RESEARCH PAPER

Content Validation of a Video-Assisted Telerehabilitation Protocol for Postoperative Total Hip Replacement Patients

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Received: 5th May, 2026; Revised: 1st July 2026; Accepted: 7th Oct, 2026; Available Online: 29th Oct, 2026

ABSTRACT

Background: Structured rehabilitation following total hip replacement (THR) is essential for restoring mobility, functional independence, and quality of life. However, access to conventional in-person physiotherapy may be limited due to geographical, financial, or mobility constraints. Telerehabilitation, particularly video-assisted delivery, has emerged as a feasible alternative that enables remote supervision and guidance of rehabilitation exercises. Despite its growing use, there is a lack of standardized and content-validated video-assisted telerehabilitation protocols specifically designed for post-operative THR patients.

Objective: To develop and content validate a structured video-assisted telerehabilitation protocol for patients following total hip replacement.

Methods: A methodological content validation study was conducted. A three-phase telerehabilitation protocol, including early functional, progressive functional, and advanced functional phases, was developed based on an extensive literature review and clinical expertise. Content validation was performed by a panel of nine experts comprising orthopaedic surgeons and musculoskeletal physiotherapists with at least 10 years of clinical experience.

Each exercise item was evaluated for relevance and ease of performance using a 5-point Likert scale. Item-level Content Validity Index (I-CVI), modified Kappa, and S-CVI/Ave were calculated to assess item-level and overall content validity.

Results: Most exercise items demonstrated excellent content validity, with I-CVI values ranging from 0.78 to 1.00. The probability of chance agreement (Pc) was calculated for each item, and modified Kappa values showed good to excellent agreement for most items after accounting for chance agreement. The S-CVI/Ave was 0.95 for relevance and 0.92 for ease of performance, indicating high content validity. A few exercises with lower validity scores were modified or deferred based on expert recommendations to improve safety and feasibility.

Conclusion: The developed video-assisted telerehabilitation protocol demonstrated excellent content validity. It may serve as a standardized and evidence-based framework for remote rehabilitation and improve accessibility and continuity of care for post-operative THR patients.

Keywords: Total hip replacement; Tele-rehabilitation; Video-assisted rehabilitation; Content validity; Physiotherapy; Orthopaedic rehabilitation; CVI; Kappa statistics; Home-based exercise; post-operative care.

How to cite this article: Rachel Arrolu, Dr T Madhavi, Content Validation of a Video-Assisted Telerehabilitation Protocol for Postoperative Total Hip Replacement Patients, 2026;16(88s): 1913-1924; DOI: 10.25258/ijddt.16.88s.195

INTRODUCTION

Total hip replacement (THR) is a commonly performed orthopedic procedure aimed at relieving pain and restoring function in patients with advanced hip pathologies, including osteoarthritis, avascular necrosis, rheumatoid arthritis, and fractures. Despite advances in surgical techniques and implant design, postoperative rehabilitation remains a critical determinant of functional recovery and long-term outcomes. Structured physiotherapy programs initiated after surgery improve muscle strength, gait, balance, and activities of daily living while reducing complications.[1]

In India, the number of THR procedures has steadily increased over the past decade due to improved surgical techniques, greater awareness, and expanding orthopedic services. The majority of patients undergoing THR belong to the older adult population, particularly within the 60–80-year age group. Effective post-operative rehabilitation is essential to restore mobility, functional independence, and quality of life in these patients. However, access to continuous physiotherapy services may be limited due to geographical, financial, and mobility constraints.[2,3] Therefore, alternative models such as video-assisted telerehabilitation have gained increasing attention for

delivering post-operative care. Traditional rehabilitation following THR is predominantly delivered through in-person sessions, which may be challenging for elderly patients, those residing in remote areas, or individuals with limited mobility.

Tele-rehabilitation has emerged as a promising alternative, utilizing information and communication technologies to deliver rehabilitation remotely. Video-assisted tele-rehabilitation allows patients to receive guided exercise instruction and therapist feedback within their home environment.[3]

Although several studies have demonstrated the feasibility and effectiveness of tele-rehabilitation following THR, there is no universally accepted, standardized, and validated video-assisted protocol tailored specifically for this population.[3,4] Moreover, many existing programs lack formal content validation to ensure clinical relevance and ease of performance.[5]

Content validation is a critical methodological step in the development of rehabilitation protocols. It ensures that each exercise included is clinically relevant, appropriate for the target population, and feasible to perform.[6]

Given the increasing role of tele-rehabilitation and the absence of a standardized and content-validated video-assisted protocol for post-operative THR patients, there exists a clear need for the development of a structured, evidence-based framework.[3,4]

Therefore, the present study aimed to develop a structured, phase-wise video-assisted telerehabilitation protocol for post-operative THR patients and to establish its content validity through expert evaluation.

MATERIALS AND METHODS

An extensive review of the literature was conducted to identify relevant evidence and recommendations for the development of an exercise protocol for patients following Total Hip Replacement (THR). [4,7]

The content validation process comprised two stages: protocol development and expert judgment. Based on the findings of the literature review, the rehabilitation protocol was developed and organized into three phases according to the expected postoperative functional progression.[4,7]

Study Design

A methodological content validation study was conducted to evaluate the relevance and ease of performance of a newly developed video-assisted telerehabilitation protocol for post-operative Total Hip Replacement (THR) patients. The study focused on expert-based evaluation of protocol components prior to clinical implementation. [5,7]

Ethical Approval

Ethical approval for the present study was obtained from the Institutional Ethics Committee of Durgabai Deshmukh Hospital and Research Centre, Hyderabad (IEC Registration No. ECR/477/Inst/AP/2013/RR-20). The study was reviewed and approved by the Institutional Ethics Committee. The study was conducted in accordance with ethical principles and institutional guidelines.

Development of the Protocol

The telerehabilitation protocol was developed based on a structured review of contemporary literature, including randomized controlled trials, systematic reviews, and established post-operative THR rehabilitation guidelines.

Databases such as PubMed, Ovid MEDLINE and Google Scholar were searched and identified evidence-based exercise components. Exercises were selected based on clinical relevance, safety considerations, post-surgical precautions, and functional recovery goals.

The protocol was organized into three progressive phases:

Early Functional Phase
Progressive Functional Phase
Advanced Functional Phase

The complete telerehabilitation protocol is provided in (Annexure 1)

Each phase included defined prerequisite, therapeutic goals, precautions, structured exercise dosage (frequency, repetitions, and duration), functional task training, and clearly specified progression criteria to ensure safe advancement.

TELEREHABILITATION PROTOCOLFOR THR PROTOCOL DETAILS

Pre-Telerehabilitation Phase (0–2 weeks postoperatively)

The pre-telerehabilitation Phase covers the immediate postoperative period and focuses on wound healing, pain and swelling management, hip precautions, and safe mobility. Basic isometric and gentle mobility exercises may be initiated according to the patient's clinical status.[1,8]

The structured Rehabilitation protocol, unfolds across three distinct phases, each defined by specific domains for weekly exercises.

We designed the protocol in 3 phases-

- Phase 1, Early function phase (protective phase) spans up to 4 weeks.
- Phase 2, Progressive function phase (transitional phase) Extends to 8 weeks, and.
- Phase 3, known as the advanced function phase (activity phase) Continues up to 12 weeks.
- The video-assisted telerehabilitation exercises were prescribed four days per week to provide an optimal balance between training stimulus and recovery in post-operative THR patients. This non-consecutive frequency helps prevent overuse, reduce fatigue, and promote tissue healing while supporting neuromuscular adaptation and functional improvement.

PHASE-WISE EXERCISE PROTOCOL

The complete telerehabilitation protocol is provided in (Annexure 1)

Phase 1: Early Functional Phase (Weeks 3–4).[4,7,8]

The primary intention of this phase was to establish basic motor control and safe functional mobility following the initial postoperative healing period. Emphasis was placed on restoring controlled lower-limb movement, initiating progressive weight-bearing and muscle activation, improving joint mobility, and developing basic balance and gait control while maintaining adherence to surgical precautions.[1,4,8]

The phase aimed to facilitate a safe transition from protected postoperative mobility toward independent functional movement.[1,4]

Phase 2: Progressive Functional Phase (Weeks 5–8).[9,10]

The primary intention of this phase was to progressively improve lower-limb strength, weight-bearing capacity, balance, gait, and functional movement. Exercise intensity and functional demands were gradually increased to promote neuromuscular control, improve dynamic stability, enhance walking tolerance, and facilitate greater independence in activities of daily living. This phase focused on progressing from basic movement control toward more efficient and coordinated functional performance. [4,8,9]

Phase 3: Advanced Functional Phase (Weeks 9–12).[4,8,]

The primary intention of this phase was to develop advanced strength, dynamic balance, endurance, and functional capacity required for higher-level daily activities. Progressive loading and functional tasks were incorporated to improve movement efficiency, gait performance, activity tolerance, and confidence in the operated limb.

The phase aimed to prepare the patient for independent performance of routine functional activities and a gradual return to preoperative levels of physical activity, as appropriative, as appropriate.[9,11]

Dislocation Precautions

Dislocation precautions should be followed as advised by the operating surgeon and according to the surgical approach used.[1,8]

The dislocation precautions are detailed in Annexure 1.

Expert Panel

A panel of nine experts was recruited for content validation, comprising two orthopedic surgeons and seven musculoskeletal physiotherapists with a minimum of 10 years of clinical and academic experience in managing THR patients. Experts were selected from different regions of South India to ensure diverse professional perspectives.

The number of experts was considered adequate based on methodological recommendations suggesting that 5–10 experts are sufficient for content validation studies when calculating Content Validity Indices.[5,6]

Table-1 Expert Panel Composition

Expert Type	Number	Experience Range (Years)
Orthopedic Surgeons	2	30–35
Musculoskeletal Physiotherapists	7	11–20

Validation Procedure

The developed protocol and structured evaluation form were circulated electronically to all experts. Each exercise item was rated on a 5-point Likert scale for:

- Relevance
- Ease of performance[5,6]

Ratings of 4 (Agree) and 5 (Strongly Agree) were considered indicative of acceptable content validity. Experts were also encouraged to provide qualitative suggestions for modification, addition, or deletion of items where necessary.[7,12]

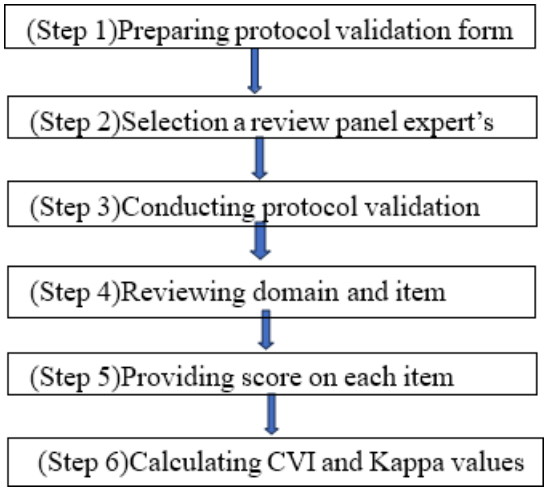


Figure-1 Flow diagram showing the stepwise development and content validation process of the video-assisted telerehabilitation protocol for post-operative Total hip replacement patients.

Statistical Analysis

Item-level Content Validity Index (I-CVI) was calculated as the proportion of experts who rated each item as either 4 or 5 on the 5-point Likert scale, indicating high relevance and ease of performance.[5] The Scale-Level Content Validity Index based on the average method (S-CVI/Ave) was calculated to assess the overall content validity of the protocol for relevance and ease of performance.

To account for the probability of chance agreement among experts, modified Kappa statistics were calculated for each item. The level of agreement was interpreted as excellent (≥0.74), good (0.60–0.73), and fair (0.54–0.59).[5,6]

RESULTS

Based on the ratings provided by the nine experts, the Content Validity Index (CVI) values for the protocol are presented in Table-2.

The proposed video-assisted telerehabilitation protocol comprised six key components mobility, strengthening, closed-chain activities, balance training, functional and gait training, and stretching with a total of 33 exercise items. All items were independently evaluated by nine experts for relevance and ease of performance.

Following the initial expert review, several modifications were made to improve clarity, safety, and phase-appropriate progression. Weighted hip movements and straight leg raises were progressed to later weeks to reduce early loading demands. Bridging with arm raise was replaced with standard pelvic bridging.

Mini squats were modified to wall-supported mini squats, while step-ups and side step-ups were rescheduled to Week 6 with external support. Single-leg stance was modified to include external support. Toe raises were added alongside heel raises, and seated knee marches were refined as short-amplitude seated knee marches for greater clarity.

Following expert evaluation and incorporation of the suggested modifications, 31 of the 33 exercise items met the predefined content validity threshold, with Item-Level Content Validity Index (I-CVI) values of 0.78 or higher. The I-CVI values for these exercises ranged from 0.78 to 1.00, indicating acceptable to excellent content validity. Modified Kappa values for the validated exercises ranged from 0.76 to 1.00, indicating substantial to excellent agreement among the experts. The Scale-Level Content Validity Index based on the average method (S-CVI/Ave) was 0.95 for relevance and 0.92 for ease of performance, indicating a high level of content validity across the evaluated exercise items.

Two exercises, IT band stretching and lunges, did not meet the predefined content validity threshold. These exercises received an I-CVI of 0.56 and a modified Kappa value of 0.46, indicating low content validity and agreement. Based on the statistical findings and expert recommendations, these exercises were excluded from the final protocol.

Component-wise analysis demonstrated high levels of agreement across the mobility, strengthening, balance, and functional and gait training components.

Several exercises, including heel slides, hip abduction in supine, hip flexion and extension in standing, pendular hip movements, straight leg raises, and gait exercises, received high expert ratings for relevance. Some variation in ease-of-performance ratings was observed for exercises involving greater loading or balance demands, prompting modifications to improve their clarity and progression.

Overall, the finalized three-phase video-assisted telerehabilitation protocol demonstrated acceptable to excellent content validity based on expert evaluation, supporting its suitability for further clinical evaluation in post-operative Total Hip Replacement patients.

DISCUSSION

The increasing use of telehealth-based rehabilitation has expanded the possibilities for delivering physiotherapy services remotely, particularly in postoperative orthopedic care. Telerehabilitation provides a practical and accessible alternative to conventional in-person physiotherapy, especially for patients who face geographical, financial, or mobility barriers to regular hospital visits.[13,14,15] The present study aimed to develop and validate the content of a video-assisted telerehabilitation protocol for patients following total hip replacement (THR), a population that requires structured and continuous rehabilitation to achieve optimal functional recovery and prevent postoperative complications.[10]

The primary objective of this study was to ensure that the exercises included in the protocol were clinically relevant, safe, and feasible for post-operative THR patients. Based on an extensive literature review and clinical expertise, the telerehabilitation protocol was structured into progressive phases focusing on mobility, muscle strengthening, balance training, and functional re-education.[4,7] Experts evaluated each component of the protocol for relevance and ease of performance, providing both quantitative ratings and qualitative recommendations to improve the safety and applicability of the program.[12]

The developed protocol followed a phased progression aligned with postoperative recovery timelines and functional goals. An initial pre-telerehabilitation phase (0–2 weeks) was incorporated to allow adequate surgical site healing and to prepare patients for subsequent active rehabilitation.[16] During this period, patients were educated about basic precautions, isometric exercises, and gentle mobility activities under hospital supervision.[1,8] Following this preparatory period, Phase 1 (weeks 3–4) focused on early functional recovery through gentle mobility exercises, basic strengthening, and gradual weight-bearing activities aimed at improving joint movement and gait mechanics.[4,7,8]

Table 2: Content validity index and kappa of Telerehabilitation THR Protocol

S. No	Phase	Exercise No.	Exercise Name	Relevance				Ease of performance				Interpretation
				Agreement	I-CVI	Pc**	K***	Agreement	I-CVI	Pc**	K***	
1	Early Functional Phase (Postoperative Weeks 3 to 4)	3.1	Heel Slides	9/9	1.00	0.0020	1.00	9/9	1.00	0.0020	1.00	Excellent
2		3.2	Hip Abduction (Supine)	9/9	1.00	0.0020	1.00	9/9	1.00	0.0020	1.00	Excellent
3		3.3	Hip Abduction (Standing)	9/9	1.00	0.0020	1.00	9/9	1.00	0.0020	1.00	Excellent
4		3.4	Hip Flexion & Extension (Standing)	9/9	1.00	0.0020	1.00	9/9	1.00	0.0020	1.00	Excellent
5		4.1	Straight Leg Raise (SLR)	9/9	1.00	0.0020	1.00	9/9	1.00	0.0020	1.00	Excellent
6		4.2	Short Arc Terminal Knee Extension	9/9	1.00	0.0020	1.00	8/9	0.89	0.0176	0.89	Excellent
7		4.3	Seated Knee extension	9/9	1.00	0.0020	1.00	9/9	1.00	0.0020	1.00	Excellent
8		4.4	Single Leg Stance(support)	9/9	1.00	0.0020	1.00	8/9	0.89	0.0176	0.89	Excellent
9		4.5	Single Arm Raise, diagonal raise in standing(support)	9/9	1.00	0.0020	1.00	9/9	1.00	0.0020	1.00	Excellent
10		4.6	Partial or full weight bearing with walker	9/9	1.00	0.0020	1.00	8/9	0.89	0.0176	0.89	Excellent
11		4.7	Calf stretch(towel)	9/9	1.00	0.0020	1.00	9/9	1.00	0.0020	1.00	Excellent
12		5.1	Pendular Motion of Hip(standing)	9/9	1.00	0.0020	1.00	9/9	1.00	0.0020	1.00	Excellent
13		5.2	Short Amplitude Seated Knee Marches	7/9	0.78	0.0703	0.76	7/9	0.78	0.0703	0.76	Excellent
14		5.3	SLR in All Planes	8/9	0.89	0.0176	1.00	7/9	0.78	0.0703	0.76	Excellent
15	Progressive Function Phase (Transitional Phase From 5-8 Weeks)	6.1	Clamshells	8/9	0.89	0.0176	1.00	8/9	0.89	0.0176	0.89	Excellent
16		6.2	Pelvic Bridging	9/9	1.00	0.0020	1.00	8/9	0.89	0.0176	0.89	Excellent
17		6.3	Multiple Angle Hip Movements with Weights	9/9	1.00	0.0020	1.00	7/9	0.78	0.0703	0.76	Excellent
18		6.4	SLR in All Planes with Weights	9/9	1.00	0.0020	1.00	8/9	0.89	0.0176	0.89	Excellent
19		6.5	Step Ups (forward and sideways with support)	9/9	1.00	0.0020	1.00	8/9	0.89	0.0176	0.89	Excellent
20		7.1	Wall Mini Squats	7/9	0.78	0.0703	0.76	7/9	0.78	0.0703	0.76	Excellent
21		7.2	Toe & Heel Raises	9/9	1.00	0.0020	1.00	8/9	0.89	0.0176	0.89	Excellent
22		8.1	Unsupported ambulation	9/9	1.00	0.0020	1.00	8/9	0.89	0.0176	0.89	Excellent
23		8.2	Stair ascent & descent	9/9	1.00	0.0020	1.00	9/9	1.00	0.0020	1.00	Excellent
24		8.3	Cycling	9/9	1.00	0.0020	1.00	9/9	1.00	0.0020	1.00	Excellent
25		7&8 Weeks	Hamstring Stretch(with towel)	8/9	0.89	0.0176	1.00	8/9	0.89	0.0176	0.89	Excellent
26		7&8 Weeks	Calf Stretch in standing with support	9/9	1.00	0.0020	1.00	9/9	1.00	0.0020	1.00	Excellent
27		7&8 Weeks	IT Band Stretch	5/9	0.56	0.2461	0.41	5/9	0.56	0.2461	0.41	Fair
28	Advanced Function Phase (Activity Phase) From 9-12 Weeks.	9.1	Bridging with Leg Raise	9/9	1.00	0.0020	1.00	8/9	0.89	0.0176	0.89	Excellent
29		9.2	Lunges	5/9	0.56	0.2461	0.41	5/9	0.56	0.2461	0.41	Fair
30		10.1	Obstacle Walking	9/9	1.00	0.0020	1.00	9/9	1.00	0.0020	1.00	Excellent
31		10.2	Tandem Walking	9/9	1.00	0.0020	1.00	9/9	1.00	0.0020	1.00	Excellent
32		11.1	Figure of 8 Walking	9/9	1.00	0.0020	1.00	9/9	1.00	0.0020	1.00	Excellent
33		12.1	Reciprocal Stair ascent & descent	9/9	1.00	0.0020	1.00	9/9	1.00	0.0020	1.00	Excellent
	S-CVI/Ave				0.95				0.92			

Table/Fig- 2 I-CVI: item-level content validity index, PC: probability of a chance occurrence, K***: modified kappa, S-CVI/Ave: Scale-Level Content Validity Index based on the Average Method**

In Phase 2 (weeks 5–8), the rehabilitation program progressed toward more functional activities emphasizing muscular strength, joint stability, and dynamic balance.[4] This stage aimed to facilitate gait normalization and safe performance of daily activities. Finally, Phase 3 (weeks 9–12) emphasized advanced functional recovery, including endurance training and return to community ambulation.[8] At this stage, patients were expected to demonstrate improved strength, minimal pain, and the ability to perform higher-level functional tasks.[16]

The use of a video-assisted format was intentionally selected to enhance patient understanding, adherence, and independence during home-based rehabilitation. Visual demonstrations allow patients to accurately replicate exercises and improve confidence in performing movements correctly. Video-based instruction is particularly beneficial for individuals with limited health literacy or those unfamiliar with physiotherapy techniques. In addition, asynchronous telerehabilitation delivery provides flexibility and scalability, making it suitable for rural or resource-limited settings where frequent in-person physiotherapy visits may not be feasible.[10,11]

The findings of the content validation process demonstrated strong agreement among experts regarding the appropriateness of the exercises included in the protocol. Most exercise items achieved Item-Level Content Validity Index (I-CVI) values ranging from 0.78 to 1.00, indicating excellent agreement among experts regarding their relevance and ease of performance.[5,6]

The high S-CVI/Ave values for relevance and ease of performance indicate that the expert panel generally considered the proposed exercise items appropriate for inclusion in the video-assisted telerehabilitation protocol. These findings, together with the item-level content validity results, support the content validity of the developed protocol for postoperative total hip replacement rehabilitation.

According to Polit and Beck, an I-CVI value of 0.78 or higher indicates acceptable content validity when evaluated by multiple experts.[5]

Additionally, Modified Kappa values for the validated exercises ranged from 0.76 to 1.00, indicating substantial to excellent agreement among the experts, suggesting that the observed agreement was not due to chance These findings further support the reliability and clinical applicability of the developed telerehabilitation protocol.

During the validation process, several constructive recommendations were provided by the expert panel to improve the safety and progression of exercises. Based on expert feedback, certain exercises were modified or rescheduled within the rehabilitation timeline. For instance, multiple-angle hip movements with weights, initially scheduled earlier in the protocol, were postponed to later weeks to avoid early loading on the hip joint. Similarly, standard pelvic bridging replaced more complex bridging variations, and wall-supported mini squats were introduced to improve stability and safety during lower-limb strengthening exercises. Experts also recommended incorporating toe raises along with heel raises to promote balanced ankle muscle activation.

Some exercises, including IT band stretch and lunges, received lower validity ratings and were excluded from the final protocol. Experts suggested that these exercises require advanced flexibility, balance, and joint loading capacity, which may not be appropriate during the early or mid-stages of post-THR rehabilitation. Therefore, their exclusion improved the safety and suitability of the final telerehabilitation program.

The findings of the present study are consistent with previous research emphasizing the importance of structured, phase-specific rehabilitation protocols following joint replacement surgery.[4,7,8] Studies have shown that validated rehabilitation programs improve patient adherence, safety, and functional outcomes in post-operative orthopedic rehabilitation. Furthermore, previous studies have demonstrated that telerehabilitation can serve as an effective alternative to conventional physiotherapy, particularly when supported by clear instructions and remote guidance.[3,10,13]

Limitations

While this study focused on expert validation for relevance and ease of performance, future research should also assess clarity, simplicity, and certainty of the exercises. The protocol's reliance on technology may limit accessibility for elderly or underserved populations. Additionally, the lack of patient or caregiver input may impact practical applicability and user-friendliness. Only content validity was assessed (using I-CVI and Modified Kappa). Other forms of validation, such as construct validity, criterion validity were not included. Incorporating patient perspectives could have enhanced the protocol's usability and acceptability

CONCLUSION

Overall, the present study provides a structured and expert-validated telerehabilitation protocol that integrates mobility training, strengthening exercises, balance training, gait re-education, and functional activities across progressive stages of recovery. The use of video-assisted instruction enhances accessibility and supports home-based rehabilitation, particularly in settings where access to physiotherapy services may be limited.

In summary, the results of this study confirm that the developed video-assisted telerehabilitation protocol for post-operative THR patients is clinically relevant, safe, and feasible according to expert consensus. The integration of structured rehabilitation progression with visual instruction has the potential to improve patient adherence and expand access to postoperative rehabilitation services.

ANNEXURE-1

Structured Video-Assisted Telerehabilitation Protocol for Patients Following Total Hip Replacement

Pre-Telerehabilitation Phase (Post-operative 0–2 Weeks)

Component	Description
Purpose	To allow surgical wound healing, ensure patient safety, and prepare patients for structured telerehabilitation.
Duration	Post-operative 0–2 weeks (first 14 days after surgery).
Rationale	This period is critical for soft tissue healing, inflammation control, and infection prevention. Early intensive rehabilitation may increase the risk of wound-related complications.
Patient Focus	Wound care, pain management, and adherence to hip precautions such as avoiding excessive hip flexion and rotation.
Hospital-Based Guidance	Patients are educated by hospital staff regarding basic precautions, isometric exercises, and gentle mobility activities.
Outcomeof Phase	To maintain muscle activation, prevent stiffness, and prepare patients to safely begin the structured telerehabilitation protocol in subsequent phases.

Dislocation Precautions

Surgical Approach	Precautions
Posterior / Posterolateral Approach	• Avoid hip flexion beyond 90° • Avoid hip internal rotation beyond neutral • Avoid hip adduction beyond neutral • Avoid combining flexion, adduction, and internal rotation
Anterior / Anterolateral / Direct Lateral Approach	• Avoid hip extension beyond neutral • Avoid hip external rotation beyond neutral • No bridging exercises • No prone lying • Avoid combined extension and external rotation • In supine position, maintain hip flexion ≥30° (pillow under knee or head of bed elevated)
Transgluteal / Lateral Approach	• Avoid hip adduction beyond neutral • Avoid active antigravity hip abduction for 6–8 weeks or until surgeon clearance • Avoid exercises involving weight bearing on the operated limb

Early Functional Phase (Postoperative Weeks 3 to 4)

Stage 1-Early Functional Phase (Protective Phase) from 3-4Weeks.	
Pre-requisite	Wound healing without signs of infection, Controlled pain and swelling Consistent adherence to hip precautions Ability to perform basic mobility tasks safely
Goals	Relieve pain during daily movements. Explain the rehabilitation steps to the patient. Move the scar gently in all directions. Glide the patella side to side and up and down. Increase hip flexion range from 80° to 90°.
Precautions	Evaluate the status of scar healing and remodelling Observe for signs of wound infection

Therapeutic exercise	Frequency	Duration
Mobility (warm up)		
• Heel slides in supine position • Hip abduction in supine and standing position • Standing hip flexion and extension	Twice/day	2 sets × 20 reps
Strengthening		
• straight leg raise without weights (10-15 degree assisted) • Short arc Terminal knee extension • Seated knee extension (90° -0°)	Twice/day	2 sets × 20 reps
Balance training		
• Single leg stance(support) • Single arm raise, diagonal raise in standing with support • Gait and Functional training	Twice/day	2 sets × 20 reps
Gait and Functional training		
• Partial weight bearing(uncemented), Full weight bearing(cemented) • standing with Assistive device • Gait training on flat surface, walking with assistive device	Twice/day	Two rounds of 15 meters hallway (as tolerated by patient) 3sets × 10 reps
Stretching's (cool down)		
• Calf Stretch (Towel-Assisted) • Self-assisted Scar tissue mobilization	Twice/day	3 reps with 30 sec hold

TRANSFER TECHNIQUES: **Bed:** Turning in bed to be initiated on the sound side with a pillow in between the legs (knees) to avoid adduction, keeping the knees bent. Bedside independent sitting should be initiated with knees hanging and transferring the weight on both the hip joints **Chair:** Depth-of-chair restrictions: avoid deep chairs. We also instruct patients to look at the ceiling as they sit down to minimize trunk flexion. **Sitting:** avoid crossing legs. **Rising from chair:** scoot to edge of the chair, then rise. Bathroom rehabilitation: Use of elevated commode seat, elevated seat is placed on commode at a slant, with higher part at the back, to aid in rising. Have elevated seat sent to house prior to surgery for installation **Ambulation:** instruct on use of anticipated assistive device (walker). **Abduction pillow:** keep a Abduction pillow between legs while on bed for 5-6 weeks.	
Criteria for progression to next phase	Ability to walk without assistive device Ability to perform phase 2 exercises with ease Independent ADL Improved voluntary control of quadriceps

Phase 2-Progressive Function Phase (From 5-8 Weeks)

Phase 2-Progressive Function Phase (From 5-8 Weeks)	
Pre-requisite	Ability to walk with or without assistive device Ability to perform 80-90-degree hip flexion Minimal or no pain in hip joint
Goals	Reduce pain related to activities Educate on progressive rehabilitation process Mobilize scar in all directions Mobilize patella in all directions

Therapeutic exercise	Frequency	Duration
Mobility (warm up)		
• Pendular motion of hip (standing) • Short amplitude seated knee marches	Twice/day	2 sets × 20 reps
Strengthening (with cuffed weights- 0.5 to 1 kg)		
• straight leg raise in all planes without weights in 5th week with weights in 6th week • Clamshells • Pelvic Bridging • Multiple angle hip movement with weights	Twice/day	2 sets × 20 reps
Closed chain activity		
• Wall mini squats • Toe and heel raise	Twice/day	2 sets × 20 reps
Balance training		
• Step ups and side step ups	Twice/day	2 sets × 20 reps
Gait and Functional training		
• Unsupported ambulation • Stair climbing and descent using hand rail	Twice/day	Two rounds of 15 meters hallway (as tolerated by patient) 3sets × 10 reps
Aerobic conditioning		
• Walking • Stationary cycling (if available at home)	Twice/day	15 min
Stretching (cool down)		
• Calf Stretch (Towel-Assisted) • Hams Stretch	Twice/day	3 reps with 30 sec hold

Criteria for progression to next phase	Ability to walk without assistive device Active hip flexion range of motion 0- 110 degree
Outcomes measured	Visual analog scale Joint mobility using universal goniometry (Range of motion) Walking distance using six-minute walk test Harris hip score

Phase-3 Advanced Function Phase (Activity Phase) From 9-12 Weeks.

Phase-3 Advanced Function Phase (Activity Phase) From 9-12 Weeks.	
Pre-requisite	Ability to have pain free walk without assistive device Ability to perform 110-degree hip flexion Ability to perform basic community related activities
Goals	Educate on full functional recovery phase Improve knee joint flexion mobility >110° Improve quadriceps and hamstring muscle endurance Improve balance and coordination Improve aerobic fitness

Therapeutic exercise	Frequency	Duration
Stretching (cool down)		
• Hamstring Stretch • Calf stretch (wall support)	Thrice/day	3-5reps with 30 sec hold
Strengthening (with cuffed weights- 1.5 to 2 kg)		
• Exercises as in previous phase • Bridging with leg raise	Twice/day	2 sets × 20 reps
Balance training		
• Obstacle walking • Tandem walking • Figure of 8 walking	Twice/day	2 sets × 20 reps
Gait and Functional training		
• Reciprocal stair ascends and descends • walking	Twice/day	Four rounds of 15 meters hallway (as tolerated by patient) 3sets × 10 reps
Aerobic conditioning		
• Walking • Stationary cycling (if available at home)	Twice/day	15 min
Stretching (cool down)		
• Calf Stretch (wall-supported) • Hams Stretch	Twice/day	3 reps with 30 sec hold

Outcomes measured	Visual analog scale Joint mobility using universal goniometry (Range of motion) Walking distance using six-minute walk test Harris hip score

Conflict of Interest

"On behalf of all authors, the corresponding author states that there is no conflict of interest."

Acknowledgment

The author sincerely acknowledges the valuable contributions and support of the expert panel members and extends heartfelt gratitude to the management and faculty members of Durgabai Deshmukh College of Physiotherapy and Yashoda Institute of Physiotherapy for their continued support, encouragement, and guidance throughout the study.

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