

Feasibility of Telerehabilitation in Orthotic Care: A Systematic Review of Acceptability, Implementation Outcomes, and Clinical Effectiveness

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Systematic Review

Keywords: Telerehabilitation, Orthotic devices, Feasibility, Clinical effectiveness, Implementation outcomes

Posted Date: October 19th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-10136903/v1>

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Additional Declarations: No competing interests reported.

Feasibility of Telerehabilitation in Orthotic Care: A Systematic Review of Acceptability, Implementation Outcomes, and Clinical Effectiveness

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Abstract

Introduction: Telerehabilitation has been described as a “beacon of hope” addressing health care challenges, making quality care accessible, bridging location gap, empowering people with disabilities and chronic diseases to live fulfilled lives. Traditional face-to-face orthotic care presents physical, financial, and geographical accessibility barriers, making remote digital service delivery a vital alternative to optimize patient outcomes. This systematic review evaluated the feasibility, acceptability, implementation outcomes, clinical effectiveness, and barriers/facilitators of telerehabilitation in orthotic care.

Methodology: Following PRISMA 2020 guidelines and a registered PROSPERO protocol (CRD420261388553), four electronic databases (Scopus, PubMed, Cochrane Library, ScienceDirect) were searched from January 2010 to March 2026. Eligible studies utilizing telerehabilitation alongside orthotic interventions across all age groups and clinical subspecialties were synthesized narratively.

Results: Twelve studies comprising 591 participants across eight countries were included. Telerehabilitation demonstrated high feasibility and usability, averaging 105 minutes/week of active training, System Usability Scale scores of 69–77.7%, and Telehealth Usability Questionnaire ratings of 5.77/7. Clinically, telerehabilitation yielded equivalent or superior functional recovery compared to face-to-face care, achieving greater Cobb angle reduction in scoliosis (-4.3° vs. -1.7°), significantly higher IKDC/KOOS scores post-anterior cruciate ligament reconstruction, and motor improvements (+4 Fugl-Meyer points) in stroke. Operationally, implementation eliminated 81 inter-hospital transfers (\$1.2M saved) and reduced length of stay from 9.25 to 4.21 days. Key barriers included the inability to perform physical palpation,

challenges in fabricating custom orthoses online, connectivity dropouts, and acute post-surgical kinesiophobia.

Conclusion: Telerehabilitation in orthotic care is a feasible, acceptable, clinically effective, and cost-saving alternative to face-to-face rehabilitation. Implementing hybrid care models combining initial in-person fitting with remote digital monitoring can overcome virtual limitations and optimize care.

Keywords: Telerehabilitation, Orthotic devices, Feasibility, Clinical effectiveness, Implementation outcomes.

Registration of protocol

This protocol was registered to PROSPERO titles Telerehabilitation in Orthotic Care: A Systematic Review of Effectiveness, Feasibility, and Implementation Outcomes with registration number CRD420261388553. This review can be accessed at <https://www.crd.york.ac.uk/PROSPERO/view/CRD420261388553>.

Key terms: Telerehabilitation, orthotic device, feasibility, effectiveness, implementation

Introduction

Orthotics are more than just a medical device. They enable users to regain independence and restore mobility, improving on their quality of life. Orthotic care has significant effects on psychosocial, well-being, social life, and opportunities in employment extending far beyond biomechanical outcome [1]. Diverse orthotic devices have shown significant effectiveness in the

management of varied health conditions [2]. The future of orthotic care lies in the incorporation of innovation with equal access. The use of telerehabilitation interfaces such as zoom conference call, smart sensor, and mobile App may revolutionize the outcome of care. Nevertheless, the true value can only be measured when they are feasible, acceptable, with significant implementation measures and clinically effective. The alignment of these will highlight a transformative role of orthotic care in advancing rehabilitation [1]. Face-to-face (F2F) rehabilitation models often require regular visits to the site which poses challenges to the user. These challenges are not limited to; inaccessible buildings and environments, long waiting time, high financial cost, low psychological support, language barrier and stigma from health care professionals [3].

Recently, technology has transformed health care. This was promoted by the Covid 19 pandemic, where virtual platforms were used for health care delivery [4]. Telerehabilitation was described as a “beacon of hope” for its ability to address health care challenges [5]. Telerehabilitation defined as rehabilitation service delivery by use of information, communication and technology at a distance [6], produce extensive benefits, and serve as a bridge in location gap. Therefore, telerehabilitation makes quality care accessible, empowering people with disability and chronic diseases to live fulfilled lives [5]. Furthermore, telerehabilitation is cost effective, affordable and convenient, giving easy access to services with equality of care. It saves travel time, transport cost, improves system familiarity with easy family and care giver support [7].

Despite the increase satisfaction in the use of telerehabilitation, its application in orthotic care is underexplored [8]. Furthermore, physical assessment during orthotic care is unique and can be challenging such as; orthosis fitting, Range of Motion (ROM), function, dexterity and coordination, muscle, joint, and sensory examination [9,10]. Monitoring brace wearing depends on self-reporting compliance [11]. Having a clear insight whether these challenges can be

addressed by telerehabilitation is vital for the promotion of a patient-centered and accessible orthotic care.

Though the concept of telerehabilitation seems appealing, there is a lack of investment in modern technologies for orthotic care [12], and a lack of integration of telerehabilitation to strengthen rehabilitation services especially in developing countries [7]. Furthermore, there is a lack of high quality evidence on impact of telerehabilitation [13], the lack of diverse and high quality mobile Apps in the assessment of brace compliance [14], a lack of high quality research with the use of telerehabilitation in orthotics with clear instructions that governs how health information are stored [8], and a lack of large sample including control group evaluation of feasibility [15]. Studies have recommended the promotion of policies that support telerehabilitation causing a revolution in rehabilitation services [5]. There is a single scoping review in orthotic care which assesses the use of mobile App in the improvement of brace-wearing compliance among patients with idiopathic scoliosis [14].

This review sought to systematically assess and summarize evidence on Feasibility of Telerehabilitation in Orthotic Care, in feasibility, acceptability, implementation, effectiveness and technological/ access barriers and facilitation. The study further summarized clinical characteristics with telerehabilitation in Orthotic Care seen in the distribution of clinical focus & orthoses and the classification of telerehabilitation platforms. An additional objective was to identify current evidence gaps. In addition to the conduction of a broader qualitative synthesis, we further assessed methodological, clinical and outcome heterogeneity of the studies. Factors such as Patient population, disease condition and intervention for clinical heterogeneity, sample size, study design, qualitative vs quantitative approach for methodological heterogeneity and feasibility, acceptability, implementation and clinical effectiveness for outcome measures were compared. A

detailed risk of bias and certainty of results assessments were also carried out. This was to ensure we do not only generate evidence in the feasibility, acceptability, implementation and clinical effectiveness of telerehabilitation in orthotic care, but also provide a more transparent, significant and clinically interpretable result of current evidence on telerehabilitation in orthotic care.

Methods

This was a systematic review of studies where telerehabilitation was utilized across varied health conditions using any form of orthotic device in the care process. The Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) 2020 guidelines [16] was strictly followed. The review proposal was earlier registered in PROSPERO (CRD420261388553).

Search strategy

A comprehensive literature to obtain studies reporting the feasibility, acceptability, implementation and effectiveness of the application of telerehabilitation in orthotic care. Search was carried out in 4 databases; Scopus, PubMed (national library for medicine), Cochrane library and ScienceDirect from January 2010 and March 2026 done on the 27th April 2026. The search was limited to articles in English language [17]. Additional search was performed on grey data (Google scholar). Recommended articles from primary studies or reference list from primary studies were considered. This assisted in identifying other works. Details of search process is seen on Figure 1. Different combinations of search terms were used in the search strategy for these databases such as; telerehabilitation, orthotic device, feasibility, implementation outcome and clinical effectiveness. Detailed search terms used for each database are presented in supplementary Table 1 in the additional file.

Eligibility criteria

Publications were restricted between January 2010- March 2026 and in English. Retrieved studies from the 4 registered databases were imported into reference manager software to remove duplicates. The population, intervention, comparison, outcomes, and study (PICOS) criteria outlined in supplementary Table 2 in the additional file was then used to screen the remaining articles. Studies comparing different platforms of telerehabilitation to traditional F2F care or no comparison, with varied age groups using any type of orthotic devices and measuring feasibility, acceptability, implementation and clinical effectiveness outcome were included. Articles that did not measure these outcomes were excluded.

Study selection process

The double-stage screening of title and abstract of these records were independently done by the two authors and records excluded. Full text of selected articles retrieved were further screened by two independent authors using eligible criteria. Some full text articles were excluded for varied reasons as demonstrated on Figure 1. Subsequently all full text articles that were relevant to the study were independently read in detail for data extraction. Disagreements in the review process were resolved by discussion. All references were also obtained.

Prisma diagram

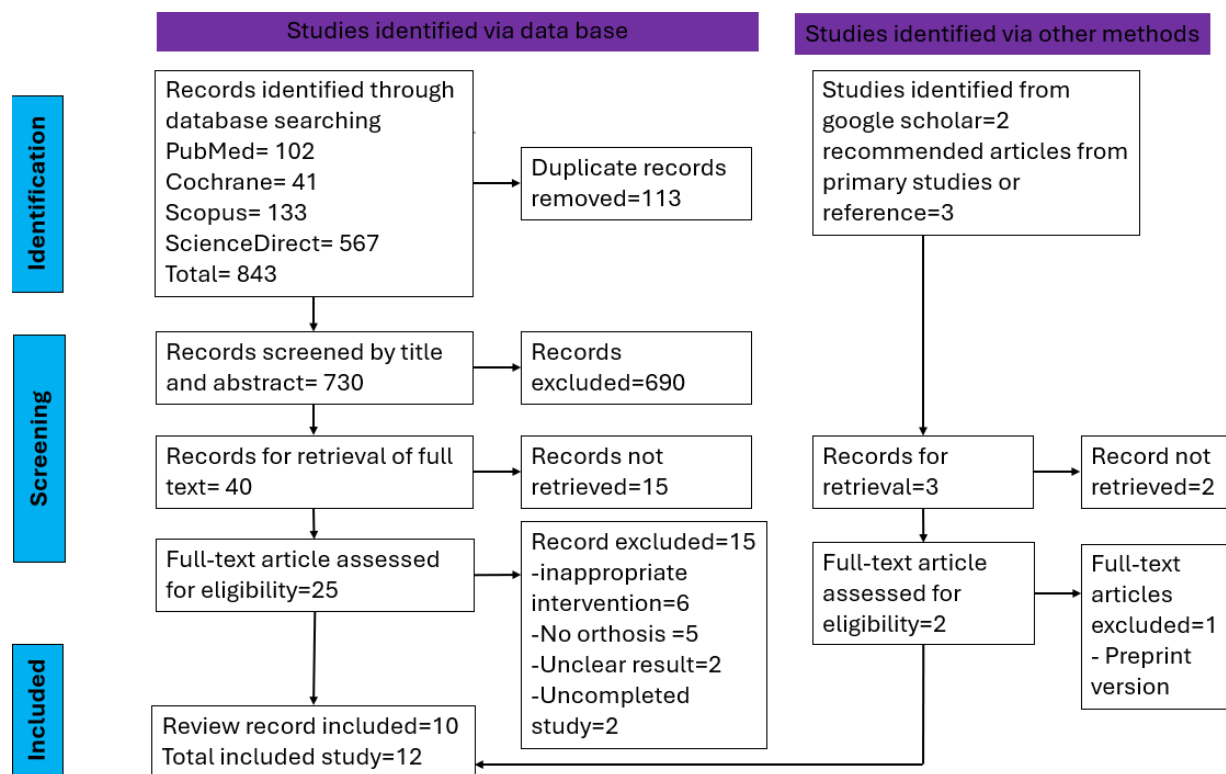


Figure 1. Prisma diagram of search results

Data extraction process

The two authors independently carried out qualitative synthesis. Crucial data from each full text article included were collected in a standardized data extraction form [18]. Study characteristics were retrieved. Details for main objective: outcome reported (feasibility, acceptability, implementation, and clinical effectiveness, barrier and facilitation) and key finding were also retrieved. Furthermore, data on clinical characteristics of studies assessing telerehabilitation in orthotic care was summarized. Data for additional objectives were evidence gaps. This standard extraction form was used to ensure that all vital data were recorded for subsequent analysis. There was no need to contact study authors since further information was not needed.

Quality assessment

Study risk of bias and certainty of results assessment were carried out on studies identified. The two authors independently determined the quality of the included studies using relevant evaluation tools: the Newcastle-Ottawa scale for observational studies, the Critical Appraisal skills program (CASP) checklist for qualitative studies and the Mixed Methods Appraisal Tool (MMAT) for mixed- Method studies. Quality assessment took into consideration the study design, sample size, data collection methods, procedure for data analysis and reporting. The findings from this evaluation were rated either as high, moderate or low [17]. In addition to risk of bias, further assessment was carried out to verify the certainty of the results using factors such as sample size and how the study addresses the objective. Any disagreement was resolved by consensus. Given the nature of this analysis, the conclusion of this review can be considered based on solid facts. The study risk of bias assessment summary is shown on supplementary Table 3 in the additional file.

Data analysis

To be able to draw a comprehensive conclusion on the feasibility of telerehabilitation on orthotic care, it was necessary to contract a synthesis of the findings from the studies included; A narrative synthesis [17] was used to summarize findings on the feasibility, acceptability, implementation and clinical effectiveness outcome measure and barriers and facilitation. Further synthesis was done on the clinical characteristics of studies assessing telerehabilitation in orthotic care. Gaps in the current evidence were sought out. Key themes and patterns discovered were grouped, providing a comprehensive summary. Assessment of methodological, clinical and outcome heterogeneity were also synthesized. Meta-analysis was not feasible due to sufficient heterogeneity in intervention, methodology and outcome. Finally, risk of bias assessment of observational,

qualitative and mixed method studies and the certainty of results were synthesized. This different analysis provided a comprehensive synthesis of evidence, with valuable insights into the feasibility, acceptability, implementation, and clinical effectiveness of telerehabilitation in orthotic care.

Declaration of generative AI and AI-assisted technology

During the preparation of the review, the authors used Gemini Notebook/AI for some data summary and interpretation. After using this service, the authors manually summarized these tables to be simple and understandable, producing a result that answers the objectives. The authors ensured this information was verified from the document to maintain accuracy. The authors take full responsibility for the content of this publication.

Results

Study characteristics

Out of 848 studies identified in the search, 12 were included in the qualitative synthesis. These reported feasibility, acceptability, usability, implementation, effectiveness and technological/access barriers and facilitation data for telerehabilitation in Orthotic Care. Ten articles were identified from database search and two from grey data. A synthesis of the 12 eligible publications assessing the feasibility of telerehabilitation in orthotic care encompasses 591 total participants across eight countries/regions (Taiwan [19–21], Turkey [9,22], Australia [23,24], United States [8], Greece [11], Netherlands [25], Brazil [26], and Canada [27]). Individual study sample sizes ranged from 14 to 224 participants, spanning a wide demographic spectrum from pediatric cohorts (aged 10–17 years) [26] to older adults (up to 83 years) [21]. Methodologically, the literature relies

on a heterogeneous mix of study designs, including prospective nonrandomized comparative clinical trials [9,22], retrospective case-control [11] and cohort studies [20], observational frameworks [23], qualitative analyses [8,27], and mixed-methods investigations [24]. The summary is presented on Table 1 in the Additional file.

Summary of outcomes in publications assessing telerehabilitation in orthotic care

Feasibility of telerehabilitation

Feasibility across orthotic care is supported by evidence demonstrating structured training completion, broad service scope, and positive participant engagement [8,14,26]. Studies report that telerehabilitation is feasible with a mean training duration of 105 minutes per week [15] and yields high overall feasibility ratings among both patients and physiotherapists [26]. The scope of feasible telehealth interventions spans the full spectrum of orthotic and prosthetic (O&P) care, including initial evaluations, routine reviews, and rare remote device deliveries [8]. Furthermore, participant willingness and learnability are demonstrated by strong engagement in home exergame rehabilitation, where learnability and confidence vary significantly across demographic subgroups, such as female older adults with prior rehabilitation experience ($p = 0.03$) and males without prior experience ($p = 0.04$) [21]. However, overall feasibility remains closely tied to underlying technology and access capabilities [8] as shown on Table 2 in the additional file.

Acceptability of telerehabilitation

Acceptability of telerehabilitation is consistently high among patients, caregivers, and clinicians across multiple orthotic care settings [26]. Patients demonstrated strong intrinsic motivation (Intrinsic Motivation Inventory score of 5.2/7) [15] and high satisfaction with received clinical services (Orthotic Prosthetic User Survey-Client Satisfaction with Service module mean T-score

of 74.6) [24]. High acceptability and appropriateness ratings were also confirmed by physiotherapists and patients in scoliotic care [26]. Qualitative and survey perspectives indicate that user satisfaction and acceptability are strongly driven by patient agency and choice, clear appointment expectations, lived-experience health literacy, patient-focused attitudes, and therapist advocacy for hybrid care models combining virtual and in-person visits [24] as shown on Table 2 in the additional file.

Usability telerehabilitation

Usability evaluations using validated tools confirm favorable technology adoption and user interface scores [21]. System Usability Scale (SUS) assessments yielded ratings of 69% ("sufficient usability") in stroke motor training [15] and 77.70 ("good usability") in home exergame interventions [21]. Similarly, the Telehealth Usability Questionnaire (TUQ) demonstrated high overall usability (mean score of 5.77/7), and therapist-reported usability was strong [24]. Learnability, system confidence, and usability satisfaction were particularly high among specific patient demographics [21]. System reliability received lower ratings (4.53/7) primarily due to cellular and internet reception dropouts [24] as shown on Table 2 in the additional file.

Implementation of telerehabilitation

Implementation outcomes highlight substantial operational, logistical, and economic efficiencies in orthotic service delivery [27]. A key implementation study demonstrated that telerehabilitation eliminated inter-hospital transfers for 81 patients, saving 24,324 km of travel and approximately \$1.2M in hospital costs [23]. Additionally, mean hospital length of stay (LOS) was significantly reduced from 9.25 to 4.21 days ($p < 0.01$) with zero reported adverse events or hospital readmissions [23]. Implementation was further strengthened by significant gains in rural clinician

knowledge, skills, and confidence to fit and manage thoraco-lumbo-sacral orthoses (TLSOs) following structured virtual training [23]. High implementation scores for appropriateness and feasibility further affirm clinician and patient endorsement of integrated hybrid workflows [26] as shown on Table 2 in the additional file.

Clinical effectiveness of telerehabilitation

Clinical effectiveness and functional recovery outcomes are equivalent or superior to traditional face-to-face care across multiple orthotic interventions [11,19,20,22,26]. Upper extremity studies showed significant time-dependent improvements in Total Active Motion (TAM) and Disabilities of the Arm, Shoulder, and Hand (DASH) scores ($p < 0.001$) with 100% of completing fingers achieving excellent Modified Strickland results [22], alongside significant gains in Fugl-Meyer motor scores (+4 points, $p = 0.02$) and Stroke Impact Scale quality of life (+3.7 points, $p = 0.004$) [15]. In knee orthotic care, full extension was restored in 1.5 months with significant gains in stability ($p = 0.026$) and IKDC functional scores ($p = 0.002$) [19]. Tele-AI cohorts achieved significantly higher IKDC and KOOS functional scores at 3 to 6 months ($p < 0.05$) and superior Tegner Activity Scale level 5 outcomes at 12 months (93.3% vs. 73.3%) [20]. In spinal orthoses, scoliosis management via online intervention achieved significantly higher success rates (88.9% vs. 80.2%, $p = 0.04$), greater Cobb angle reduction (-4.3° vs. -1.7° , $p = 0.03$), and significantly higher exercise compliance (>3 days/week; 78.3% vs. 52.8%, $p = 0.006$) compared to control groups [11] as shown on Table 2 in the additional file.

Barriers

Barriers to telerehabilitation encompass physical, technological, and psychological challenges [8,9,27]. Primary clinical and physical limitations include the inability for clinicians to touch or

palpate patients, virtual communication hurdles, acute post-surgical restrictions, and the inability to fabricate custom orthoses online, necessitating prefabricated or mailed materials [27]. Technology and access barriers, such as poor cellular/internet connectivity and phone dropouts, frequently impaired system reliability [8]. Psychologically, patients in early rehabilitation exhibited fear of damaging tendon repairs (42.1%), requiring physical assistance during treatment (47.4%), and higher fear of movement/kinesiophobia (Tampon Scale of Kinesiophobia median 39 vs. 37, $p = 0.017$) [9]. Technical and motivational factors also contributed to higher dropout rates (5/14 patients) in specific telerehabilitation groups, although scoliosis online intervention achieved lower loss to follow-up than control groups (5.1% vs. 10.9%, $p = 0.03$) [11,22] as shown on Table 2 in the additional file.

Facilitation

Facilitation of successful telerehabilitation relies on practical contextual advantages, patient-centered approaches, and clinician skill sets [8,9,27]. Key operational facilitators include the complete elimination of travel time and transportation costs, effective home environment adaptations, and timely access to specialist care [27]. From a service perspective, facilitators include expanding the scope of telehealth across evaluation, review, and remote device delivery phases [8]. Critical interpersonal facilitators comprise patient-focused clinician attitudes, high-level virtual communication skills, active client choice, clear expectation setting, and emphasizing the functional benefits of telehealth rather than its technological limitations [8] as shown on Table 2 in the additional file.

Clinical characteristics of studies assessing telerehabilitation in Orthotic Care

The distribution of Clinical Focus & Orthoses revealed literature targeting four main clinical subspecialties within orthotic care: Upper Extremity & Hand Rehabilitation: This addressed post-surgical and neurological conditions, including extrinsic hand tendon repairs [9,22,25,27], Zone 1 and 2 flexor tendon repairs managed with dorsal blocking orthoses [22], hemiparetic arm/hand recovery in chronic stroke using dynamic wrist/hand orthoses (SCRIPT) [15], and general remote hand therapy involving assessment, exercise instruction, and activity adaptation [27]. Spinal Orthotic Management: Focuses on Adolescent Idiopathic Scoliosis (AIS) treated with asymmetric Chêneau braces or TLSO [11], alongside conservative management for thoracic or lumbar spine fractures using TLSOs in rural populations [26]. Lower Extremity Rehabilitation: Centers on postoperative Anterior Cruciate Ligament Reconstruction (ACLR) using smart or AI-enabled knee braces [19,20], lower-limb rehabilitation in frail older adults [21], and general lower-limb orthotic care, including Ankle-Foot Orthoses (AFOs) and foot orthoses [24]. Broad Orthotic & Prosthetic (O&P) Care: Encompasses multidisciplinary services across pediatric, cranial, scoliosis, neuro-orthotics, and upper/lower limb orthotics and prosthetics [8] as shown on Table 3 in the additional file.

The classification of telerehabilitation platforms revealed that the technological infrastructure employed spans simple tele-communication tools to specialized sensor-driven platforms: Synchronous Consumer Videoconferencing & Communication: Widespread adoption of accessible mobile applications and software (e.g., Zoom, WhatsApp, FaceTime, Doxy.me) combined with phone calls, photo sharing, and email for real-time exercise supervision and clinical consultations [8,9,11,22,26,27]. Specialized Smart Wearables & IoT Systems: Dedicated hardware platforms, such as the KNEESUP Compact system (combining a smart core motion tracker on a

brace, mobile app, and cloud database/clinician portal) for ACLR monitoring [19,20] and the SSWAD system (utilizing wireless surface electromyography [sEMG] sensors integrated with lower-limb exergames) for frail older adults [21]. Telerobotic & Gamified Environments: Interactive hardware-software systems like SCRIPT, which features a remotely monitored gaming environment controlled directly via a dynamic wrist/hand orthosis [15]. Decentralized & Rural Consultation Models: Systems utilizing tablet computers over Wi-Fi networks to deliver specialist guidance to rural healthcare staff [23], as well as hybrid models integrating videoconferencing with postal/delivery services for orthotic shipping and physical reviews [24] as shown on Table 3 in the additional file.

Gaps in the current evidence

Table 4: Gaps in the current evidence		
Publications	Existing Evidence	Research Gap
[9,15,19–22,26]	Preliminary studies show that TR and wearable devices can yield functional outcomes comparable to in-person (IP) therapy for conditions like flexor tendon repairs, ACL reconstruction, and chronic stroke. However, most findings are derived from pilot studies or case series.	Methodological Gap: There is a critical need for large-scale, well-powered, and fully randomized controlled trials (RCTs) to validate the non-inferiority and safety of remote interventions across broader clinical populations
[9,15,19,20,26]	Current research provides short-term clinical outcomes, typically ranging from 8 weeks to 12 months post-intervention. Initial results suggest high patient satisfaction and early functional recovery.	Evidence Gap: The long-term efficacy and sustainability of functional gains achieved through home-based telerehabilitation remain unknown. Studies rarely track outcomes beyond one

		year to assess permanent recovery or device durability
[11,26]	Telerehabilitation is effective for managing AIS, with both synchronous and hybrid protocols showing reductions in Cobb angles. Evidence focuses generally on thoracic or lumbar curves.	Methodological Gap: Current protocols do not adequately differentiate treatment responses based on the specific type of scoliotic curvature or the clinical severity of the condition, which is necessary for refined clinical planning
[9,24,26,27]	Therapists successfully use video conferencing for exercise guidance and education. However, traditional hand therapy and orthotic management are heavily reliant on physical touch and manual adjustments	Methodological Gap: A significant gap exists in developing reliable methods for remote palpation, manual therapy, and complex orthotic fabrication/fitting, which are currently viewed as impossible to perform online
[8,19,23,26]	Telerehabilitation is assumed to be cost-effective due to reduced travel expenses and therapist time. Some practitioners use it as a "loss leader" to maintain service continuity	Evidence Gap: There is a lack of rigorous, formal cost-effectiveness or economic impact analyses that compare the total healthcare investment of TR systems vs. traditional IP care models
[9,15,22]	Patients in telerehabilitation groups often show similar functional status to IP groups but may exhibit higher levels of kinesiphobia or higher dropout rates due to technical frustrations	Evidence Gap: There is insufficient research exploring the specific psychological barriers and motivational factors (such as fear of movement or technical anxiety) that impede adherence in unsupervised remote settings
[8,9,20,21,24,27]	Studies often reflect specific geographic populations (e.g., Taiwan, Australia, or the USA) and	Methodological Gap: Research lacks generalizability across diverse socioeconomic contexts and among populations with low digital literacy,

	often recruit participants already comfortable with technology	cognitive impairments, or limited internet access in remote/developing regions
[8,9,27]	Practitioners and users report that a hybrid approach—combining initial in-person visits with remote follow-ups—may be superior	Theoretical Gap: There is no established theoretical framework or standardized clinical guideline that defines the optimal ratio of IP to TR sessions for different injury phases or age groups

Heterogeneity of study

These were assessed comparing factors such as patient population, disease condition and intervention for clinical heterogeneity, sample size, study design, qualitative vs quantitative approach for methodological heterogeneity and effectiveness, feasibility and implementation for outcome measures.

Clinical Heterogeneity:

This is marked by a variety of patient populations, conditions treated, and technical nature of the interventions used. Patient populations projects an entire human lifespan, with studies including children with congenital dislocated hip [24], adolescents (10–17 years) for scoliosis [11,26], young adults recovering from ACL reconstruction, and geriatric populations focused on frailty and stroke recovery [15,21]. Disease conditions varied from acute postoperative recovery (flexor tendon repairs, ACLR) [19,20], to chronic neurological impairments (stroke), and orthopedic trauma (spinal fractures) [15,19,22,23]. Intervention platforms recorded technologies from standard synchronous video calls (WhatsApp, Zoom, FaceTime) [11,22,24,26] to AI-assisted smart systems using computer vision for real-time feedback [19,20]. Other integrated high-tech wearables, such as smart knee braces with motion trackers or robotic hand exoskeletons with gamified

environments were used [15,21]. Orthoses used varied from spinal [11,23,26], to upper limb orthoses [9,15,22], to lower limb [8,19,20,24] and cranial orthosis [8].

Methodological Heterogeneity:

Different studies explored varied study design and rigor ranging from small prospective case series or feasibility studies without control groups were also included [15,19] to retrospective matched case-control designs [11] or pre-post observational models to evaluate system-wide changes [23]. Qualitative vs. Quantitative Approaches: While some studies focus entirely on interpretive description and thematic analysis to reveal practitioner perspectives [8,24], others used mixed methods to a combination of survey data with in-depth interviews [24]. There was a wide range of sample sizes across the review which range from 15 [19] to 224 [11]. Follow-up duration was equally diverse, ranging from short-term 8-week assessments [9] to an extensive mean follow-up of 29.7 months [11]. Studies were conducted throughout the globe. Countries such as the United state [8], Australia [23,24], Taiwan [19–21], Greece [11], Turkey [9,22], and Netherland [15].

Outcome Heterogeneity

These varied based on whether the study's objective was practical feasibility, user acceptability, practical technical implementation and clinical effectiveness. Feasibility is assessed using a diverse array of objective and subjective metrics, demonstrating significant methodological heterogeneity [11,15,20,22,26]. Some studies define feasibility through monitored adherence and compliance rates, utilizing digital logs from AI-enabled braces or applications to track exercise duration and frequency [15,19,20]. In contrast, others rely on self-reported compliance or loss-to-follow-up percentages to gauge the viability of the protocol [11]. Operational feasibility is further measured by recruitment and retention rates, which vary from 100% in controlled case series to

significant attrition in acute remote hand therapy [11,15,19,22]. Validated tools like the Feasibility of Intervention Measure (FIM) provide a standardized perception of implementability by patients and providers [26], while other studies evaluate feasibility through clinical safety and the absence of adverse events during local orthotic management [23].

Heterogeneity in acceptability is driven by the use of standardized usability scales versus qualitative satisfaction assessments [15,21,24]. Usability is quantified through the System Usability Scale (SUS), where scores range from marginal to good, and the Telehealth Usability Questionnaire (TUQ) [15,21,24]. Satisfaction with the clinical service itself is measured by the OPUS-CSS module and the Acceptability of Intervention Measure (AIM) [24,26]. A unique layer of heterogeneity is introduced by psychological metrics, such as the Tampa Scale for Kinesiophobia (TSK), which links acceptability to a patient's fear of movement during remote care [9]. Qualitative data further synthesizes acceptability through themes of patient agency, communication quality, and the perceived "friendship" vs. professionalism in the remote relationship [8,24].

Implementation outcomes are heterogeneous, ranging from individual-level perceptions to macro-level health system metrics [8,23,26,27]. At the individual level, the Intervention Appropriateness Measure (IAM) is used to judge the fit of remote care for specific conditions [26]. At the system level, implementation success is defined by practicality and cost-efficiency, measured through Length of Stay (LOS) reductions, elimination of inter-hospital transfers, and total distance saved [23]. Further heterogeneity exists in professional-focused measures, such as gains in clinician knowledge and confidence following telehealth training workshops [23]. Qualitative synthesis of barriers and facilitators across multiple jurisdictions identifies implementation success through themes of regulatory navigation, reimbursement models, and technological readiness [8,27].

Clinical effectiveness and function exhibits the highest degree of domain-specific heterogeneity, with measurement tools dictated by the anatomical focus of the intervention [9,11,15,19,20,22,23,26]. Spinal outcomes are measured via radiographic Cobb angles, Nash and Moe scores, and Trunk Rotation (ATR) [11,26]. Orthopedic effectiveness in ACL reconstruction is quantified using the IKDC and KOOS subjective knee forms alongside objective measures like laxity and muscle torque. Hand therapy effectiveness is determined by Total Active Motion (TAM) and the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire [9,22]. Neurological and geriatric status is evaluated through the Fugl-Meyer (FM) and ARAT tests, or sEMG muscle activity data [15,21]. This heterogeneity prevents direct cross-study comparisons, as effectiveness is defined by functional improvements unique to each clinical population [8,9,15].

Risk of bias Assessment

Out of the 12 studies included, 7 studies were classified as overall high risk [9,11,15,19,20,22,23], 3 moderate risks [21,24,26] and 2 low risks of bias [8,27]. All overall high risks of bias studies were observational studies. All mixed study and qualitative studies included were classified as moderate and low risk of bias respectively.

Risk of bias across observational studies

Risk of bias was assessed across domains such as; selection, confounding, exposure measurement, outcome measurement, information, attrition, performance/co-intervention, reporting, temporality, analytical and funding/conflict of interest. There was an overall high risk of bias across observational studies. Out of 8 studies, 7 were classified as high risk [9,11,15,19,20,22,23]. Major contributors to the high risk of bias were; Failure to select participants based on similar criteria and among comparable population, failure to identify and

controlled confounders, the testing group receiving different care apart from the exposure. All studies were classified as low risk of bias for carrying out exposure before outcome (Temporality bias) and moderate risk for participants represent target population (Selection bias) [9,11,15,19,20,22,23,26]. 6 studies had low risk of bias for exposure measurement bias, Outcome measurement bias and funding/ conflict of interest. Detail risk of bias is demonstrated on supplementary Figure 1.

Risk of bias across qualitative studies

Risk of bias was assessed across domains such as; appropriateness of research design, sample strategy, data collection method, researcher flexibility, data analysis rigor, internal validity, reliability, objectivity, external validity, ethical considerations and clarity of findings. There was an overall low risk of bias across qualitative studies [8,27]. A single study was classified as low-risk bias in all items assessed [8]. Yet 7 out of 22 items were classified as moderate risk in one study; data collection methods, researcher reflexivity, credibility (Internal validity), reliability, objectivity and external validity [27]. Detail risk of bias is demonstrated on supplementary Figure 2.

Risk of bias across mixed studies

Risk of bias was assessed across domains such as; screening criteria, quantitative component, qualitative component, consistency and diversity and weighing of component. Overall, there was moderate risk of bias across mixed studies [21,24]. Detail risk of bias is demonstrated on supplementary Figure 3.

Certainty of Results

In addition to risk of bias, certainty of results was analyzed considering factors such as study design (randomized vs observational), sample size, measurement tool objective, follow-up and rigor. Authors were not contacted.

Studies with Higher Certainty were five, with rigorous design employing randomization, blinding and large-scale longitudinal tracking that addresses objectivity with higher statistical reliability: A long-term clinical trend in a retrospective matched case-control design, with a large sample size of 224 and very long follow-up duration of 29.7 months was classified as high degree of certainty. Nevertheless, the study relied on self-reported compliance [11]. A qualitative study which used interpretive description to identify barriers and facilitators was classified as high degree of certainty. A high rigor with independent coding by multiple investigators and expert group triangulation was employed. Objectives of these studies were achieved yet limited by nonrandomization and small sample size [8,20]: A prospective study, with sample size of 66, calculated target for 80% power [26] and a high post-hoc power of 85% despite a small sample size and using a homogenous group was classified as high degree of certainty [22].

Studies with moderate certainty of results were two. Though studies with spinal measurements demonstrated excellent intra-examiner reliability ($ICC > 0.89$), it was classified as moderate certainty of result due to limited follow-up duration of 6months with self-reported compliance. In the investigation of functional outcomes and barriers among 44 participants with a 90% statistical power with a high certainty of result in detecting kinesiphobia, the study was classified as moderate certainty of result in detecting effectiveness due to non-randomization [9]. Similarly, though reliable data on usability and muscle activity was provided, it was classified as moderate certainty of result due to its small sample size and from a single community [21].

Studies with Lower Certainty were pilot and case series with primary focus on feasibility, with low sample size and no control group. 5 studies were classified as low certainty of result: A prospective case series with sample size 15 was classified as low certainty of result for effectiveness due to lack of control group [19]. A retrospective cohort design with sample size of 30 was classified as low result certainty due to information bias of design and low sample size [20]. A longitudinal feasibility study with a sample size of 24 with 21 completing the study was classified as moderate result certainty in usability and motivation and low result certainty in effectiveness due to variability in training and lack of control [15]. A survey with 20 sample size was classified as low result certainty due to small cohort and non-validation of tool [24]. Finally, study with insufficient coding practices in hospital record was classified as low certainty of result [23].

Discussion

The primary purpose of this systematic review was to evaluate and synthesize evidence regarding the feasibility of telerehabilitation in orthotic care. Secondary objectives were to map the clinical characteristics of the literature, specifically the distribution of clinical focus, orthotic device types, and the classification of telerehabilitation platforms and to identify current evidence gaps to inform clinical practice and future research.

Feasibility of telerehabilitation in orthotic care

The available evidence demonstrates that telerehabilitation is a highly feasible, acceptable, and clinically effective mode of delivery across diverse orthotic care domains, achieving functional outcomes that are equivalent or superior to traditional face-to-face care while offering substantial operational advantages. Feasibility and usability are supported by mean active training durations of 105 minutes per week [15], favorable System Usability Scale (SUS) scores ranging from 69%

to 77.7% [15,21], and Telehealth Usability Questionnaire (TUQ) ratings averaging 5.77/7 [24]. High acceptability and client satisfaction were consistently reported across pediatric, adult, and geriatric cohorts, as well as among treating physiotherapists (OPUS-CSS mean T-score of 74.6; high AIM, IAM, and FIM implementation scores) [24]. Implementation metrics revealed major system-level efficiencies, including the elimination of 81 inter-hospital transfers (saving 24,324 km of travel and ~\$1.2M in hospital costs) and a significant reduction in hospital length of stay from 9.25 to 4.21 days without adverse events or readmissions [23]. Clinically, telerehabilitation matched or exceeded face-to-face care in Total Active Motion (TAM) and DASH scores for flexor tendon repairs [22], upper-limb Fugl-Meyer motor scores (+4 points) for stroke [15], IKDC and KOOS functional scores for post-anterior cruciate ligament reconstruction (ACLR) [20], and Cobb angle reduction with superior exercise compliance for Adolescent Idiopathic Scoliosis (88.9% vs. 80.2% success rate) [11].

Key facilitators included the elimination of travel time and transportation costs, effective home environment adaptations, patient agency/choice, clear appointment expectations, and strong virtual communication [27]. Conversely, technological barriers such as cellular/internet reception [8], lack of physical contact/palpation [27], acute post-surgical limitations, and the inability to fabricate custom orthoses online presented challenges [27]. In acute hand trauma cohorts, patients experienced fear of damaging tendon repairs (42.1%) and elevated fear of movement/kinesiophobia (TSK median 39 vs. 37, $p = 0.017$) [9], contributing to higher dropout rates (5/14 patients) [9]. These findings align closely with broader musculoskeletal and telehealth literature, which confirms that remote delivery provides comparable pain and functional recovery to in-person care while resolving geographical access barriers [5,7,13,17]. However, discrepancies emerge between acute traumatic conditions and chronic/post-operative joint replacement settings:

while chronic stroke, scoliosis, and post-arthroplasty cohorts demonstrate high adherence and satisfaction [13,20], acute tendon repairs exhibit higher anxiety and attrition in remote environments, underscoring the necessity of initial in-person reassurance and hands-on instruction [9,22].

Clinical Characteristics of studies assessing TR in orthotic care

The synthesized literature spans four primary clinical subspecialties and utilizes four distinct technological platform categories. Clinically, the focus encompasses: (1) Upper Extremity & Hand Rehabilitation, addressing extrinsic hand tendon repairs with dynamic dorsal blocking orthoses or custom thermoplastics [22], chronic stroke upper-limb recovery using dynamic wrist/hand orthoses (SCRIPT) [15], and general hand therapy [27]; (2) Spinal Orthotic Management, targeting Adolescent Idiopathic Scoliosis (AIS) with asymmetric Chêneau braces or Thoraco-Lumbo-Sacral Orthoses (TLSOs) [11] and conservative management of thoracic/lumbar spine fractures using TLSOs in rural hospitals [26]; (3) Lower Extremity Rehabilitation, centered on post-ACLR recovery via smart or AI-enabled knee braces [19,20], lower-limb exergame rehabilitation in frail older adults [21], and general lower-limb orthotic care (AFOs, foot orthoses) [24]; and (4) Broad Orthotic & Prosthetic Care, covering multidisciplinary pediatric, cranial, scoliosis, and upper/lower limb orthotic/prosthetic service delivery [8].

Technologically, platforms were categorized into: (1) Synchronous Consumer Videoconferencing & Communication (Zoom, WhatsApp, FaceTime, Doxy.me, phone, email) for real-time exercise supervision and clinical reviews [8,9,11,22,26,27]; (2) Specialized Smart Wearables & IoT Systems, such as the KNEESUP Compact smart motion tracking knee brace with cloud portals [19,20] and the SSWAD wireless surface electromyography (sEMG) sensor system integrated with exergames [21]; (3) Telerobotic & Gamified Environments, including the SCRIPT system

featuring orthosis-controlled interactive gaming [15]; and (4) Decentralized & Rural Consultation Models, using tablet computers over local Wi-Fi networks to connect metropolitan specialists with rural hospital staff [23]. These trends reflect a rapid technological evolution from simple audio-visual calls to sensor-driven, biofeedback-integrated, and decentralized care models [20,21]. In real-world clinical practice, integrating objective digital tracking (e.g., IMU motion sensors, sEMG) effectively compensates for the absence of physical palpation [20,21]., enabling clinicians to track compliance dynamically, deliver automated feedback, and tailor rehabilitation protocols remotely [20,21].

Current Evidence Gaps

Beyond establishing feasibility, this review reveals eight critical evidence gaps that currently limit the widespread adoption and standardization of telerehabilitation in orthotic care:

1. **Methodological RCT Gaps:** A shortage of large-scale, well-powered, multi-center randomized controlled trials (RCTs), as most existing studies rely on pilot designs, small case series, or observational cohorts [9,15,19–22,26].
2. **Long-Term Follow-Up Gaps:** Follow-up periods rarely extend beyond 8 weeks to 12 months, leaving the long-term sustainability of functional gains, permanent recovery, and device durability unexamined [9,15,19,20,26].
3. **Clinical Severity & Curve Differentiation Gaps:** Spinal orthotic research fails to stratify outcomes based on specific scoliotic curve classifications (e.g., Lenke types) or clinical severity grades [11,26].

4. Remote Tactile & Fabrication Gaps: A lack of validated methods for remote physical palpation, manual therapy, and virtual custom orthosis fabrication/fitting, which remain significant physical barriers [9,24,26]
5. Economic Impact Gaps: An absence of formal cost-effectiveness and cost-utility analyses comparing total healthcare expenditures of telerehabilitation against traditional in-person models[8,19,23,26].
6. Psychological & Adherence Gaps: Insufficient research exploring the psychological mechanisms (e.g., kinesiphobia, technical anxiety) that drive attrition and non-compliance in unsupervised home settings [9,15,22].
7. Generalizability & Equity Gaps: Limited generalizability across low-resource regions, populations with low digital literacy, cognitive impairments, or restricted internet connectivity [8,9,20,21,24,27].
8. Theoretical Hybrid Framework Gaps: The absence of a standardized theoretical framework or clinical guideline establishing the optimal ratio and timing of in-person versus remote visits across different injury phases [8,9,27]

Recommendations for Future Research

Based on the evidence gaps identified in the findings, the following recommendations are proposed for future research:

1. Conduct Large-Scale, Long-Term RCTs: Design adequately powered, multi-center RCTs with extended follow-up durations (>12 months) to establish long-term clinical efficacy, functional retention, and device longevity [5,13].

2. **Develop and Validate Hybrid Care Protocols:** Evaluate structured hybrid delivery models that mandate initial in-person visits (for comprehensive physical evaluation, exercise modeling, and orthotic fitting) followed by remote telerehabilitation sessions, specifically testing their capacity to reduce kinesiophobia and patient dropouts [9,22,27].
3. **Execute Formal Economic Evaluations:** Perform rigorous cost-effectiveness and cost-utility analyses comparing direct and indirect healthcare costs between telerehabilitation and conventional care to inform health policy, reimbursement frameworks, and insurance coverage [5,13].
4. **Advance Remote Fitting and Sensing Technologies:** Investigate innovative digital solutions, including 3D scanning, computer vision, smart motion sensors, and AI-driven compliance monitoring, to overcome virtual palpation and custom orthotic fabrication challenges [4,5,20].
5. **Target Low-Resource and Diverse Populations:** Evaluate low-cost, offline-enabled, and culturally adapted telerehabilitation tools in low- and middle-income countries (LMICs) and rural communities to bridge the digital divide and ensure equitable healthcare access [5,7].

Limitations

The findings of this review must be interpreted considering several methodological limitations.

(1) The high risk of bias and low study quality was the major limitation of this review revealed by the quality assessment. Out of 12 studies 7 were low risk, 3 moderate risk of bias, 5 with lower certainty and 2 with moderate result certainty. Major contributors to the high risk of bias were; Failure to select based on similar criteria and among comparable population, failure to

identify and controlled confounders, the testing group receiving different care apart from the exposure. Furthermore, studies with lower result certainty were pilot and case series with primary focus on feasibility, with low sample size and no control group [13]. (2) Substantial clinical, methodological, and outcome heterogeneity existed across the included studies, spanning diverse age groups (pediatric to geriatric), health conditions (acute tendon trauma, ACLR, stroke, scoliosis, spinal fractures), study designs (RCTs, observational cohorts, qualitative interviews, case series), and outcome metrics, such as implementation measured by; AIM,SUS,IMI,OPUS-CSS which precluded quantitative meta-analysis. (3) Furthermore, language restrictions were applied (English only) restricting studies in other language that could have a huge impact on the result.

Conclusion

This systematic review demonstrates that telerehabilitation in orthotic care is a feasible alternative to conventional face-to-face rehabilitation. This is supported by the fact that telerehabilitation platforms are implementable, acceptable, usable, and clinical effectiveness. Among pediatric, adult, geriatric and professional cohorts, and across varied health conditions, telerehabilitation has been feasible supported by long active training durations, favorable system usability scale, high acceptability and client satisfaction and major system-level efficiencies in implementation metrics. Across upper limb, lower limb, and spinal orthotic applications, remote intervention consistently yields functional recovery, motor improvement, and deformities control comparable or superior to in-person care. Operationally, telerehabilitation delivers significant implementation benefits by eliminating inter-hospital transfers, reducing hospital length of stay, and lowering overall healthcare expenditure. Although physical assessment limitations, custom fabrication hurdles, and acute kinesiophobia remain notable barriers, structured hybrid models combining initial in-person

visits with remote sensor-assisted monitoring offer a transformative, patient-centered pathway for modern orthotic service delivery.

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List of Abbreviation

Table 8: List of Abbreviation			
Word	Meaning	Word	Meaning
ROM	Range of Motion	QoL	Quality of life
PRISMA	Preferred Reporting Items for Systematic Review and Meta-Analyses	OPUS CSS	Orthotic prosthetic users survey – client satisfaction with services module
F2F	Face to Face	FM	Fugl-Meyer
AI	Artificial Intelligence	AIS	Adolescent idiopathic scoliosis
CASP	Critical Appraisal skills program	FIM	Feasibility of Intervention Measure
TAS	Tegner Activity Scale	SUS	System Usability Scale
TR	Telerehabilitation	USA	United state of America
TSST	Tele-scoliosis-screening and treat	SCRIPT	Supervised Care and Rehabilitation Involving Personal Telerobotics
TLSO	Thoraco lumbo-sacral orthosis	TUQ	Telehealth usability questionnaire
LOS	Length of stay	AFO	Ankle-foot orthoses
IKDC/KOOS	International Knee Documentation Committee/knee injury and osteoarthritis outcome score	DASH/TAM	Disabilities of the Arm, Shoulder, and Hand and Total active motion
ACLR	Anterior cruciate ligament reconstruction	TAM	Total Active Motion
IAM	Intervention appropriateness Measure	TSK	Tampa Scale for Kinesiophobia
O/P	Othotic/Prosthetic	ARAT	Action Research Arm Test
ATR	Angle of trunk	RCT	Randomized Control Trial

IP	In-person	sEMG	surface electromyography
PICOS	population, intervention, comparison, outcomes and study	MMAT	Mixed Methods Appraisal Tool
LMICs	low- and middle-income countries		

Declarations

Ethical approval and consent to participate; Not applicable. This was a systematic review.

Consent for Publication: Not applicable

Availability of data and materials: The extracted synthesis outcome data revealing the findings of this review are provided in the supplementary material titled additional file 1. The corresponding author will make available additional synthesis on reasonable requests.

Competing Interests: No competing interests exist between authors.

Clinical trial number: Not applicable

Funding: No funding was received by any private or public agency to carry out this study.

Authors' contributions: Asongafac and Navjyot Trivedi together conceived this study, performed the literature search, extracted data, assessed study quality and analysed the data. Asongafac drafted the manuscript. Navjyot Trivedi supervised the study and critically corrected the manuscript. The final manuscript was read and approved by all authors.

Additional File 1

Table 1: Summary of study characteristics of publications assessing telerehabilitation in orthotic care.

Publications	Setting	Age (years)	Number of participants	Study design
Dillon et al 2024 [8]	United States	Mean 47.2 ± 13.5	30	Qualitative study
Seven et al 2024 [9]	Turkey	Mean: 39.25 ± 12.72 (TR); 31.58 ± 12.02 (FTF)	44	Prospective, open-label, nonrandomized comparative clinical study.
Karavidas & Tzatzaliaris 2026 [11]	Greece	>10	224	Retrospective matched case-control study, from a prospective database.
Nijenhuis et al 2015 [15]	Netherland	18-80	24	Longitudinal feasibility study
Emir et al 2026 [22]	Turkey	25-40	23	Prospective, nonrandomized comparative clinical study
Andrade et al 2024 [26]	Brazil	10-17	66	Prospective cohort study
Gallagher et al 2018 [23]	Australia	Mean: 54 ± 21 (post-implementation); 60 ± 22 (pre-implementation)	81	Observational
Hong et al 2022 [19]	Taiwan	18-50	15	Prospective case series.
Liao et al 2023 [20]	Taiwan	Mean: 26.27 ± 8.59 (Tele-AI group); 28.60 ± 9.30 (FTF group)	30	Retrospective cohort study
Farzad et al 2023 [27]	Canada,	Mean age 44	14	qualitative study
Dillon et al 2024 [24]	Australia	Adult mean: 56.2 ± 15.3; Parent/guardian mean: 32.3 ± 2.1	15	Sequential explanatory mixed-methods study
Chang et al 2023 [21]	Taiwan	60-83	25	Explorative study

Abbreviations: FTF, face to face; AI, Artificial intelligence; TR, Telerehabilitation

Table 2: Summary of outcomes in publications assessing telerehabilitation in orthotic care

Publications	Outcome reported	Key findings
Seven et al 2024 [9]	Technology/access barriers Function	DASH-T scores (40.2 vs. 28.5) and pain showed no statistically significant intergroup differences at 8 weeks ($p > 0.05$). The telerehabilitation group experienced significantly higher fear of movement/kinesiophobia (TSK median 39 vs. 37, $p = 0.017$). Primary barriers to telerehabilitation were fear of damaging the tendon repair (42.1%) and requiring physical assistance during treatment (47.4%).
Nijenhuis et al 2015 [15]	Feasibility (training duration, system usability scale, intrinsic motivation inventory) Clinical changes	System was feasible with a mean training duration of 105 min/week, sufficient usability (SUS 69%), and positive motivation (IMI 5.2/7). Upper extremity Fugl-Meyer motor scores (+4 points, $p = 0.002$) and Stroke Impact Scale quality-of-life scores (+3.7 points, $p = 0.004$) improved significantly post-training and were sustained at 2 months. Dexterity (ARAT) did not show significant overall group improvement, but individual gains strongly correlated with weekly training duration ($\rho = 0.686$, $p = 0.001$)
Emir et al 2026 [22]	Effectiveness	Both telerehabilitation and in-person groups showed significant time-dependent improvements in TAM and DASH scores ($p < 0.001$), with no significant intergroup differences at 6, 8, or 12 weeks. 100% of fingers completing telerehabilitation achieved excellent results on the Modified Strickland classification. A higher dropout rate occurred in the telerehabilitation group (5/14 patients) due to technical and motivational factors
Farzad et al 2023 [27]	Implementation (satisfaction, usability) Barriers Facilitation	Therapists reported high satisfaction and usability overall, strongly advocating for a hybrid care model combining in-person and virtual visits. Major facilitators included eliminated travel time/costs, home environment adaptations, and timely access. Primary barriers included the inability to touch/palpate, virtual communication challenges, acute post-surgical limitations, and the inability to fabricate custom orthoses online (requiring prefabricated or mailed materials)
Hong et al 2022 [19]	Function	Mean time to return to full knee extension was 1.5 months. Knee stability/laxity significantly improved (GNRB side-to-side difference reduced from 3.4 mm to 1.8 mm, $p = 0.026$) and IKDC functional scores improved from 58.2 to 80.6 ($p = 0.002$) at 6 months. Peak flexor/extensor muscle torques and thigh circumference remained unchanged without muscle wasting.
Liao et al 2023 [20]	Function Compliance	The Tele-AI group achieved significantly higher IKDC scores at 3 and 6 months ($p < 0.05$) and higher KOOS scores at 1 and 6 months ($p < 0.05$) compared to the face-to-face group. No significant intergroup differences remained at 12 months. At 12 months, 93.3% of Tele-AI patients vs. 73.3% of FTF patients reached TAS level 5. Patient compliance was maintained in the Tele-AI group, whereas 40% of the FTF group showed poor compliance due to COVID-19 infection fears
Karavidas & Tzatzaliaris 2026 [11]	Effectiveness Compliance Loss to follow up	The online intervention group (OIG) demonstrated a significantly higher success rate (88.9% stable/improved vs. 80.2% control, $p = 0.04$) and greater Cobb angle reduction (-4.3° vs. -1.7° , $p =$

		0.03). Exercise compliance (>3 days/week) was significantly higher in OIG (78.3% vs. 52.8%, $p = 0.006$) and loss to follow-up was significantly lower (5.1% vs. 10.9%, $p = 0.03$)
Andrade et al 2024 [26]	Effectiveness Implementation (acceptability, appropriateness, feasibility)	Main scoliotic Cobb angle decreased significantly after 6 months in both the telerehabilitation (-2.4°) and in-person (-4.9°) groups. Thoracic/lumbar Cobb angles and Nash & Moe vertebral rotation scores showed no significant intergroup differences. Telerehabilitation demonstrated high acceptability, appropriateness, and feasibility scores among both patients and physiotherapists.
Gallagher et al 2018 [23]	Implementation (hospital length of stay, inter-hospital transfers, cost efficiencies, clinician confidence)	Inter-hospital transfers were eliminated for 81 patients, saving 24,324 km of travel and ~\$1.2M in hospital costs. Mean hospital length of stay was significantly reduced from 9.25 to 4.21 days ($p < 0.01$). Zero adverse events or hospital readmissions were reported. Rural clinician knowledge, skills, and confidence to fit and manage TLSOs increased significantly following structured training
Dillon et al 2024 [8]	Perspectives (barriers, facilitators, and scope)	Telehealth is feasible across the full spectrum of O&P services, including initial evaluations, routine reviews, and rare remote device deliveries. Primary barriers included poor cellular/internet connectivity and lack of access to technology. Key facilitators included a patient-focused attitude, high-level communication skills, client choice, and focusing on telehealth benefits rather than limitations
Dillon et al 2024 [24]	Usability Satisfaction	High overall satisfaction was reported for telehealth usability (TUQ mean 5.77/7) and clinical services received (OPUS-CSS mean T-score 74.6). System reliability received the lowest ratings (4.53/7) due to internet and phone reception dropouts. User satisfaction was strongly driven by patient agency/choice, clear appointment expectations, and lived-experience health literacy
Chang et al 2023 [21]	Usability Willingness Learnability	Overall SUS score was 77.70 ("Good" usability), demonstrating strong willingness to engage in home exergame rehabilitation. Female older adults with prior rehab experience achieved significantly higher Learnability ($p = 0.03$) and Confidence ($p = 0.01$) scores. Male older adults without prior rehab experience showed higher willingness to adopt new technologies ($p = 0.02$) along with higher Learnability ($p = 0.04$) and Confidence ($p < 0.001$)

Abbreviations:

AI, Artificial intelligence; DASH-T, Disabilities of the Arm, Shoulder, and Hand-Turkish; SUS, System Usability Scale; O&P, Orthosis and prosthesis; TAM, Total active motion; IMI, Intrinsic Motivation Inventory; TUQ, Telehealth Usability Questionnaire; OPUS-CSS, Orthotic Prosthetic User Survey-Client satisfaction with Service module; TLSO, Thoraco lumbo-sacral orthosis; OIG, Online intervention group; IKDC/KOOS, International Knee Documentation Committee/knee injury and osteoarthritis outcome score; TAS, Tegner Activity scale; ARAT, Action Research Arm Test; FTF, Face to face;

Table 3: Summary of clinical characteristics assessing telerehabilitation in orthotic care.

Publications	Clinical focus	Telerehabilitation Platform
Seven et al 2024 [9]	Postoperative extrinsic hand tendon repair rehabilitation using custom thermoplastic splints	Video conference via mobile phones for real-time supervision.
Nijenhuis et al 2015 [15]	Hemiparetic arm/hand rehabilitation in chronic stroke using a dynamic wrist/hand orthosis (SCRIPT)	SCRIPT system; remotely monitored gaming environment controlled by an orthosis.
Emir et al 2026 [22]	Rehabilitation post Zone 1 & 2 flexor tendon repairs using dorsal blocking orthosis	Synchronous video conferencing via smartphone video conferencing apps (WhatsApp, FaceTime, Zoom)
Farzad et al 2023 [27]	Remote hand therapy including assessment, exercise instruction, activity adaptation using hand orthosis	Videoconferencing (Zoom, Doxy.me, PTTRX home video program), telephone calls, photo sharing.
Hong et al 2022 [19]	Postoperative rehabilitation of ACLR using KNEESUP smart knee brace.	KNEESUP Compact system: smart core motion tracker, mobile app, and clinician web portal.
Liao et al 2023 [20]	Postoperative rehabilitation after ACLR using an AI knee brace	KNEESUP Compact system: portable tracker on a brace, app, and cloud-based database.
Karavidas & Tzatzaliaris 2026 [11]	Adolescent idiopathic scoliosis (AIS) rehabilitation with asymmetric Chêneau brace	Zoom platform for weekly supervised sessions as part of the TSST protocol.
Andrade et al 2024 [26]	Rehabilitation of adolescents with idiopathic scoliosis (AIS) using thoracic-lumbar-sacral orthosis (TLSO)	WhatsApp video calls for real-time exercise supervision.
Gallagher et al 2018 [23]	Conservative management of thoracic or lumbar spine fractures using TLSO	Tablet computers using Wi-Fi networks to provide specialist support to rural staff.
Dillon et al 2024 [8]	O&P care across pediatric, cranial, scoliosis, upper/lower limb prosthetics, and neuro orthotics	Video conferencing, phone calls, text, email, and postal/delivery services.
Dillon et al 2024 [24]	Adult and pediatric users of lower/upper limb orthoses (AFOs, foot orthoses) and prostheses	Telephone consultations, videoconferencing (PowerDiary, Zoom, FaceTime), and email.
Chang et al 2023 [21]	Lower limb rehabilitation of Frail older adults using SSWAD wearable device	SSWAD: Wireless sEMG sensors integrated with lower-limb exergames.

Abbreviations: TLSO, Thoraco lumbo-sacral orthosis; AI, Artificial intelligence; ACLR, Anterior crutiate ligament reconstruction; SSWAD, smart somatosensory wearable assistive device; sEMG, surface electromyography; O&P, Orthosis & prosthesis; TSST, tele-scoliosis-screening; SCRIPT, Supervised Care and Rehabilitation Involving Personal Telerobotics; AFO, Ankle foot orthosis; O&P, Orthotic and prosthetic; AIS, Adolescent Idiopathic Scoliosis; PTTRX, Physical Therapy treatment

Supplementary Table 1: Search terms		
Key terms	Scopus, PubMed and Cochrane library	ScienceDirect
telerehabilitation, orthotic device, feasibility, implementation outcome and clinical effectiveness.	("telerehabilitation" OR "tele-rehabilitation" OR "telehealth" OR "telemedicine" OR "remote rehabilitation") AND ("orthotic*" OR "orthos*" OR "brace*" OR "splint*") AND ("feasibility" OR "outcome*" OR "implementation" OR "effectiveness").	("tele-rehabilitation" OR "telehealth" OR "remote rehabilitation") AND ("orthotic" OR "brace" OR "splint").

Supplementary Table 2: Summary of inclusion and exclusion criteria		
Criteria	Inclusion	Exclusion
Study design	Articles with observational, qualitative and mixed method studies.	Studies with non-orthotic population, technological studies without outcomes, editorials, book chapters, conference papers and reviews.
Population	Participants of any age or gender using any form of orthotic device during the rehabilitation process for varied health conditions.	Participants with brain damage and other complications.
Intervention	Telerehabilitation: video conferences, trackers, zoom, exercise videos, telemonitoring, mobile health applications, virtual rehabilitation platforms, wearable sensors, remote brace compliance monitoring.	Technologies where rehabilitation service cannot be delivered by use of information and communication at a distance.
Comparison	Any other care such as traditional F2F rehabilitation in clinics, conventional orthotic care, other rehabilitative interventions or no comparator.	Any other rehabilitation that is not physical with medical science background.
Outcome	Feasibility: acceptability, implementation and clinical effectiveness	Studies not related to these outcomes.
Language	English	Non English.

Date of publication January 2010- March 2026.

Out of this duration.

Supplementary Table 3: Study risk of bias assessment tools

Study type	Quality assessment tool	Criteria evaluated
Observational studies	Newcastle-Ottawa Scale	Participants selection, comparability, exposure and outcome, missing data, causality and timing, reporting, data analysis,
Qualitative studies	Critical Appraisal skills program (CASP) checklist	Study design, sampling strategy, data collection, research reflexivity, data analysis, credibility, reliability, objectivity, and transferability
Mixed-studies	Method Mixed Methods Appraisal Tool (MMAT)	Screening, quantitative component, qualitative component, integration of methods, interpretation of results, limitation and coherence

A: (Selection bias) B: (Confounding) C: (Exposure measurement bias) D: (Outcome measurement bias)	E: (information bias) F: (Attrition bias) G: (Performance/co-intervention) bias H: (Reporting bias)	I: (Temporality) J: (Analytical bias) K: (Funding/conflict of interest)
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Supplementary Figure 1; Risk of bias traffic-light plot across observational studies

[8]	A: Justification of approach	A: Does the design fit the research question	B: Appropriateness of sampling methods	B: Relevance of participants to research question	C: Systematic and appropriate data collection	C: Clearly described setting	D:Reflection on self influence, assumptions, and bias	D: Clearly described role of researcher	E: Clearly explained analysis	E: Systematically derivation of themes from data	F: Supports findings by direct participants quotes	F: Use of member checkers	G: Consistent and well documented process	G: Easily replicable steps	H: Findings are grounded in data	H: Availability of audit trail	I: Explicit description of context and participants	J: Ethical approval obtained	J: Informed Consent and confidentiality maintained	K: Clear presentation of results	K: Conclusions follow from data	Overall
[27]																						



A: (Appropriateness of research design) B: (Sample strategy) C: (Data collection methods) D: (researcher reflexivity)	E: (Data analysis rigor) F: (Internal validity) G: (Reliability) H: (Objectivity)	I: (External validity) J: (Ethical considerations) K: (clarity of findings)
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Supplementary Figure 2; Risk of bias traffic-light plot across qualitative studies

[24]		A: Clear research question
		A: Appropriate data collection to address the question
[21]		A: Explicit justification for using mixed method
		B: Sampling and representativeness
		B: Randomization or selection process
		B: Control of confounding variables
		B: Validation and reliability of documents
		B: Handling of missing data
		B: Appropriate statistical analysis
		C: Appropriate qualitative approach
		C: Sampling strategy and data saturation
		C: Data collection methods
		C: Researcher reflexivity
		C: Rigor of data analysis
		C: Credibility measures
		Reason for mixed method
		Integration strategy
		Interpretation of results from both components
		D: Do results agree if not is divergence explained?
		E: Are both components given equal importance
		Limitation and coherence in both components
		Overall

	Low		Moderate		high
A: (Screening Criteria) B: (Quantitative components)		C: (Qualitative component) D: (Consistency and diversity)		E: Weighing of components	

Supplementary Figure 3; Risk of bias traffic-light plot across mixed studies