

## ORIGINAL ARTICLE

## MEAN LIMB LENGTH DISCREPANCY AFTER TOTAL HIP ARTHROPLASTY

Adnan Rasheed, Muhammad Kaleem Shaukat, Farhad Alam

Orthopaedics Department, University Medical and Dental College, Madinah Teaching Hospital, Faisalabad-Pakistan

**Background:** Limb length discrepancy (LLD) is one of the most common complications of primary total hip arthroplasty (THA) causing patients dissatisfaction. In this study we determined the mean of preoperative limb length discrepancy (LLD), postoperative LLD after THA and their difference. Previously very little literature is available on this topic in Pakistan, so the results of my study will be a useful addition in the existing as well as local literature. Also, on the basis of these results, need of some preoperative planning and executing the plan in the operating room to eliminate LLD can be recommended. **Methods:** It is a descriptive case series study (Clinical Practice Article) conducted on 44 patients undergoing primary Total Hip arthroplasty (THA) at orthopaedics department Madinah Teaching Hospital Faisalabad from Sep 2018 to Sept 2019. Patients having age between 18–70 years including both genders were studied with non-probability, consecutive sampling. **Results:** In our study mean of pre-operative LLD is -19.02 with standard deviation of 21.31 and mean of post-operative LLD is 7.25 mm with standard deviation of 9.46. This study tells that 91% of patients undergoing primary THA without using any method to eliminate LLD have postoperative LLD but 88.6% of patients (39 patients out of 44) have postoperative LLD in the range of 0 to  $\pm 10$  mm which is not much significant. But 11.4% of patients (5 patients out of 44) have postoperative LLD  $>10$  mm which causes functional impairment. **Conclusion:** We can say that in most of the patients postoperative LLD after primary THA is very minimal and within acceptable range in experienced hands but a few patients can have a significant LLD in order to gain better joint stability which can be compensated by shoe wears.

**Keywords:** Limb length discrepancy (LLD); Total Hip arthroplasty (THA); Preoperative LLD, Postoperative LLD; Age and gender distribution of THA

**Citation:** Rasheed A, Shaukat MK, Alam F. Mean limb length discrepancy after total hip arthroplasty. J Ayub Med Coll Abbottabad 2020;32(Suppl. 1):651–4.

## INTRODUCTION

Total Hip arthroplasty (THA) is a procedure in which the ball and socket joint of hip is replaced with an artificial implant.<sup>1–3</sup> THA is performed as a treatment for severe arthritis of hip joint, avascular necrosis of head of femur and fracture neck of femur.<sup>1,2</sup> THA provides good pain relief in these patients of hip pathology<sup>2,5</sup> but limb length discrepancy is one of the most common complications of THA which causes patient's dissatisfaction.<sup>4,5</sup> Limb length discrepancy (LLD) is defined as a condition in which paired limbs are noticeably unequal. Preoperative LLD exists in most of the patients undergoing THA due to cartilage and bone degeneration and reduced joint space.<sup>1</sup> In majority of these cases this LLD is in the form of shortening.<sup>1,7</sup> It is a great challenge for an orthopaedic surgeon to correct this LLD during THA Procedure. Most of times when this discrepancy is corrected during THA, patient can have a sensation of leg lengthening.<sup>1</sup> These patients perceive LLD despite anatomic equality because of pelvic tilt which is due to weak abductors of hip. This usually resolves 3–6 months post-operatively.

But many times, leg lengthens more than the required in an attempt of decreasing hip dislocation risk and to achieve greater joint stability after THA.<sup>1,5</sup> So LLD exists postoperatively in most of the patients

undergoing THA.<sup>1</sup> Surgeon uses long femoral implant to decrease dislocation risk which is the most common cause of post-operative LLD.<sup>6</sup> Limb length discrepancy can also result from component positioning which occurs in the form of incomplete stem insertion (a stem which sits too proud) and low placement of acetabular cup.<sup>7</sup> When post-operative LLD exists, patient may experience increased pain in back and muscle fatigue.<sup>1,6</sup> According to several studies, patients with post-operative LLD of less than 1 cm have well-tolerated symptoms.<sup>4,7</sup> But when post-operative LLD increases to few centimetres, the nerves of the leg become stretched which causes sciatica, numbness, back pain, gait disorder and pain of the lower limb.<sup>1,4,7</sup>

Limb length discrepancy is measured with patients in supine position. Length of each lower limb is measured from anterior superior iliac spine to medial malleolus.<sup>7,8</sup> Limb length discrepancy is the difference of the effected side than that of the normal. So LLD is either shortening or lengthening of the effected limb.<sup>7</sup> The aim of this study is to determine the mean of preoperative LLD, postoperative LLD and their difference. Previously very little literature is available on this topic in Pakistan, so the results of my study will be a useful addition in the existing as well as local literature. On the basis of these results, need of some

preoperative planning and executing the plan in the operating room to eliminate LLD can be recommended as most of the surgeons in Pakistan don't use any technique to eliminate LLD. Now a days various techniques are available to minimize post-operative LLD including pre-operative templating, intra operative techniques and computer assisted navigation system.<sup>7</sup>

**MATERIAL AND METHODS**

It was a descriptive case series study conducted on 44 patients undergoing primary THA at orthopaedics department Madinah Teaching Hospital Faisalabad Pakistan from September 2018 to September 2019. The sample size was calculated by taking 95% confidence level and 10% margin of error. After extensive literature review Desai AS et al. and Pathak PK et al. found that post-operative LLD after primary THA ranges from 1–27% of patients.<sup>4,7</sup> So, we took a mean of 14% with standard deviation of ±13. Standard deviation was taken as population proportion to calculate the sample size by putting these values in calculator.net. Patients having age between 18–70 years including both genders were studied with consecutive sampling. Informed consent was taken from each patient. All patients of this criteria undergoing THA were included but the patients with contralateral lower limb pathology or with revision of THA were excluded. No decisive method was used pre-operatively or intra-operatively to eliminate LLD. All Total Hip arthroplasties were performed by consultant orthopaedic surgeon having experience of at least five years and approach in all cases was posterior. Modular heads were used to adjust the head neck ratio. Pre-operative and post-operative LLD was noted and their difference were also calculated. This difference was the total increase in limb length after Total Hip arthroplasty (THA).

Pre-operative LLD was measured one day before surgery and post-operative LLD was measured at one month after surgery but the patients were followed up for six months to see improvement in perception of limb inequality.

Limb length discrepancy in form of shortening was symbolled with negative value while LLD in the form of lengthening was in positive value. Frequency and range were calculated for age and gender. Mean with standard deviation was calculated for preoperative LLD, Postoperative LLD and for their difference. Statistical Data was analysed by SPSS version 25 and paired t test was applied with 95% confidence interval

of the difference and *p*-value ≤0.05 was taken as significant.

**RESULTS**

Mean of age was 39.29 with standard deviation of 13.92. Range of age was from 18 to 70 years. Patients were distributed into 3 classes. Frequency of female patients was 34% (15 out of 44) while frequency of male patients was 67% (29 out of 44).

Frequency of right sided Total Hip arthroplasty (THA) was 43% (19 out of 44) While Frequency of left sided Total Hip arthroplasty (THA) was 57% (25 out of 44).

**Pre-operative LLD**

Mean of pre-operative LLD was -19.02mm with standard deviation of 21.31.

Negative symbol was used for leg shortening. Range of pre-operative LLD was from -120 mm to 2 mm.

**Post-operative LLD**

Mean of post-operative LLD was 7.25mm with standard deviation of 9.46.

Range of Post-operative LLD was from -60mm to 16mm. 91% of patients (40 out of 44) undergoing primary THA had postoperative LLD and 9% patients (4 out of 44) had equal limbs after primary THA. Our study concluded that 88.6% of patients had postoperative LLD in the range of 0 to ± 10 mm (39 patients out of 44) But 11.4% of patients (5 out of 44) had postoperative LLD >10 mm. Out of these five patients, two were having shortening which was corrected by shoe lift of the affected side. Both patients were known cases of post-polio paralysis and limb length was much improved in both cases. Three patients with significant leg lengthening after THA improved after three months and did not needed shoe wear of normal limb. 66% patients (29 out of 44) had post-operative LLD in the form of leg lengthening while 25% patients (11 out of 44) had post-operative LLD in the form of leg shortening.

**Difference of Pre-Op and Post-OP LLD**

Mean of difference of pre-operative and post-operative LLD was 20.36 with standard deviation of 11.59. Range of difference of pre-operative and post-operative LLD was 2mm to 60 mm. 100% patients (44 out of 44) had increase in limb length after THA.

Our results showed that 70% of the patients (31 out of 44) have 11 to 30 mm of increase of limb length of the affected limb after primary THA. It means that up to 30 mm of leg shortening can be easily corrected during total hip replacement.

Results of Paired t test of Pre op and Post op LLD

**Table-1: Age Distribution of THA**

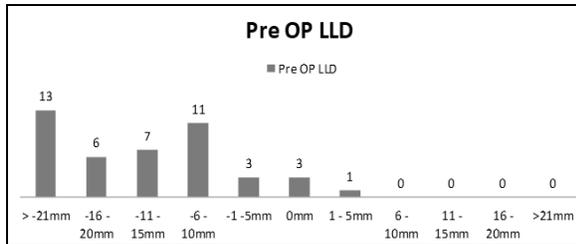
Class 1	Young age	18–35 years	19 patients	43%
Class 2	Middle age	36–55 years	19 patients	43%
Class 3	Old age	>55 years	6 patients	14%

**Table 2: Simple t-test**

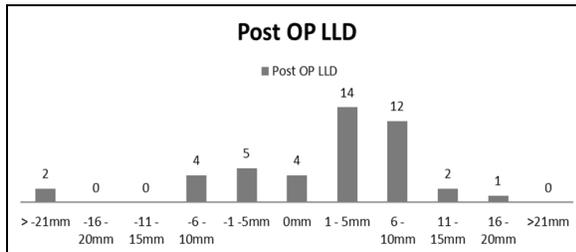
Pair 1		Mean	n	Std. Deviation	Std. Error Mean
Pair 1	VAR00001	-19.0227	44	21.31654	3.21359
	VAR00002	7.2500	44	9.46996	1.42765

**Table 3: Paired t-test**

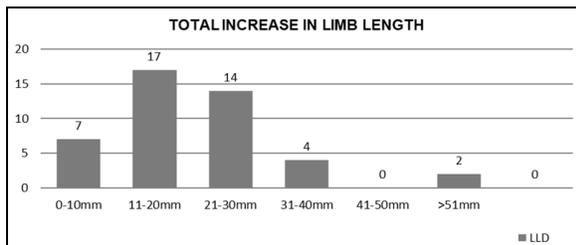
Pair 1	VAR00001 - VAR00002	Paired Differences				T	df	Sig. (2-tailed)	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower				Upper
		-26.27273	29.10395	4.38759	-35.12114	-17.42432	-5.988	43	.000



**Figure-2: Preoperative LLD**



**Figure 2: Postoperative LLD**



**Figure-3: Total increase in Limb length**

**DISCUSSION**

In our study 86% of patients undergoing THA belongs to young and middle age group and mean age of patients undergoing THA is 39.29 with standard deviation of 13.92. Our mean age of THA is comparable with findings of Saglam Y *et al.*, who found it as 41.3±10.2 years.<sup>9</sup> This mean age is low in comparison with other studies done by Ragab *et al.*, Todkar *et al.*, Ghani *et al.*, and Berli BJ *et al.* According to them the mean age for THA was 62.2year, 65year, 57 year and 67.3 years respectively. Average age of patients of THA noted by Saeed UB *et al.* was 49.25 years.<sup>10</sup> In a study by Shahabuddin *et al.*, the average age of the patients was 34 years.<sup>10</sup> The mean age of THA in our study is in consistent with a study

conducted by Reddy DMRS *et al.*, in which the mean age of THA was 37.63±16.32 while maximum number of patients undergoing THA were between 21–40 years of age. Kakaria *et al.*, also found similar age distribution.<sup>11</sup> This decrease in mean age of THA could be due to increased number of RTA and trauma resulting in hip fractures of young patients requiring THA. Our study shows that frequency of THA in young and middle age group is equal in Pakistan (43% in each age group). But in old age group frequency of THA is very low (14%) as also noted by Saglam Y *et al.* Results of our study showed that frequency of THA in males (67%) is more than in females (34%) which is also supported by the studies of Saeed UB *et al.* and Reddy DMRS *et al.*

Mean of pre-operative LLD before undergoing THA in our study is -19.02 mm with standard deviation of 1.41 and range of pre-operative LLD is from -120 mm to +2 mm. Pathak PK *et al.* found that range of pre-operative LLD varies from -70 mm to +14 mm.<sup>7</sup> Our study shows that 93% (41 out of 44 patients) of patients have pre-operative LLD and 91% of patients (40 out of 44 patients) have pre-operative LLD in form of leg shortening. Fujimaki H. *et al.* found that 94% of affected legs were shorter than unaffected legs.<sup>12</sup> Pathak PK *et al.* found that prevalence of LLD in general population is 90% in their systemic review of LLD after THA. So, a few patients have equal limbs prior to undergoing THA which also noted by Yassin WA *et al.*<sup>13</sup> Most patients have leg shortening than lengthening before undergoing THA.

Mean of post-operative LLD is 7.25 mm with standard deviation of 9.46 and range of post-operative LLD is from -60 mm to 16 mm. In literature reviews conducted by Desai AS *et al.* and Pathak PK *et al.* the range of mean post-operative LLD after primary THA is from 3 to 17 mm.<sup>4,7</sup> So our mean of post-operative LLD falls in this range. According to study by Maloney WJ *et al.* LLD after THA cannot be eliminated completely.<sup>14</sup>

Patient’s dissatisfaction increases with the increase in amount of post-operative LLD.<sup>4,7</sup> According to studies by Pathak PK *et al.* and O’Brien S *et al.* up to 6 mm of post-operative LLD does not impose significant effect on patient’s life.<sup>7,15</sup> But patients with post-

operative LLD greater than 6mm may have pain, limping, fatigue, nerve palsy and functional impairment. In the review of 23 THAs complicated by peroneal and sciatic nerve palsy, Edward *et al.* noted an average lengthening of 2.7 cm for peroneal palsy and 4.4 cm for sciatic palsy.<sup>7</sup> According to Pathak PK *et al.* post-operative LLD >10 mm is unacceptable and if present, it requires correction.<sup>7</sup>

Mean of increase in limb length after THA is 20.36 with standard deviation of 11.59. Our study tells that almost all patients have increase in limb length after THA. This increase in limb length covers the pre-operative limb shortening. Many patients perceive limb lengthening after THA but patient perception of LLD does not correlate with actual LLD. This perception is due to apparent limb lengthening due to pelvic tilt. According to studies by Pathak PK *et al.* patients having LLD in form of lengthening perceived it more significantly than those with shortening.<sup>7</sup> According to a study 30% of patients perceived that they have LLD but radiographic analysis shows only 36% of these patients have actual LLD of  $\geq 5$  mm. According to a study by Sykes A *et al.* this perception of these patients would be due to pre-existing shortening of limb.<sup>16</sup>

## CONCLUSION

Our study concludes that THA is a useful procedure to cover the pre-operative limb shortening and post-operative LLD is very minimal in experienced hands even without using any method to eliminate LLD. Most patients have acceptable post-operative LLD or have only perception of LLD despite anatomic equality of lower limbs after THA. So, during THA, emphasis should be given to proper implant positioning for joint stability to prevent dislocation.

## CONFLICT OF INTEREST

Authors declared no conflict of interest.

## PATIENT CONSENT

Consent of the patient/guardian was taken prior to the writing of the manuscript.

## AUTHORS' CONTRIBUTION

AR: Conception of idea, data collection, statistical analysis, manuscript writing. KS: Conception of idea, discussion. FA: Patients follow-up and data collection

## REFERENCES

1. Leg Length Discrepancy After Hip Replacement. [Internet]. Verywell Health. [cited 2019 Sep 29]. Available from: <https://www.verywellhealth.com/leg-length-discrepancy-after-hip-replacement-2549561>
2. H.G. DRK, T DA, C.K DD, Mruthunjaya D. Limb length discrepancy in total hip replacement. *Int J Orthop Sci* 2017;3(2a):16–8.
3. Siwach R, Kadyan VS, Sangwan S, Gupta R. A retrospective study of total hip arthroplasty. *Indian J Orthop* 2007;41(1):62–6.
4. Desai AS, Dramis A, Board TN. Leg length discrepancy after total hip arthroplasty: A review of literature. *Curr Rev Musculoskelet Med* 2013;6(4):336–41.
5. Peck CN, Malhotra K, Kim WY. Leg Length Discrepancy in Cementless Total Hip Arthroplasty. *Surg Sci* 2011;2(4):183–7.
6. Konyves A, Bannister GC. The importance of leg length discrepancy after total hip arthroplasty. *J Bone Joint Surg Br.* 2005;87(2):155–7.
7. Pathak PK, Gupta RK, Meena HS, Fiske R. Limb length discrepancy after total hip arthroplasty: a systematic review. *Int J Res Orthop* 2018;4(5):690.
8. Gurney B, Mermier C, Robergs R, Gibson A, Rivero D. Effects of limb-length discrepancy on gait economy and lower-extremity muscle activity in older adults. *J Bone Joint Surg Am* 2001;83(6):907–15.
9. Saglam Y, Ozturk I, Cakmak MF, Ozdemir M, Yazicioglu O. Total hip arthroplasty in patients with ankylosing spondylitis: Midterm radiologic and functional results. *Acta Orthop Traumatol Turc* 2016;50(4):626–32.
10. Saeed UB, Khan RD, Zain-Ur-Rehman M, Yasin A. Short term evaluation of total hip arthroplasty; our experience at tertiary care center. *J Pak Med Assoc* 2015;65(11 Suppl 3):S190–4.
11. Reddy MR, Shivakumar MS, Phad P. Study of clinical and functional outcome of total hip replacement in avascular necrosis of femoral head. *Int J Orthop Sci* 2018;4(1):252–8.
12. Fujimaki H, Inaba Y, Kobayashi N, Tezuka T, Hirata Y, Saito T. Leg length discrepancy and lower limb alignment after total hip arthroplasty in unilateral hip osteoarthritis patients. *J Orthop Sci* 2013;18(6):969–76.
13. Yassin WA, Al-Mirah AR, Almoaish AA, Aung MMT, Atif AB, Ali TI, *et al.* Cemented Versus Cementless Primary Hip Replacement: Assessment of Leg Length Inequality. *J Young Pharm* 2017;9(3):327–31.
14. Maloney JW, Keeney JA. Leg length discrepancy after total hip arthroplasty. *J Arthroplasty* 2004;19(Suppl 1):108–10.
15. O'Brien S, Kernohan G, Fitzpatrick C, Hill J, Beverland D. Perception of imposed leg length inequality in normal subjects. *Hip Int* 2010;20(4):505–11.
16. Sykes A, Hill J, Orr J, Humphreys P, Rooney A, Morrow E, *et al.* Patients' perception of leg length discrepancy post total hip arthroplasty. *Hip Int* 2015;25(5):452–6.

Submitted: November 2, 2019

Revised: June 28, 2020

Accepted: July 19, 2020

## Address for Correspondence:

**Adnan Rasheed**, Department of Orthopaedics, University Medical and Dental College, Madinah Teaching Hospital, Faisalabad-Pakistan

**Cell:** +92 333 253 8470

**Email:** info@mth.org.pk