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Latitud total hip replacement system in younger and older patients: a comprehensive multi-center assessment of clinical and functional outcomes

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ABSTRACT

Background: Total hip arthroplasty (THA) is a standard treatment for end-stage hip disease. With rising demand across age groups, evaluating implant performance in younger and older patients is important. The Latitud total hip replacement system (HRS) is a novel implant,with no data on its safety and performance in younger patinets. Hence, We aimed to evaluate safety and functional outcomes of the Latitud HRS in younger (≤40 years) and older (>40 years) patients undergoing unilateral or bilateral THA.
Methods: This prospective multicenter study across 11 Indian centers enrolled 192 patients undergoing primary THA with the Latitud HRS, followed for 2 years. Primary outcomes were implant survivorship and revision rates; secondary outcomes were clinical improvement using Harris Hip Score (HHS), Oxford Hip Score (OHS), and adverse events.
Results: Of 192 patients, 67 were ≤40 years (55 unilateral, 12 bilateral) and 125 were >40 years (119 unilateral, 6 bilateral). Avascular necrosis predominated in younger patients, while osteoarthritis dominated older cases. At 2 years, OHS improved significantly in all groups: younger (unilateral 10.18±3.39 to 43.76±4.8; bilateral 8.75±2.83 to 43.08±4.01) and older (unilateral 8.06±4.67 to 43.69±4.68; bilateral 10.83±0.98 to 44.67±5.82). HHS also increased substantially: younger (unilateral 23.58±8.55 to 84.9±9.79; bilateral 19.71±10.93 to 89.4±5.07) and older (unilateral 18.16±12.13 to 86.38±7.89; bilateral 27.09±4.77 to 90). Implant survivorship was 100% in all except older unilateral (99.15%) due to one liner breakage.
Conclusion: The Latitud HRS demonstrated excellent survivorship and functional recovery across both age groups, supporting its safety and durability in Indian patients, including younger adults with high functional demands.

Keywords: Avascular necrosis, Functional outcomes, Implant survivorship, Latitud total hip replacement system, Osteoarthritis

INTRODUCTION

Total hip arthroplasty (THA) has long been established as a successful intervention for relieving hip pain, improving joint mobility, and enhancing the quality of life in patients with severe hip pathologies, such as osteoarthritis (OA) and avascular necrosis (AVN).[1] Over the years, continuous advancements in implant design, surgical techniques, and perioperative management have contributed to improved patient outcomes and increased implant longevity.[2] However, the influence of patient age on THA outcomes remains a topic of significant interest, as age-related factors profoundly impact surgical decision-making, implant selection, and recovery patterns.[1]

Younger patients (≤40 years) undergoing THA typically present with complex conditions such as AVN or post-traumatic arthritis rather than primary degenerative OA.[3,4] This patient population often leads physically active lifestyles, placing higher mechanical demands on implants and posing a greater risk of long-term complications, including aseptic loosening and early revision surgeries.[5] Consequently, implant survivorship and functional durability are pivotal concerns when planning THA for younger individuals.[4,5] On the other hand, older patients (>40 years) undergoing THA frequently have degenerative OA and may present with age-associated factors such as reduced bone density, muscle weakness, and systemic comorbidities.[6]

These patients may experience slower functional recovery and face an increased risk of perioperative complications, such as infections and thromboembolic events, particularly in bilateral procedures.[7] Surgical planning for younger patients presents distinct challenges, as implants must be selected to endure higher levels of physical activity over longer periods. Furthermore, younger individuals typically have greater postoperative expectations, aspiring to resume more active and demanding lifestyles.[8]

Bilateral (BTHA), which involves replacing both hips during a single or staged procedure, offers significant functional improvements for patients with bilateral hip disease.[9] However, it presents unique perioperative challenges due to increased surgical time, higher blood loss, and a greater risk of complications such as infections and thromboembolic events.[10] Bilateral THA, while restoring mobility in patients with bilateral hip dysfunction, is associated with increased surgical complexity, particularly in older patients with comorbid conditions.

While younger patients may tolerate BTHA well due to fewer comorbidities, older patients often face additional risks that can influence both immediate recovery and long-term outcomes.[9,10] The Latitud total HRS, developed with innovative design features such as highly cross-linked polyethylene (HXLPE) liners and hydroxyapatite-coated femoral stems, has demonstrated potential in improving implant stability and wear resistance.[11] However, to date, there is no robust comparative data evaluating its performance in unilateral and bilateral THA or across different age groups. Therefore, it was hypothesized that the Latitud total HRS may exhibit functional and clinical differences between younger (≤40 years) and older (>40 years) patient cohorts. Given the higher mechanical demands and increased activity levels of younger patients, they may be at a greater risk of implant wear and component breakage over time. Conversely, older patients, despite lower implant stress, may experience limitations in achieving full mobility and functional satisfaction due to age-related musculoskeletal factors. This study aims to evaluate whether these anticipated challenges manifest in early clinical and radiographic outcomes with the Latitud total HRS.

METHODS

Study design

This was a prospective, multicenter, observational study conducted (between April 2017 to July 2021) as part of a post-marketing surveillance program across 11 centers in India, which are Barod Hospital, Indore; Saifee Hospital, Mumbai; Yashfeen Hospital, Navsari; Anup Institute of Orthopaedic and Rehabilitation, Patna; Ashoka Medicover Hospital, Nashik; Wockhardt Hospital, Nashik; Bombay Hospital, Indore; Medi-Square Hospital and Research Centre, Indore; Lovee Shubh Clinic Pvt. Ltd., Lucknow; Maxcure Hospital, Hyderabad, Telangana; Currae Hospital, Thane. The primary objective was to evaluate the survivorship and functional outcomes of the Latitud total HRS in younger (≤40 years) and older (>40 years) patients undergoing unilateral or bilateral THA. The study was registered under the Clinical Trials Registry of India (CTRI No: CTRI/2017/06/008774) and received ethical approval from the institutional ethics committees at each participating center.

Participants and surgical approach

Patients meeting the eligibility criteria were enrolled after obtaining written informed consent. Surgical procedures were performed using either the lateral or posterior approach, as determined by the surgeon's preference and patient characteristics. Both unilateral and bilateral THA procedures were included to capture a comprehensive evaluation of the implant's performance in different clinical scenarios.

Inclusion criteria

Patients was a candidate for a total hip replacement. Male and female patients >18 years of age at the time of the study. Patients were willing and able to provide written informed consent by signing and dating the institutional review board (IRB) or ethical committee (EC) approved informed consent form. Patients were willing and able to comply with postoperative scheduled clinical and radiographic evaluations.

Exclusion criteria

Patient with a BMI greater than or equal to 40. Patient with an active infection within the affected hip joint. Patient with neuromuscular or neurosensory deficiency that may limit the ability of the patient to evaluate the safety and efficacy of the device. Patients with a known sensitivity to device materials. Patients who were known drug or alcohol abusers or with psychological disorders that could affect follow-up care or treatment outcomes. Patients was unwilling or unable to sign the informed consent document. Patients with short life expectancy of less than 5 years (e.g., Cancer, HIV/AIDS). Patient with history of deep vein thrombosis or other thrombotic disorders. Patient for whom the surgical procedure is a revision of a previous THR or hemi-arthroplasty, or who had previously undergone arthrodesis or osteotomy of the hip. Patients who, in consideration of treating doctor, would not be suitable for compliance of the follow up.

Follow-up schedule

Patients were evaluated pre-operatively and at post-operative intervals of 6 weeks, 6 months, 1 year, and 2 years. Each assessment included a thorough review of the patient's medical history, physical examination, and radiographic imaging to monitor implant position and stability.

Study endpoints

The study utilized both primary and secondary endpoints to assess clinical outcomes.

Primary endpoints

Implant survivorship

Assessed by the absence of revision or reoperation during the follow-up period.

Performance of implant

The clinical and radiographic performance of the Latitud total HRS was evaluated in all participants. The incidence of complications, adverse events, and serious adverse events among the study population served as an indicator of the system's safety.

Cumulative revision rate

Calculated based on the proportion of patients requiring revision surgery.

Secondary endpoints

Functional outcomes

Assessed using the Harris hip score (HHS) and Oxford hip score (OHS), which measure pain relief, functional improvement, and patient mobility.

Radiographic evaluations

Focused on detecting complications such as implant loosening, subsidence, osteolysis, and any signs of malalignment. This study ensured a comprehensive evaluation of the Latitud total HRS by capturing both quantitative and qualitative patient outcomes, providing robust data on implant performance in both younger and older populations over a two-year period.

Components of the Latitud™ total Hip Replacement System

The Latitud™ total HRS (Meril Healthcare Pvt. Ltd, India) is a system of different components intended to replace hip joint. It comprises an acetabular cup, and a femoral stem (available in both cemented and uncemented forms).[11] The acetabular cup, or modular shell, is made from a titanium alloy (Ti6Al4V ELI) per ASTM F136 standards, designed for cementless fixation in the acetabulum. Its outer surface is coated with commercially pure titanium to enhance its stability. The acetabular liner is constructed from HXLPE according to ASTM F648 standards. The modular femoral head is fabricated from cobalt-chromium alloy (ASTM F1537-1). The femoral stem comes in uncemented and cemented variants. The uncemented version, made from a titanium alloy (ASTM F136), is coated with hydroxyapatite to promote fixation both proximally and distally. The stem has a 12/14 taper designed to interface with the modular femoral head. It is available in 11 different sizes with provision of 135º standard, 135º lateral, 125º standard (coxavera) neck angle and polished distal section. The shell size ranges from 40 mm to 70 mm, while the liner sizes vary between 35 mm and 52 mm. The modular femoral head is available in sizes from 22 mm to 40 mm (Figure 1).[11]

Statistics analysis

All analyses were conducted using SPSS and RStudio software. Continuous variables were expressed as means with standard deviations, while categorical variables were summarized using frequencies and percentages. Inter-group comparisons between younger (≤40 years) and older (>40 years) cohorts, as well as between unilateral and bilateral THA procedures, were performed. Independent sample t-tests were used to assess differences in continuous variables such as age, body mass index (BMI), and functional scores (OHS and HHS) across groups. Categorical variables, including gender distribution, comorbidities, surgical approach, and indication for surgery, were analyzed using chi-square or Fisher's exact tests as appropriate. Implant survivorship was assessed over the 24-month follow-up period, and revision surgery was noted as the endpoint for survivorship analysis. Adverse events and serious adverse events were reported descriptively. Functional outcome improvements from baseline to 24 months were analyzed using paired t-tests within each subgroup, and the magnitude of change was further assessed using Cohen's d to determine effect size.

A Cohen's d value ≥0.8 was interpreted as a large effect, indicating clinically meaningful improvement. All statistical tests were two-tailed, and a p value of <0.05 was considered statistically significant.

RESULTS

Baseline demographic

A total of 192 patients were enrolled in the study, comprising 67 younger patients (≤ 40 years) and 125 older patients (> 40 years). Among the younger cohort, 55 patients (82.1%) underwent unilateral THA and 12 (17.9%) underwent BTHA. In the older cohort, 119 patients (95.2%) had unilateral THA while 6 (4.8%) underwent BTHA (Table 1). There was a significant age difference between younger and older patients between both unilateral ($p<0.0001$) and bilateral groups ($p<0.0001$). The mean age for younger unilateral patients was 31.64±5.73 years, and for bilateral patients mean age was 31.74±2.78 years. In contrast, the mean age for older unilateral patients was 56.94±8.84 years, while for bilateral patients, it was 54.21±9.57 years (Table 1). In terms of gender distribution, the younger cohort was predominantly male (83.64% for unilateral and 83.33% for bilateral cases), whereas the older cohort had a relatively lower male proportion (59.66% for unilateral and 66.67% for bilateral cases) (Figure 2). BMI values were comparable, with the younger cohort showing a mean BMI of 24.62±2.55 kg/m^2 in unilateral cases and 25.4±2.71 kg/m^2 in bilateral cases. The older cohort exhibited slightly higher BMI values of 25.37±2.71 kg/m^2 (unilateral) and 27.24±4.03 kg/m^2 (bilateral). The baseline demographic and pre-operative clinical characteristics of the study population are summarized in Table 1.

Medical history

The most common indication for hip arthroplasty in the younger cohort was AVN, observed in 55.22% of unilateral and 58.33% of bilateral cases. Conversely, OA was more prevalent in the older cohort, present in 36.97% of unilateral and 83.33% of bilateral cases. Other less frequent indications included post-traumatic arthritis (5.97% of the younger unilateral cohort and 3.36% of the older unilateral cohort) and femoral neck fractures 12.6% among older unilateral cohort (Figure 3). Comorbidities were more prevalent in the older cohort. Diabetes was noted in 5.88% of older unilateral patients compared to 1.82% of younger unilateral patients, whereas among bilateral patients 33.3% (n=2) of patients had diabetes from older cohort and no cases of diabetes in younger patients. Hypertension was also more common among older patients (unilateral: n=11; and bilateral: n=2) compared to the younger cohort (unilateral: n=1) Table 2.

Surgical approach and laterality

The posterior approach was the most commonly used for bilateral hip replacements in both cohorts, with 70.83% of younger and 83.33% of older bilateral patients. For unilateral procedures, the lateral approach was commonly employed in 54.55% of younger and 49.58% of older patients (Table 1).

Implant details

The distribution of femoral stem types among 192 patients who underwent THA with the Latitud total HRS showed predominant use of uncemented stems (n=206) across both age groups. Cemented stems were used exclusively in the older unilateral group, suggesting selective use based on clinical factors such as bone quality in this age group. Detailed distribution of implant is presented in Table 3.

Figure 1: Components of the Latitud total hip replacement system.

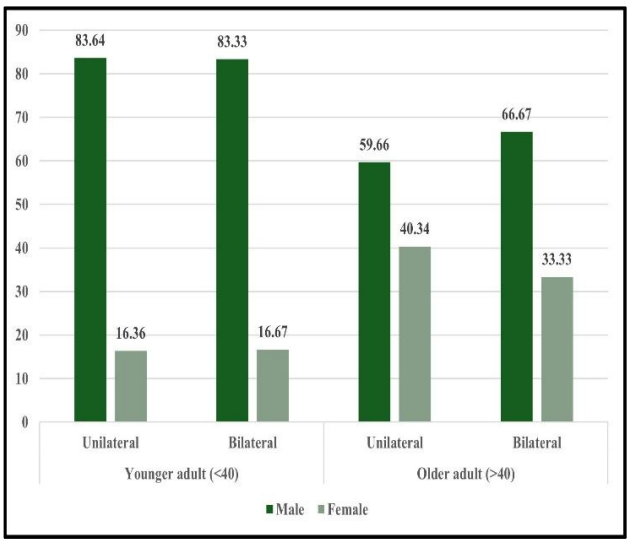

Figure 2: Percentage of male and female distribution in younger and older patients in patients undergoing total hip arthroplasty using Latitud total hip replacement system.

Table 1: Baseline characteristics of younger and older patients undergoing total hip arthroplasty with Latitud total hip replacement system.

Variables	Younger patients (<40 years)		Older patients (>40 years)		P value	
	Unilateral	Bilateral	Unilateral	Bilateral	Unilateral	Bilateral
Total no. of patients (n)	55	12	119	6		
Age (in years) Mean±SD	31.64±5.73	31.74±2.78	56.94±8.84	54.21±9.57	<0.0001	<0.0001
BMI (kg/m^2) Mean±SD	24.62±2.55	25.4±2.71	25.37±2.71	27.24±4.03	0.0688	0.3492
Systolic BP (mmHg), Mean±SD	121.37±6.8	124.33±7.71	124.54±11.07	120±14.14	0.0539	0.4067
Diastolic BP (mmHg), Mean±SD	80.39±5.38	79.08±8.92	80.03±7.02	75.00±8.37	0.7415	0.3645
Surgical approach (N)						
Lateral	30	7	59	2		
Posterior	25	17	60	10		
Laterality (N)						
Left hip	24	12	52	6		
Right hip	31	12	67	6		

Table 2: Comorbidities of younger and older patients undergoing total hip arthroplasty with Latitud total hip replacement system.

Co-morbidities	Younger patients ≤40 n (%)		Older patients >40 n (%)	
	Unilateral	Bilateral	Unilateral	Bilateral
Diabetes mellitus	1 (1.82)	0 (0.00)	7 (5.88)	2 (33.33)
Smokers	1 (1.82)	0 (0.00)	1 (0.84)	0 (0.00)
Alcoholic	0 (0.00)	1 (8.33)	0 (0.00)	0 (0.00)
Previous joint surgery	1 (1.82)	0 (0.00)	5 (4.2)	0 (0.00)
Ischemic heart disease	0 (0.00)	0 (0.00)	2 (1.68)	0 (0.00)
Hypertension	1 (1.82)	0 (0.00)	11 (9.24)	2 (33.33)
Hypothyroidism	0 (0.00)	0 (0.00)	0 (0.00)	2 (33.33)
Severe skin allergy	0 (0.00)	1 (8.33)	0 (0.00)	0 (0.00)
Bronchial asthma, pulmonary tb 4 years back	0 (0.00)	0 (0.00)	0 (0.00)	1 (16.67)

Table 3: Distribution of type of component of Latitud total HRS (Femoral Stem) implanted in the study population.

Type of stem implanted	Younger cohort (67 subjects)				Older cohort (125 subjects)				Total implant
	Unilateral (55 subject)		Bilateral (12 subjects)		Unilateral (119 subjects)		Bilateral (6 subjects)		
	Right	Left	Right	Left	Right	Left	Right	Left	
Uncemented femoral stem	31	24	12	12	64	51	6	6	206
Cemented femoral stem	0	0	0	0	3	1	0	0	4

Table 4: Oxford hip score of younger and older patients undergoing total hip arthroplasty with Latitud total hip replacement system.

Oxford hip score	Younger patients ≤40		Older patients >40	
	Unilateral	Bilateral	Unilateral	Bilateral
At baseline	10.18±3.39	8.75±2.83	8.06±4.67	10.83±0.98
6 weeks	27.33±6.85	25.83±9.41	27.63±7.92	23.17±8.75
6 months	35.44±3.25	36.83±5.77	36.05±4.37	36.67±3.78
1 year	40.31±4.41	40.67±3.58	40.1±4.1	39.5±2.43
2 years	43.76±4.8	43.08±4.01	43.69±.68	44.67±5.82
P value (baseline vs. 2 years)	<0.0001	<0.0001	<0.0001	<0.0001
Cohen's d (baseline vs. 2 years)	8.08	9.89	7.62	8.11

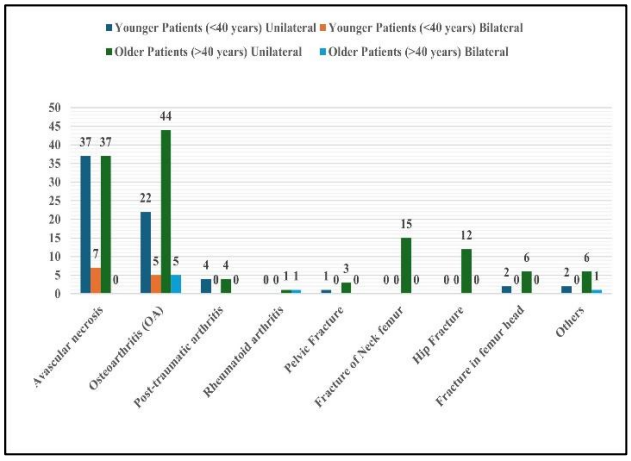

Figure 3: Primary indications in younger and older patients undergoing total hip arthroplasty with Latitud total hip replacement system.

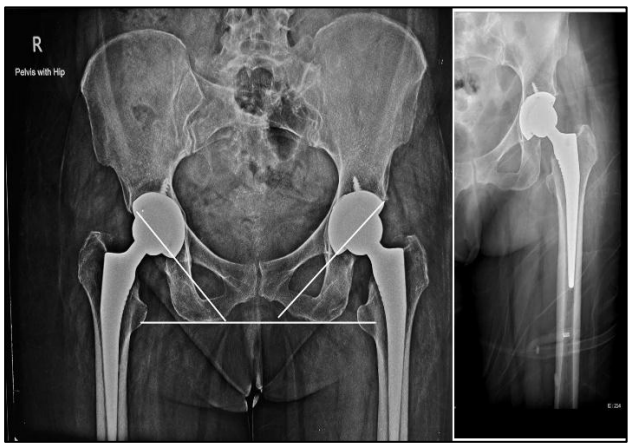

Figure 4: Postoperative radiograph of a showing bilateral (panel A) and unilateral THA (panel B) with Latitud total hip replacement system.

Radiographic assessment, implant survivorship

The hip implant survivorship in younger patients (≤40 years) was exceptional, with no reoperation component removals, or revisions reported for either unilateral or bilateral replacements, including cases of aseptic loosening, at all follow-up intervals. Among older patients (>40 years), initial outcomes were similarly excellent, with a 100% success rate within the first year. However, during the 24-month follow-up, one unilateral case required revision due to liner breakage and hence the implant survivorship among older unilateral cohort was 99.15% for 24 months postoperatively (Figure 4).

Functional outcomes

Significant improvements in functional scores were observed across both younger (≤40 years) and older (>40 years) patient cohorts at all follow-up intervals. During the 24 months, the OHS and HHS demonstrated statistically significant gains ($p<0.0001$), with effect sizes (Cohen's d) confirming clinically meaningful improvements. For the younger unilateral group, OHS increased from 10.18±3.39 at baseline to 43.76±4.8 in 24 months ($p<0.0001$, Cohen's d = 8.08), while the younger bilateral group improved from 8.75±2.83 to 43.08±4.01 ($p<0.0001$, Cohen's d=9.89). In the older unilateral group, OHS increased from 8.06±4.67 to 43.69±4.68 ($p<0.0001$, Cohen's d=7.62), whereas older bilateral patients showed an improvement from 10.83±0.98 to 44.67±5.82 ($p<0.0001$, Cohen's d=8.11) (Table 4). A similar trend was observed in HHS scores, with the younger unilateral group increasing from 23.58±8.55 to 84.9±9.79 ($p<0.0001$, Cohen's d=6.67), and younger bilateral patients improving from 19.71±10.93 to 89.4±5.07 ($p<0.0001$, Cohen's d=8.18). The older unilateral group saw an increase from 18.16±12.13 to 86.38±7.89 ($p<0.0001$, Cohen's d=6.67), while the older bilateral group exhibited the largest effect size, with HHS rising from 27.09±4.77 to 90 ($p<0.0001$, Cohen's d=18.65) (Table 5). The effect size analysis demonstrated very large clinical improvements across all groups, with Cohen's d values ranging from 6.67 to 18.65, confirming that the Latitud total HRS provides meaningful functional recovery in both younger and older patients.

Adverse events and serious adverse events

The younger cohort reported minimal adverse events, including one case (30 years old male) of septic loosening of acetabular component in a unilateral group at the 12-month follow-up, which was resolved through medications, and one case (23 years old male) of periprosthetic fracture in femoral stem in a patient with bilateral THA observed at 6 months, which was conservatively managed and eventually resolved within eight weeks. Among older cohort, one case of liner breakage occurred in a unilateral patient (59 years old male, cardiac patient) at 12 months, necessitating revision performed during the 24-month follow-up period (Table 6). No further complications were noted in either cohort.

Table 5: Harris hip score of younger and older patients undergoing total hip arthroplasty with Latitud total hip replacement system.

Harris hip score	Younger patients ≤40		Older patients >40	
	Unilateral	Bilateral	Unilateral	Bilateral
At baseline	23.58±8.55	19.71±10.93	18.16±12.13	27.09±4.77
6 weeks	57.1±10.32	46.4±21.76	56.62±12.3	55.18±15.39
6 months	74.56±7.56	78.57±10.19	73.52±9.34	76.86±9.57
1 year	86.96±4.69	84.53±8.51	83.22±8.09	85.03±3.37

Continued.

Harris hip score	Younger patients ≤40		Older patients >40	
	Unilateral	Bilateral	Unilateral	Bilateral
2 years	84.9±9.79	89.4±5.07	86.38±7.89	90±0
P value (baseline vs. 2 years)	<0.0001	<0.0001	<0.0001	<0.0001
Cohen's d (baseline vs. 2 years)	6.67	8.18	6.67	18.65

Table 6: Serious adverse event and cumulative revision rate following total hip arthroplasty with Latitud total hip replacement system.

	Younger patients					Older patients				
	At baseline	6 weeks	6 months	1 year	2 years	At baseline	6 weeks	6 months	1 year	2 years
Serious adverse event										
Unilateral	0	0	0	1	1	0	0	0	1*	1*
Bilateral	0	0	1	1	1	0	0	0	0	0
Revision rate										
Unilateral	0	0	0	0	0	0	0	0	0	1*
Bilateral	0	0	0	0	0	0	0	0	0	0

*A 59-year-old male patient was hospitalized with complaint of liner breakage in left hip at one year follow up at two-year follow-up, revision surgery was performed.

DISCUSSION

This study provides a comparative analysis of younger (≤40 years) and older (> 40 years) patients undergoing both unilateral and bilateral THA using the Latitud total HRS, with early outcome data extending to 24 months. Our findings highlight the system's efficacy in terms of functional recovery, implant survivorship, and radiographic stability in a diverse patient population. This study addresses a crucial gap in the literature by focusing on a substantial cohort of younger patients-a demographic that is typically underrepresented in THA studies due to their lower prevalence of end-stage hip disease but higher mechanical demands.

Clinical relevance

A novel aspect of this study is the inclusion of bilateral cases in both younger and older cohorts, which remains disputed in THA literature. The findings of this study provide critical clinical insights into the real-world performance of the Latitud total HRS in both younger and older THA patients. The absence of implant wear or breakage in younger patients contradicts concerns that early mechanical failure might be more common in this cohort, suggesting that the hydroxyapatite-coated femoral stem and HXLPE liner contribute to enhanced durability. Additionally, the 99.15% implant survivorship in older patients with one revision due to liner breakage reinforces the reliability of this system. Older patients might still perceive limitations in mobility due to pre-existing musculoskeletal deterioration, achieving excellent functional scores in this cohort underscores the need for tailored strategies and use of advanced implants designs to maximize postoperative functional gains in this demographic. Furthermore, the exceptional survivorship observed in bilateral procedures suggests that the Latitud total HRS could be a preferred implant choice for patients requiring simultaneous or staged bilateral THA, given its stable fixation and low complication rates.

The results align with existing literature, demonstrating substantial improvements in functional outcomes following THA. Reported failure rates in young THA patients vary between 3% and 25%, as highlighted by Metcalfe et al with key contributing factors including aseptic loosening, osteolysis, implant wear, and infection.[3,12] Similarly, Negm et al noted that although younger patients face a higher likelihood of reoperation over time, THA survival rates at five years remain high, ranging from 90% to 100%.[3] Furthermore, data from the National Joint Registry of England suggest that ceramic-on-ceramic bearings demonstrate the lowest failure rates (2%) and a five-year survival rate of 98%.[13] Additional studies corroborate these findings, reporting a two-year implant survivorship rate of 97%.[14] In contrast to these findings, our study observed no instances of revision due to aseptic loosening during a two-year follow-up period. This outcome suggests that the advanced porous coating and optimized design of the Latitud total HRS facilitate superior initial integration, potentially reducing early complications. Historically, BTHA has been associated with elevated complication rates and extended recovery durations due to the increased surgical complexity.[10] Complication rates for BTHA have been reported at 7.1%, marginally higher than those for unilateral procedures.[15] In younger patients, common complications include dislocation, infection, and loosening of femoral or acetabular components.[16] However, our study observed no adverse events in BTHA cases, underscoring the robustness and reliability of the Latitud total HRS, even in complex surgical scenarios. Evidence from prior studies indicates that BTHA contributes to improved hip function and stable implant fixation in short- to mid-term follow-up periods.[17] Cementless THA has shown excellent long-term survivorship in younger patients, while mid-term studies

in older patients have confirmed the efficacy of unilateral cementless THA, with low revision rates and high survival outcomes.[17,18] The distribution of femoral stem fixation in our study reflects a strong preference for uncemented implants across both age groups. All younger patients and all bilateral cases, irrespective of age, received uncemented femoral stems.

Cemented fixation was selectively employed in four older unilateral cases. This pattern is consistent with prevailing trends in the Indian context, where uncemented THA is increasingly common, particularly among younger patients. A prospective study from a tertiary care hospital in Maharashtra reported exclusive use of uncemented implants in 123 patients with avascular necrosis as the leading indication.[19] Another Indian study in a socioeconomically challenged population also documented significant functional gains following uncemented THA, with postoperative modified Harris Hip Scores exceeding 88.[20] In Western countries as well, uncemented fixation is increasingly favored in younger, active individuals, with data from the National Joint Registry of England and Wales indicating higher use in patients under 70.[13] Taking together, the 100% implant survivorship in our younger cohort and high success rate across bilateral cases underscore the durability and evolving clinical promise of the Latitud total HRS.

Significant functional improvements were observed consistently in both younger and older cohorts across all follow-up periods. In both younger and older unilateral patients, the OHS improved significantly compared to pre-operative scores. These outcomes surpass the average OHS improvements reported for standard THA prostheses, which typically plateau at approximately 39.5 points after two years.[13,17] The HHS exhibited a similarly robust pattern of improvement. Among younger unilateral patients, HHS improved significantly from preoperative to 24 months, aligning with other studies utilizing advanced implants. Chapot et al documented mean HHS scores of 81 at two years in young THA patients.[13] Another study demonstrated preoperative HHS improvements from 48.53±6.28 to 88.22±3.78 within 12 months postoperatively, while another cohort showed mean HHS scores of 91.26±4.75 at 18 months.[21,22] Older unilateral patients similarly demonstrated substantial improvements, with HHS increasing from 18.16±12.13 to 86.38±7.89, paralleling outcomes reported by Lu et al where HHS improved from 41 preoperatively to 88.4 at an average follow-up of 20.3 months.[23]

Bilateral cases demonstrated equally remarkable functional recovery. Younger bilateral patients achieved a substantial increase in HHS from 19.71±10.93 preoperatively to 89.4±5.07 postoperatively, comparable to outcomes from staged bilateral procedures. Choudhary et al. reported similarly high HHS values of 89.96±3.32 and 88.08±12.53 for right and left hips, respectively, at six months.[24] Among older bilateral patients, HHS improved significantly from 27.09±4.77 to 90, outperforming the findings of Gaurang et al. where HHS increased from 43.1 to 83.7 over two years.[25] Similar to these findings, the outcomes from our study underscores the Latitud total HRS's efficacy in achieving superior postoperative functional outcomes across diverse patient demographics, including younger and older populations, as well as in complex bilateral procedures. The very large effect sizes (Cohen's d >6 across all groups) confirm that these improvements were not only statistically significant but also clinically meaningful, surpassing established minimum clinically important difference (MCID) thresholds for THA. These findings highlight the Latitud total HRS's efficacy in restoring function across diverse patient populations, particularly in younger, active patients and older individuals undergoing bilateral THA. Radiographic evaluations showed no evidence of femoral or acetabular osteolysis, radiolucency, or subsidence in the younger cohort across all follow-up periods. In the older cohort, isolated cases of femoral stem subsidence (≤ 2 mm) and acetabular shell migration (≤ 2 mm) were identified in one unilateral and two bilateral patients within the first six weeks postoperatively. Notably, these cases stabilized over time and did not require surgical intervention.

Consistent with our findings, a two-year prospective study by Munir et al demonstrated excellent implant stability and fixation, reporting no signs of implant loosening.[26] In addition, the literature highlights variations in femoral stem subsidence rates based on rehabilitation protocols. Leiss et al. documented higher subsidence rates in patients undergoing full weight-bearing with enhanced recovery rehabilitation compared to those following partial weight-bearing protocols within the first four weeks of radiological evaluation.[27] The risk of femoral stem subsidence prior to achieving osteointegration remains a significant concern in hip replacement surgery, with reported rates ranging from 5% to 61.5%, posing a potential factor for early THA failure.[27] However, our results underscore a more favorable early radiographic profile, likely attributable to the advanced design and optimized biomechanics of the Latitud total HRS. The occurrence of adverse events was minimal across both cohorts. In the younger bilateral group, there was one case of septic loosening at 12 months, which was successfully managed non-surgically. Among older patients, a single serious adverse event occurred-a liner breakage in a unilateral case at 12 months, necessitating revision surgery at 24 months. Notably, no cases of infection, dislocation, or catastrophic failure were observed in either cohort during the follow-up period. The findings from a meta-analysis by Kunutsor et al reported dislocation rates following primary THA to range from 2% to 10%, based on data from 125 studies involving approximately five million hip replacements.[28] Furthermore, the incidence of infection over a 90-day to one-year period was documented to be 0.49% as seen in a meta-analysis underscoring the rarity of such complications.[29] With acceptable minor adverse events from our study, highlight the favorable safety profile of the Latitud total HRS, demonstrating its effectiveness in minimizing adverse

events across diverse patient populations. This study highlights the Latitud total HRS's adaptability in catering to the needs of both younger, physically active patients and older individuals with comorbidities. The implant demonstrated consistent performance in bilateral procedures, with no cases of aseptic loosening, affirming its applicability in high-demand clinical situations. Furthermore, the findings underscore the necessity of individualized follow-up strategies for older patients, who may exhibit minor early postoperative implant migration. Proactive radiographic monitoring and timely clinical evaluations during the early recovery phase could help mitigate potential long-term complications.

This study provides valuable insights into the clinical and radiographic outcomes of the Latitud total HRS across a heterogeneous patient population in a multicenter setting. The prospective design with standardized follow-ups till 2 years ensures robust longitudinal data collection, allowing for accurate assessment of implant survivorship, functional outcomes, and revision rates. Additionally, the inclusion of both younger (≤40 years) and older (>40 years) patients, undergoing unilateral and bilateral THA, provides a comprehensive evaluation of the implant's performance across different age groups. The use of validated outcome measures such as the OHS and HHS enhances the reliability of functional assessments. Furthermore, the statistical rigor, employing parametric and non-parametric tests, ensures objective comparisons while minimizing bias. Despite these strengths, the study has certain limitations. First, the sample size, particularly for the bilateral THA cohort is relatively small, which may limit the generalizability of findings for this subgroup. Additionally, while the follow-up duration of two years is sufficient to assess early- to mid-term outcomes, longer-term follow-up is needed to evaluate implant longevity and late complications, such as aseptic loosening or polyethylene wear. Another limitation is the lack of a control group with an alternative hip implant system, which prevents direct comparative efficacy analysis.

CONCLUSION

This study iterates that novel Latitud total HRS is a safe, durable, and effective implant for THA across different age groups. Notably, the anticipated risks of early implant wear in younger patients and functional dissatisfaction in older patients were not observed within the 24-month follow-up period, challenging existing concerns regarding early failure in high-demand cases. The 100% survivorship in younger patients and 99.15% in older unilateral THA patients affirm the system's reliability, with single case requiring revision. Additionally, the minimal adverse event rate reinforces the system's favorable safety profile.

The Latitud total HRS demonstrates strong functional recovery in both unilateral and bilateral THA, with no revisions due to aseptic loosening-a critical indicator of long-term implant stability. Given these findings, this system could serve as an optimal choice for younger patients, where implant longevity is paramount, and for older patients undergoing bilateral THA, where surgical complexity is higher. However, long-term studies extending beyond 5–10 years are warranted to assess implant wear progression, potential late-stage complications, and long-term patient-reported satisfaction.

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