osteoarthritis Cartilage* 2005;13:1076-1083.
  27. Preoperative templating for total hip arthroplasty (Capello) in textbook of operative orthopaedics campbell's volume one 12th edition. Page 182-183, (159-300) Chapter 3.
  28. Foucher KC, Wimmer MA, Moision KC, et al. Time course and extent of functional recovery during the first postoperative year after minimally invasive total hip arthroplasty with two different surgical approaches: a randomized controlled trial. *J Biomech*.2011;44:372.
  29. Ganz SB, Levin AZ, Peterson MG, Ranawat CS. Improvement in driving reaction time after total hip arthroplasty. *Clinorthop Relat Res*.2011;413:372.
  30. Hio AM, Van Grinsven S, Lucas C, et al: Partial versus unrestricted weight bearing after an uncemented femoral stem in total hip arthroplasty: recommendation of a concise rehabilitation protocol from a systematic review of the literature. *Arch Orthop Trauma Surg*.2010; 130:547.
  31. Trudelle Jackson E, Emerson R, Smith S. Outcomes of total hip arthroplasty: a study of patients one year post surgery. *J Orthop Sports Phys Ther*.2002;32:260. 51-A (1969):737-755.
  32. Priberg O, Koivisto E, Wegelius C: A radiographic method for measurement of leg length inequality. *Diagn Imag Clin Med*.1985;54:78-81.
  33. Aravind S. Desai, Asterios Dramis, and Tim N. Board. Leg length discrepancy after total hip arthroplasty: a review of literature. *Curr Rev Musculoskelet Med*. 2013 Dec;6(4):336–341.
  34. Dawson J, Fitzpatrick R, Murray D, Carr A. Comparison of measures to assess outcomes in total hip replacement surgery. *Quality in Health Care*.1996;5:81-88. 2 Davidson D, Pike J, Garbuz D, et al. Intraoperative periprosthetic fractures during total hip arthroplasty. Evaluation and management. *J Bone Joint Surg Am*. 2008;90:2000.