



A STUDY TO EVALUATE LIMB LENGTH DISCREPANCY IN PATIENTS UNDERGOING PRIMARY TOTAL HIP ARTHROPLASTY : PROSPECTIVE COHORT ANALYSIS.

Orthopaedics

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ABSTRACT

Introduction: Total hip arthroplasty (THA) has emerged as a trustworthy and very successful surgical treatment for reducing the pain related to advanced arthritis. As evidenced by an ignored joint score of 70% at one year and a further 75% at the two-year milestone after the operation, functional outcomes are often significantly improved by patients. **Methods:** The study was conducted in department of orthopaedics at SRMS-IMS Bareilly. It lasted August 1, 2022, until January 31, 2024. Patients had primary total hip replacements. The institutional Ethics Committee approved the study before it began to assure research ethics. The study included 30 primary total hip arthroplasty patients. For inclusion, patients aged 20-80 and unilateral primary THA were required. Patients with non-hip pathologies, ages <20yr and >80yr, and bilateral primary THA were excluded. **Results:** According to the study, preoperative LLD measurements predicted postoperative LLD outcomes with a very significant positive correlation (Pearson correlation coefficient = 0.898) and a 0.000 p-value. Community prevalence of various THA-causing preceding illnesses. With 44% of patients, avascular necrosis was most common. Neck of femur fractures (24%), inflammatory arthritis (12%), infective arthritis sequelae (10%), and post-traumatic arthritis (10%) followed. **Conclusion:** We found that THA maintains leg length consistency, providing a detailed assessment of patient demographics, past comorbidities, and the procedure's clinical and radiological effects on LLD. For severe arthritis pain, total hip arthroplasty (THA) is a reliable surgical treatment that often improves function.

KEYWORDS

THA, LLD, Arthritis

INTRODUCTION

Total hip arthroplasty (THA) has become a surgical procedure that is both dependable and highly effective in alleviating the discomfort associated with advanced arthritis.¹ As demonstrated by a neglected joint score of 70% at the one-year mark and an additional 75% at the two-year milestone following the procedure, patients frequently report significant improvements in their functional outcomes.²

Leg length discrepancy, characterized by unequal leg lengths, poses potential challenges such as gait abnormalities, persistent discomfort, and patient dissatisfaction. Leg length discrepancy has surfaced as a prominent factor contributing to litigation in the aftermath of THA.³

A more satisfactory postoperative experience and a reduced likelihood of legal issues arising from leg length discrepancies post-total hip arthroplasty can be achieved by establishing a transparent dialogue with patients preoperatively and incorporating their concerns into the surgical planning process.⁴ The primary objective of total hip arthroplasty (THA) is to achieve the restoration of normal hip biomechanics, a pivotal factor in fostering optimal functional recovery.

METHODS

The present study was conducted in the department of orthopaedics at SRMS-IMS Bareilly. It ran from August 1, 2022, until January 31, 2024. The patients were primary complete hip replacement patients. The institutional Ethics Committee approved the study before it began to ensure research ethics were followed. The study involved 50 primary total hip arthroplasty patients. Patient age >20 and <80 years and unilateral primary THA were the inclusion criteria. Exclusion criteria: pre-existing LLD with non-hip pathology, patients <20yr and >80 years old, and bilateral primary THA patients.

Methodology

There are about twenty intra-operative procedures to correct limb length disparity (LLD) during Total Hip Arthroplasty. Each approach uses stable pelvic and changeable femoral reference points. Measurement before hip dislocation is typical. A suture was connected to the patient's skin below the iliac crest, aligned with the greater trochanter. Arterial forceps secured the suture ends. By employing diathermy, the greater trochanter was marked to match the artery forceps tip.

Pilot research validated leg length discrepancy treatment methods with 10 THA patients. A specialized orthopedic center conducted this prospective study after ethical approval. Patients 18 and older getting

primary THA were eligible, however hip surgery patients were not. We prioritized pre- and intra-operative planning for limb length equality. Radiographs and clinical examinations examined postoperative limb symmetry.

Statistical Analysis

The statistical analysis used T-tests to compare the means of two groups to determine the statistical significance of continuous data differences. For index comparisons, Pearson correlations were used. To demonstrate statistical significance, all tests were compared to a 0.05 alpha level.

RESULTS

Baseline characteristics

Age, gender, and total hip arthroplasty side were baseline characteristics of the study population. The younger age group has a higher prevalence of THA in this study, with 66% of the population aged 21–60 and 34% aged 61–80. Males make up 58% of the population, while females make up 42%. THA is performed on the left hip 56% of the time and on the right 44%.

Cause of LLD

The distribution of the study population by different medical problems that resulted in total hip arthroplasty (THA) is shown in table 2. The most common disorder, accounting for 44% of cases, is avascular necrosis. Fractures of the neck or femur come next, making up 24% of cases. Eleven percent of individuals have inflammatory arthritis, and ten percent have post-traumatic arthritis and the sequelae of infective arthritis.

Pre and post clinical evaluation

Discrepancy (LLD) for total hip arthroplasty patients with diverse prior diseases. Avascular necrosis averaged 1.63 cm, neck of femur fracture 2.50 cm, inflammatory arthritis 1.33 cm, sequelae of infective arthritis 0.50 cm, and post-traumatic arthritis 1.50 cm preoperatively. After surgery, LLD changed minimally for all cases, with avascular necrosis changing 0.011 cm, neck of femur fracture 0.100 cm, inflammatory arthritis 0.033 cm, sequelae of infective arthritis 0.100 cm, and post-traumatic arthritis 0.200 cm. This data shows that THA lowers LLD with minimal postoperative variation between situations.

Limb length discrepancy (LLD) in patient undergoing primary total hip arthroplasty clinically

Table 4 summarizes the clinical evaluation of limb length discrepancy (LLD) among patients before and after primary total hip arthroplasty. Pre-operatively, the mean LLD was 1.580 cm ± 0.9916 (range: 0-4

cm), which significantly decreased post-operatively to 0.250 cm \pm 0.4315 (range: 0-1 cm). This resulted in a mean difference of 1.33 cm \pm 0.76 (95% CI: 1.114, 1.546), indicating a significant reduction in LLD following surgery ($p < 0.001$).

Limb length discrepancy (LLD) in patient undergoing primary total hip arthroplasty radiologically

Table 5 represents the radiological assessment of limb length discrepancy (LLD) in patients before and after primary total hip arthroplasty. Prior to surgery, the mean LLD was 0.432 cm \pm 0.2171 (range: 0-1 cm), which significantly reduced to 0.074 cm \pm 0.1226 (range: 0-0.3 cm) post-operatively. This resulted in a mean difference of 0.3580 cm \pm 0.1604 (95% CI: 0.3124, 0.4036), indicating a significant improvement in LLD following surgery ($p < 0.001$).

Mean Change in Limb Length Discrepancy in Pre-existing Causes of LLD through Clinical findings

Table 6 represents the mean change in limb length discrepancy (LLD) among patients with different pre-existing causes undergoing primary total hip arthroplasty, assessed clinically. Significant reductions in LLD were observed across all categories. Patients with Avascular necrosis showed the largest mean decrease in LLD from 1.705 cm \pm 0.8952 pre-operatively to 0.341 cm \pm 0.4727 post-operatively (mean difference: 1.364 cm, $p < 0.001$). Similar improvements were noted in inflammatory arthritis (mean difference: 1.667 cm, $p = 0.023$) and Sequelae of infective arthritis (mean difference: 1.800 cm, $p = 0.041$). Post-traumatic arthritis and neck of femur fracture cases also demonstrated reductions in LLD, although statistical significance varied ($p = 0.066$ and $p = 0.007$, respectively).

Distribution of Change in Limb Length Discrepancy in Pre-existing Causes of LLD through Clinical findings

Table 7 depicts the distribution of changes in limb length discrepancy (LLD) categorized by pre-existing causes, based on clinical assessments. The majority of patients across all categories experienced a decrease in LLD post-operatively, indicated by negative ranks. Patients with Avascular necrosis (90%), post-traumatic arthritis (80%), neck of femur fracture (66.66%), inflammatory arthritis (100%), and Sequelae of infective arthritis (100%) exhibited significant reduction in LLD. Minimal instances of no change (ties) were observed across categories.

Mean Change in Limb Length Discrepancy in Pre-existing Causes of LLD through Radiological findings

Table 8 shows the mean change in limb length discrepancy (LLD) among patients with different pre-existing causes undergoing primary total hip arthroplasty, assessed radiologically. Significant reductions in LLD were observed across all categories. Patients with avascular necrosis exhibited a mean decrease in LLD from 0.459 cm \pm 0.2085 pre-operatively to 0.086 cm \pm 0.1320 post-operatively (mean difference: 0.3727 cm, $p < 0.001$). Similar improvements were noted in neck of femur fracture (mean difference: 0.2750 cm, $p = 0.002$), inflammatory arthritis (mean difference: 0.4167 cm, $p = 0.026$), and Sequelae of infective arthritis (mean difference: 0.4600 cm, $p = 0.042$). Post-traumatic arthritis cases also demonstrated a reduction in LLD, although statistical significance varied (mean difference: 0.3200 cm, $p = 0.066$).

Distribution of Change in Limb Length Discrepancy in Pre-existing Causes of LLD through Radiological findings

Table 9 depicts the distribution of changes in limb length discrepancy (LLD) categorized by pre-existing causes, assessed through radiological findings post-primary total hip arthroplasty. The majority of patients across all categories experienced a decrease in LLD post-operatively, indicated by negative ranks. Specifically, patients with avascular necrosis (90%), post-traumatic arthritis (80%), and neck of femur fracture (91.66%), inflammatory arthritis (100%), and Sequelae of infective arthritis (100%) predominantly showed improvements in LLD. Minimal instances of no change (ties) were observed across categories.

DISCUSSION

The purpose of our study was to evaluate the age, sex, and procedure side distribution of the population undergoing total hip arthroplasty (THA). The findings showed that 34% of the patients were between the ages of 61 and 80, and 66% of the patients were between the ages of 21 and 60, suggesting a higher prevalence of THA in the younger age group. In terms of gender distribution, there were 42% female patients

and 58% male patients. Furthermore, 44% of THA surgeries were done on the right hip and 56% on the left. Another study conducted by **Kim et al.**⁵ reported that a mean age of 47.3 years in their study population, aligning closely with our finding that younger patients (21-60 years) had a higher prevalence of THA. **Rahman et al.**⁶ found that a mean age of 47 years, and **Garino and Steinberg et al.**⁶⁷ reported an average age of 45 years, both consistent with our study's age distribution. **Seyler et al.**⁷ noted that a male preponderance in THA patients, similar to our finding of 58% males. **Garino and Steinberg et al.**⁸ found 68.75% male patients, further corroborating the male predominance observed in our study.

The goal of our study was to determine the prevalence of several antecedent diseases that contribute to THA in the community. With 44% of the patients affected, avascular necrosis was the most prevalent condition. This was followed by neck of femur fractures (24%), inflammatory arthritis (12%), infective arthritis sequelae (10%), and post-traumatic arthritis (10%). According to this data, the most common causes of LLD requiring THA were neck of the femur fractures and avascular necrosis. **Seyler et al.**⁹ indicated that osteonecrosis patients often require THA at a younger age and have a higher risk of implant failure, consistent with our finding of avascular necrosis being the most common preexisting condition. **Garino and Steinberg et al.**¹⁰ also highlighted avascular necrosis and femoral fractures as common causes for THA, aligning with our study.

Preexisting conditions were used to analyse changes in LLD after surgery. The mean linear length difference (LLD) for inflammatory arthritis and avascular necrosis was 0.0 cm, with standard deviations of 0.2 and 0.3 cm, respectively. The mean LLD increase for neck of femur fractures and infective arthritis sequelae was 0.1 cm, with standard deviations of 0.1 and 0.2 cm, respectively. In post-traumatic arthritis, the mean LLD decreased by 0.2 cm without fluctuation, suggesting that LLD was not significantly affected by the underlying condition. **Garino and Steinberg et al.**¹⁰ reported minimal discrepancies post-THA in patients with osteonecrosis and femoral fractures, consistent with our findings. **Chiu KH et al.**¹¹ noted improvements in postoperative LLD, demonstrating the effectiveness of THA, similar to our results.

Preoperative mean LLD alterations were found to be 0.0 cm for avascular necrosis, -0.1 cm for a neck of femur fracture, 0.1 cm for inflammatory arthritis, -0.2 cm for infective arthritis sequelae, and 0.1 cm for post-traumatic arthritis based on radiological results. Avascular necrosis, femur neck fractures, infective arthritis sequelae, and post-traumatic arthritis all had mean postoperative changes of 0.0 cm, whereas inflammatory arthritis had a mean change of 0.2 cm. The data indicated that under most circumstances, there would be little to no discernible radiological changes in LLD after surgery. **Seyler TM et al.**⁷ noted minimal radiological changes in LLD post-THA across multiple studies, consistent with our findings. **Garino and Steinberg et al.**¹⁰ and **Chiu KH et al.**⁶⁵ also reported minimal postoperative changes in LLD, similar to our study.

Preoperative LLD measurements were highly predictive of postoperative LLD outcomes, according to the study, which demonstrated a very significant positive correlation (Pearson correlation coefficient = 0.898) between preoperative and postoperative LLD measurements, with a significance level (p -value) of 0.000. **Garino and Steinberg et al.**¹⁰ and **Chiu KH et al.**¹² found strong correlations between preoperative conditions and postoperative improvements, corroborating our study's results.

CONCLUSION

Our results show that THA is an effective operation for maintaining leg length consistency, including a thorough summary of patient demographics, prior comorbidities, and the influence of the procedure on LLD, both clinically and radiologically. Total hip arthroplasty (THA) is an effective and dependable surgical treatment for severe arthritis pain, with patients often experiencing significant functional gains. Management of leg length discrepancy (LLD) after surgery remains difficult. Failure to appropriately restore leg lengths can cause gait problems, pain, patient unhappiness, and legal issues. Thus, careful surgical planning and execution are essential to reduce LLD and related consequences.

This study concludes that limb length discrepancy (LLD) before and after primary total hip arthroplasty (THA) showed significant

reductions in LLD both clinically and radiologically. The study refuted the primary hypothesis, which stated that there would be no significant difference in LLD before and after primary THA when measured clinically and radiologically. Additionally, it refuted the secondary hypothesis, which suggested that the incidence of clinically and radiologically significant LLD in patients undergoing primary THA would be less than 10%, impacting patient satisfaction. This study recommended further research with larger sample sizes to confirm these findings and explore additional factors that may influence LLD outcomes post-THA.

Table 1: Baseline characteristics

Baseline characteristics	Frequency (n=50)	Percentage (%)
Age group		
21-60 years	33	66%
61-80 years	17	34%
Gender		
Male	29	58%
Female	21	42%
Side of THA		
Right	28	56%
Left	22	44%

Table 2: Preexisting Causes of LLD in the study population

Causes of LLD	Frequency (n=50)	Percentage (%)
Avascular necrosis	22	44%
Neck of femur fracture	12	24%
Inflammatory arthritis	6	12%
Sequelae of infective arthritis	5	10%
Post traumatic arthritis	5	10%

Table 3: Distribution of Study Participants according to pre and post-clinical evaluation, Radiological evaluation

Parameters	Preexisting causes for LLD	Mean supra-trochanteric length (cm)
Change in LLD (cm) (preop clinically)	Avascular necrosis	1.63
	Neck of femur fracture	2.50
	Inflammatory arthritis	1.33
	Sequelae of infective arthritis	0.50
	Post traumatic arthritis	1.50
	Total	7.43
Change in LLD (cm) (Postop clinically)	Avascular necrosis	0.011
	Neck of femur fracture	0.100
	Inflammatory arthritis	0.033
	Sequelae of infective arthritis	0.100
	Post traumatic arthritis	0.200
	Total	0.017

Table 4: Limb length discrepancy (LLD) in patient undergoing primary total hip arthroplasty clinically

Parameter	Pre-op Clinical	Post-op Clinical	Mean Difference	p-value
	Mean ± SD	Mean ± SD		
	(Range)	(Range)	(95% CI)	
LLD(cm)	1.580 ± 0.9916 (0-4)	0.250±0.4315 (0-1)	1.33 ± 0.76 (1.114, 1.546)	0.000
<i>Wilcoxon Signed-Rank Test</i>	Number of patients (%)	Mean Rank	Sum of Ranks	
Negative Ranks (Post-Op. Clinical LLD.(cm) < Pre-op Clinical LLD(cm))	43 (86%)	22	946	
Positive Ranks (Post-Op. Clinical LLD.(cm) > Pre-op Clinical LLD(cm))	0 (0%)	0	0	
Ties (Post-Op. Clinical LLD.(cm) = Pre-op Clinical LLD(cm))	7 (14%)	-	-	

Note: Wilcoxon Signed-Rank Test applied due to non-normality of data [Normality test: Kolmogorov-Smirnov (p<0.05)]

Table 5: Limb length discrepancy (LLD) in patient undergoing primary total hip arthroplasty radiologically

Parameter	Pre-op Radiological	Post-Op. Radiological	Mean Difference	p-value
	Mean ± SD (Range)	Mean ± SD (Range)	(95% CI)	
LLD(cm)	0.432 ± 0.2171 (0-1)	0.074±0.1226 (0-0.3)	0.3580±0.1604 (0.3124,0.4036)	0.000
<i>Wilcoxon Signed-Rank Test</i>	Number of patients (%)	Mean Rank	Sum of Ranks	
Negative Ranks (Post-op Radiological Finding < Pre-op Radiological Finding)	46 (92%)	23.50	1081.00	
Positive Ranks (Post-op Radiological Finding > Pre-op Radiological Finding)	0 (0%)	0.00	0.00	
Ties (Post-op Radiological Finding = Pre-op Radiological Finding)	4 (8%)	-	-	

Note: Wilcoxon Signed-Rank Test due to non-normality of data [Normality test: Kolmogorov-Smirnov (p<0.05)]

Table 6: Mean Change in Limb Length Discrepancy in Pre-existing Causes of LLD through Clinical findings

Pre-existing Causes of LLD	Pre-op Clinical	Post-Op. Clinical	Mean Difference	p-value
	Mean ± SD (Range)	Mean ± SD (Range)		
Avascular necrosis	1.705 ± 0.8952 (0-3)	0.341 ± 0.4727 (0-1)	1.364	0.000
Post traumatic arthritis	1.700 ± 1.0954 (0-3)	0.000 ± 0.0000 (0-0)	1.700	0.066
Neck of femur fracture	0.750 ± 0.6216 (0-2)	0.000 ± 0.0000 (0-0)	0.750	0.007
Inflammatory arthritis	2.000 ± 0.6325 (1-3)	0.333 ± 0.5164 (0-1)	1.667	0.023
Sequelae of infective arthritis	2.400 ± 1.3416 (1-4)	0.600 ± 0.5477 (0-1)	1.800	0.041

Table 7: Distribution of Change in Limb Length Discrepancy in Pre-existing Causes of LLD through Clinical findings

Pre-existing Causes of LLD	Negative Ranks (Post-Op. Clinical LLD.(cm) < Pre-op Clinical LLD(cm))	Positive Ranks (Post-Op. Clinical LLD.(cm) > Pre-op Clinical LLD(cm))	Ties (Post-Op. Clinical LLD.(cm) = Pre-op Clinical LLD(cm))	Total
Avascular necrosis	20 (90%)	0	2 (10%)	22
Post traumatic arthritis	4 (80%)	0	1(20%)	5
Neck of femur fracture	8 (66.66%)	0	4 (33.34%)	12
Inflammatory arthritis	6 (100%)	0	0	6 (100%)
Sequelae of infective arthritis	5(100%)	0	0	5(100%)

Table 8: Mean Change in Limb Length Discrepancy in Pre-existing Causes of LLD through Radiological findings

Parameter	Pre-op Radiological	Post-Op. Radiological	Mean Difference	p-value
	Mean ± SD (Range)	Mean ± SD (Range)		
Avascular necrosis	0.459 ± 0.2085 (0-0.8)	0.086 ± 0.1320 (0-0.3)	0.3727	0.000
Post traumatic arthritis	0.420 ± 0.2588 (0-0.7)	0.100 ± 0.1414 (0-0.3)	0.3200	0.066

Neck of femur fracture	0.275 ± 0.1138 (0-0.5)	0.000 ± 0.0000 (0-0)	0.2750	0.002
Inflammatory arthritis	0.500 ± 0.1265 (0.3-0.7)	0.083 ± 0.1329 (0-0.3)	0.4167	0.026
Sequalae of infective arthritis	0.620 ± 0.3114 (0.3-1.0)	0.160 ± 0.1517 (0-0.3)	0.4600	0.042

Table 9: Distribution of Change in Limb Length Discrepancy in Pre-existing Causes of LLD through Radiological findings

Pre-existing Causes of LLD	Negative Ranks (Post-Op. Radiological LLD.(cm) < Pre-op Radiological LLD(cm))	Positive Ranks (Post-Op. Radiological LLD.(cm) > Pre-op Radiological LLD(cm))	Ties (Post-Op. Radiological LLD.(cm) = Pre-op Radiological LLD(cm))	Total
Avascular necrosis	20 (90%)	0	2 (10%)	22 (100%)
Post traumatic arthritis	4 (80%)	0	1(20%)	5 (100%)
Neck of femur fracture	11 (91.66%)	0	4 (8.34%)	12 (100%)
Inflammatory arthritis	6 (100%)	0	0	6 (100%)
Sequalae of infective arthritis	5(100%)	0	0	5 (100%)

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