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A study to assess leg length discrepancy and functional outcome after total hip replacement

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Abstract

Introduction: Pelvic radiographs are helpful in assessing limb-length discrepancy (LLD) before and after Total Hip Replacement (THR), but are subject to variation. Different methods are used to determine LLDs. As a pelvic reference, both ischial tuberosities and the teardrops are used, and as a femoral reference, the lesser trochanter and center of the femoral head are used.

Methods: We evaluated 20 cases undergoing THR for degenerative arthritis at BGS GIMS Kengeri from July 2022 to January 2024. Radiological assessment was done for LLD using digital x-rays preoperatively and postoperatively (On digital X-ray AP view of hip, a line is drawn at the level of & parallel to inter teardrop area and intersecting the lesser trochanter on each side. Compare 2 points of intersection & measure difference to determine the amount of limb discrepancy). Functional assessment was done using Harris hip score.

Results: The majority (12 of 20; 60%) of limbs were lengthened in the course of THR. Before the surgery, leg length discrepancy of involved hip ranged from -2.1cm to 0 cm (mean, 0.865cm short) compared with unaffected side. After reconstruction, the leg length discrepancy ranged from -0.2 cm to 1.9cm (mean, 0.01 cm). The mean increase in leg length after surgery was 0.845cm.

Harris hip score preoperatively was poor in 11, fair in 9, which had improved post operatively to good in 11, fair in 7 and poor outcome in 2 patients. At 1 year follow up Harris hip score was excellent in 7, good in 9, fair in 2 and poor in 2 patients.

Conclusion: Use of radiological measurement of Limb Length Discrepancy using inter teardrop as pelvic reference and lesser trochanter as femoral reference is a reliable and cost effective method.

Keywords: THR-Total hip replacement, LLD-Limb length discrepancy, Digital X-ray

Introduction

The main objectives of total hip arthroplasty are, in order of priority, pain relief, stability, mobility, and equal leg length. If lengthening of the limb provides a substantially more stable hip, the discrepancy is preferable to the risk of recurrent dislocation.

Ideally, the leg lengths should be equal after total hip arthroplasty, but leg length is difficult to determine accurately at the time of surgery. Over lengthening is more common than a residually shortened leg, and a lengthened limb is more poorly tolerated.

Vast majority of limb inequality is due to lengthening, ranging from 3 mm to 16mm [1, 2]. Jastey [3] reported 16% patients had a lengthening more than 5 to 10mm. Ranawat [4] reported 13% patients had a lengthening greater than 6 mm. If lengthening exceeds 2.5 cm, sciatic palsy and limping with a vaulting-type gait may result.

The functional significance of leg-length inequality after total hip arthroplasty has not yet been well defined. Leg lengthening of more than approximately 1 cm frequently is a source of significant patient dissatisfaction despite an otherwise technically satisfactory operation, and the commonly used hip rating systems vastly underestimate the degree of dissatisfaction. Lengthening may result from insufficient resection of bone from the femoral neck, from use of a prosthesis with a neck that is too long, or from inferior displacement of the center of rotation of the acetabulum.

Careful preoperative templating should alert the surgeon to this possibility, and arrangements should be made for implants that allow reproduction of the patient's natural offset and appropriate soft tissue tensioning without over lengthening of the limb.

Multiple intraoperative methods of limb-length determination have been described using transosseous pins placed above and below the hip joint and a measuring device between the pins. Ranawat *et al.* [6] used a pin below the infracotyloid groove and measured the distance between it and a mark on the greater trochanter.

The radiological assessment gives fair degree of limb inequality measurements. Different methods are used to determine LLDs. As a pelvic reference, both ischial tuberosities and the teardrops are used, and as a femoral reference, the lesser trochanter and center of the femoral head are used.

The risk of excessive leg lengthening can be minimized by a combination of careful preoperative planning and operative technique. Edeen *et al.* [5] found that clinical measurements of leg lengths correlated with radiographic measurements to within 1 cm in only 50% of patients.

This study is conducted to assess the short term outcome of Total hip replacement in degenerative arthritis in terms of

1. Estimating leg length discrepancy pre and post op in Total hip replacement using digital X-ray.
2. Harris Hip Score to measure clinical outcome at pre op, post op, 6 weeks and 3 months, 6 months and 1 year post operatively.

Materials and Methods

Source: It is Observational Cross-sectional study done on Patients of age more than 20yrs of either sex who have chronic symptoms of degenerative arthritis fitting inclusion criteria after excluding those who meet exclusion criteria were chosen among the outpatients at the Orthopaedic Department of BGS GIMS Kengeri during July 2022 to January 2024

Methods of collection of data: After obtaining valid consent, the complete data was collected from the patients by taking history, detailed clinical examination and relevant investigations. All cases with TOTAL HIP replacement were evaluated for limb length using the proposed criteria. Following consent and surgery, patients were followed up at regular intervals. Details were noted in a pre-formatted proforma and the data analyzed.

Inclusion Criteria

1. Patients of age more than 20yrs & of either sex
2. X Ray of the patient's hip must show well established arthritic changes

Exclusion Criteria

1. Patients less than 20 yrs age.
2. Patients unwilling to consent for the study.
3. Patients medically unfit for major surgery.
4. Patients with clinically detectable focus of active infection.

Results

The majority (12 of 20; 60%) of limbs were lengthened in the course of THR. Before the surgery, leg length discrepancy of involved hip ranged from -2.1cm to 0 cm (mean, 0.865cm short) compared with contralateral side.

After reconstruction, the leg length discrepancy ranged from -0.2 cm to 1.9cm (mean, 0.01 cm). The mean increase in leg length after surgery was 0.845cm. Postoperatively, 17 of 20

hips (85%) were within +/- 5mm of the contralateral limb. In the 12 patients with increased leg length, 1 perceived this at 3 months post operatively.

Harris hip score preoperatively was poor in 11, fair in 9, which had improved post-operatively to good in 11, fair in 7 and poor outcome in 2 patients. At 1 year follow up harris hip score was excellent in 7, good in 9, fair in 2 and poor in 2 patients.

Even at 1 year follow up, one patient had poor outcome because of ankylosing spondylitis of spine, while the other patient had bilateral hip involvement.

Discussion

Besides relieving the hip and thigh pain, restoration of the hip joint biomechanics with femoral offset and leg length as normal as possible is an important goal of THR. Many techniques to measure these two parameters intraoperatively have been thoroughly discussed in the literature [6].

Leg length discrepancy after THR has been associated with general dissatisfaction as well as other complaints, e.g. gait disorders, suspected aseptic loosening, greater trochanteric pain and nerve palsy. However, the magnitude of a clinically significant LLD after THR is still a matter of debate and controversy among many authors.

Several strategies have been described to assess LLD using different clinical and radiological methods. The degrees of precision and validity of certain methods such as computed tomography (CT) scanogram, X-ray scanogram and magnetic resonance imaging (MRI) scanogram are well documented.

Unfortunately, the above mentioned methods cannot be routinely used in THR patients due to the high cost as well as the artefacts encountered with the MRI scanogram because of the presence of a metal in the field of radiation.

It is quite common to use an AP view of a plain radiograph of the pelvis when templating for THR. The measurement of LLD on this view as the distance between a line passing through the lower margin of teardrop points to the tip of the lesser trochanter was described and used by many authors [6, 11, 13]. This method has been reported to be as reliable as orthoroentgenograms.

The inter-observer reliability of this method was tested by Woolson *et al.* [13] and found to be high (0.5 mm) while the intra-observer reliability was tested by White & Dougall [11] and found to give a measurement error of ± 1 mm. Goodman *et al.* [33] recommended the use of the teardrop points as a landmark for measurements rather than other points in the pelvis because the vertical position of the teardrop points is not affected significantly by rotation of the pelvis.

In our study 85% of the patients post operatively had LLD within 5mm of the non operated leg. At one year follow up 45% had excellent and 35% had good functional outcomes. Our results are comparable to most studies in the literature.

The limitation of this study is lack of a control group, less sample size and less follow up period.

The following observations were made from the data collected during the study.

Table 1: Age of the patients.

		Frequency	Percentage
Age category	<40 yr	9	45.0%
	>40 yr	11	55.0%

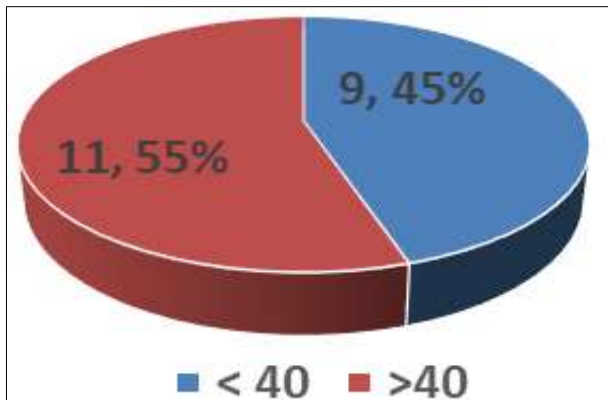


Fig 1: Age distribution

In our study, total nine (45%) patients were <40 yrs of age, and eleven (55%) patients were >40 yrs of age. Mean age was 42.8.

Table 2: Sex distribution.

		Frequency	Percentage
Sex	Female	8	40.0%
	Male	12	60.0%

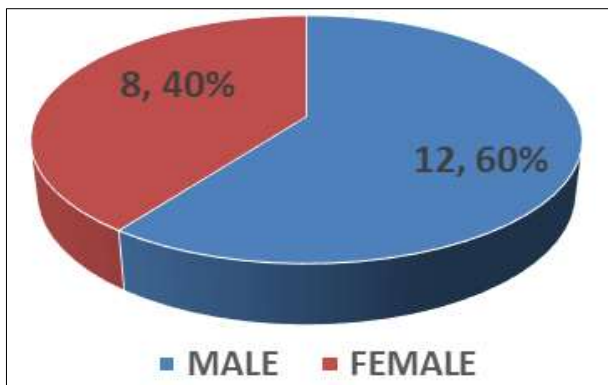


Fig 2: Sex distribution.

Table 3: Side of involvement

Side	Count	Column N %
Left	13	65.0%
Right	7	35.0%

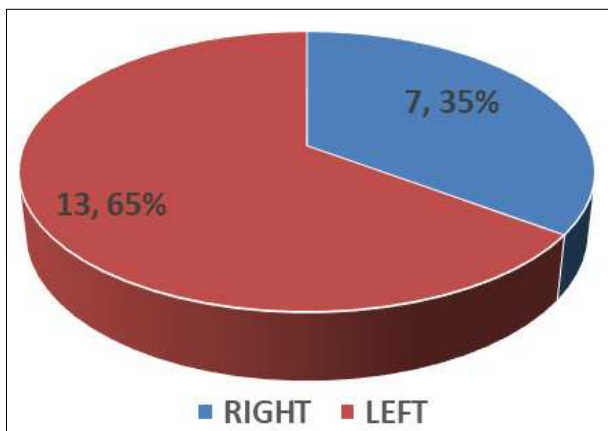


Fig 3: Side involvement

In our study, 13 patients had THR on right hip and 7 patients on left hip

Table 4: Indications

Indications	No of patients	Distribution
AVN	7	35%
OA	9	45%
TB	2	10%
AS	2	10%

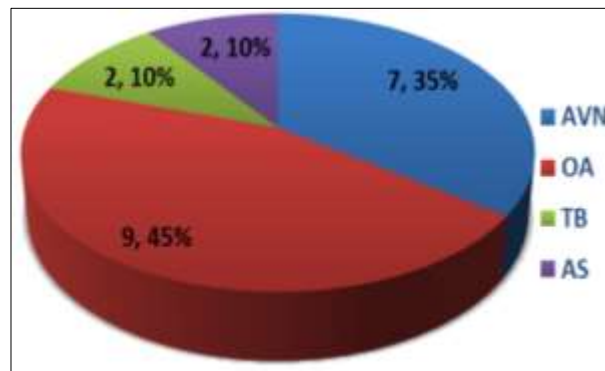


Fig 4: Indications

Table 5: Risk factors

Risk factors	Count	Column N %
DM	1	10%
IHD	1	5%
HTN	2	10%
Nil	17	85%

Comorbidities like Diabetes was found in 2(10%)
Ischemic heart disease was found in 1(5%)
Hypertension was found in 2 (10%)

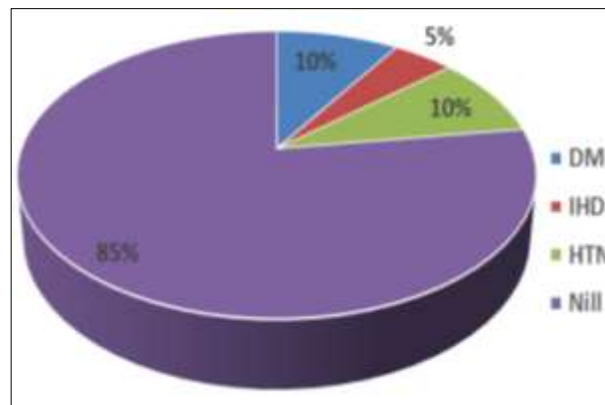


Fig 5: Risk factors

Table 6: Complications

Complications	Count	Column n%
Nerve injury	0	0
Vascular injury	0	0
DVT	1	5%
Heterotrophic ossification	0	0
Infection	0	0
Dislocation	0	0
Nil	19	95%

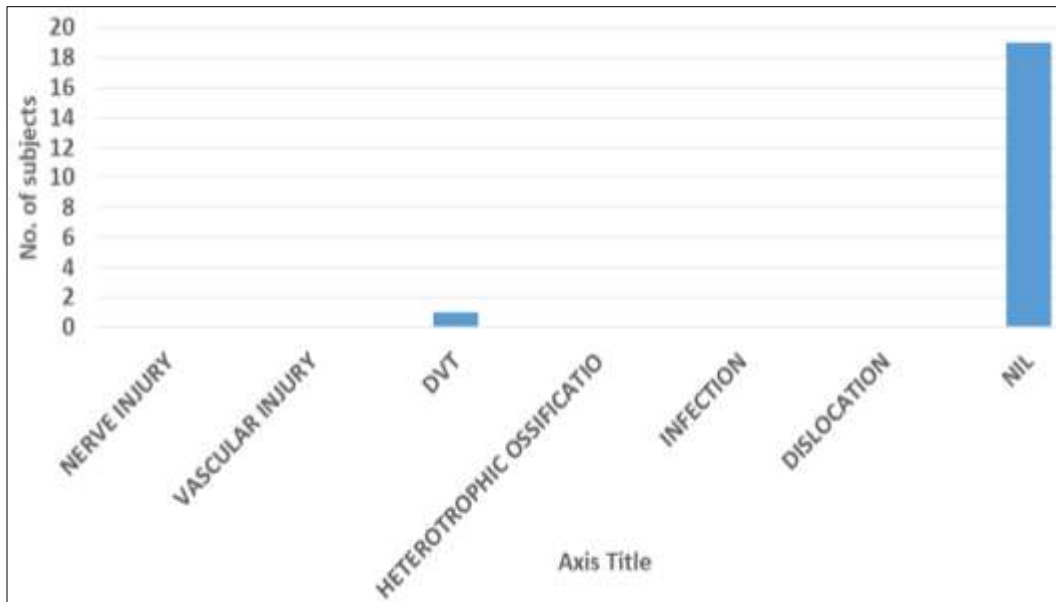


Fig 6: Complications

Table 7: Harris hip score

Harris hip score	Pre op	Post op	1 year
Poor	11	2	2
Fair	9	7	2
Good	0	11	9
Excellent	0	0	7

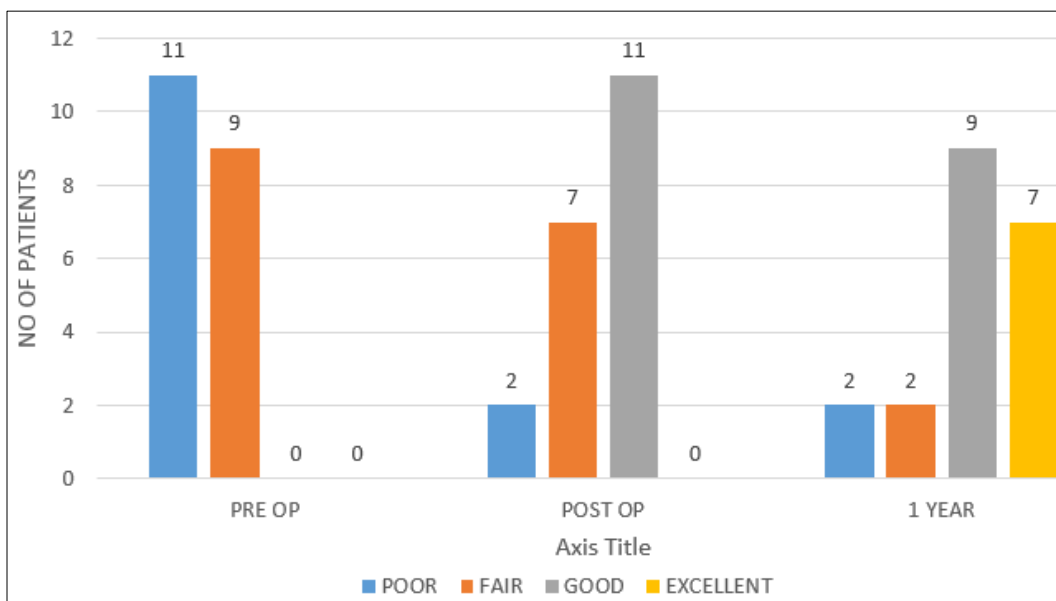


Fig 7: Harris hip score

Conclusion

It is paramount that surgeons maintain their focus on avoiding LLD as one of the primary goals of THR. Based on the current literature available it can be concluded that the combined use of templating to predict the necessary length correction and plan femoral neck osteotomy level and the intraoperative use of a simple pelvic reference pin with accuratere-positioning of the leg during measurements will provide the surgeon with a practical method for measuring leg length during THR. Such a method helps the surgeon to select appropriate implants and to adjust final leg lengths without compromising the stability of the hip.

In future, computer assisted techniques may hold promise in achieving limb length equality after total hip arthroplasty.

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