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Different per-operative techniques to evaluate limb length discrepancy in hip arthroplasty.

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ABSTRACT… Objective: To assess the limb length discrepancy (LLD) among patients going through total hip arthroplasty using different per-operative techniques. **Study Design:** Cross-sectional study. **Setting:** Department of Orthopedic Surgery, Agha Khan University Hospital, Karachi, Pakistan. **Period:** 1st June 2023 to 30th December 2023. **Methods:** Trauma patients of both genders, aged less than 50 years, with inflammatory or non-inflammatory degenerative joint diseases, peri-prosthetic fractures, or Garden type 2, 3, or 4 neck of femur fractures, avascular necrosis of the hip or developmental dysplasia of the hip were analyzed. Following implant placement, the limb length discrepancy was assessed by either direct, indirect, or Judd pin method. The distance was compared with the contralateral side being the same if there had been no LLD. LLD was further categorized as type-I, II, III or IV as 0-5 mm, >5-10 mm, >10-15 mm, or >15mm, respectively. **Results:** In a total of 52 patients, 34 (65.4%) female and 18 (34.6%) male. The mean age was 63.02±7.74 years. The mean LLD was 3.40±3.90 mm. The LLD in indirect, Judd pin, and direct method were 4.16±5.06, 2.00±2.17, and 3.62±2.57, respectively. The LLD was ≤ 10 mm in 94.2% patients. **Conclusion:** The LLD in patients undergoing total hip arthroplasty seems acceptable in vast majority of the patients with respect to common approaches adopted for assessing the LLD.

Key words: Arthroplasty, Femur, Hip, Inflammatory, Limb.

INTRODUCTION

Limb length discrepancy (LLD) is a frequency occurrence following hip arthroplasty, and can impact an otherwise successful outcome. Leg length is anatomically described as the segment of the lower limb from the knee joint to the ankle mortise.[1] Different methods are in practice to described LLD. Anatomical classification assesses physical shortening from the head of the femur to the ankle mortise, and functional classification, which involves asymmetrical shortening without significant bony pathology.[2] A quantification system introduced by Reid and Smith categorizes LLD as mild (0 to 30 mm), moderate (30 to 60 mm), or severe (> 60 mm).[3]

During hip arthroplasty, it is essential to address limb discrepancy without compromising hip stability, aiming to facilitate normal gait function through appropriate hip joint biomechanics, femoral off-set, and limb length.[4] LLD is more noticeable when lengthening the operated limb compared to shortening.[5] Numerous techniques have been represented in the international literature to calculate limb length in total hip arthroplasty (THA) procedures.[6] The literature has reported the occurrence of LLD after primary hip arthroplasty to range from 1-27%, with variations in discrepancy from 3-70 mm and mean values ranging between 3-17 mm.[7-9]

LLD following THA is been associated with a variety of issues such as back pain, sciatica, neuritis, gait disorders, general dissatisfaction, dislocation, and early component loosening.[10-12] Given the importance of limb length equality, accurate assessment and management of LLD in THA are crucial to achieving optimal patient outcomes. Various methods are used to measure LLD, including direct tape measurement,

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radiological assessment, and pelvic leveling.[9-11]

There is a considerable lack of data from our part of the world comparing the outcomes of different per-operative techniques for assessing LLD in hip arthroplasties. Hip arthroplasties are performed regularly; LLD secondary to per-operative techniques have been reported in international literature[1,12], but are not practiced routinely in Pakistan. Therefore, this study was planned with the objective of assessing the LLD among patients going through total hip arthroplasty using different per-operative techniques. Results from this study would help orthopedic surgeons in Pakistan better decide which surgical technique to opt for with minimal LLD post-operatively.

METHODS

This cross-sectional study was accomplished at the Orthopedic Section, Department of Surgery, Agha Khan University Hospital, Karachi, Pakistan, during the period of 1st June 2023 to 30th December 2023. Approval from "Ethics Review Committee" was obtained (letter number: 2022-1274-23591, dated 15th December 2022). A sample size of 40 was calculated using an OpenEpi sample size calculator for proportional studies. Population size was kept at 1 million, the confidence limit at 5%, and the design effect at 1.0. The anticipated frequency of outcome, i.e., LLD, was kept to less than 5 mm.[13] A non-probability consecutive sampling technique was employed. Written as well as informed consents were acquired from the study participants or guardians. The inclusion criteria were trauma patients of both genders, aged less than 50 years, with inflammatory or non-inflammatory degenerative joint diseases, peri-prosthetic fractures, or Garden type 2, 3, or 4 neck of femur fractures on x-rays. Patients who had avascular necrosis of the hip or developmental dysplasia of the hip were also included. The exclusion criteria were patients who needed bilateral hip arthroplasty or a contralateral Girdlestone procedure. Those with scoliosis were also excluded.

Intra-operatively, the patient's position was supine or lateral, and the posterior approach "(Moore or Southern)" and the direct lateral approach "(Hardinge)", were performed. Following implant placement, the LLD was assessed by the performing surgeon himself. Three methods are commonly used in our setting. The Judd pin method involves inserting a suture from a Judd pin into the ilium just above the acetabulum to assess intraoperative leg length.[10] Direct method measured LLD by keeping the subject in the supine position, and measurement done between the "anterior superior iliac spine (ASIS)" and the medial malleolus of the ankle.[14] In indirect method, bony prominences (e.g., knee and heel) were palpated with the operative leg on top of the contralateral limb in lateral position, using the contralateral limb as a reference to check for any difference. The method's accuracy was scrutinized more by getting routine post-operative X-rays. On post-operative pelvis X-rays, LLD was evaluated by measuring the distance between the most prominent part of the lesser trochanter and ischial tuberosity. The distance was compared with the contralateral side being the same if there had been no LLD. LLD was further categorized as type-I, II, III or IV as 0-5 mm, >5-10 mm, >10-15 mm, or >15mm, respectively.[15] A special format was designed to record study data.

The data analysis utilized "IBM-SPSS Statistics," version 26.0. Continuous data such as age and leg length discrepancy (LLD), were presented as mean and standard deviation (SD). Qualitative variables like gender were expressed as frequencies and percentages. Statistical comparisons for continuous variables, including age and LLD, were performed using the independent sample t-test. Chi-square analysis was employed to compare categorical variables. $P<0.05$ was considered statistically significant.

RESULTS

Throughout the study duration, a total of 52 patients met the specified inclusion and exclusion criteria and were consequently subjected to analysis. There were 34 (65.4%) female and 18 (34.6%) male patients, representing female to male ratio of 1.9:1. The mean age was 63.02 ± 7.74 years, ranging between 48-75 years. There were 38 (73.1%) patients who were aged ≥ 60 years. The mean LLD was 3.40 ± 3.90 mm. Mean LLD by

different methods employed is shown in Figure-1.

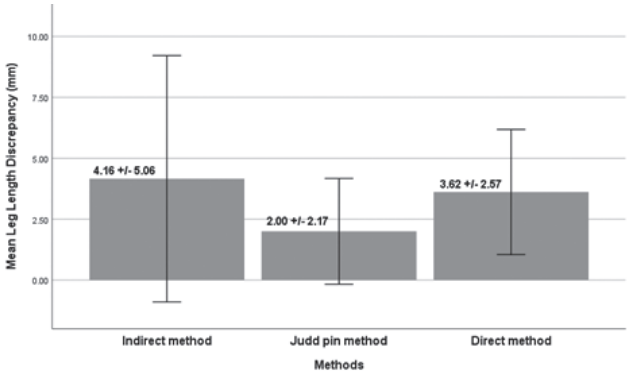

Figure-1. LLD with respect to different per-operative techniques

Comparison of different methods of LLD measurement with respect to LLD types showed statistically insignificant difference (p=0.361) and the details are shown in Table-I.

Leg Length Discrepancy Type	Methods			P-Value
	Indirect	Judd Pin	Direct	
Type-I	19 (79.2%)	14 (93.3%)	11 (84.6%)	0.361
Type-II	2 (8.3%)	1 (6.7%)	2 (15.4%)	
Type-III	3 (12.5%)	-	-	

Table-I. LLD with respect to different per-operative techniques

Comparison of mean LLD with respect to gender (p=0.0941) and age (p=0.962) distribution showed no statistically significant differences and the details are shown in Table-II.

Characteristics		Leg Length Discrepancy (mm) Mean±SD	P-Value
Gender	Male	3.34±2.88	0.941
	Female	3.43±4.39	
Age (years)	<60	3.44±3.88	0.962
	≥60	3.38±3.96	

Table-II. Comparison of mean leg length discrepancy with respect to gender and age

DISCUSSION

The LLD is considered to be an important complication of hip arthroplasty. The literature lacks a consensus on defining a "significant" LLD following hip arthroplasty.[16,17] In the present study, we observed LLD up to 10 mm (classified as type I or II LLD) constituting 94.2% of cases, while none of the patients had LLD above 15 mm. These findings are better than what was reported by Sathappan et al where 80% of the patients following total hip arthroplasty had LLD up to 10 mm.[15] Numerous authors advocate for maintaining the operated leg within 10 mm of the contralateral limb, a range believed to have minimal impact on gait functional parameters and generally result in satisfactory outcomes for the majority of patients.[18,19] Previous research suggests that leg length discrepancy (LLD) confirmed through radiographic assessment tends to correspond with patients' perceptions of a symptomatically longer or shorter limb. This correlation becomes notably apparent when the surgical limb is lengthened by 6 mm or shortened by 10 mm.[20]

Various methods, including full-length hip-to-ankle radiographs, ultrasound approaches, and "computed tomographic scanograms", are utilized for limb length measurement.[21,22] To maintain measurement accuracy, our study excluded patients with complex hip pathology, as hip position and pelvic obliquity can influence results. Despite some studies reporting differences in dislocation rates related with specific surgical methods, none have suggested major variations in LLD or cumulative post-surgery outcomes.[23-25] In a recent comparative analysis of postoperative LLD, which assessed three measurement techniques (direct intraoperative leg-to-leg comparison, measurement with a compass-like device with supra-acetabular fixation, and an intraoperative device measuring the trochanteric/joint ratio), findings indicated that LLD exceeding 5 mm was observed in 26% of the patients. Direct intraoperative leg-to-leg assessment exhibited the highest proportion of LLD exceeding 5 mm (31%), followed by the compass group (27%).[26]

The findings of this study were based entirely on the clinical assessment and radiological assessment of the operating surgeon, and findings may vary according to the expertise, experience, and acceptability of the per-

operative findings of the operating surgeon. Evidence-based data collection on per-operative techniques for assessing limb discrepancy can help in yielding better surgical outcomes if a monotonous technique with a minimum LLD is applied. (strength of the study).

CONCLUSION

The reported LLD in patients undergoing THA seems acceptable and comparable with the contemporary literature. No differences were observed in the yield of LLD with respect to common approaches adopted for assessing the LLD.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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REFERENCES

1. Vogt B, Gosheger G, Wirth T, Horn J, Rödl R. **Leg length discrepancy- treatment indications and strategies.** Dtsch Arztebl Int. 2020; 117(24):405-411. doi:10.3238/arztebl.2020.0405

2. Sabharwal S, Kumar A. **Methods for assessing leg length discrepancy.** Clin Orthop Relat Res. 2008; 466(12):2910-22. doi:10.1007/s11999-008-0524-9

3. Applebaum A, Nessim A, Cho W. **Overview and Spinal Implications of Leg Length Discrepancy: Narrative Review.** Clin Orthop Surg. 2021; 13(2):127-34. doi:10.4055/cios20224

4. Gupta R, Pathak P, Singh R, Majumdar KP. **Double-Stitch technique: A simple and effective method to minimize limb length discrepancy after total hip arthroplasty.** Indian J Orthop. 2019; 53(1):169-73. doi:10.4103/ortho.IJOrtho_188_18

5. Pradhan SS, Tripathy SK, Jain M, Behera H, Velagada S, Srinivasan A. **Impact of limb length discrepancy on functional outcome in total knee arthroplasty patients: A prospective cohort study.** Arthroplasty. 2022; 4(1):22. doi:10.1186/s42836-022-00123-w

6. Lambers AP, Marley MA, Jennings R, Bucknill A. **Accuracy of leg length and offset measurements during total hip arthroplasty using an imageless navigation system.** Cureus. 2023; 15(5):e38689. doi:10.7759/cureus.38689

7. Ranawat CS, Rodriguez JA. **Functional leg-length inequality following total hip arthroplasty.** J Arthroplasty. 1997; 12(4):359-64. doi:10.1016/s0883-5403(97)90190-x

8. Rand JA, Ilstrup DM. **Comparison of Charnley and T-28 total hip arthroplasty.** Clin Orthop Relat Res. 1983; (180):201-205.

9. Turula KB, Friberg O, Lindholm TS, Tallroth K, Vankka E. **Leg length inequality after total hip arthroplasty.** Clin Orthop Relat Res. 1986; (202):163-68.

10. 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. doi:10.1007/s12178-013-9180-0

11. Dundon JM, Mays RR. **Revising substantial leg length discrepancy in total hip arthroplasty using computer-assisted navigated systems: A case series of three patients.** Cureus. 2019; 11(7):e5137. doi:10.7759/cureus.5137

12. Waibel FWA, Berndt K, Jentzsch T, Farei-Campagna J, rahm S, Dora C, et al. **Symptomatic leg length discrepancy after total hip arthroplasty is associated with new onset of lower back pain.** Orthop Traumatol Surg Res. 2021; 107(1):102761. doi:10.1016/j.otsr.2020.102761

13. Stathopoulos IP, Andrianopoulos N, Paschaloglou D, Lampropoulou-Adamidou K, Spetsaki M, Tsarouchas IK. **A new method for intraoperative assessment of leg length, sizing and placement of the components in total hip replacement.** Eur J Orthop Surg Traumatol. 2020; 30(4):689-94. doi:10.1007/s00590-019-02621-1

14. Jamaluddin S, Sulaiman AR, Imran MK, Juhara H, Ezane MA, Nordin S. **Reliability and accuracy of the tape measurement method with a nearest reading of 5 mm in the assessment of leg length discrepancy.** Singapore Med J. 2011; 52(9):681-84.

15. Sathappan SS, Ginat D, Patel V, Walsh M, Jaffe WL, Di Cesare PE. **Effect of anesthesia type on limb length discrepancy after total hip arthroplasty.** J Arthroplasty. 2008; 23(2):203-09. doi:10.1016/j.arth.2007.01.022

16. Smolle MA, Fischerauer SF, Maier M, Reinbacher P, Friesenbichler J, Ruckenstuhl P, et al. **Leg length measures appear inaccurate in the early phase following total hip arthroplasty.** Sci Rep. 2021; 11(1):23262. doi:10.1038/s41598-021-02684-3

17. Abouelela A, Mubark I, Nagy M, Hind J, Jayaumar N, Ashwood N, et al. **Limb length inequality in patients after primary total hip arthroplasty: Analysis of radiological assessment and influencing risk factors based on a district general hospital experience of 338 cases.** Cureus. 2021; 13(11):e19986. doi:10.7759/cureus.19986

18. Tripathy SK, Pradhan SS, Varghese P, Purudappa PP, Velagada S, Goyal T, et al. **Limb length discrepancy after total knee arthroplasty: A systematic review and meta-analysis.** World J Clin Cases. 2021; 9(2):357-71. doi:10.12998/wjcc.v9.i2.357

19. Doehrmann R, Comer BJ, Chatterji R, Diedring B, Knapp P, Afsari A. **Accuracy of leg length and hip offset measurements using a fluoroscopic grid during anterior approach total hip arthroplasty.** Arthroplast Today. 2023; 22:101154. doi:10.1016/j.artd.2023.101154

20. Konyves A., Bannister G.C. **The importance of leg length discrepancy after total hip arthroplasty.** J Bone Joint Surg Br. 2005; 87:155-57. doi: 10.1302/0301-620x.87b2.14878

21. Zak L, Tiefenboeck TM, Wozasek GE. **Computed tomography in limb salvage and deformity correction-3D assessment, indications, radiation exposure, and safety considerations.** J Clin Med. 2021; 10(17):3781. doi:10.3390/jcm10173781

22. Greatrex F, Montefiori E, Grupp T, Kozak J, Mazzà C. **Reliability of an integrated ultrasound and stereophotogrammetric system for lower limb anatomical characterisation.** Appl Bionics Biomech. 2017; 2017:4370649. doi:10.1155/2017/4370649

23. Ritter MA, Harty LD, Keating ME, Faris PM, Meding JB. **A clinical comparison of the anterolateral and posterolateral approaches to the hip.** Clin Orthop Relat Res. 2001; (385):95-99. doi:10.1097/00003086-200104000-00016

24. Roberts JM, Fu FH, McClain EJ, Ferguson AB Jr. **A comparison of the posterolateral and anterolateral approaches to total hip arthroplasty.** Clin Orthop Relat Res. 1984; (187):205-10.

25. Horwitz BR, Rockowitz NL, Goll SR, Booth Jr RE, balderston RA, Rothman RH, et al. **A prospective randomized comparison of two surgical approaches to total hip arthroplasty.** Clin Orthop Relat Res. 1993; (291):154-63.

AUTHORSHIP AND CONTRIBUTION DECLARATION

No.	Author(s) Full Name	Contribution to the paper	Author(s) Signature
1	Pervaiz Hashmi	Critical revisions, Drafting, Responsible for data.	
2	Wajahat Alam	Concept and Designing, Proof reading, Critical revisions.