

# Analysis of the Functional Outcome of Limb Length Discrepancy after Total Hip Replacement.

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## ABSTRACT

**Background:** The Aim of the study was to analyze the functional outcome of limb length discrepancy after total hip replacement. **Methods:** It is a Prospective study on 21 patients who underwent total hip replacement with different hip pathology between November 2015 and October 2017. **Results:** 13 males and 8 females patients with a mean age of 35.31±7.42 (21-50) were followed up for a time of 12months. Limb length discrepancy and hip function of 21 patients who underwent primary total hip arthroplasty were assessed before surgery and 1month, 3 month and 12 month after surgery. Limb length discrepancy was evaluated before and after surgery by clinical and radiological method, Functional outcome assessed by using the Oxford hip score (OHS) and Harris hip score(HHS). Preoperatively all patients had shorter limb length as compared to contra lateral side. Postoperatively in 42.9% (9/21) the limb operated on was longer, in 19 % (4/21) of cases limb operated on was shorter and in 31 % (8/21) postoperative limb length were equal. Postoperatively limb length discrepancy was present in 61.9 % (13/21) & was perceived by 53.8 % (7/13 of cases) when either shortening or lengthening exceeded 10mm. Oxford hip score (OHS) and Harris hip score (HHS) were significantly increased at subsequent follow up (at 1, 3 and 12 months). Functional scores (OHS and HHS) were excellent in patients with equal limb length as compared to those having shorter or longer limb length. **Conclusion:** Patient with limb length discrepancy had negative influence in relation to limping and pain. Patients should be counseled preoperatively about possible limb length differences and associated symptoms.

**Keywords:** Limb length discrepancy (LLD), Total hip arthroplasty (THA).

## INTRODUCTION

Total Hip Arthroplasty (THA) is a common, successful, safe and cost-effective procedure to regain pain-free mobility and to restore hip joint function in patients suffering from severe hip joint disease or trauma.<sup>[2,12]</sup> The overall risk of THA complications including implant revision are generally low and nearly 90% of patients have good function 10 years after the index THA operation. This is obviously the result of advances in surgical technique and prosthetic design.<sup>[3,12]</sup>

Total hip replacement (THR) is considered an effective surgical intervention for the relief of chronic pain and functional disability. Survivorship analysis and surgeon based outcome measures suggest that outcomes after THR are excellent.<sup>[4,11]</sup> However, patient-reported outcome measures have uncovered a significant proportion of patients who

experience a poor functional outcome after THR.<sup>[5-7,11]</sup> Patient factors that correlate with a poor outcome include higher pre-operative pain and functional disability, older age and more medical co-morbidities.<sup>[8,9,11]</sup> A surgical aspect of THR which can lead to reduced functional outcome is limb length discrepancy (LLD).<sup>[10,11]</sup>

Generally, the outcome of THA can be affected by factors related to the surgery or patient. Surgical factors include surgeon's experience, surgical approach, prosthesis design and modularity and implant positioning. In this regard, restoration of the operated limb length, and hence the periarticular soft-tissue tensioning, represents an important goal.<sup>[13,14]</sup>

Limb length inequality is defined by Gurney as a condition in which paired limbs are noticeably unequal in length. When this occurs in the lower limbs it is known as leg length inequality. The inequality can be described as a relative lengthening or shortening of a lower limb when compared to the contra-lateral side.<sup>[17,18]</sup>

Limb length discrepancy[LLD] after total hip arthroplasty is important to optimize hip biomechanics and limb length discrepancy has

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several potential negative consequences for the patient, including Sciatica, chronic back pain, hip dislocation, the need for a shoe raise and a limp.<sup>[19,20]</sup> LLD most commonly involves over-lengthening of the limb on the operative side because of a lengthening of the prosthetic head-neck distance.<sup>[10]</sup> Although the prevalence of anatomical LLD after THA is high,<sup>[10]</sup> the impact of this leg length inequality on patient-reported functional outcome is unclear where as research has found that LLD has no effect on functional outcome but recent study found that patients with LLD reported a poorer functional outcome than those patients with equal leg lengths.<sup>[11,21]</sup>

#### **Aims and objective**

- To analyse the functional outcome of limb length discrepancy after total hip replacement.
- To prevent limb length discrepancy.
- To prevent the complication like subluxation/dislocation/deformity.
- To achieve functional range of movement at hip joint.

### **MATERIALS AND METHODS**

This prospective observational study was conducted from November 2015 to October 2017. 21 patients were taken into study having O.A. of hip, Patients with failed hemiarthroplasty, Old neglected femoral neck fracture, Old dislocations of hip, Dysplastic hip, previous failed T.H.R. We reviewed all patients who underwent unilateral or bilateral total hip arthroplasty clinically and radiologically. In bilateral operated hips, the one hip operated first was taken as standard, and later operated hip compared with it.

Informed and written consent was obtained from all patients before surgery and none of them rejected participation. The mean age of patients was  $35.31 \pm 7.42$  -years ranging from 21-50 years. More than half of patients were males (61.9%). One third of patients (38.1%) operated bilaterally followed by right side (33.3%) and left side (28.6%) among selected patients 8 patients suffered from avascular necrosis of femoral head, 2 suffered from ankylosing spondylitis, 5 suffered from post-traumatic arthritis of hip and 3 suffered from post tubercular secondary osteoarthritis, 3 patient suffered from osteoarthritis.

Limb length was measured clinically by relative (apparent) lengths and absolute (true) length before and after surgery. We measured the length of both limbs on preoperative and post operative single standard AP views of the pelvis with hips extended and internally rotated. We used as reference points the inferior margins of acetabular tear drops and the most prominent points of the lesser trochanter measuring the distance between them. We used the Oxford hip score (OHS) and Harris hip score

(HHS) to measure functional status of hip operated. All patients were evaluated at 1, 3, and 12 months of follow up. The operations were performed by 5 surgeons using posterolateral approach. After inserting the cup and rimming the femur a trial femoral component was inserted and intraoperative evaluation done to assess soft-tissue tension and length (The shuck test, The dropkick test, with the hip held in extension and the knee flexed to 90°; and leg-to-leg comparison of length based on the heels or medial malleoli).

#### **Statistical tools**

The results are presented in frequencies, percentages and mean $\pm$ SD. Unpaired t-test was used to compare hip scores between two strata. Paired t-test was used to compare the changes in hip scores from pre-operative to subsequent time periods. One way analysis of variance (ANOVA) followed by Tukey's post-hoc tests was used to compare the scores among more than 2 strata. Mixed linear model was used to find per month change in hip scores. The p-value < 0.05 was considered significant. All the analysis was carried out on SPSS 16.0 version (Chicago, Inc., USA).

### **RESULTS**

Discrepancy of limb length has been reported to be common after arthroplasty of the hip.<sup>[10,35]</sup>

Preoperatively, all the patients (21) had shorter limb length as compared with opposite side by absolute method (true length) and trochanteric method in the present study.<sup>[33,35]</sup>

In this study, postoperatively after THA, in 42.9% (9/21) of cases, the limb to be operated were longer, in 19% (4/21) of cases, the limb to be operated was shorter and in 38.1% (8/21) postoperative limb length was equal as measured with absolute method and trochanteric method. Postoperatively, the mean LLD of lengthen group was  $16.33 \pm 6.96$  mm measured with absolute method,  $13.66 \pm 6.89$  mm with trochanteric method. Postoperatively, the mean shortening of shorten group was  $14.5 \pm 5.25$  mm measured with absolute method

Limb length discrepancy	No. (n=21)	%
<b>Pre-operative</b>		
Shorter	21	100.0
<b>Post-operative</b>		
Shorter	4	19.0
Equal	8	38.1
Longer	9	42.9

Postoperatively, LLD was present in 61.9% (13/21) patients. LLD was perceived by 53.8% (7/13) of cases when both shortening and lengthening exceeds 10mm. All 7 patients with perceived LLD reporting that they use a shoe raise. In our study,

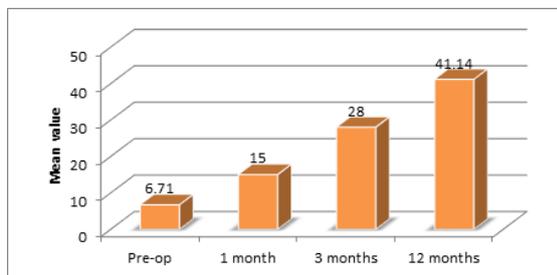
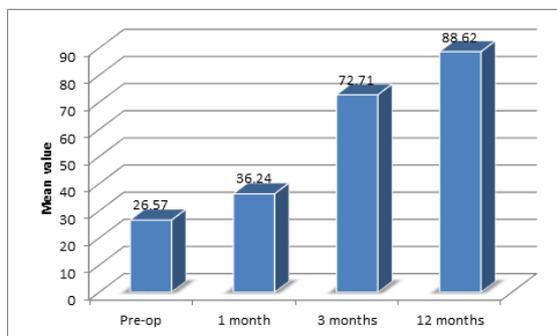
we found that postoperative LLD up to 10 mm did not perceive.

The Custom-Made Questionnaire On Self-Perceived Postoperative Limb-Length Discrepancy and Corresponding Results (N = 21 Respondents).

1	Did THA improve the quality of Your life?	21(100%)	(0%)
2	Do you feel that after THA Your legs are Equally long?	14(66.6%)	7(33.3%)
	Subjects who answered Question No. 2), with "NO" (N = 7 patients) further replied to the following questions:		
3	Do You use a shoe raise?	7(33.3%)	(0%)
4	Do You have more problems with LLD than Prior to THA?	(0%)	21(100%)

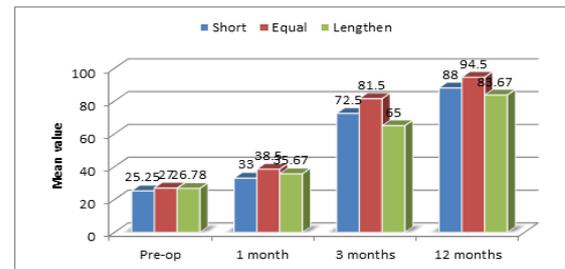
To assess functional outcome after THR in our study, we have used the Oxford hip score(OHS)54 and Harris hip score (HHS)55 preoperatively and postoperatively follow up at 1 month, 3 months, and 12 months.

Harris hip score was 26.57±1.96 at pre-operative which increased postoperatively to 36.24±2.77 at 3 month, 72.71±8.13 at 6 months and 88.62±6.77 at 12 months in the present study. In this study, there was significant (p=0.0001) mean increase in Harris hip score from pre-operative to subsequent time periods postoperatively.



We found that Oxford hip score was 6.71±1.27 at pre-operative which increased to 15.00±1.44 at 1 month, 28.00±3.89 at 3 months and 41.14±4.83 at 12 months. There was significant (p=0.0001) mean increase in Oxford hip score from pre-operative to subsequent time periods postoperatively.<sup>[11]</sup>

In this study, analysis of variance revealed that there was no significant (p>0.05) difference in Harris hip score at pre-operative among limb length discrepancy group at post-operative (equal, shorten and lengthen group). However, Harris hip score was significantly (p<0.01) different among limb length discrepancy at post-operative at 1 month, 3 months and 12 months. The post-hoc tests showed that Harris hip score was significantly (p<0.05) higher in equal limb length discrepancy compared to shorter and longer group at 1 month, 3 months and 12 months.



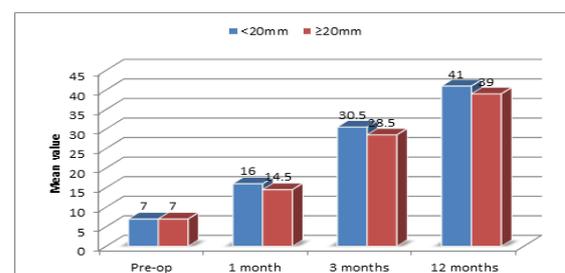
In this study, there was significant (p=0.0001) mean change in Harris hip score from pre-operative to subsequent time periods in all the limb length discrepancy groups.

In the present study, analysis of variance also revealed that there was no significant (p>0.05) difference in Oxford hip score at pre-operative and 1 month among limb length discrepancy groups (equal, shorten and lengthen group) at post-operative in this study. However, Oxford hip score was significantly (p=0.0001) different among limb length discrepancy at post-operative at 3 months and 12 months in the present study. In this study, the post-hoc tests showed that Oxford hip score was significantly (p<0.05) higher in equal limb length discrepancy compare to short and lengthen at 3 months and 12 months.<sup>[21,11]</sup>

In the present study, there was significant (p=0.0001) mean change in Oxford hip score from pre-operative to subsequent time periods in all the limb length discrepancy group in this study.

In shorten subgroup, Harris hip score was found to be insignificantly (p>0.05) higher in <20mm than >20mm at all the time periods in this study.

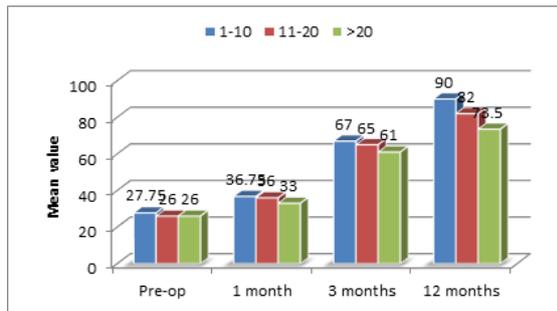
Similarly, in shorten category, Oxford hip score was found to be insignificantly (p>0.05) higher in <20mm than >20mm at all the time periods in the present study.



### Comparison of Oxford Hip score according to Shorten category

In lengthen subgroup, Harris hip score was found to be insignificantly ( $p>0.05$ ) higher in 1-10mm, 11-20mm than  $>20$ mm at postoperative follow up at 1 month, 3 month, and 12 month in this study.

Similarly, lengthen subgroup, Oxford hip score was found to be insignificantly ( $p>0.05$ ) higher in 1-10mm, 11-20mm than  $>20$ mm at postoperative follow up at 1 month, 3 month, and 12 month in the present study.<sup>[10,11,39]</sup>



### Comparison of Harris Hip score according to Lengthen category

In the present study, conditional on time period, Harris hip score was estimated to increase by 0.51 points for each additional Harris hip score (95%CI= -1.28-2.31) and conditional on pre-operative Harris hip score, Harris hip score was increased by 3.84 points per month (95%CI=3.12-4.56).

Similarly, conditional on time period, Oxford hip score was estimated to increase by 1.28 points for each additional Oxford hip score (95%CI= 0.26-2.29) and conditional on pre-operative Oxford score, Oxford score was increased by 2.10 points per month (95%CI=1.83-2.35) in this study.

## DISCUSSION

Out of the 21, there were 13 male patients (61.9%) and 8 female patients (38.1%).

8 patients had been operated on bilaterally followed by 7 patients who were operated right hip and 6 patients operated on left hip. Majority of patients included in our study had avascular necrosis of femoral head (8 patients, 38.1%) followed by post traumatic osteoarthritis (5 patients, 23.8%).

Limb length discrepancy was analyzed clinically (relative and absolute) and radio logically in all the patients before and after surgery.

Preoperatively, all the patients (21) had shorter limb length as compared with opposite side by absolute method (true length) and trochanteric method in the present study.

In this study, postoperatively after THA, in 42.9% (9/21) of cases, the limb to be operated was longer, in 19% (4/21) of cases, the limb to be operated was shorter and in 38.1% (8/21) postoperative limb

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In this study, postoperatively after THA, in 42.9% (9/21) of cases, the limb to be operated was longer, in 19% (4/21) of cases, the limb to be operated was shorter and in 38.1% (8/21) postoperative limb length was equal as measured with absolute method and trochanteric method. Postoperatively, the mean LLD of lengthen group was 16.33+6.96mm measured with absolute method, 13.66+6.89mm with trochanteric method. Postoperatively, the mean shortening of shorten group was 14.5+5.25mm measured with absolute method. These finding in our study are similar to the study of Keršič M et. Al.<sup>[31]</sup>

Postoperatively, LLD was present in 61.9% (13/21) patients. LLD was perceived by 53.8% (7/13) of cases when both shortening and lengthening exceeds 10mm. This was supported by previous studies of Konyves A. et al,<sup>[9]</sup> Edeen J et al,<sup>[34]</sup> and Sarangi PP.<sup>[40]</sup> All 7 patients with perceived LLD reported that they use a shoe raise. In our study, we found that postoperative LLD up to 10 mm did not perceive. Although nearly one third of patients perceived LLD, only half of these patients reported that they were bothered by the discrepancy. This finding is again in agreement with previous research of Kutty S, et al,<sup>[39]</sup> and Love BRT et al,<sup>[38]</sup> who reported that half of the patients with LLD were disturbed by the inequality. . The extent of LLD has been found to correlate with awareness of the problem, abnormal gait and use of shoe raise (Kutty S, et. al and Love BRT et. al).<sup>[38,39]</sup> Jasty M et Al,<sup>[35]</sup> also mentioned postoperative limb length discrepancy more than 2cm presents social problems. Similar to our study Edeen et al,<sup>[34]</sup> concluded that even a small disparity may be a source of dissatisfaction in some patients, but up to 10 mm of LLD is well tolerated.

To assess functional outcome after THR in our study, we have used the Oxford hip score(OHS)36and Harris hip score (HHS) 37 preoperatively and postoperatively during follow up at 1month ,3 months, and 12 months.

In this study, there was significant ( $p=0.0001$ ) mean increase in Harris hip score from pre-operative to subsequent time periods postoperatively. Similarly, there was significant ( $p=0.0001$ ) mean increase in Oxford hip score from pre-operative to subsequent time periods postoperatively. This finding was in agreement with previous studies Konyves et al and Wylde V et al they found Oxford hip score improved with time duration in subsequent follow up.<sup>[9,10]</sup>

In this study, analysis of variance revealed that there was no significant ( $p>0.05$ ) difference in Harris hip score at pre-operative among limb length discrepancy group at post-operative (equal, shorten and lengthen group). However, Harris hip score was significantly ( $p<0.01$ ) different among limb

length discrepancy at post-operative at 1 month, 3 months and 12 months. The post-hoc tests showed that Harris hip score was significantly ( $p < 0.05$ ) higher in equal limb length discrepancy compared to short and lengthen group at 1 month, 3 months and 12 months.

In this study, there was significant ( $p = 0.0001$ ) mean change in Harris hip score from pre-operative to subsequent time periods in all the limb length discrepancy groups.

In the present study, analysis of variance also revealed that there was no significant ( $p > 0.05$ ) difference in Oxford hip score at pre-operative and 1 month among limb length discrepancy groups (equal, shorten and lengthen group) at post-operative in this study. However, Oxford hip score was significantly ( $p = 0.0001$ ) different among limb length discrepancy at post-operative at 3 months and 12 months in the present study. In this study, the post-hoc tests showed that Oxford hip score was significantly ( $p < 0.05$ ) higher in patients with equal limb length discrepancy compare to short and lengthen at 3 months and 12 months. Similar to our study another study by Knoyves and Bannister,<sup>[9]</sup> 33 % of patients perceived lengthening and 18 % of patients had worst Oxford Hip Score (OHS) who perceived true lengthening at the end of 12 months after THA. Wylde V. et al also concluded that patients with LLD had significantly poorer OHS and limped more frequently.<sup>[10]</sup>

In contrast to all these studies, White and Dougall,<sup>[19]</sup> concluded that radiological lengthening upto 35mm and shortening upto 21mm during THA do not correlate with functional outcome of the patients (the authors used OHS and Harris Hip Scoring outcomes). However, the lack of correlation between LLD and functional outcome by using such surgeon based and generic tool, which lacks sensitivity and specificity of other disease-specific or joint-specific questionnaires has been well criticized by Wylde V. et al,<sup>[10]</sup>

In the present study, there was significant ( $p = 0.0001$ ) mean change in Oxford hip score from pre-operative to subsequent time periods in all the limb length discrepancy group in this study.

In shorten subgroup, Harris hip score was found to be insignificantly ( $p > 0.05$ ) higher in  $< 20$ mm than  $> 20$ mm at all the time periods in this study.

Similarly, in shorten category, Oxford hip score was found to be insignificantly ( $p > 0.05$ ) higher in  $< 20$ mm than  $> 20$ mm at all the time periods in the present study.

In lengthen subgroup, Harris hip score was found to be insignificantly ( $p > 0.05$ ) higher in 1-10mm, 11-20mm than  $> 20$ mm at postoperative follow up at 1 month, 3 month, and 12 month in this study.

Similarly, lengthen subgroup, Oxford hip score was found to be insignificantly ( $p > 0.05$ ) higher in 1-10mm, 11-20mm than  $> 20$ mm at postoperative follow up at 1 month, 3 month, and 12 month in the

present study. Similar to our study Jasty et al,<sup>[35]</sup> found that LLD up to 20mm well tolerated and patients have better functional outcome than patients with lengthening more than 20 mm. Our results also supported by study of Konyves et al and Wylde V. et al.<sup>[9,10]</sup>

#### **Limitations of our study**

This study had some limitations. Firstly, the patients have different diagnosis that may confound the outcome particularly in the long term. Secondly, this study reports the outcome of Total hip arthroplasty at a relatively short follow-up period. Thirdly, sample size of this study is small. The studies having larger sample is being recommended for robust findings. Fourth operative surgeon were different. Fifth, different implant were used (cemented, uncemented, hybrid).

### **CONCLUSION**

Total hip arthroplasty remains unchallenged and this study confirms that the outcome of total hip arthroplasty is excellent in terms of pain relief, increased walking distance, and functional capabilities in patients in age group of 21 to 50 years.

All patients have good functional outcome after total hip replacement as functional score (OHS and HHS) increases with time in subsequent follow up, irrespective of limb length discrepancy.

- Limb length discrepancy is very common after total hip replacement, it may be either lengthening or shortening. Lengthening is more common than shortening.
- Regardless of whether limb length inequality is clinically or radiographically measured, perceived LLD influences function and satisfaction.
- Patients with no limb length discrepancy have excellent functional outcome as compared to patients with limb length discrepancy (shortening or lengthening group)
- Lengthening group have poor functional outcome as compared to shortening group i.e. lengthening is less tolerated than shortening.
- Limb length discrepancy up to 10mm could not be perceived.
- The outcome assessment of the patients with limb length discrepancy was worse than patients with no limb length discrepancy as assessed with Oxford hip score and Harris hip score.
- At 3 months after operation, the mean Oxford hip score in patients with lengthened limb (3 groups) were significantly lower i.e. worse than in patients with shortened limb or in patients with limb of the same length.
- Significant difference in Oxford hip score was not found between the groups of lengthened legs (1 to 10 mm vs 11 to 20 mm)

- No significant difference of Oxford hip score and Harris hip score were found in patients with limb length discrepancy (1 to 10 mm shortening or lengthening ), the patients with of equal limb length.
- In last we concluded that clinically equal leg length was associated with the best functional results and highest satisfaction rates. A shorter operated leg was associated with limping, as others have noted and patients with a longer operated leg had more hip pain. We cannot be sure whether increased pain related to lower satisfaction, but we believe the detected difference in pain can be attributed to the Limb length discrepancy.

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