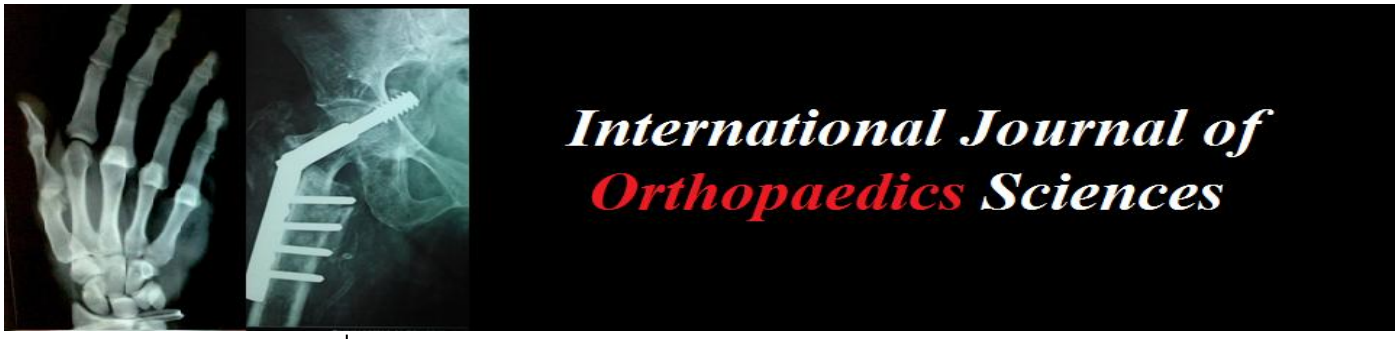

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Limb length discrepancy in total hip replacement

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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 9 cases undergoing THR for degenerative arthritis at JSS hospital from sept2014 to jan2017 for LLD using digital x-rays by 2 different examiners (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).
Results: There was excellent interobsever agreement for radiological measurments (kappa=0.86-0.96) and moderate agreement for manual measurements (kappa=0.44-0.58).Compared to normal limb, the operated limb postoperatively had shortening in 8 cases and lengthening in 1case by radiological method; 8cases had shortening and 1 had same length on manual measurment. In the operated limb compared to pre op, postoperatively 6cases had shortening and 3 had lengthening in radiological measurment; 5cases had shortening, 3cases had lengthening, 1 case had same length on manual measurement. All the patients had perceived limb shortening after surgery.
Conclusions: Our data show use of radiological measurement of Limb Length Discrepancy (using intertear drop as pelvic reference and lesser trochanter as femoral reference) is more reliable than manual measurement of Limb Length Discrepancy.

Keywords: THR-total hip replacement, LLD-limb length discrepancy, digital Xray

1. Introduction
The incidence of chronic disabling conditions of the hip such as osteoarthritis, inflammatory arthritis, osteonecrosis is on the rise. Evaluation of long term outcomes of an operative procedure is important to determine the durability of the procedures like total hip replacement (THR). Patient derived outcome scales have become increasingly important to surgeons and clinical researchers for measuring improvement in function after surgery. It provides a means for comparison of the results of different clinical interventions which may lead to any changes in operative technique, implant design, type of joint that occurs over time.
Hip replacement surgery is performed as a treatment for severe arthritis of the hip joint. During a hip replacement surgery, the ball and socket of the joint are replaced with an artificial implant, commonly made of metal and plastic. After hip replacement surgery, some patients notice one leg may be longer than the other, most commonly the leg that had surgery. To prevent a post-operative leg length discrepancy, surgeon will template x-rays of your hip with overlay schematics of the hip replacement prosthesis. In addition, some surgeons are now using computer-guided systems to help confirm position and size of the hip replacement implants [1].
When leg lengths are unequal, patients may experience increased pain and muscle fatigue. When the leg length is increased by more than a few centimetres, the nerves of the leg may become stretched to the point that patients experiences numbness or pain further down the limb.
Total hip replacement (THR) relieves the pain and functional disability experienced by patients with moderate to severe arthritis of the hip, improving their quality of life. [2] It is a highly cost-effective procedure [3] Generally acknowledged indications for primary THR

Include joint pain, functional limitation and some radiographic evidence of joint damage [4]. Leg length inequality has been described as lengthening or shortening of a limb beyond normal anatomy so that the leg is either longer or shorter than the contralateral limb. This definition assumes that the contralateral limb has no pathology and is normal [6]. In 1979, Sir John Charnley [7] stated that over lengthening of up to 1 cm can be justified because it permits active rehabilitation and patients very soon become adjusted to 1 cm over-lengthening.
In their study, White and Dougall [8] reported leg length differences within 10 mm in 72% of all patients, with the operative leg longer (>10 mm) in 22% of patients and shorter (>10 mm) in 8% of patients.

1.1 Objectives of the study
To assess the short term outcome of Total hip replacement in degenerative arthritis in terms of estimating leg length discrepancy pre and post op in Total hip replacement using digital X-ray

2 Materials and Methods
2.1 Source
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 are chosen among the outpatients at the Orthopaedic Department of JSS HOSPITAL, MYSURU during sept 2014 to jan 2017 fulfilling the inclusion criteria.

2.2 Type of study
A Prospective study.

2.3. Methods of collection of data
After obtaining valid consent, the complete data is collected from the patients by taking history, detailed clinical examination and relevant investigations. All cases with

2.3.1 Total Hip Replacement
Were evaluated for limb length using the proposed criteria. Written informed consent was obtained from all the patients who were subjected to the proposed research work.

2.3.2 Area of study
Department of Orthopaedics, JSS Hospital, Mysore.

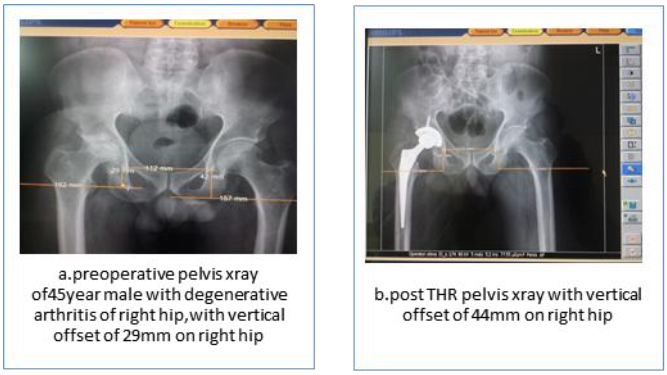
2.3.3 Methodology
We evaluated all cases undergoing THR for degenerative arthritis. Leg length was calculated using digital x-rays by 2examiners (who were blinded) preoperatively and postoperatively. Leg length: On digital X-ray a line was drawn at the level of & parallel to inter teardrop area and intersecting the lesser trochanter on each side. Compare 2 points of intersection & measure difference to determine the amount of limb discrepancy 10. We also manually measured the limb length from anterior superior iliac spine to medial malleolus pre and post operatively. We asked patient perceivingness of limb length pre and post operatively

2.4 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

2.5 Exclusion Criteria
1. Patients less than 20yrs 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

2.6 Analysis of data
We evaluated 9 cases undergoing THR for degenerative arthritis at JSS hospital for functional outcome using Harris hip score and LLD using digital x-rays by 2 different examiners. Postoperative patients are evaluated for radiological outcome. The statistical data analysis is done by SSPS version 21.0

Pictures a & b depicting x-rays, where measurments were taken on a digital x-ray using a computer software

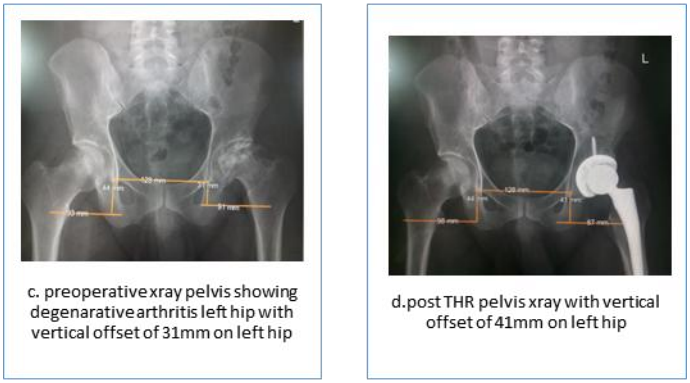


a.preoperative pelvis xray of45year male with degenerative arthritis of right hip,with vertical offset of 29mm on right hip

b.post THR pelvis xray with vertical offset of 44mm on right hip

Fig 1

Pictures c & d depicting preop and postop x-rays of a 34 year male



c. preoperative xray pelvis showing degenarative arthritis left hip with vertical offset of 31mm on left hip

d.post THR pelvis xray with vertical offset of 41mm on left hip

Fig 2

3. Results
There was excellent interobsever agreement for radiological measurments (kappa=0.86-0.96) and moderate agreement for manual measurements (kappa=0.44-0.58).Compared to normal limb, the operated limb postoperatively had shortening in 8 cases and lengthening in 1case by radiological method 8cases had shortening and 1 had same length on manual measurment. In the operated limb compared to pre op, postoperatively 6cases had shortening and 3 had lengthening in radiological measurment; 5cases had shortening, 3cases had lengthening, 1 case had same length on manual measurement. All the patients had perceived limb shortening after surgery.

4. Discussion
The leg length equality is an important functional parameter that is strongly related to the success in THA. The LLD can

contribute to hip instability, ipsilateral knee pain, low back pain, sciatic nerve palsy, and aseptic prosthesis loosening. These problems can lead to revision surgeries and may even be the sources of litigation. Ranawat *et al*. [12] wrote that the leg-length difference must be 10 mm or less, in order for a patient to have a good quality of life. In spite of the careful attention, an unexpected difference of 10-16 mm can sometimes occur. The possible reasons are the excessive acetabular reaming during the surgery, sinking of the collarless stem, flexion contracture of the hip joint before the surgery, inaccurate preoperative planning based on the radiographs at several different magnifications, and an inexperienced surgeon. The minor discrepancies of up to 1cm are usually asymptomatic, but in some patients even a small discrepancy may be a source of dissatisfaction.

Avoiding postoperative LLD remains an important focus for all surgeons performing THR. To this end, a number of techniques have been proposed to assess leg length intraoperatively, which can produce varying results.

Pelvic radiographs are helpful in assessing limb-length discrepancy (LLD) before and after THA 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 [9].There is no universal agreement as to what reference points should be taken for accurate measurements of limb lengths. Various authors have pointed out that the linear measurements and calculations from plain X-rays are susceptible to error, due to variations in positioning of the pelvis relative to the plane of the film and the divergence of the X-ray beams.

The inaccurate abduction/adduction repositioning of the femur with respect to the pelvis also can cause substantial error in the measurement of the length and can offset changes. These points should be improved in order to achieve more accurate measurements.

5. Conclusion

Of the patients with LLD, over 50% were bothered by the LLD and over a third used a shoe raise to equalise leg lengths. It is therefore important that patients are informed preoperatively of the high risk of LLD after THR and the associated negative impact this may have on their outcome.

In our study, there was excellent interobsever agreement for radiological measurments and moderate agreement for manual measurements, suggesting that radiological measurement is more accurate than the manual measurments.

We recognize that our study has some limitations. First, LLD was evaluated based on the plain pelvic radiographs instead of the CT scans, which have been used in other studies to eliminate the variables of pelvic tilt that exists while taking radiographs. [14, 15] Various authors have pointed out that the linear measurements and calculations from plain X-rays are susceptible to error, due to variations in positioning of the pelvis relative to the plane of the film and the divergence of the X-ray beams. [13, 15]. Secondly, our study comprises of small study group.

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