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Leg Length Discrepancy after Total Hip Replacement: Evaluation of causes and effect on patient satisfaction

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Abstract

Background: Leg length discrepancy (LLD) remains subject of ongoing debate regarding its significance and the clinical impact it has after total hip arthroplasty (THA). We aimed to assess the LLD causes and its impact on patient satisfaction after primary THA.

Patients and Methods: This study was done at Menoufia University Hospital on 51 patients who had primary THA from December 2022 to December 2023. A pelvis anteroposterior X-ray was used to measure the preoperative and postoperative LLD. A computed tomography (CT) scanogram was used to measure true LLD precisely. Evaluation of patient satisfaction included the Harris Hip Score (HHS), the Oxford Hip Score (OHS), and a self-administered patient satisfaction scale.

Results: The study included 51 patients, 24 males and 27 females, with a mean age of 49.5 years. Overall, 31 patients were very satisfied, 17 patients were somewhat satisfied, and 3 patients were somewhat dissatisfied. No one was very dissatisfied, according to the Likert scale.

Conclusion: Understanding the elements of leg length assessment in THA is crucial for avoiding postoperative LLD and its associated complications. This involves comprehensive preoperative planning, precise intraoperative measurement, and vigilant postoperative management.

Keywords: Leg length discrepancy; Total hip replacement; THA; Patient satisfaction; Likert scale.

Introduction

Leg length discrepancy (LLD) is widely recognized as a frequent issue after total hip arthroplasty (THA) presents a significant challenge for orthopedic surgeons [1,2]. LLD has been linked to several adverse outcomes, including low back pain, a higher likelihood of nerve damage, implant dislocation, abnormal gait, diminished patient satisfaction, and the necessity for revision surgery [3,4].

Meticulous preoperative and postoperative LLD evaluation and patient education are critical for obtaining satisfactory outcomes. Nonetheless, achieving perfectly equal leg lengths should not be assured following THA. Rather, patients should be provided with a realistic evaluation of what can reasonably be anticipated [5,6].

Implant selection and placement, including proper femoral offset and leg length, is crucial in THA with the primary goal of restoring the hip joint center of rotation and regaining the hip biomechanics to ensure a normal gait and hip function [7,8].

The optimal goals of THA encompass alleviating pain, enhancing hip mobility and stability, maintaining the hip normal mechanics, and achieving leg length equality when feasible [9,10, 11,12].

Considering the critical role of leg length assessment, this study was designed to investigate the causes of leg length discrepancy and its influence on patient satisfaction after THA.

Patients and Methods

This is a prospective study that was performed at Menoufia University Hospital on patients who had primary THA from December 2022 to December 2023.

Inclusion criteria were adult patients who had primary THA. Exclusion criteria included revision hip replacement, pathological causes of leg length discrepancy such as neurofibromatosis, multiple hereditary exostoses, history of bone infection, soft tissue shortening, or joint contracture.

Patients were subjected to full history taking and general examination. For local examination, abductor muscle strength was tested using the Trendelenberg test and resisted side-lying abduction.

The apparent leg length was the distance between umbilicus to medial malleolus, offering a straightforward method for measuring functional length. However, this approach does not account for factors like soft tissue contractures and pelvic tilt. The true leg length was determined by measuring from the anterior superior iliac spine to the medial malleolus using tape. In the intraoperative measurement, two Steinmann pins were placed in the pelvis and the greater trochanter. The distance between the two was measured both before dislocating the hip and during the implant trial.

Plain X-rays, including pelvis anteroposterior view with 20 degrees internal rotation of both femurs, were employed to evaluate LLD preoperatively and postoperatively, **Fig. 1, 2, 3, 4**. The evaluation involved measuring the perpendicular distance from the inter-teardrop line or the bi-ischial line to the tip of the lesser trochanter on each side. The difference between these measurements on each side was the LLD. A positive LLD value indicated that the operated limb was longer than the contralateral side, while a negative value meant that the operated limb was shorter. A computed tomography (CT) scanogram was used to measure true LLD precisely.

Patient satisfaction was assessed using the Harris Hip Score (HHS) and the Oxford Hip Score (OHS), along with a self-administered patient satisfaction scale based on the Likert scale. This scale evaluated several aspects: overall satisfaction with surgery, the degree of pain relief achieved, the ability to perform domestic or yard tasks, and the capacity for recreational activities. Each item on the scale was rated on a 4-point Likert scale, with responses categorized as very satisfied (100 points), somewhat satisfied (75 points), somewhat dissatisfied (50 points), and very dissatisfied (25 points). The overall scale score represented the unweighted average of the points from each item, which could range from 25 to 100 per item, with 100 indicating the highest level of satisfaction.

Data were analyzed statistically using the Statistical Package for the Social Sciences (SPSS) version 26 (SPSS Inc., Released 2018, IBM SPSS Statistics for Windows, Version 26.0, Armonk, NY: IBM Corp.). The Chi-square, paired samples t-test, and Kruskal-Wallis test were used to compare results when appropriate. The results of the significance tests were reported as two-tailed probabilities, with P-values of less than 0.05 considered statistically significant.

Results

The study included 51 patients, 24 males and 27 females, with a mean age of 49.5 years. Regarding medical disorders, 29 patients had no medical disorders, 12 patients were hypertensive, 2 patients had rheumatoid arthritis, one patient had diabetes, and one patient had a history of cardiac disease, **Table 1**.

Out of all patients, 42 patients complained of unilateral hip osteoarthritis (OA), 23 of them were right-sided, and 19 were left-sided, and 9 patients had bilateral hip OA. Additionally, 13 patients were diagnosed with avascular necrosis, 17 patients were diagnosed with primary OA, 16 patients had a history of fracture of neck of femur, trochanteric fracture or fracture-dislocation hip, 2 patients had failed fixation of neck femur fracture and 3 patients were diagnosed by neglected Developmental dysplasia of the hip (DDH) or Perth's disease.

The HHS and the OHS were done for 39 patients preoperatively and 51 patients postoperatively as it could not be done preoperatively for the 12 patients with recent hip fractures. The pre-HHS ranged from 33 to 88 and the post-HHS ranged from 65 to 93, P-value <0.001. The Pre-OHS ranged from 15 to 36 and post-OHS ranged from 30 to 40, P-value <0.001.

Regarding the satisfaction rate, according to the Likert scale, 31 patients were very satisfied, 17 patients were somewhat satisfied, 3 patients were somewhat dissatisfied, and no one was very dissatisfied.

No LLD difference was noticed in 32 patients, and 19 patients showed LLD differences between preoperative and postoperative measurements. Preoperative LLD ranged from 0 to 6.5 cm (mean, 1.4±2 cm), while postoperative LLD ranged from 0 to 2 cm (mean, 0.5±0.7 cm). The LLD difference for all patients ranged from 0 to 4.5 cm, and for the 19 patients who showed a difference, it ranged from 1 to 4.5 cm, **Table 2**.

Nonsurgical measures of patient education, physical therapy and shoe lift were done for patients with LLD, and no surgical intervention was required.

In the very satisfied patients (n=31), the mean pre-LLD was 0.8±1.5 cm (ranged from 0 to 4.5 cm), the mean post-LLD was 0.2±0.5 cm (ranged from 0 to 1.5 cm) and the mean LLD difference was (-0.5±1.0 cm) ranged from 0 to 3 cm, with 24 patients with no LLD difference and 7 patients with LLD difference. Their pre-HHS ranged from 33 to 88 and the post-HHR ranged from 85 to 93. Also, their pre-OHS ranged from 17 to 36 and the post-OHS ranged from 33 to 40.

In the somewhat satisfied (n=17), the mean preoperative LLD was 2.4±2.3 cm (ranged from 0 to 6.5 cm), the mean postoperative LLD was 0.8±0.8 cm (ranged from 0 to 2 cm), and the mean LLD difference was -1.6±1.5 cm (ranged from 0 to 4.5 cm), with 7 patients with no LLD difference and 10 patients showing LLD difference. Their pre-HHS ranged from 35 to 55 and post-HHR ranged from 75 to 85, while their pre-OHS ranged from 18 to 29 and post-OHS ranged from 30 to 36.

In the somewhat dissatisfied patients (n=3), the mean pre-LLD was 3.0±3.0 cm (ranged from 0 to 6 cm), the mena post-LLD was 1.0±1.0 (ranged from 0 to 2 cm) and the mean LLD difference was -2.0 ±2.0 cm (ranged from 0 to 4 cm). One patient of them had no LLD difference and 2 patients showed LLD difference. Their pre-HHS ranged from 38 to 52 and post-HHR ranged from 65 to 72, while their pre-OHS ranged from 15 to 21 and post-OHS ranged from 30 to 32, **Table 3**.

In total, 19 patients showed LLD differences ranging from 1 to 4.5 cm; one patient had a 1 cm difference, and he was somewhat satisfied, 2 patients had a 1.5 cm difference, and they were very satisfied, and 3 patients had a 2 cm difference. Two of them were somewhat satisfied, while one of them was somewhat dissatisfied.

Additionally, 5 patients had a 2.5 cm difference, and 3 of them were very satisfied, while 2 were somewhat satisfied. Also, 5 patients had a 3 cm difference, and 3 of them were somewhat satisfied, while 2 were very satisfied.

One patient had a 3.5 cm difference, and he was somewhat satisfied. One patient had a 4 cm difference, and he was somewhat dissatisfied. One patient had a 4.5 cm difference and was somewhat satisfied.

Discussion

LLD is widely recognized as a prevalent complication following THA. It has been linked to several adverse outcomes, including back pain, an increased likelihood of nerve damage and dislocation, diminished patient satisfaction, and increased revision rate [13].

Good functional outcomes were reported in our study with significant improvement of HHS and OHS. Out of 51 patients, 31 patients were very satisfied, 17 patients were somewhat satisfied, and 3 patients were somewhat dissatisfied. No one was very dissatisfied, according to the Likert scale. Patients with LLD of longer operated legs had poorer functional outcomes than those without LLD, which coincided with the findings of the Konyves and Bannister study [14]. Nevertheless, a study by White and Dougall [15] found no correlation between LLD and patient satisfaction rate or overall outcomes. Both studies were limited by small sample sizes and were conducted at single centers

Turula et al. [16] reported an LLD between 20 (shortened leg) and +15 mm (lengthened leg), with a mean of 2.8 mm. In Ranawat and Rodriguez study [17], the mean LLD was 3.4 mm (range, 10-18 mm). The significant LLD has been documented in the literature as being poorly tolerated by patients [18, 19].

In our study, we did not find a certain LLD difference that affected the results of OHS. We found a highly significant difference between the pre-OHS (ranging from 15 to 36) and post-OHS (ranging from 30 to 40), which coincided with Beard et al. [20] results.

Sathappan et al. [21] observed that using an epidural was linked to a reduced risk of experiencing an LLD of 10 mm or more. No significant relationship between patient satisfaction and sociodemographic data of the patients regarding age, sex, and medical disorders was reported in the literature [19,21].

Preoperative templating is the initial step toward achieving satisfactory clinical outcomes regarding leg length. Yet, this approach should be complemented with intraoperative technique to ensure ideal leg length, such as intraoperative radiographic assessment [22].

In our study, through precise preoperative templating, we ensured that acetabular component placement was close to the preoperative template, thereby defining the hip center of rotation and directly influencing leg length. In certain cases, to increase the offset, we performed a more inferior neck cut, utilized a longer neck, and employed lateralized femoral components. Using lateralized femoral components offered more easily restoring offset without limb lengthening [23].

We believe that integrating the preoperative templating, which predicts the required length correction and plans the femoral neck osteotomy level, with the intraoperative placement of a simple pelvic reference pin and accurate leg re-positioning during measurements, offers a practical method for assessing leg length during THA. This approach enables the surgeon to select suitable implants and adjust final leg lengths effectively without compromising hip stability.

Nonsurgical measures of patient education, physical therapy, and shoe lift are satisfactory resolution for LLD, and no surgical intervention is required to correct LLD after THA [24,25]. Reducing the gap between the surgeon's and patient's expectations offers a chance for patients to better grasp their likely outcomes and set more realistic goals for their recovery. This alignment can enhance patient satisfaction and improve overall results, taking into account the diverse patient populations undergoing this procedure and the broad spectrum of factors that influence their outcomes [25,26].

Our study has multiple strengths. Firstly, it is free from patient selection bias, as it included all consecutive patients who underwent THA over a one-year period. Additionally, employing a validated joint-specific questionnaire (HHS-OHS) to assess the impact of LLD on functional outcomes enhances the study's sensitivity. Also, using patient self-reporting of perceived leg length inequality, using the Likert Scale served as an effective method for gathering large-scale data on LLD. Limitations of the study included the relatively small sample size.

Conclusion

LLD is a common issue following primary THA, highlighting the importance of fully understanding the components involved in leg length assessment. These components include preoperative templating, intraoperative assessment, and postoperative management. LLD following primary THA has good functional outcome and a high patient satisfaction rate.

Tables

Table 1: Sociodemographic characteristics and medical conditions of patients.

	Distribution of patients (n= 51)	
Age (in years):		
Mean ± SD	49.5 ± 16.7	
Median	54	
Range	16-80	
	N	**%**
Sex:		
Male	24	47.1
Female	27	52.9
Medical disorders:		
Yes	22	43.1
- Cardiac	1	2.0
- DM	1	2.0
- HTN	12	23.5
- Rheumatoid	2	3.9
- Others	6	11.7
No	29	56.9

Table 2: Preoperative and postoperative LLD.

	Distribution of patients (n=51)	
Pre- LLD:		
Mean ± SD	1.4±2.0	
Range	0.0 to 6.5	
Post- LLD:		
Mean ± SD	0.5±0.7	
Range	0.0 to 2.0	
LLD difference for all cases (n= 51):		
Mean ± SD	-0.97±1.4	
Range	-4.5 to 0	
	N	**%**
LL Discrepancy final result:		
No difference	32	62.7

Difference ≤ -1	19	37.3
LL Discrepancy difference for cases showed difference (n= 19):		
Mean ± SD	-2.6±0.9	
Range	-1 to -4.5	

Table 3: Relation between postoperative patient satisfaction and LLD.

	Very satisfied (N= 31)		**Somewhat satisfied (N=17)**		**Somewhat dissatisfied (N=3)**		**Kruskal-Wallis test**	**P-value**
Pre-LLD								
Mean ± SD	0.8±1.5		2.4±2.3		3.0±3.0		8.28	**0.016***
Range	0.0 to 4.5		0.0 to 6.5		0.0 to 6.0			
Post-LLD								
Mean ± SD	0.2±0.5		0.8±0.8		1.0±1.0		7.90	**0.019***
Range	0.0 to1.5		0.0 to 2.0		0.0 to 2.0			
LLD difference								
Mean ± SD	-0.5±1.0		-1.6±1.5		-2.0±2.0		7.97	**0.019***
Range	-3.0 to 0.0		-4.5 to 0.0		-4.0 to 0.0			
	N	**%**	**N**	**%**	**N**	**%**	χ^2	**P-value**
LLD final result:								
No difference	24	77.4	7	41.2	1	33.3	7.35	**0.025***
Difference	7	22.6	10	58.8	2	66.7		

Figure legends

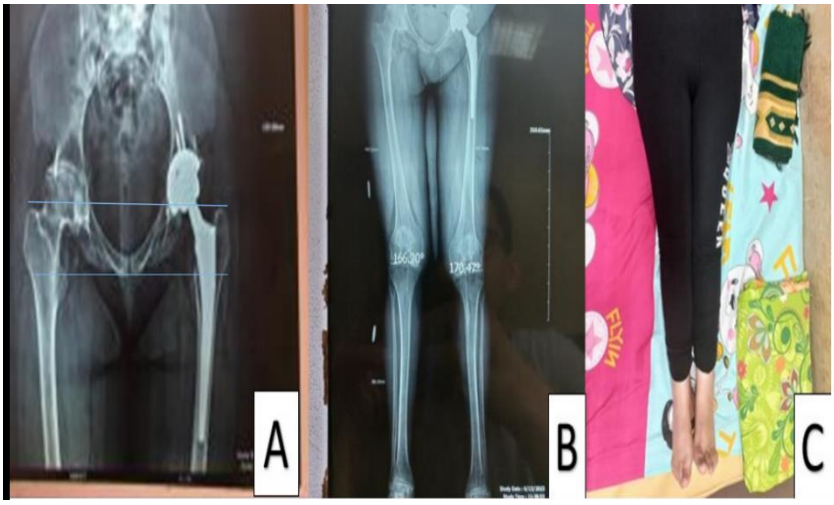

Fig. 1: Female patient 27 years old (A) plain X-ray AP view showing right advanced OA hip and left THA. (B) Long-standing CT scanogram showing LLD of 4 cm. (C) clinical photo of preoperative LLD.

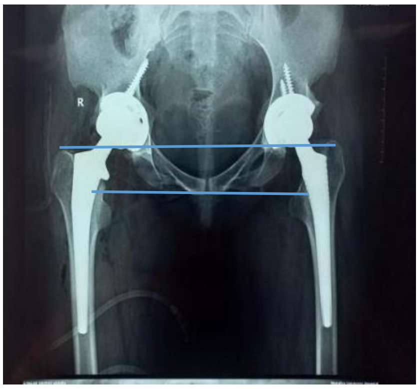

Fig. 2: Plain radiographs anteroposterior view showing bilateral THR.

Fig.3: Female patient 27 years old (A) Plain X-ray AP view showing bilateral advanced AVN of thehip joints. (B) Clinical photo showing preoperative LLD.

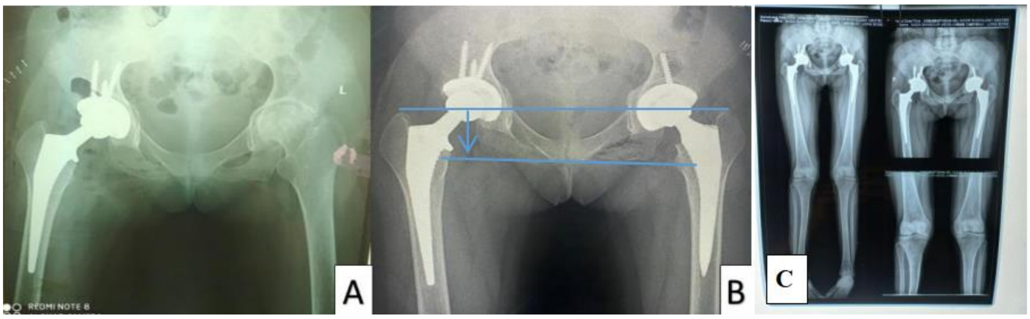

Fig.4: (A) Plain X-rays AP view showing right THA. (B) Plain X-rays AP view showing bilateral THA. (C) Long-standing CT sonogram showing LLD of 0 cm after bilateral THR.

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