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Leg Length Discrepancy Following Primary Hip Arthroplasty: A Comparison between two different procedures; Hemiarthroplasty and Total Hip Arthroplasty.

Abdul Rakib Al-Mirah[1], Abdullah Ali Almoaish[1], Myat Moe Thwe Aung[1], Atif AB[2], Naghem Farouk Abed[2], TarikIbrahem Ali[3], and Wisam A Yassin[2]*.

[1]Orthopaedic Department – 48 Model Hospital, Raiz St, SawdHezeaz Road, Box 17887, Sana`a, 00967 Yemen
[2]Faculty of Medicine, University Sultan Zainal, Jalan Sultan Mahmud, 20400 Kuala Terengganu, Malaysia
[3]Faculty of Medicine & Defense Health-National Defense University Malaysia (UPNM). Kem Sungai Besi, 57000 Kuala Lumpur, Malaysia

ABSTRACT

Orthopaedic surgeons still concerned about the development of discrepancy in patient`s leg length following hip arthroplasty as it is a common reason for litigation against them. Consequently, this cross-sectional study evaluated and compared the leg length discrepancy (LLD) between two different procedures of primary hip arthroplasty; Hemi- and total hip arthroplasty (THA). During the period from January 2012 to December 2014, twenty-six patients underwent these surgeries and all were conducted by the same principal orthopaedic surgeon. This is to eliminate the errors which were recorded in the statistics of many studies and explained by the participation of more than one surgeon. The direct clinical method was the method of measurement. Our results showed that the overall postoperative LLD was lengthened with a mean of 2.69 mm (range, -20 to 30 mm). There was no significant statistical difference between LLD after hemiarthroplasty and THA (P value, 0.702). Keeping in mind the limited number of the respondents, we concluded that, in this study, the type of hip arthroplasty procedure has no influence on the prevalence of postoperative LLD.
Keywords: Discrepancy; Hemiarthroplasty; Leg Length; Limb Length; Total Hip Arthroplasty.

Corresponding author

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INTRODUCTION

Hip arthroplasty is one of the most common in use orthopaedic surgeries. Since the commencement of these surgeries, there is a constant improvement in their outcomes due to the new advances in the implemented materials, operative techniques and planning methods. Although these operations aim to relieve pain and restore functions, surgeons are serious about maintaining equalisation of limb lengths to avoid a well-known complication; leg length discrepancy (LLD). However, avoiding LLD without compromising hip stability is regarded as one of the intra-operative challenges in hip arthroplasty (HA)[1]. The general assumption is that increased length translated directly into increased stability. According to The Joint Commission, LLD following HA is a major adverse event and counted about 4.7% of medical errors [2]. LLD has been described as shortening or lengthening of a limb beyond normal anatomy so the leg is either shorter or longer than the contralateral limb [3]. This definition assumes that the contralateral limb has no pathology. The LLD can be conceptually divided into two main categories; structural and functional [4]; in some patients, both are present [5]. Most studies of a large group of people showed that approximately 30% of the population have a discrepancy between 10 and 20 mm. LLD is common after HA and the majority of patients can tolerate up to 10 mm of discrepancy and most of them remark lengthening more than shortening [1]. In some patients, however, even such minor discrepancies are a source of dissatisfaction. A different study reported different prevalence, mean and range of LLD. Most reports indicated its occurrence to be about 2.0% to 2.5% of cases and more likely to follow lengthening exceeds 25 mm; Ranawat et al, have reported it ranged from 1% to 27 % [6].Djerf and Wahlstrom did emphasize that up to 50 % of their patients developed LLD after THA [7]. Love and Wright stated that up to 18 % of their studied patients developed lengthening of more than 15 mm, of whom 6 % needed shoe correction [8].Edeen et al [9] stated that patients of their series who were aware of LLD counted up to 32% with an average of 15 mm discrepancy and in the literature; LLD was reported to vary from 3 - 70 mm [10] with a mean between 3 and 17 mm [11]. A small LLD may produce no symptoms or may be unrecognised by the patient while a large discrepancy may cause several complications such as a low backache, patient`s dissatisfaction, nerve palsy, abnormal gait, sciatica and neuritis [12], hip instability [12, 13],dislocation [14] and early loosening of components [15]. In actual, partial or complete sciatic nerve palsy following limb`s over lengthening is the most apprehended drawback. Its prevalence may reach as high as 13% after primary hip replacement [16]. Very few similar studies have been reported in this geographical region and not well documented. This study specifically assessed the LLD following primary HA between two different types of surgical procedures; hemiarthroplasty and total hip arthroplasty (THA). We intended to analyse this LLD which developed in our hospital`s patients after surgeries conducted by the same principal surgeon. This is to avoid statistical bias, which has been observed because of surgeries being performed not by the same surgeon.

MATERIALS AND METHODS

This cross-sectional study was conducted between January 2012 to December 2014 in the main referral hospital in the Sana`a - Republic of Yemen after obtaining an approval from the institutional Ethical Committee. The study included 20-year-old and above patients, with a unilateral hip problem, underwent unilateral primary hip replacement without postoperative dislocation or subluxation. All surgeries were in accordance with the ethical standards of the responsible institutional committee on human experimentation and with the Helsinki Declaration of 1975, as revised in 2000. Those who had previously hip arthroplasty, medical calcar bone loss, revision hip replacement, pathology of contralateral hip, angular deformity of hip or spine or flexion contraction of hip or knee joint were excluded from this study. Out of thirty-nine primary HA surgeries, performed during the study period, twenty-sixpatients met the inclusion criteria of the study and all of them have been operated by the same principal orthopaedic surgeon with two assistants. With the patient in a supine position, the length of each lower extremity was measured by both the direct (true) and the apparent method, using a measurement tape. In the first method, the limb length was measured on each side from the anterior superior iliac spine to the medial malleolus and is referred to as the “direct clinical method.” While the second method encompassed the measurement of the length of the lower limb from the umbilicus to the medial malleolus in each side and referred to as “apparent method”. We considered the LLD as the difference between the length of the affected side and that of the normal one depending on the direct clinical method only, while the apparent length measurements were recorded as an additive information. LLD was assessed by using the clinical (not radiographic) measurement alone because it is still be used by many surgeons at discrete areas in the world till now. Preoperatively, we measured the lower limbs length of both sides for each patient and classified the results into equal, lengthening and shortening by comparing the

affected side length to the normal side. Then, we repeated these measurements postoperatively and finally, we compared the postoperative overall mean LLI between these two techniques.

All surgeries used the standard lateral approach. The used implants were uncemented fully Hydroxyapatite - coated stem (Corail, DePuy Int. Ltd, Leeds, UK), with porous coated un-cemented cup (PINNACLE, Depuy Int. Ltd, Leeds, UK). The cemented femoral stem was fully polished, stainless steel (Corail, DePuy Int. Ltd, Leeds, UK). All acetabular components were un-cemented. In order to reduce intra-observer errors, a researcher assistant who was not involved in the surgical procedures measured the true and the apparent lengths both pre- as well as postoperatively. The postoperative clinical measurements of both methods were done immediately after the operation when the patient was still on the operating table and on the 2nd postoperative day. Then the average value was considered and documented.

Data Analysis

Statistical program for social science (SPSS) version 22 was used for data entry and analysis. Descriptive statistics were applied such as frequency and percentage (%) for qualitative data while mean and standard deviation (SD) for quantitative data. Independent t-test was applied and the level of significance (α) of $p < 0.05$ was set for this study.

RESULTS

There were 13 (50%) male and 13 (50%) female patients aged between 20 and 78 years old. Right hip arthroplasty ratio was equal to the left side and constituted 13 (50%) for each side. This study reflected that, 14 (53.8%) patients presented with femoral neck fracture, 5 (19.2%) osteoarthritis, 3 (11.5%) developmental dysplasia, 2 (7.7%) avascular necrosis, 1 (3.8%) with rheumatoid arthritis and 1 (3.8%) post-traumatic arthritis [Table 1].By direct clinical measurement method, preoperatively, 3 (11.5%) patients had longer limb on the affected side, 19 (73.1%) patients had a shorter limb, whereas only 4 (15.4%) patients had equal legs lengths. Post-operatively, we found that the majority of cases 11 (42.3%) were with equal leg lengths, 10 (38.5%) developed lengthening, and 5 (19.2%) developed shortening [Table 2].In respect to a comparison between two different types of arthroplasty and according to the true length measurement, there was no significant difference in the overall mean LLD preoperatively ($p = 0.446$) as well as postoperatively ($p = 0.702$) [Table 3].

Table 1: Demographic and clinical characteristics of patients (n= 26)

Characteristics	Frequency (%)	Mean (SD)
Gender		
Male	13 (50.0)	
Female	13 (50.0)	
Age (years)		49.50 (16.74)*
Side		
Left	13 (50.0)	
Right	13 (50.0)	
Diagnosis		
Femoral neck fracture	14 (53.8)	
Osteoarthritis	5 (19.2)	
Dysplasia	3 (11.5)	
Osteonecrosis	2 (7.7)	
Rheumatoid arthritis	1 (3.8)	
Post-traumatic osteoarthritis	1 (3.8)	
Type of operation		
THA	19 (73.1)	
Hemi-arthroplasty	7 (26.9)	

*Minimum = 20 years old; Maximum = 78 years old

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Table 2: Preoperative and Postoperative LLD (n=26)

Measurement in mm	Preoperative LLD			Postoperative LLD		
	Lengthening	Shortening	Equal	Lengthening	Shortening	Equal
n	3	19	4	10	5	11
(%)	(11.5)	(73.1)	(15.4)	(38.5)	(19.2)	(42.3)
Minimum	10.00	-10.00	0.00	10.00	-10.00	0.00
Maximum	20.00	-60.00	0.00	30.00	-20.00	0.00
Mean	13.33	-21.58	0.00	15.00	-16.00	0.00
SD	5.77	12.59	0.00	7.07	5.48	0.00
Overall mean	-14.23			2.69		

Table 3: Preoperative and Postoperative LLD in hemi-arthroplasty and THA (n =26)

Measurement in mm		Type of arthroplasty				*t* statistics (df)	*P* value*
		Hemi-arthroplasty n = 7 (26.9%)		THA n = 19 (73.1%)			
		Mean	SD†	Mean	SD†		
Preoperative LLD	**Overall**	-10.00	12.91	-15.79	18.05	-0.774 (24)	0.446
	Lengthening	-	-	15.00	7.07	0.577 (1)	0.667
	Shortening	-16.00	8.94	-23.57	13.36	-1.166 (17)	0.260
	Equal	-	-	-	-	-	-
Postoperative LLD	**Overall**	4.29	7.87	2.11	13.98	-0.387 (24)	0.702
	Lengthening	15.00	7.07	15.00	7.56	0.000 (8)	>0.950
	Shortening	-	-	-16.00	5.48	-	-
	Equal	-	-	-	-	-	-

***Independent t-test. †Standard deviation. (-) Couldn`t be determined.**

DISCUSSION

LLD after HA is a problem often encountered by orthopaedic surgeons. Although apparent LLD will resolve with time while true LLD will persist and, if severe, give rise to patient`s dissatisfaction. Literatureemphasised, lengthening not, shortening, is more common [9, 17].Most of the authors who studied LLD after HA used the radiographic measurements as the gold standard method for its higher accuracy than the physical measurement [1, 18].Although, it considered more accurate and reliable than physical measurement, it still has its limitation of variation of the pelvic positioningwith respect to the x-ray film and variations in the relative magnification due to the differences of distance from the x- ray tube. However, an interesting study evaluated the reliability and accuracy of the tape measurement method in assessing LLD. They compared between two measurement methods; tape measurement with the CT scanogram measurement and found that there was a good correlation between them. Hence, they concluded that using tape measure is reliable and accurate [19].This study found that femoral neck fracture was the indication for HA in the majority of cases 14 (53.8%) [Table 1]. This ratio varies from results of Aaronand colleagues [20],showedthat the ratio of the underlying problem of their patients was as follows; osteoarthritis (64%), avascular necrosis (10%), dysplasia (4%), rheumatoid arthritis (3%), trauma/fracture (3%), and Perthes disease (2%). This variation is because our study was carried out in a hospital which has a traumacentre; hence femoral neck fracture is a common referral case. Most of them were neglected cases and they initially were treated traditionally due to their fear of operation. Over the whole sample, preoperatively, we found that most of the patients 19 (73.1%) developed shortening in their affected side with a mean of -21.58 mm and a range of (- 10 to – 60 mm) [Table 2]. This may be explained by the majority of our respondents presented for femoral neck fracture with shortening of their affected legs. This may also explain the high rate of limbs equalisation postoperatively by gaining length. These results were comparable to results stated by A. Konyves and G. C. Bannister [18] who used radiographic measurement. They revealed that, before the operation, most of their

studied patients 65 (71%) had shortening,18 (20%) had lengthening and 8 (9%) had equal legs lengths. {The overall mean was 5.7 mm (-40 to 16 mm)}.On the other hand, the current study found that the number of patients who have elongated leg on the affected side was increased from3 (11.5%) preoperatively to 10 (38.5%) postoperatively and patients with an equal extremity length have increased from 4 (15.4%) to 11 (42.3%) patients. There was a noticeable drop off patients` number with shortening from 19 (73.1%) to 5 (19.2%) [Table 2]. In comparison, A. Konyves and G. C. Bannister [18] have reported that the number of their patients with leg lengthening have increased from 18 (20%) to 56 (62%) while those with equal legs have reduced from 8 (9%) to 5 (6%) patients. Their patients with shortening have also reduced from 65 (71%) to only 29 (32%) patient. Besides, the current study revealed that the overall post-operative LLD was lengthened with a mean of 2.69 mm and ranged between -20 to 30 mm [Table 2]. This outcome was close to the finding of A. Konyves`s [18] study, which stated that there was alsoa lengthening with a mean of 3.5 and a range of -22 to 27 mm. Likewise, WoolsonST [21]studied a consecutive series of 84 patients underwent primary total hip replacement and stated that the mean postoperative LLD was 2.8 mm. 75 patients (89%) had ≤ 6 mm postoperative discrepancy, 6 patients (7%) got a discrepancy of 7 - 13 mm, and only 3 patients (4%) had > 13 mm leg length difference. Only 2 patients (2.5%) lengthened more than 6 mm. Woolson and colleagues [22] followed up with a larger study sample (351 patients) and obtained better results. They used radiographic measurement and found that the mean postoperative LLD was only 10 mm, 97% of them had < 1 mm LLD and 86% developed < 6 mm discrepancy. They used a precise preoperative templating method that relies on replacing the amount of femoral head and neck and remaining joint cartilage that is removed with prosthetic implants that have the same height in order to attain equal leg lengths. This attention to the precise measurement during templating was the focus of their technique. By contrast, our results were higher than the results obtained by Aaron`s study [20]. He determined whether significant LLD (>6 mm) can be minimised with the use of an intraoperative X-ray. In each case, preoperative templating was carefully performed, an intraoperative pelvic X-ray was obtained to assess accuracy, and appropriate adjustments were made. An 86 consecutive primary THA and their associated X-rays were retrospectively reviewed. He found that the mean postoperative LLD was only 0.3 mm lengthening (range –6 to +6 mm) and concluded thata significant LLD can be minimised by the use of an intraoperative pelvic X-ray. This divergence in results could be attributed to the non-usage of standardized anteroposterior (AP) x-ray of the pelvis and both hips, which provide a proper measurement for templating as it used by Aaron et al [20].Our study revealed that within the hemiarthroplasty group and before the operation, there was only one case developed lengthening (10 mm) hence its mean value could not be determined. Likewise, we could not determine it for postoperative shortening as there was no shortening case. In the hemiarthroplasty group, an overall mean of postoperative LLD was -10 mm preoperatively and 4.29 mm postoperatively. While in THA group, it was -15.79 mm and 2.11 mm before and after operation respectively. We found that post-operatively, there was no significant difference in the overall mean LLD between these two groups (P = 0.702) [Table 3].White and Dougall [23] revealed that leg length is not critically important. They prospectively studied 200 patients underwent unilateral THA. Results showed no statistical association between LLD and functional outcome or patient satisfaction. Their study group included 41 patients with a lengthening of more than 10 mm. Despite this result, it seems that most surgeons continue to try to maintain equal leg lengths after hip arthroplasty. Ranawat and colleagues [1] placed a pin in the infracotyloid groove to assist with intraoperative leg-length determination and reported a postoperative LLD of 1.9 mm, but still 11% of cases were lengthened more than 6 mm. The range reported in their study was –7 to +8 mm.

CONCLUSION

In conclusion, total hip arthroplasty is a safe, effective and reproducible treatment for variable traumatic and pathological conditions of the hip joint. Despite all orthopaedics surgeons` attempts, it is impossible to eliminate LLD after THA. It can be minimisedby preoperative planning, including templating, and executing the plan in the operating room using intraoperative cues that help to ensure accomplishment of planned goals. This study showed that there was no significant difference in LLD between hemiarthroplasty and THA hence, we concluded that, in this study, the type of HA procedure has no impact on the prevalence and extent of postoperative LLD.

The current study has some limitations, which need to be considered when interpreting our results. The number of patients was limited (26) because this study aimed to analyse LLD following primary HA conducted by the same principal surgeon. In addition, many patients were excluded because they did not fit the inclusion criteria. Furthermore, differences in the girth of the two limbs, and the difficulty in identifying the

bony prominences may contribute to errors in using this clinical measurement tool. We did our best to reduce this error by performing a strict technique of measurement.

We recommend the perioperative clinical and radiographical measurements to reduce this discrepancy. Besides, informing the patient about the risk of LLD in advance will avoid patient`s surprise and consequent medico-legal action.

ABBREVIATIONS USED

1. Leg length discrepancy **(LLD).**
2. Hip arthroplasty **(HA).**
3. Total hip arthroplasty **(THA).**

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REFERENCES

[1] Ranawat CS, Rao RR, Rodriguez JA, Bhende HS. Correction of limb-length inequality during total hip arthroplasty. J Arthroplasty.2001;16(6): 715-20.
[2] Herndon J. One more turn of the wrench. J Bone Joint Surg Am. 2003; 85: 2036–48.
[3] Unequal Leg Length. The leg is too long (usually). Available at: http://www.totaljoints.info/Long_leg_TH.htm. Accessed December 17, 2003.
[4] Abraham WD, Dimon JH III, . Leg length discrepancy in total hip arthroplasty. OrthopClin North Am. 1992 Apr; 23(2): 201-9.
[5] Vincent Y. Ng, John R. Kean, Andrew H. Glassman. Limb-Length Discrepancy After Hip Arthroplasty.J Bone Joint Surg Am, 2013 Aug 07; 95 (15): 1426 -36.
[6] Ranawat CS, Rodriguez JA. Functional leg-length inequality following total hip arthroplasty. J Arthroplasty. 1997 Jun; 12(4): 359–64.
[7] Djerf K, Wahlstrom O. Total hip replacement comparison between the Mckee-Farrar and Charnley prostheses in a 5-year follow-up study. Arch Orthop Trauma Surg. 1986; 105: 158–62.
[8] Love BRT, Wright K. Leg length discrepancy after total hip replacement. Proceedings of Australian Orthopaedic association. J Bone Joint Surg Br. 1983; 65: 103.
[9] Edeen J, Sharkey PF, Alexander AH. Clinical significance of leg-length inequality after total hip arthroplasty. Am J Orthop (Belle Mead NJ). 1995 Apr; 24(4): 347-51.
[10] Sathappan SS, Ginat D, Patel V, Walsh M, Jaffe WL, Di Cesare PE. Effect of anaesthesia type on limb length discrepancy after total hip arthroplasty. J Arthroplast. 2008; 23: 203–9.
[11] TurulaKB, Frieberg O, Lindholm S, Tallroth K, Vankka E. Leg length inequality after total hip arthroplasty. ClinOrthopRelat Res. 1986; 202: 163–8.
[12] Mihalko WM, Philips MJ, KrackowKA. Acute sciatic and femoral neuritis following total hip arthroplasty. J Bone Joint Surg Am. 2001; 83: 589–92.
[13] Clark CR, Huddleston HD, Schoch EP, Thomas BJ. Leg-length discrepancy after total hip arthroplasty. J Am AcadOrthop Surg. 2006 Jan; 14(1): 38–45.
[14] Woo RYG, Morrey BF. Dislocations after total hip arthroplasty. J Bone Joint Surg Am. 1982; 64: 1295–306.
[15] Amstutz HC, Ma SM, Jinnah RH, Mai L. Revision of aseptic loose total hip arthroplasties. ClinOrthopRelat Res. 1982; 170: 21–33.
[16] Schmalzried TP, Amstutz HC, Dorey FJ. Nerve palsy associated with total hip replacement. Risk factors and prognosis. J Bone Joint Surg Am. 1991 Aug; 73(7): 1074-80.
[17] Williamson JA, Reckling FW. Limb length discrepancy and related problems following total hip replacement. ClinOrthopRelat Res. 1978 Jul-Aug; 134:135–8.
[18] Konyves A, Bannister GC. The importance of leg length discrepancy after total hip arthroplasty. J Bone Joint Surg Br. 2005 Feb; 87(2): 155-7.
[19] 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 Sep; 52 (9): 681-4.

[20] Aaron A. Hofmann, Michael Bolognesi, Amit Lahav, Stephen Kurtin. Minimizing Leg-Length Inequality in Total Hip Arthroplasty: Use of Preoperative Templating and an Intraoperative X-Ray. Am J Orthop. 2008; 37(1): 18-23.
[21] Woolson ST. Leg length equalization during total hip replacement.Orthopedics. 1990;13(1):17-21.
[22] Woolson ST, Hartford JM, Sawyer A. Results of a method of leg-length equalization for patients undergoing primary total hip replacement. J Arthroplasty. 1999;14(2):159-164.
[23] White TO, Dougall T W. Arthroplasty of the hip. Leg length is not important. J Bone Joint Surg Br. 2002 Apr; 84(3): 335-8.