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Effect of systematic soft-tissue repair on functional outcomes following posterior approach total hip arthroplasty

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ABSTRACT

Background: Posterior approach total hip arthroplasty (THA) is widely used but historically has been associated with a higher dislocation risk. Systematic posterior soft-tissue repair (capsule and external rotator reconstruction) can mitigate this instability. However, few studies have assessed this technique alongside validated functional outcomes in routine secondary-care settings.
Methods: In a prospective consecutive case series at rural secondary-care centres in India, 150 patients (age 40-85) undergoing primary posterior-approach THA with systematic posterior capsule and external rotator repair were enrolled (Jan-Dec 2024). All surgeries used a standard Kocher-Langenbeck posterior approach by one surgeon. Functional outcomes were measured preoperatively and at 6 weeks, 3 months, 6 months, and 12 months. Patients were followed for 12 months postoperatively, and all complications were recorded.
Results: Of 150 patients, 138 (92%) completed the 12-month follow-up. Mean Harris Hip Score (HHS) improved from 35.9 preoperatively to 84.7 at 12 months (mean gain ≈49 points). Mean Western Ontario McMaster Universities Osteoarthritis Index (WOMAC) improved from 60.1 to 18.0 (mean reduction ≈42 points). Notably, there were no hip dislocations. The overall complication rate was 13.0% (18/138), predominantly minor (hematoma 6.5%, intraoperative fracture 2.9%), with no major complications.
Conclusions: Systematic posterior soft-tissue reconstruction in posterior-approach THA produced substantial improvements in hip function and effectively prevented dislocation in this series. The favourable outcomes and low complication rate support the efficacy and safety of this technique in routine THA practice, even in secondary-care settings.

Keywords: Posterior approach total hip arthroplasty, Soft tissue reconstruction, HHS, WOMAC, Dislocation prevention, Secondary care hospital

INTRODUCTION

Total hip arthroplasty (THA) constitutes the most effective surgical intervention for the management of advanced-stage hip osteoarthritis, consistently delivering sustained pain amelioration and functional restoration in exceeding 95% of surgical recipients.[1,2] The posterior approach, originally delineated by Moore in 1957, persists as the predominant technique for primary THA implementation internationally, comprising 60-70% of all procedural interventions performed globally.[1,3,4] This widespread adoption reflects the inherent technical merits of the posterior approach, encompassing preservation of abductor musculature integrity, superior acetabular visualization, and diminished propensity for heterotopic ossification relative to alternative surgical approaches.[2-4] Nevertheless, the posterior approach has been historically restrained with an augmented risk of postoperative hip

instability in comparison to anterolateral or transtrochanteric alternatives. This complication perpetuates substantial patient morbidity and necessitates revision arthroplasty.[5,6]

Postoperative hip dislocation consequent to posterior approach THA has conventionally been regarded as a formidable clinical challenge. Historical data documents incidence rates between 2-4% in the absence of targeted prophylactic interventions.[5,6] Notably, approximately 60-70% of such events transpire within the initial six-week postoperative interval. This coincides with the period of incomplete soft tissue reconstitution and compromised dynamic hip stabilization. Decades of meticulous scientific investigation have established that careful restoration of posterior soft tissue architecture encompassing the external rotator musculature (piriformis, obturator internus, gemellus superior and inferior) and the posterior joint capsule, substantially attenuates postoperative dislocation risk.[7,8] Contemporary peer-reviewed evidence demonstrates that systematic reconstruction of posterior soft tissues following posterior approach THA diminishes dislocation incidence to 0.5–2%, rendering outcomes commensurate with anterior and anterolateral methodologies.[6,7,9] Evolving posterior soft tissue reconstruction techniques, including transosseous repair employing suture anchor fixation and transmuscular soft-tissue-only reconstruction, have progressed to facilitate anatomically precise reconstitution of posterior hip stabilizing structures, establishing a powerful mechanical barrier against instability.[8,10] These refined technical approaches have fundamentally reconceptualized the posterior approach. A procedure burdened with elevated dislocation propensity has turned into one demonstrating safety profiles equivalent to competing surgical alternatives.[7,9]

Magnetic resonance imaging interrogation extending beyond four years postoperatively demonstrates that in maximum patients, the posterior joint capsule achieves durable osseous integration, with intervening scar tissue maturation between the external rotators and bone acquiring architectural and signal characteristics approximating native tendinous tissue.[11,12] This extended-duration structural integrity provides for a strong foundation for the persistent loss of dislocation observed among patients receiving systematic posterior soft tissue reconstruction relative to those without such intervention. The proven durability of repair supports the adoption of methodical posterior soft tissue reconstruction as essential surgical practice in posterior approach total hip arthroplasty.

For total hip arthroplasty, dislocation mitigation remains crucial for procedural safety. However, a thorough assessment of surgical efficacy requires a precise evaluation of functional outcomes using validated measurement instruments. The Harris Hip Score (HHS), established over four decades, endures as the internationally recognized instrument for quantifying hip-specific functional capacity subsequent to THA.[13,14] The WOMAC questionnaire furnishes supplementary multidimensional functional assessment, evaluating pain, stiffness and functioning capacity, with diminished scores signifying enhanced outcomes.[15] Both instruments have demonstrated exceptional responsiveness to surgical intervention in THR populations. Characteristic postoperative improvements encompassing 40-50 point increments on the HHS and 100+ point reductions in WOMAC aggregate scores have been noted.[16,17]

Despite the well-established benefits of posterior soft tissue reconstruction in reducing dislocation risk, as demonstrated by Tsai and colleagues' research showing a 6.38% to 0% dislocation reduction with posterior capsule repair.[7] Crompton and colleagues' systematic review documented reductions in dislocation rates, showing modern posterior approach rates of 0.5-2.0%.[9] However, the widespread use of validated functional outcome assessment methodologies in THA research hasn't fully integrated with technical outcomes reporting. Holistic researches integrating systematic soft tissue reconstruction technique and functional outcome assessment using Harris Hip Score and WOMAC questionnaire, remains conspicuously deficient within the scientific literature.[13,15,18] The lack of comprehensive integration across these multiple outcome domains represents a critical knowledge gap.[7,19,20]

Most published case series and observational cohort studies tend to focus on only one major aspect of total hip arthroplasty outcomes rather than evaluating both technical and functional domains together. A large portion of the literature emphasizes surgical technique and dislocation prevention through posterior soft tissue reconstruction. For example, Pellicci et al detailed about enhanced repair methods aimed at improving stability, while Hernandez et al described specific capsular repair techniques that lowered early dislocation rates.[8,10] In contrast, other investigations primarily assess postoperative functional recovery using validated tools such as the Harris Hip Score, as demonstrated by Kumar et al or the WOMAC index, as analyzed by Nubila et al.[16,17] However, studies that integrate both technical repair outcomes and comprehensive functional evaluation within the same cohort remain exceptionally limited, creating a persistent gap in the literature.[19,20] This bifurcation in the literature limits the completeness of surgical outcome documentation.

Furthermore, systematic documentation of posterior approach total hip arthroplasty outcomes emanating from secondary-care institutional contexts and non-tertiary medical centers remains substantially underrepresented, with most published investigations originating from high-volume academic medical institutions. This gap in contemporary literature becomes even more important as THA procedures are increasingly being used worldwide across diverse healthcare systems.

As Learmonth and colleagues noted in their landmark Lancet review, total hip replacement represents "the operation of the century".[3] However, documenting outcomes across different institutional and geographic settings is crucial for achieving generalisability and optimising clinical applicability in diverse surgical and healthcare environments. The absence of outcomes data from secondary-care settings limits the external validity of current THR literature for surgeons practicing outside high-volume tertiary centers.

The aim of this study is to conduct a methodical evaluation of functional recovery utilizing the HHS, as originally described by Harris in 1969, and the WOMAC, as validated by Bellamy and colleagues and further refined by Bilbao and colleagues for hip osteoarthritis within a consecutive cohort of posterior approach total hip arthroplasties incorporating systematic posterior soft tissue reconstruction.[7,11,13,15,18] Also to comprehensively profile all intraoperative and postoperative complications using the standardized Clavien-Dindo classification system, with particular emphasis on dislocation prevention outcomes achieved through systematic soft tissue repair technique.

METHODS

This prospective case series investigation was conducted at multiple secondary-care orthopedic surgical institutions located in rural Rajasthan, India. The study was designed as a consecutive case series with longitudinal functional outcome assessment spanning a 12-month postoperative period. All study participants were provided written informed consent following detailed explanation of the study procedures and objectives. The study cohort comprised 150 consecutive patients who underwent primary posterior approach total hip arthroplasty with systematic posterior soft tissue reconstruction for advanced-stage hip osteoarthritis between January 2024 to December 2024. Patients were eligible for inclusion if they were aged 40 to 85 years, had a confirmed primary diagnosis of advanced hip osteoarthritis, underwent primary posterior approach total hip arthroplasty incorporating systematic posterior soft tissue reconstruction (including capsular and external rotator repair), [6,9] had complete preoperative and postoperative follow-up data available for analysis, and possessed the cognitive and linguistic capacity to provide informed written consent in either Hindi or English.

Exclusion criteria comprised patients undergoing revision total hip arthroplasty; individuals treated via a posterior approach without systematic posterior soft tissue reconstruction; patients with significant neurological or psychiatric disease impairing completion of outcome instruments; those with severe cognitive impairment; individuals with active local or systemic infection at the time of surgery; cases with inadequate preoperative or postoperative follow-up data; and patients who withdrew from the study during the 12-month follow-up period.

All procedures were performed by a single surgeon using standardized surgical technique.[7,9] The posterior (Kocher-Langenbeck) approach was utilized for all cases, with strict adherence to anatomical tissue plane dissection. Following femoral and acetabular component implantation and provisional component positioning assessment, systematic posterior soft tissue reconstruction was performed in all cases prior to wound closure.

Posterior soft tissue reconstruction encompassed: careful preservation of the sciatic nerve; repair of the external rotator musculature (piriformis, obturator internus, and gemellus complex) to the posterior aspect of the hip capsule utilizing 1-0 absorbable sutures (polyglactin 910) with direct muscle-to-capsule and muscle-to-bone fixation; reconstruction of the posterior joint capsule utilizing 1-0 absorbable sutures in interrupted fashion, restoring capsular continuity between the repair of external rotators and the acetabular rim; and confirmation of posterior repair integrity through manual testing of hip stability in multiple positions (flexion, adduction, internal rotation combination).[10-12]

Soft tissue repair was performed systematically in all 150 cases. Documentation of repair adequacy included: surgeon assessment of repair integrity, absence of audible/palpable "clunking" during stability testing, and absence of gross posterior instability on manual stress testing. All cases utilized cementless femoral stems and cementless acetabular components with identical prosthetic designs to ensure consistency across the cohort.

The HHS is a 100-point composite scale incorporating three domains: pain quantification, functional capacity assessment, and hip range of motion evaluation, with higher scores denoting superior functional outcomes. The HHS has undergone thorough psychometric validation for its outcomes assessment of THA. This demonstrates its superior internal consistency (Cronbach's α >0.90), excellent test-retest reliability (intraclass correlation coefficient 0.89-0.95) and a strong correlation with patient-reported satisfaction.[14,16] HHS data were collected at baseline (preoperative), 6 weeks postoperatively, 3 months postoperatively, 6 months postoperatively, and 12 months postoperatively. Improvement of ≥10 points on the HHS is considered a clinically meaningful change, and improvement of ≥20 points represents substantial functional gain.[22]

The WOMAC questionnaire constitutes a secondary functional outcome instrument with multidimensional assessment capability. The WOMAC consists of 24 items organized into three subscales: pain, stiffness, and physical function, for a total possible score of 0-96 points, with lower scores indicating improved outcomes. The WOMAC has demonstrated high internal consistency (Cronbach's α 0.80-0.94), excellent test-retest reliability (intraclass correlation coefficient 0.85-0.97), and exceptional responsiveness to surgical intervention in THA populations. WOMAC data were collected at

identical timepoints as HHS assessment (preoperative, 6 weeks, 3 months, 6 months, and 12 months postoperatively). Clinically meaningful improvement on WOMAC in THA populations is defined as reduction of ≥20 points on the aggregate score.[15,17,18]

Pain was quantified utilizing a Numerical Pain Rating Scale (NPRS, 0-10 scale) at each follow-up interval, with 0 representing no pain and 10 representing worst imaginable pain.

All intraoperative and postoperative complications were documented and classified utilizing the standardized Clavien-Dindo grading system, which stratifies complications from minor (Grade I) to fatal events (Grade V).[23] Specific documentation included intraoperative complications (component malpositioning, intraoperative fracture, vascular injury, nerve injury), early postoperative complications (dislocation, infection, thromboembolism, hematoma, wound complications) and later postoperative complications (infection, loosening, osteolysis, heterotopic ossification).

Data collection was performed utilizing standardized paper-based case report forms. Preoperative assessment included completion of demographic questionnaire, Harris Hip Score, WOMAC questionnaire and Numerical Pain Rating Scale. Intraoperative data were recorded by the operating surgeon immediately following procedure completion, including operative time, estimated blood loss and qualitative assessment of soft tissue repair integrity. Postoperative data collection occurred at four sequential timepoints: 6 weeks postoperatively (routine first follow-up visit); 3 months postoperatively; 6 months postoperatively; 12 months postoperatively (final assessment).

At each follow-up interval, patients completed Harris Hip Score, WOMAC questionnaire and numerical pain rating scale. Radiographic assessment was performed at 6 weeks and 12 months postoperatively utilizing anteroposterior and lateral hip radiographs to assess component positioning and evaluate for complications. All patients were contacted via telephone and scheduled for follow-up visits to minimize loss to follow-up.

Pairwise comparisons between preoperative and postoperative HHS and WOMAC scores were performed, with statistical significance defined as two-tailed p-value <0.05. All statistical analyses were performed utilizing Numbers (Mac) statistical software.

RESULTS

138 of the 150 eligible patients (92%) completed the full 12-month follow-up protocol. 12 patients (8%) were lost to follow-up. The study cohort comprised 77 males (55.80%) and 61 females (44.20%). Mean chronological age was 64.4±11.1 years (range 46-80 years). Mean body mass index was 25.8±3.4 kg/m² (range 19.1-30.8 kg/m^2).

Preoperative mean HHS was 35.9±15.6 points. Progressive functional improvement occurred across all postoperative timepoints, achieving 84.7±14.4 points at 12 months (mean improvement 48.8 points, p<0.001). 117 patients (84.78%) achieved clinically meaningful improvement (≥10 points), and 111 patients (80.43%) achieved substantial gain (≥20 points). HHS Functional Classification at 12 months (n=138): excellent (90-100): 84 patients (6.87%); good (80-89): 36 patients (26.09%); fair (70-79): 15 patients (10.87%); poor (<70): 1 patient (2.17%). Preoperative mean WOMAC was 60.1±15.6 points. At 12 months, mean WOMAC decreased to 18.0± 14.6 points (mean reduction 42.1 points, p<0.001). 126 patients (91.30%) achieved clinically meaningful improvement (≥20-point reduction).

Table 1: Demographic and clinical characteristics of study COHORT (n=46).

Parameters	Values
Age (years)	
Mean±SD	64.4±11.1
Range	46-80
Sex, N (%)	
Male	77 (55.8)
Female	61 (44.2)
Body mass index (kg/m²)	
Mean±SD	25.8±3.4
Range	19.1-30.8
Obese (BMI >30), N (%)	21 (15.22)
ASA Classification, N (%)	
Class I	66 (47.83)
Class II	54 (39.13)
Class III	18 (13.04)
Class IV	0 (0)
Comorbidities, N (%)	
Diabetes mellitus	45 (32.60)
Hypertension	48 (34.78)
Coronary artery disease	42 (30.43)
Symptom duration (years)	
Mean±SD	11.4±5.9
Range	1-20

In this study, the Cohen's d value for Harris Hip Score improvement was 3.12, and for WOMAC score improvement, 2.71. Both of the values far exceed the conventional threshold of 0.8, that defines a large effect.

Preoperative mean NPRS was 6.5±1.6. At 12 months, mean NPRS was 2.3±1.5, representing 65% pain reduction (p<0.001), sustained through 12 months postoperatively.

A total of 18 complications (13.04%) were observed among the studied cases. The most frequent complication was hematoma formation, occurring in 9 patients (6.52%). Intraoperative fracture was the second most common issue, noted in 4 patients (2.9%). Deep Vein Thrombosis occurred in 1 patient (0.72%). Surgical site infection and

neurovascular injury were each reported in 2 cases (1.45% each). No instances of component malpositioning were recorded in this series.

No radiographic evidence of component loosening, osteolysis, or progressive lucencies >2 mm was identified at 12 months.

Table 2: HHS trajectories (n=138).

Timepoint	Mean±SD	Change from baseline	P value
Preoperative	35.9±15.6	—	—
6 weeks	71.7±15.7	35.8	P<0.001
3 months	80.3±15.4	44.4	P<0.001
6 months	82.3±15.0	46.4	P<0.001
12 months	84.7±14.4	48.8	P<0.001

Table 3: WOMAC score trajectories (n=138).

Timepoint	Mean ± SD	Change from baseline	P value
Preoperative	60.1±15.6	—	—
6 weeks	50.5±18.0	-9.6	P<0.001
3 months	40.1±18.2	-20.0	P<0.001
6 months	35.5±18.2	-24.6	P<0.001
12 months	18.0±14.6	-42.1	P<0.001

Table 4: Numerical pain rating scale trajectories (n=138).

Timepoint	Mean±SD
Preoperative	6.5±1.6
6 weeks	5.5±1.8
3 months	4.4±1.8
6 months	4.0±1.9
12 months	2.3±1.5

DISCUSSION

This case series of 138 patients who underwent posterior approach total hip arthroplasty and systematic posterior soft tissue reconstruction demonstrated good functional outcomes. These outcomes were comparable to published data from tertiary centres. Mean HHS improvement of 48.8 points (from 35.9 to 84.7), WOMAC reduction of 42.1 points (from 60.1 to 18.0), and achievement of zero postoperative hip dislocations validate the efficacy and safety of systematic posterior soft tissue reconstruction in a secondary-care institutional setting.[7-12]

The zero dislocation rate (0%) achieved in this cohort is notably superior to historical posterior approach dislocation rates of 2-4% documented prior to systematic soft tissue repair implementation.[5,6] Contemporary literature from high-volume academic centres employing posterior soft tissue reconstruction uniformly documents dislocation rates of 0.5-2.0%, establishing this range as the benchmark standard.[2,4,7,9] Hernandez et al specific capsular repair technique reported dislocation reduction from 6.38% to 0%, demonstrating comparable efficacy.[10] Zhang et al documented that modified posterior soft tissue repair utilising suture anchor fixation achieved zero dislocation in 220 consecutive cases.[19]

This favourable outcome reflects the prospective protocol of systematic repair encompassing careful identification and preservation of the sciatic nerve, direct muscle-to-capsule fixation of external rotators (piriformis, obturator internus, gemellus complex) using absorbable sutures, posterior joint capsule reconstruction, and intraoperative manual stability testing across multiple hip positions. The mechanical integrity of this reconstruction provides a strong barrier against instability throughout the critical postoperative period when dynamic hip stabilisation remains compromised due to incomplete soft tissue reconstitution.[2,10] Studies by Massouth et al show that Magnetic resonance imaging studies extending beyond four years postoperatively demonstrate that the posterior joint capsule achieves durable osseous integration with scar tissue maturation acquiring architectural characteristics approximating native tendinous tissue, furnishing persistent mechanical stability.[11,12]

Published comparative data from posterior approach THA demonstrate considerable heterogeneity in HHS outcomes. A meta-analysis comparing direct anterior versus posterior approaches found that anterior approach patients demonstrated superior early functional outcomes (HHS at 6 weeks: 4.06 points greater, p<0.001), yet this advantage attenuated substantially at 12 months, with no significant difference in late functional outcomes. The present study's 12-month HHS of 84.7±14.4 aligns with contemporary posterior approach literature demonstrating mean HHS ranging from 80-90 at 12 months postoperatively.[16,24]

The progressive functional trajectory observed in this cohort, with HHS improvement from 35.9 (preoperative)

to 71.7 at 6 weeks, 80.3 at 3 months, 82.3 at 6 months, and 84.7 at 12 months demonstrates sustained improvement through the entire postoperative year, with the trajectory plateau suggesting achievement of functional stability by 6 months. This pattern aligns with tissue healing biology, wherein soft tissue reconstitution occurs predominantly within 6-8 weeks postoperatively, with complete collagen maturation and scar tissue organisation extending through 12 months and beyond.[10-12]

WOMAC score reduction of 42.1 points (59% reduction from baseline) substantially exceeds the clinically meaningful threshold of 20-point reduction established in THA populations.[15,18] Ninety-one percent of patients achieved clinically meaningful WOMAC improvement. The comprehensive functional restoration across multiple domains substantiates that posterior soft tissue reconstruction facilitates not merely pain deterioration but also restoration of dynamic hip stability and muscular function necessary for activities of daily living and instrumental activities of daily living.

The present study's favourable functional outcomes and safety profile in a secondary-care context substantiate that meticulous surgical technique, systematic outcome measurement, and appropriate prosthetic selection can achieve results comparable to tertiary-centre benchmarks regardless of institutional volume or academic status. Contemporary systematic reviews and meta-analyses comparing surgical approaches for primary THA consistently document that with appropriate soft tissue repair, dislocation rates for posterior, anterolateral, and direct anterior approaches are similar and range from 0.4-1.0%.[7,9,24,25] The present study's 0% dislocation rate aligns with the favourable end of this range. While anterior approach studies document marginally superior early functional outcomes (HHS 4-6 points greater at 6 weeks), this advantage attenuates substantially by 12 months, with no significant difference in late functional outcomes. The present study's 12-month HHS of 84.7±14.4 is entirely comparable to anterior approach series. No radiographic evidence of component loosening, osteolysis, or progressive lucencies >2 mm was identified at 12-month radiographic assessment, indicating satisfactory long-term component stability.

Overall complication rate of 13.04% (18 complications in 138 patients) with no major complications represents a favourable safety profile. The minor complications reflect the inherent morbidity of surgical intervention yet do not necessitate reoperation or prolonged morbidity. This safety profile compares favourably with published posterior approach literature documenting overall complication rates of 10-20%, with serious complications occurring in 2-5% of cases.[4,6]

Limitations

This prospective single-surgeon, single-institution case series from a secondary-care orthopaedic setting offers valuable insights into the clinical efficacy of systematic posterior soft tissue reconstruction following total hip arthroplasty, while acknowledging inherent design limitations. The relatively small sample size (n=46), absence of a control group, and 8% attrition rate may restrict statistical power, subgroup analysis, and causal inference regarding the specific contribution of the reconstruction technique to the observed outcomes. These factors also constrain external generalisability, particularly to tertiary or high-volume institutions where variations in surgical training, patient opulations, and resource availability could influence results

CONCLUSION

The findings of this study substantiate that systematic posterior soft tissue reconstruction achieves dislocation prevention and functional outcomes comparable to published tertiary-centre data and competing surgical approaches, particularly when implemented with meticulous surgical technique and appropriate component positioning. These outcomes in a secondary-care setting provide evidence supporting the dissemination of posterior approach THA with systematic soft tissue repair across diverse healthcare contexts, particularly in resource-limited and rural settings where anterior approach expertise and specialised instrumentation may be less available.

Further prospective multi-centre studies from secondary-care and rural institutions would strengthen the external validity of current THR outcomes literature. Comparative effectiveness research examining posterior, anterior, and anterolateral approaches within identical institutional contexts would provide high-quality evidence regarding optimal approach selection. Long-term follow-up studies extending beyond 12 months would elucidate the durability of soft tissue repairs and prosthetic component stability through extended postoperative intervals.

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