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A clinical and functional outcomes after modified harding's approach (antero-lateral) for total hip replacement

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Abstract
Background: To assess the Clinical and Functional outcomes of Total Hip Replacement after Modified Harding's approach (Antero-lateral). For this Harris Hip Score was used which comprised of Pain, Functional disabilities, Deformity, Range of movements with radiological assessment for evaluation of outcome and complications.
Materials and Methods: The study was carried out on 30 patients operated in the Department of Orthopaedics. Information on the patients was compiled from clinical details, case files and operation theatre records. This was a retrospective as well as prospective study. Patient's follow up was minimum from 6 months to 1 year.
Result: Out of the 30 patients 3 had a fair score between 70-80, 6 had a good score between 80-90 while the 21 having an excellent score.
Conclusion: Our study suggests that the anterolateral approach is a good approach for the outcome of the Harris hip score with no complication with satisfactory clinical, functional and radiological outcomes after an intermediate duration of follow-up. The study didn't have any complications.

Keywords: Modified Harding's approach, Harris Hip Score, Total Hip Arthroplasty (THR/THA)

1. Introduction
Total hip replacement/arthroplasty is a surgical procedure, has relieved millions of people from incapacitating pain arising from the hip joint. It is the most commonly performed adult re-constructive hip procedure [1]. Total hip replacement was a revolution to mankind to help the person with hip disorder and relief of pain.
Chronic debilitating conditions like Osteoarthritis, inflammatory arthritis and osteonecrosis is on rise. 70% cases accounting to total hip replacement are associated with osteoarthritis of hip. Total hip arthroplasty is a surgery of masters who must have lots of experience before doing it, so the primary condition where we warrant that this procedure should be recommended is pain which is refractory to conservative measures such as oral nonsteroidal anti-inflammatory medication, weight reduction, activity restriction, and the use of supports such as a cane.
The field of total joint replacement is in an evolutionary state. The first total hip replacement is thought to be done in LONDON by Philip Wiles in 1938 [2]. The procedure was further developed in the 1950s by pioneers such as McKee and Farrar [3]. This early work laid the groundwork for the innovative studies of Sir John Charnley who, in the late 1960s, approached the problem of artificial hip joint design by using biomechanical principles of human hip joint function [4, 5]. Improvements in implant design materials and fixation techniques continued but Charnley's basic concept continues to be valid.
Total hip replacement dramatically improves function and quality of life. With contemporary and modern cementing techniques, the rate of loosening appears to be substantially reduced.6 Mechanical loosening occurs more commonly in young, heavy, active men and with certain prosthetic designs. Cemented arthroplasty had problems of osteolysis and loosening of implants due to cement debris, then came the era of uncemented arthroplasty. Prosthetic devices have been developed that achieve fixation without cement, either by "press-fit" or by

biologic in growth. Stabilization is achieved by interference fit of the implant into the femur, which is called as press fit technique. The uncemented arthroplasty implants have a porous coating which has biological ingrowth. Uncemented devices are most frequently used in young patients with high physical demands, where a revision surgical procedure in the future will be more likely. Data suggest that uncemented total hip arthroplasties have a relatively low revision rate and excellent prosthetic durability for as long as 15 years. Compared with cemented, patients have more incidence of low grade thigh pain. Short-term results appear to be less satisfactory compared with cemented hip arthroplasty, after 5 to 20 years, the results in the two procedures are similar.7 With surgeries like this, complications risk is high which are differentiated into early and late. Early complications include fracture, nerve injury, dislocation, deep vein thrombosis and pulmonary embolism. Late complications include infection, heterotopic ossification and loosening. Aseptic femoral and acetabular loosening which is a potential cause of pain and loss of function have emerged as the most serious complications of THR and the most common indication for revision.8 Most difficult to manage is periprosthetic fracture. Several factors contributing to these adverse effects, which may eventually result in failure of the total hip arthroplasty, include the selection of the patients and the materials and design of the implant.9 Total hip arthroplasty relieves the pain and functional and disability experienced by patients to severe arthritis of the hip, improving their quality of life.10 With new improved anatomical implants the complications of anterior thigh pain and loosening has decreased. It is highly cost- effective procedure [11].

The most important way to see the success of the implant is by long term evaluation by seeing the durability of the procedure of total hip replacement. There are many scales to evaluate the clinical and functional outcome of total hip replacement. The parameters for a successful total hip replacement depend on surgeon skills, the approach he takes, implants used with post op care and mobilization. The widely used among all the scores is Harris Hip Score [12].

There are many approaches to Total hip replacement performed but this depends on surgeon's capabilities and experience.

The most commonly performed approach is Posterior approach [13]. Several versions of posterior approach have been used since von Langenbeck first described in 1874, the modern Posterior approach most closely resembles Moore's approach (1957) [14, 15].

The second most commonly approach done is Direct lateral approach.13 McFarland and Osborne described theirs in 1954, the modern Direct lateral approach was popularized by Hardinge in 1982 [16, 17].

The other approach is direct anterior approach. Smith-Petersen first described DAA to the hip in 1917 [18]. This approach was used for congenital dislocation of hip. In 1949 Smith-Petersen also credited with the first direct anterior approach for hip arthroplasty [19].

With time these procedures got modified and with small incisions. This study is undertaken to assess the clinical and functional outcome after Modified Harding's approach (Antero-Lateral) to total hip replacement in our institution.

2. Materials and method

The study was carried out on 30 patients operated in the Department of Orthopaedics. Information on the patients were compiled from clinical details, case files and operation theatre records. This was a retrospective as well as prospective study. Patient's follow up was minimum from 6 months to 1 year.

2.1.1 Inclusion criteria

- Fracture non-union neck of femur
- AVN (avascular necrosis) of femur head
- OA (osteoarthritis) of hip

2.1.2 Exclusion criteria

- Previous Girdlestone
- Revision Total hip replacement
- Fracture of Acetabulum
- Active sinus or infection of hip joint

2.2 Methodology

30 patients were available for the study. The follow up was done with previous operative records, subsequent X-rays and follow up papers. All patients underwent a standard clinical and laboratory evaluation that includes briefly information about age, sex, address, clinical history and routine investigation which were done pre- operatively. X-Ray of hip joint with AP view was done. Information on the patients was also compiled from clinical details, Case files and Operation theatre records. Pre- op ROM, deformities and its values were recorded for the study by clinical evaluation or from the hospital case sheets and discharge summaries.

Pre-Operative Planning

Clinical assessment

Detailed history and proper clinical examination is essential to find out: Duration of illness, focus of infection in the body, sensory motor examination, and vascularity of limb, ambulatory status of the patient, and deformity of the hip, ROM of the hip and status of the other joints.

The deformity and ROM were measured with goniometer. All the patients were assessed using Harris Hip Score.

Radiological assessment

Radiogram of pelvis with both hips with proximal half of shaft of femur AP view was taken for all patients. The radiograph was evaluated for

- Size of the acetabulum
- Bone stock of the acetabulum
- Any protrusion and periacetabular osteophyte formation
- The structural integrity of the acetabulum
- Need for bone grafting
- Size of the femoral canal

Templating was done for the acetabular and femur components. The appropriate acetabular cup size and anteversion were determined. On the femoral side, using a template, appropriate neck length, offset and stem size of the implant were chosen.

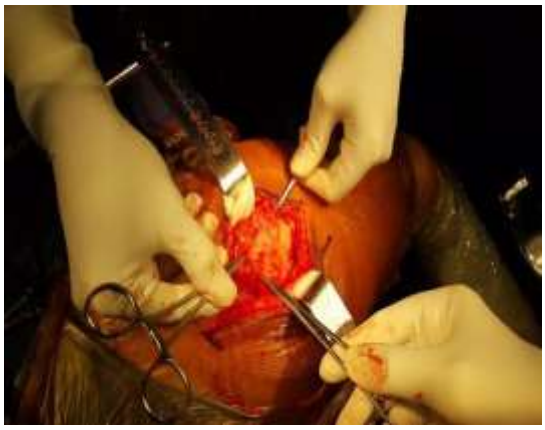
The aim of the pre-op planning was to obtain the following results post-operatively.

1. An acetabular socket located in the anatomical position.
2. Centre of rotation of femoral head located in its normal anatomical position.
3. Restoration of limb length.
4. Restoration of abductor moment arm.

Surgical Technique: The patient is positioned in lateral position. The incision centres at the anterior 3rd of the greater trochanter and extends about 5 cm distally and 5 cm proximally towards posterior superior iliac spine. The

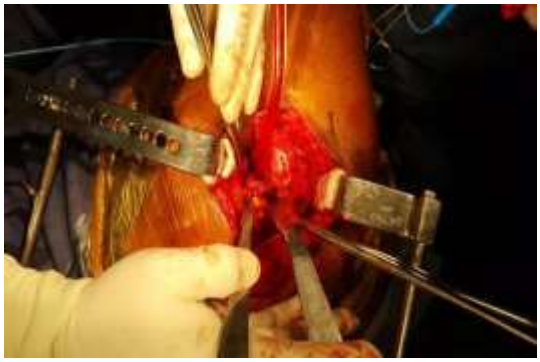
subcutaneous tissue and fascia lata are cut in line of the incision. The bursa over greater trochanteric is incised and reflected anteriorly. The gluteus medius insertion is identified around the greater trochanter. It extends from trochanteric ridge extending superiorly and posteriorly. Distal one third off gluteus medius is released with 5MM soft tissue cuff at the trochanter. The gluteus minimus is also, similarly released with a soft tissue cuff. Both the gluteal muscles and tendons are retracted anteriorly with help of self- retaining retractors. This exposes anterior hip capsule. The anterior capsule is incised along the posterior border of the gluteus minimus superiorly and along the IT line till distally. Adequate capsulectomy is done and femoral head is dislocated out of acetabulum by manoeuvring hip in flexion and external rotation. The femoral neck cut is done as per preoperative planning and using neck cutting guide. The leg is then positioned with hip in 30° of flexion and mild external rotation to give good acetabular exposure. Excision of labrum along with osteophytes from acetabular rim is done to achieve good acetabular exposure. Synovial tissue from the fovea and medial osteophyte is excised. The transverse acetabular ligament is identified. Progressive and Concentric reaming of acetabulum is done keeping in view the version and inclination of the implant. In case of cemented cup anchor holes using 5MM drill bit is done. The trial implant is inserted and confirmed. The original implant is then implanted. The implant is further protected by acetabular swab. Leg is now maneuverer with hip in flexion and external rotation to expose the femoral neck the femoral canal is prepared with use of serial broaching and trial model femoral stem is inserted Trial reduction is done using appropriate stem and head size the leg length and stability are assessed. The gluteal flap is repositioned at insertion to assess discrepancies in leg length and in offset. The final femoral implant is inserted, and appropriate head size is chosen and inserted. The hip joint is checked for stability and range of moment and impingement obstructing osteophytes are removed. The incision is closed by reattaching gluteii. Fascia lata, subcutaneous tissue and skin are closed over a drain.

Incision marked over the Greater Trochanter



Gluteus medius incision marked after TFL dissection

G. minimus tendon after fat layer is retracted



Capsulotomy & Neck of femur cut with saw

Post-Operative Care and Rehabilitation: The hip is positioned in approximately 15 degrees of abduction while the patient is recovering from the anaesthesia using a triangular pillow to maintain abduction and prevent extremes of flexion. First post op day, check X-rays are taken. The patient is taught static quadriceps exercises, knee and ankle mobilization exercised and made to sit. Second post op day dressing changed, and smaller dressing is applied. Gait training was started using a walker with weight bearing to tolerance. Drains were removed 24 to 48 hours after surgery. IV antibiotics were given for 48 hrs later switched over to oral antibiotics for further 5 days more. DVT prophylaxis was given in the form of low molecular weight heparin for first five days after surgery. 12th post op day sutures are removed.

They were advised

- Not to squat
- Not to sit cross legged
- Not to use Indian toilets
- Not to cross the lower limb across the midline.

Follow up Protocol: The patients were followed up after a month, then 3 months and then 6 months. Henceforth the patient was reviewed according to their compliance, but the study was taken place for a minimum 6 months to a max of 12 months.

Assessment of results: During each visit, medical history was taken, and physical examination was done. The deformity

and ROM were measured with goniometer. The clinical and functional outcomes were evaluated by Harris Hip Score. Based on a total of 100 points possible, each question is awarded a certain number of points. Questions are further grouped into categories. The score is reported as 90-100 for excellent results, 80-89 being good, 70-79 fair, 60-69 poor, and below 60 a failed result.

Pre-Op Post-Op

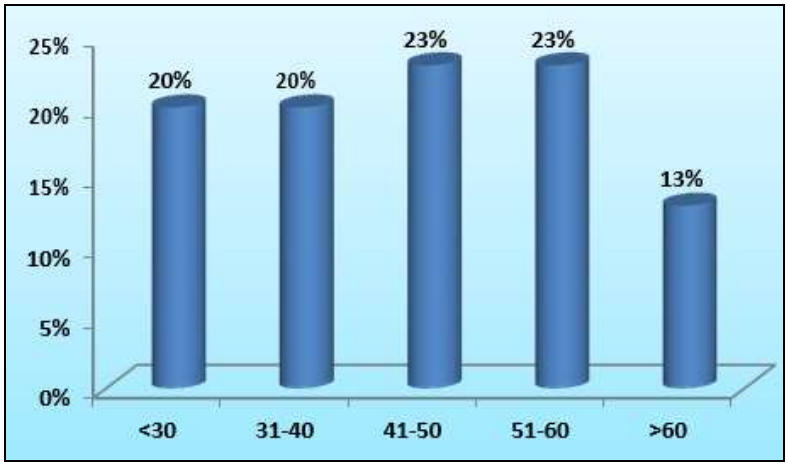
Fig 1: Cases showing AVN of Hip

3. Results

The results were seen in 30 patients having 30% (9) females and 70% (21) males, with anterolateral approach to total hip replacement, out of which 24 were uncemented and 6 were cemented. In this study, operative hip sides were equal i.e. 15 each. The results are tabulated in the following order

Table 1: Age distribution

Years	No. of cases	Percentage
<30	6	20%
31-40	6	20%
41-50	7	23%
51-60	7	23%
>60	4	13%
Total	30	100%



Number of cases-30, Mean-46.23, Standard deviation-14.61, Min-Max-25 – 83

Table 2: Indications of Surgery

Indication	No. of cases	Percentage
Austin Moore prothesis removal and THR	1	3.33%
Non-union NOF#	5	16.67%
OA due to Ankylosing Spondylosis	2	6.66
OA Secondary TO AVN	21	70.00%
OLD # NOF	1	3.33%
Total	30	100%

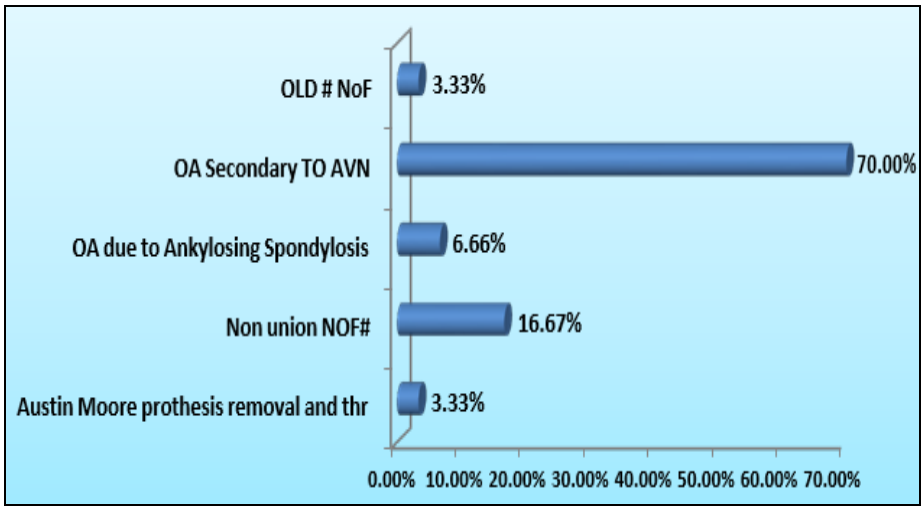


Table 3: Pain and functional gait with total of functional gait

Components		Pre-OP Mean ± SD	Post OP Mean ± SD	Mean Difference	P-Value
Pain		12.0 ± 7.14	41.67 ± 2.97	29.67	<0.001
Functional Gait	Support	3.53 ± 1.38	9.67 ± 1.92	6.13	<0.001
	Distance	4.63 ± 1.40	10.30 ± 1.29	5.67	<0.001
	Limb	4.77 ± 1.41	9.10 ± 1.47	4.33	<0.001
	Total Score	12.93 ± 3.66	29.07 ± 3.47	16.13	<0.001

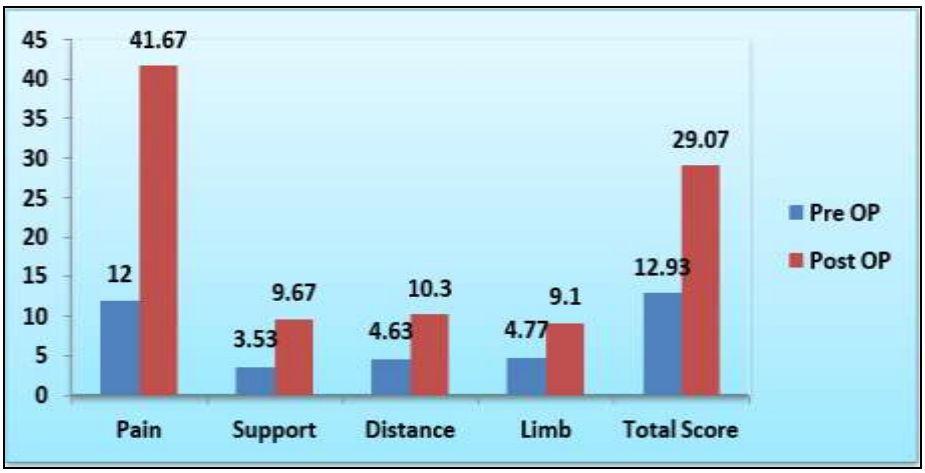


Table 4: Functional activity

Components	Pre-OP Mean ± SD	Post OP Mean ± SD	Mean Difference	P-Value
Activities	1.60 ± 0.81	3.73 ± 0.69	2.13	<0.001
Stairs	1.60 ± 0.62	3.47 ± 0.90	1.87	<0.001
Public transport	0.87 ± 0.34	1.00	0.13	0.043
Sitting	2.70 ± 0.91	4.73 ± 0.69	2.03	<0.001
Total	6.77 ± 2.36	12.93 ± 1.95	6.17	<0.001

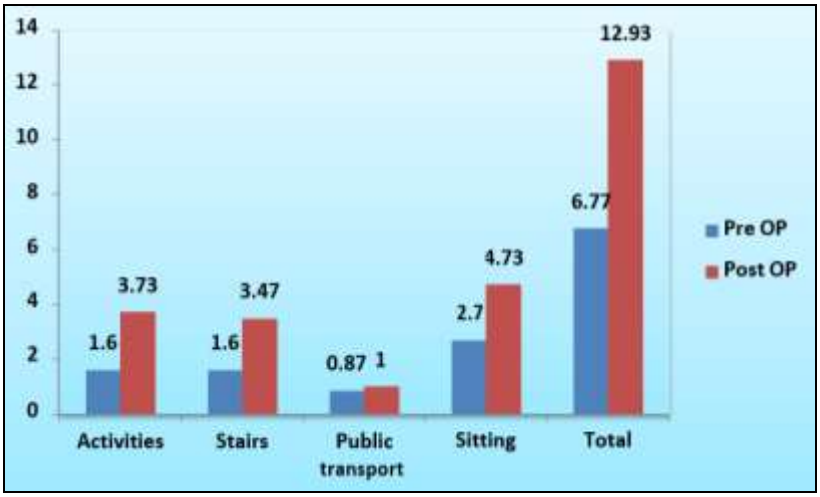


Fig 4: Absence of deformity score in all pre-op patients is 0 and post op is 4

Table 5: Range of motion

Range of motion	Pre-OP	Post OP	Mean Difference	P-Value
	Mean ± SD	Mean ± SD		
	2.76 ± 0.53	4.73 ± 0.08	1.97	<0.001

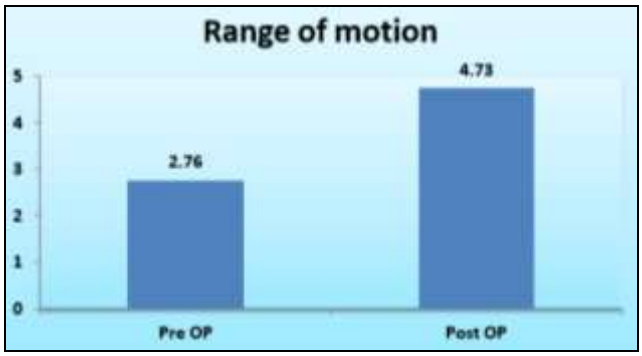


Fig 5: Range of motion

Fig 6: Total Harris Hip score

Total Harris Hip score	**Pre-OP**	**Post OP**	**Mean Difference**	**P-Value**
	Mean ± SD	Mean ± SD		
	34.47 ± 12.30	92.39 ± 6.09	57.94	<0.001

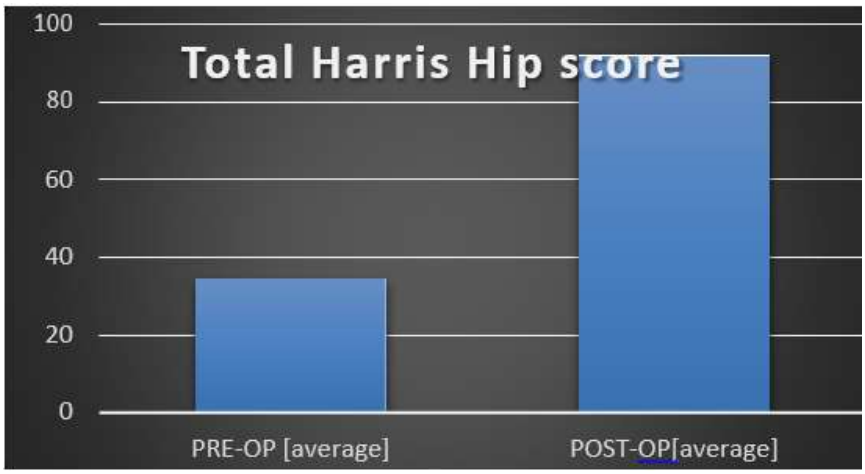


Fig 6: Post op Harris hip score comparison with cases

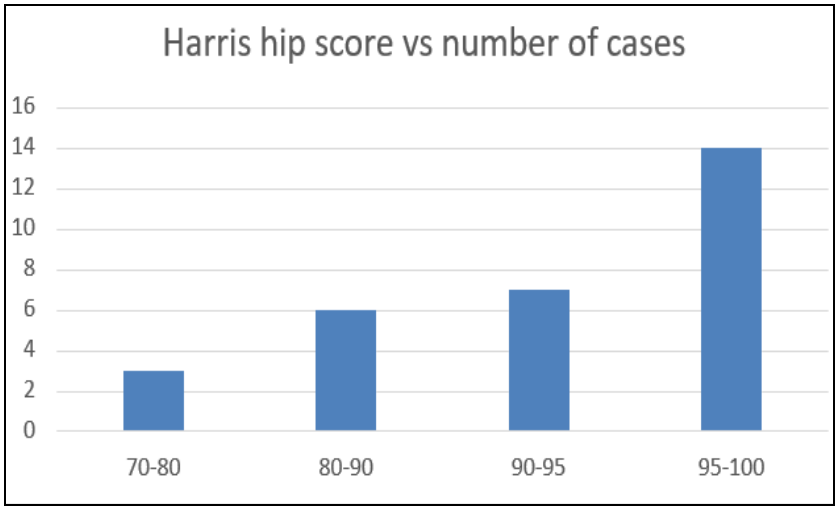


Fig 7: Pre-op and Post-op comparison of uncemented vs cemented Harris hip score

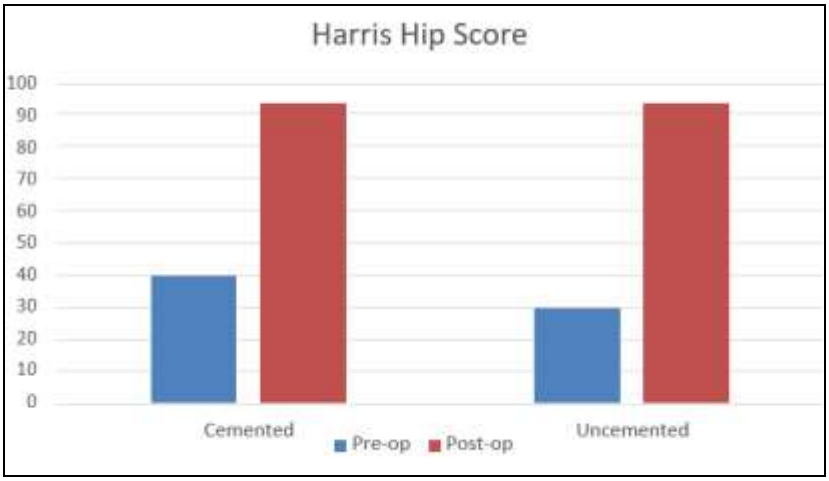


Fig 8: Harris Hip Score

Table 7: There were no complications *viz*. nerve injury, DVT/PE, osteolysis in all the cases

	Lengthening	Follow up Months
Mean	0.50	7.73
SD	0.55	1.80
Min - Max	0 – 2	6-12

4. Discussion

Total hip arthroplasty is a well-documented surgery [20]. Pain and functional disability experienced by the patient is relieved by this surgery [21]. The study was carried out in 30 patients, out of that [24] were uncemented and 6 were cemented. The approach used for Total hip replacement was Anterolateral (modified Harding's approach). In western literature, as per Harkness [20], Charney [22], Eftekhar [21] total hip arthroplasty has primarily been described for patients in older age group of sixty and above. Due to revolution in total hip replacement, with better implants and better diagnostic approaches total hip replacement are taking place in young individuals too. In our study there is a wide range of 25-83 years with age more than 50 comprising of 36% of the study but the mean age came about to 46.23 years. Majority of the sex was male about 21 cases amounting to 70% of the study. The average Harris hip score preop is 34.47 versus the post-op which is 92.39 at the end of last follow up. The number of patients having post op score between 70-80 are 3, 80-90 are 6, 90-95 are 7 and 95-100 are 14. The range of Harris hip score in post-operative patients range from 79.55 to 99.7.

The most common cause of total hip replacement was OA secondary to AVN accounting to 70% of cases. The other cases account only 30% of the hip replacement in our study. Our study included new generation prosthesis that demonstrated improved clinical and radiological outcomes compared with those associated with early designs of prostheses [23-29]. Bourne *et al*., in a study of 101 total hip replacements reported an average Harris hip score of 96 points, but only patients who were free of pain were evaluated. When patients who had pain were included, the overall average score was 90 points. Heekin *et al*. [30] reported an average score of 93 points after a minimum of five years of follow-up of 91 hips that had been treated with the PCA prosthesis. In a study by Katz *et al*. [27] the results of 14 arthroplasties, in which the stem had been fixed without cement, the hip score averaged 84 points at forty-six months. Barrack and Lebar31 reported an average Harris hip score of 93 points after 49 arthroplasties. In our study, we had done the anterolateral approach and no complications were seen after the last follow up. Patients who had anterolateral and posterolateral approaches in total hip replacement surgery were compared clinically for limp, dislocation, hospital stay, and discharge disposition. The only statistical difference was that the posterior approach had a statistically higher

dislocation rate. Although the number of patients with limp was higher in the anterolateral group, the difference was not statistically different [32]. So the mini invasive anterolateral approach the rate of dislocations are very less. Compared with a standard incision, patients who underwent a minimally invasive total hip arthroplasty demonstrated decreased blood loss and limped less at 6-week follow-up [33]. Restricting weight bearing postoperatively to protect the Hardinge abductor repair appears unnecessary, and recovery of activity is improved with immediate weight bearing [34] In our study mini incision was done with the anterolateral approach giving us advantage for less blood loss and less probability of nerve damage.

Currently, the experience comprises over 3,500 patients operated on using the minimally invasive anterolateral approach since March 2003. Restrictions regarding indications are not known. In experienced hands, the technique can even be used for revision surgery. The clinical results show significant differences with improved clinical results as compared to patients after standard approaches, especially in terms of skin-to-skin time, blood loss, use of analgesics, rehabilitation time, and functional outcome. The accuracy of implant placement is not compromised.

After a fundamental learning curve, there is no evidence.35 The functional recovery in patients treated with muscle sparing method was faster than in patients operated with conventional lateral approach. Based on the results, we could recommend anterolateral muscle sparing approach for a total hip replacement for its faster and fuller functional recovery.36 Another factor involved in good overall score of Harris hip post-op is the consideration of selection of cases. If there had been cases of rheumatoid arthritis the Harris hip score would have been low. Rheumatoid arthritis, avascular necrosis or congenital hip dysplasia may influence the biological integration of the implant and bone-remodelling, thereby affecting the overall outcome [26]. In our studies there were no mark difference barring Ankylosing Spondylosis where the Harris Hip score was in the range of 70-80 post-op but the improvement seen in these cases were the maximum. Surgeons may have some concerns about long term outcome in young patient who undergo total hip replacement, several reports have shown good to excellent functional results with longer survivorship of the implant in ankylosing spondylosis patients [37-40]. As the study was done in the view of antero-lateral approach over other approaches, it is seen in literature that the advantages of the anterolateral approach are decreased incidence of dislocations [41, 42] and providing good exposure of the acetabulum [32].

A study done by Vicar *et al*l for dislocation rate in different approaches showed that dislocation rates are very less in trans trochanteric [2.2%] and anterolateral approach [2.2%] compared to posterior approach, the same study shows that heterotrophic ossification is three times more common in posterior and trans trochanteric approach, then anterolateral approach. Trochanteric bursitis was twice as common in the trans trochanteric approach than in the other two. So, this study suggest that anterolateral approach is better than other two approaches.43 A study shows that abductor tendon defects and fatty atrophy of the gluteus medius muscle and the posterior part of the gluteus minimus muscle are uncommon in asymptomatic patients after THA.44 This was seen on MRI.

5. Conclusion

In conclusion, the outcome of total hip arthroplasty by anterolateral approach (modified Harding's approach) is determined by many factors, including the design of the component, the selection of patient and the operating surgeon. Our study suggests that the anterolateral approach is a good approach for the outcome of the Harris hip score with no complication with satisfactory clinical, functional and radiological outcomes after an intermediate duration of follow-up. The study didn't have any complications, though this study should be carried on a long-term basis.

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Conflicts of interest: There are no conflicts of interest

6. References

1. Harkess F, JW. Arthoplasty of the hip". Campbell's Operative Orthopaedics Mosby 1998.
2. Petty WP, Saunders WB. Total Joint Replacement-VI, Lower Extremity Replacement. The Hip. Philadelphia, 1991, 189-465.
3. McKee GK, WFJ. Replacement of arthritic hips by the McKee-Farrar prosthesis. J Bone Joint Surg [Br] 1966;48:245-259.
4. JC. Total hip replacement. JAMA 1974;230:1025-1028.
5. JC. Low Friction Arthroplasty of the Hip – Theory and Practice. Berlin. Springer-Verlag. 1979, 332-345.
6. Russotti GM, Stauffer CM, RN, Cemented total hip arthroplasty with contemporary techniques. Clin Orthop 1988;235:141-145.
7. Cook SD, Martir ML. PC Inflammatory response in retrieved noncemented porous-coated materials. Clin Orthop 1991;264:209-222.
8. Siwach RC *et al*. A retrospective study of total hip arthroplasty. Indian Journal of Orthopaedics 2007;41(1):62-66
9. Ashraf A Ragab, Matthew J Kraay, Victor M Goldberg. "Clinical and radiographic Outcomes of Total Hip Arthroplasty with Insertion of an Anatomically Designed Femoral Component without Cement for the Treatment of Primary Osteoarthritis. The Journal of Bone and Joint Surgery 1999;81-A(2):210-218.
10. Murray D. Surgery and joint replacement for joint disease, Acta Orthop Scand Suppl 1998;281:17-20.
11. Faulkner A, Kennedy LG, Baxter K, Donovan J, Wilkinson M, Bevan G. Effectiveness of hip prostheses in primary total hip replacement: a critical review of evidence and an economic model, Health Technol Assess 1998:2:1-133.
12. Sharma S, Kingsley S, Bhamra P. Primary total hip replacement for acute displaced subcapital femoral fractures. British Editorial Society of Bone and Joint Surgery, Supplement I 2006;88-B:168.
13. Chechik O, Khashan M, Lador R, Salai M, Amar E. Surgical approach and prosthesis fixation in hip arthroplasty world wide. Arch Orthop Trauma Surg. 2013;133:1595-600. [PubMed]
14. Von Langenbeck B. Uber die schussverletzungen des huftgelenks. Arch Klin Chir 1874;16:263.
15. Moore AT. The self-locking metal hip prosthesis. J Bone Joint Surg Am 1957;39-A:811-27. [PubMed]
16. McFarland B, Osborne G. Approach to the hip: A suggested improvement on Kocher's method. J Bone Joint Surg Br 1954;36B:364-7.
17. Hardinge K. The direct lateral approach to the hip. J Bone Joint Surg Br 1982;64:17-9. [PubMed]
18. Smith-Petersen MN. A new supra-articular subperiosteal

approach to the hip joint. Am J Orthop Surg 1917;15:592-5.
19. Smith-Petersen MN. Approach to and exposure of the hip joint for mold arthroplasty. J Bone Joint Surg Am 1949;31A:40-6. [PubMed]
20. Harkess JW. Arthroplasty of hip., Campbells Operative Orthpeadics, Edited by AH Crenshaw, 8 editions, CV Mosby Company, St. Louis, Washington DC, Torto, 1982, 1.
21. Eftekhar NS. Total hip replacement using principles of low-friction arthroplasty: The Hip. Surgery of the musculoskeletal system, Edited by CM Evarts, Churchill Livingston 1983, 3:
22. Charnley J. Low friction arthroplasty of the hip: Theory and practice, Springer-Verlag, Berlin, Heidelberg, New York 1979.
23. Bourne RB, Rorabeck CH, Ghazal ME, Lee MH. Pain in the thigh following total hip replacement with a porous-coated anatomic prosthesis for osteoarthrosis. A five-year follow-up study. J. Bone and Joint Surg 1994;76-A:1464-1470
24. Brown IW, Ring PA. Osteolytic changes in the upper femoral shaft following porous-coated hip replacement. J. Bone and Joint Surg 1985;67-B(2):218-221
25. Callaghan JJ, Dysart SH, Savory CG. The uncemented porous- coated anatomic total hip prosthesis. Two-year results of a prospective consecutive series. J. Bone and Joint Surg 1988;70-A:337-346.
26. Campbell ACL, Rorabeck CH, Bourne RB, Chess D, Nott L. Thigh pain after cementless hip arthroplasty. Annoyance or ill omen. J. Bone and Joint Surg 1992;74-B(1):63-66.
27. Katz RL, Bourne RB, Rorabeck CH, McGee H. Total hip arthroplasty in patients with avascular necrosis of the hip. Follow-up observations on cementless and cemented operations. Clin. Orthop 1992;281:145-151.
28. Lord GA, Hardy JR, Kummer FJ. An uncemented total hip replacement. Experimental study and review of 300 madre-porique arthroplasties. Clin. Orthop 1979;141:2-16.
29. McBeath AA, Foltz RN. Femoral component loosening after total hip arthroplasty. Clin. Orthop 1979;141:66-70,
30. Heekin RD, Callaghan JJ, Hopkinson WJ, Savory CG, Xenos JS. The porous-coated anatomic total hip prosthesis, inserted without cement. Results after five to seven years in a prospective study. J. Bone and Joint Surg 1993;75-A:77-91.
31. Barrack RL, Lebar RD. Clinical and radiographic analysis of the uncemented LSF total hip arthroplasty. J. Arthroplasty 1992; 7(Supplement):353-363.
32. 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. [PubMed]
33. Chimento GF, Pavone V, Sharrock N *et al* Minimally invasive total hip arthroplasty: a prospective randomized study. J Arthroplasty 2005;20:139-144.
34. Bernasek TL, Thatimatla NK, Levering M, Haidukewych GJ. Division of Adult Reconstruction, Florida Orthopaedic Institute, Tampa, FL 33637, USA. mlevering@foreonline.org
35. Röttinger H. German Orthopaedic Hospital WLL, Königreich Bahrain. Heinz.Roettinger@germanortho.com of increased complications.
36. Tudor A, Ruzic L, Vuckovic M, Prpic T, Rakovac I, Madjarevic T *et al*. Orthopaedic Clinic Lovran, University of Rijeka, Croatia. Faculty of Kinesiology, University of Zagreb, Croatia.
37. Joshi A, IIchmann T, Markovic L. Socket wear in bilateral simultaneous total hip arthroplasty J Arthroplast, 2001;16:117-120.
38. Bhan S, Eachempati KK, Malhotra R. Primary cementless total hip arthroplasty for bony ankylosis in patients with ankylosing Spondylitis J Arthroplast 2008;23:859-866.
39. Sweeney S, Gupta R, Taylor G, Calin A. Total hip arthroplasty in ankylosing spondylitis: outcome in 340 patients J Rheumatol 2001;28:1862-1866.
40. Tang WM, Chiu Primary KY. total hip arthroplasty in patients with ankylosing spondylitis J Arthroplast, 15 2000, 52-58.
41. Masonis JL, Bourne RB. Surgical approach, abductor function, and total hip arthroplasty dislocation. Clin Orthop Relat Res. 2002;405:46-53. [PubMed]
42. Woo RY, Morrey BF. Dislocations after total hip arthroplasty. J Bone Joint Surg Am. 1982;64:1295-1306. [PubMed]
43. Vicar AJ, Coleman CR. A comparison of the anterolateral, transtrochanteric, and posterior surgical approaches in primary total hip arthroplasty. Clin Orthop Relat Res 1984;188:152-159. [PubMed]
44. Pfirrmann CW, Notzli HP, Dora C, Hodler J, Zanetti M. Abductor tendons and muscles assessed at MR imaging after total hip arthroplasty in asymptomatic and symptomatic patients. Radiology 2005;235:969-976. [PubMed]