Digitally assisted versus conventional home-based rehabilitation after rotator cuff tear: A systematic review and meta-analysis

Search date: 26 June 2024

Table 1: MESH and key words for search strategy

Mesh terms	"Virtual reality" "Augmented reality" "Virtual Reality Exposure Therapy" Exergaming	"Rotator Cuff" "Rotator Cuff Tear Arthropathy" "Rotator Cuff Injuries"
Tittle/abstract	"Virtual reality" "Augmented reality" "Virtual Reality Exposure Therapy" "Exergam*" "Virtual Reality Exercis*" (Exercis*[tiab] AND "Virtual Reality"[tiab]) "Active-Video Gaming*" "Active Video Gaming" (gaming[tiab] AND active-video[tiab]) "Virtual Reality Immersion Therapy" "Virtual Reality Therapy" (Reality Therap*[tiab] AND virtual[tiab]) (therap*[tiab] AND "virtual reality"[tiab]) (reality[tiab] AND virtual[tiab]) ("virtual reality"[tiab] AND educational[tiab]) "Educational Virtual Realit*" (realit*[tiab] AND "Educational Virtual"[tiab]) ("virtual realit*"[tiab] AND educational[tiab]) ("virtual realit*"[tiab] AND instructional[tiab]) "Instructional Virtual Realit*" (Realit*[tiab] AND "Instructional Virtual"[tiab]) "Mixed Realit*" (Augmented[tiab] AND realit*[tiab) (Realit*[tiab] AND Mixed[tiab])	"Rotator Cuff*" Supraspinatus Infraspinatus Subscapularis "Teres Minor" (Cuff[tiab] AND Rotator[tiab]) "Rotator Cuff Tear Arthropathy" "Cuff Tear Arthropathy" "Milwaukee Shoulder" (Shoulder[tiab] AND Milwaukee[tiab]) "Milwaukee Shoulder Syndrome" (arthropathy[tiab] AND "cuff tear"[tiab]) "Rotator Cuff Injuries" (Injury[tiab] AND Rotator Cuff[tiab]) ("Cuff Injury"[tiab] AND Rotator[tiab]) "Rotator Cuff Tear*" (Tear[tiab] AND Rotator Cuff[tiab]) (Tears[tiab] AND "Rotator Cuff"[tiab]) "Rotator Cuff Tendiniti*" "Rotator Cuff Tendinos*" (Tendinit*[tiab] AND "Rotator Cuff"[tiab]) "Glenoid Labral Tear*" ("Labral Tear*[tiab] AND Glenoid[tiab]) (Tear[tiab] AND "Glenoid Labral"[tiab])

Pubmed: 19 results

("Rotator Cuff"[Title/Abstract] OR "Supraspinatus"[Title/Abstract] OR "Infraspinatus"[Title/Abstract] OR "Subscapularis"[Title/Abstract] OR "Teres Minor"[Title/Abstract] OR (Cuff[tiab] AND Rotator[tiab]) OR "Rotator Cuff Tear Arthropathy"[Title/Abstract] OR "Milwaukee Shoulder"[Title/Abstract] OR (Shoulder[tiab] AND Milwaukee[tiab]) OR "Milwaukee Shoulder Syndrome"[Title/Abstract] OR (arthropathy[tiab] AND "cuff tear"[tiab]) OR "Rotator Cuff Injuries"[Title/Abstract] OR (Injury[tiab] AND Rotator Cuff[tiab]) OR ("Cuff Injury"[tiab] AND Rotator[tiab]) OR "Rotator Cuff Tear"[Title/Abstract] OR (Tear[tiab] AND Rotator Cuff[tiab]) OR (Tears[tiab] AND "Rotator Cuff"[tiab]) OR "Rotator Cuff Tendin"[Title/Abstract] OR (Tendinit*[tiab] AND "Rotator Cuff"[tiab]) OR "Glenoid Labral Tear"[Title/Abstract] OR ("Labral Tear"[tiab] AND Glenoid[tiab]) OR (Tear[tiab] AND "Glenoid Labral"[tiab]) OR "Rotator Cuff"[MeSH Terms] OR "Rotator Cuff Tear Arthropathy"[MeSH Terms] OR "Rotator Cuff Injuries"[MeSH Terms]) AND ("Virtual reality"[Title/Abstract] OR "Augmented reality"[Title/Abstract] OR "Virtual Reality Exposure Therapy"[Title/Abstract] OR "Exergam"[Title/Abstract] OR "Virtual Reality Exercis"[Title/Abstract] OR (Exercis*[tiab] AND "Virtual Reality"[tiab]) OR "Active-Video Gaming"[Title/Abstract] OR "Active Video Gaming"[Title/Abstract] OR (gaming[tiab] AND active-video[tiab]) OR "Virtual Reality Immersion Therapy"[Title/Abstract] OR "Virtual Reality Therapy"[Title/Abstract] OR (Reality Therap*[tiab] AND virtual[tiab]) OR (therap*[tiab] AND "virtual reality"[tiab]) OR (reality[tiab] AND virtual[tiab]) OR ("virtual reality"[tiab] AND educational[tiab]) OR "Educational Virtual Realit"[Title/Abstract] OR (realit*[tiab] AND "Educational Virtual"[tiab]) OR ("virtual realit"[tiab] AND educational[tiab]) OR ("virtual realit"[tiab] AND instructional[tiab]) OR "Instructional Virtual Realit"[Title/Abstract] OR (Realit*[tiab] AND "Instructional Virtual"[tiab]) OR "Mixed Realit"[Title/Abstract] OR (Augmented[tiab] AND realit*[tiab]) OR (Realit*[tiab] AND Mixed[tiab]) OR "Virtual reality"[MeSH Terms] OR "Augmented reality"[MeSH Terms] OR "Virtual Reality Exposure Therapy"[MeSH Terms] OR "Exergaming"[MeSH Terms])

Scopus: 39 results

(TITLE-ABS-KEY ("Rotator Cuff") OR TITLE-ABS-KEY (supraspinatus) OR TITLE-ABS-KEY (infraspinatus) OR TITLE-ABS-KEY (subscapularis) OR TITLE-ABS-KEY ("Teres Minor") OR (TITLE-ABS-KEY (cuff) AND TITLE-ABS-KEY (rotator)) OR TITLE-ABS-KEY ("Rotator Cuff Tear Arthropathy") OR TITLE-ABS-KEY ("Milwaukee Shoulder") OR (TITLE-ABS-KEY (shoulder) AND TITLE-ABS-KEY (milwaukee)) OR TITLE-ABS-KEY ("Milwaukee Shoulder Syndrome") OR (TITLE-ABS-KEY (arthropathy) AND TITLE-ABS-KEY ("cuff tear")) OR TITLE-ABS-KEY ("Rotator Cuff Injuries") OR (TITLE-ABS-KEY (injury) AND TITLE-ABS-KEY ("Rotator Cuff")) OR (TITLE-ABS-KEY ("Cuff Injury") AND TITLE-ABS-KEY (rotator)) OR TITLE-ABS-KEY ("Rotator Cuff Tear") OR (TITLE-ABS-KEY (tear) AND TITLE-ABS-KEY ("Rotator Cuff")) OR (TITLE-ABS-KEY (tears) AND TITLE-ABS-KEY ("Rotator Cuff")) OR TITLE-ABS-KEY ("Rotator Cuff Tendin") OR (TITLE-ABS-KEY (tendinit*) AND TITLE-ABS-KEY ("Rotator Cuff")) OR TITLE-ABS-KEY ("glenoid labrale tear") OR (TITLE-ABS-KEY ("labrale tear") AND

TITLE-ABS-KEY (glenoid)) OR (TITLE-ABS-KEY (tear) AND TITLE-ABS-KEY ("glenoid labrale"))) AND (TITLE-ABS-KEY ("Virtual reality") OR TITLE-ABS-KEY ("Augmented reality") OR TITLE-ABS-KEY ("Virtual Reality Exposure Therapy") OR TITLE-ABS-KEY (exergam*) OR TITLE-ABS-KEY ("Virtual Reality Exercis*") OR (TITLE-ABS-KEY (exercis*) AND TITLE-ABS-KEY ("Virtual Reality")) OR TITLE-ABS-KEY ("Active-Video Gaming") OR TITLE-ABS-KEY ("Active Video Gaming") OR (TITLE-ABS-KEY (gaming) AND TITLE-ABS-KEY (active-video)) OR TITLE-ABS-KEY ("Virtual Reality Immersion Therapy") OR TITLE-ABS-KEY ("Virtual Reality Therapy") OR (TITLE-ABS-KEY ("Reality Therapy") AND TITLE-ABS-KEY (virtual)) OR (TITLE-ABS-KEY (therapy) AND TITLE-ABS-KEY ("virtual reality")) OR (TITLE-ABS-KEY (reality) AND TITLE-ABS-KEY (virtual)) OR (TITLE-ABS-KEY ("virtual reality") AND TITLE-ABS-KEY (educational)) OR TITLE-ABS-KEY ("Educational Virtual Reality") OR (TITLE-ABS-KEY (reality) AND TITLE-ABS-KEY ("Educational Virtual")) OR (TITLE-ABS-KEY ("virtual reality") AND TITLE-ABS-KEY (educational)) OR (TITLE-ABS-KEY ("virtual reality") AND TITLE-ABS-KEY (instructional)) OR TITLE-ABS-KEY ("Instructional Virtual Reality") OR (TITLE-ABS-KEY (reality) AND TITLE-ABS-KEY ("Instructional Virtual")) OR TITLE-ABS-KEY ("Mixed Reality") OR (TITLE-ABS-KEY (augmented) AND TITLE-ABS-KEY (reality)) OR (TITLE-ABS-KEY (reality) AND TITLE-ABS-KEY (mixed)))

Web Of Science: 26 results
TS=("Rotator Cuff" OR Supraspinatus OR Infraspinatus OR Subscapularis OR "Teres Minor" OR
(Cuff AND Rotator) OR "Rotator Cuff Tear Arthropathy" OR "Milwaukee Shoulder" OR
(Shoulder AND Milwaukee) OR "Milwaukee Shoulder Syndrome" OR
(arthropathy AND "cuff tear") OR "Rotator Cuff Injuries" OR
(Injury AND "Rotator Cuff") OR ("Cuff Injury" AND Rotator) OR
"Rotator Cuff Tear" OR (Tear AND "Rotator Cuff") OR
(Tears AND "Rotator Cuff") OR "Rotator Cuff Tendin" OR
(Tendinit* AND "Rotator Cuff") OR "Glenoid Labral Tear" OR
("Labral Tear" AND Glenoid) OR (Tear AND "Glenoid Labral"))
AND
TS=("Virtual reality" OR "Augmented reality" OR
"Virtual Reality Exposure Therapy" OR Exergam* OR
"Virtual Reality Exercis*" OR
(Exercis* AND "Virtual Reality") OR
"Active-Video Gaming" OR "Active Video Gaming" OR
(gaming AND active-video) OR
"Virtual Reality Immersion Therapy" OR

"Virtual Reality Therapy" OR
("Reality Therapy" AND virtual) OR
(therapy AND "virtual reality") OR
(reality AND virtual) OR
("virtual reality" AND educational) OR
"Educational Virtual Reality" OR
(reality AND "Educational Virtual") OR
("virtual reality" AND educational) OR
("virtual reality" AND instructional) OR
"Instructional Virtual Reality" OR
(reality AND "Instructional Virtual") OR
"Mixed Reality" OR (Augmented AND reality) OR
(reality AND Mixed))

Embase: 25

```
(
   'rotator cuff':ti,ab OR supraspinatus:ti,ab OR infraspinatus:ti,ab OR subscapularis:ti,ab OR
   'teres minor':ti,ab OR (cuff:ti,ab AND rotator:ti,ab) OR 'rotator cuff tear arthropathy':ti,ab OR
   'milwaukee shoulder':ti,ab OR (shoulder:ti,ab AND milwaukee:ti,ab) OR
   'milwaukee shoulder syndrome':ti,ab OR (arthropathy:ti,ab AND 'cuff tear':ti,ab) OR
   'rotator cuff injuries':ti,ab OR (injury:ti,ab AND 'rotator cuff':ti,ab) OR
   ('cuff injury':ti,ab AND rotator:ti,ab) OR 'rotator cuff tear':ti,ab OR
   (tear:ti,ab AND 'rotator cuff':ti,ab) OR (tears:ti,ab AND 'rotator cuff':ti,ab) OR
   'rotator cuff tendin':ti,ab OR (tendinit*:ti,ab AND 'rotator cuff':ti,ab) OR
   'glenoid labral tear':ti,ab OR ('labral tear':ti,ab AND glenoid:ti,ab) OR
   (tear:ti,ab AND 'glenoid labral':ti,ab)
)
AND
(
   'virtual reality':ti,ab OR 'augmented reality':ti,ab OR
   'virtual reality exposure therapy':ti,ab OR exergam*:ti,ab OR
   'virtual reality exercis*':ti,ab OR (exercis*:ti,ab AND 'virtual reality':ti,ab) OR
   'active-video gaming':ti,ab OR 'active video gaming':ti,ab OR
   (gaming:ti,ab AND active-video:ti,ab) OR 'virtual reality immersion therapy':ti,ab OR
   'virtual reality therapy':ti,ab OR ('reality therapy':ti,ab AND virtual:ti,ab) OR
```

(therapy:ti,ab AND 'virtual reality':ti,ab) OR (reality:ti,ab AND virtual:ti,ab) OR
('virtual reality':ti,ab AND educational:ti,ab) OR 'educational virtual reality':ti,ab OR
(reality:ti,ab AND 'educational virtual':ti,ab) OR
('virtual reality':ti,ab AND educational:ti,ab) OR
('virtual reality':ti,ab AND instructional:ti,ab) OR 'instructional virtual reality':ti,ab OR
(reality:ti,ab AND 'instructional virtual':ti,ab) OR 'mixed reality':ti,ab OR
(augmented:ti,ab AND reality:ti,ab) OR (reality:ti,ab AND mixed:ti,ab)
)

Cochrane registry: 32

#1 MeSH descriptor: [Virtual Reality] explode all trees 1133

#2 MeSH descriptor: [Virtual Reality Exposure Therapy] explode all trees 331

#3 MeSH descriptor: [undefined] explode all trees 0

#4 (“Virtual reality”):ti,ab,kw OR ("Augmented reality"):ti,ab,kw OR (“Virtual Reality Exposure Therapy”):ti,ab,kw OR (“Exergaming”):ti,ab,kw OR (“Virtual Reality Exercise”):ti,ab,kw (Word variations have been searched)8085

#5 (“Active-Video Gaming”):ti,ab,kw OR (“Active Video Gaming”):ti,ab,kw OR (“Virtual Reality Immersion Therapy”):ti,ab,kw OR (“Virtual Reality Therapy”):ti,ab,kw OR (“Educational Virtual Reality”):ti,ab,kw (Word variations have been searched) 334

#6 (exercise):ti,ab,kw AND ("virtual reality"):ti,ab,kw (Word variations have been searched) 1401

#7 (gaming):ti,ab,kw AND ("active-video"):ti,ab,kw (Word variations have been searched) 176

#8 ("reality therapy"):ti,ab,kw AND ("virtual"):ti,ab,kw (Word variations have been searched) 153

#9 (realiry):ti,ab,kw AND (virtual):ti,ab,kw (Word variations have been searched) 0

#10 (“virtual realities”):ti,ab,kw AND (educational):ti,ab,kw (Word variations have been searched) 1289

#11 (“Educational Virtual”):ti,ab,kw AND (reality):ti,ab,kw (Word variations have been searched) 12

#12 (“Virtual reality”):ti,ab,kw AND (instructional):ti,ab,kw (Word variations have been searched) 450

#13 ("Instructional Virtual Reality"):ti,ab,kw OR ("Mixed reality"):ti,ab,kw (Word variations have been searched) 147

#14 ("reality"):ti,ab,kw AND (mixed):ti,ab,kw (Word variations have been searched) 520

#15 (reality):ti,ab,kw AND (Augmented):ti,ab,kw (Word variations have been searched) 760

#16 (reality):ti,ab,kw AND ("Instructional Virtual"):ti,ab,kw (Word variations have been searched) 0

#17 #1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 8400

#18 MeSH descriptor: [Rotator Cuff] explode all trees 655

#19 MeSH descriptor: [Rotator Cuff Tear Arthropathy] explode all trees20

#20 MeSH descriptor: [Rotator Cuff Injuries] explode all trees 905

#21 ("Rotator Cuff"):ti,ab,kw OR (Supraspinatus):ti,ab,kw OR (Infraspinatus):ti,ab,kw OR (Subscapularis):ti,ab,kw OR ("Teres Minor"):ti,ab,kw (Word variations have been searched) 3383

#22 ("Rotator Cuff Tear Arthropathy"):ti,ab,kw OR (“Cuff Tear Arthropathy”):ti,ab,kw OR (“Milwaukee Shoulder”):ti,ab,kw OR (“Milwaukee Shoulder Syndrome”):ti,ab,kw OR (“Rotator Cuff Injuries”):ti,ab,kw (Word variations have been searched) 1165

#23 (“Rotator Cuff Tear”):ti,ab,kw OR (“Rotator Cuff Tendinitis”):ti,ab,kw OR (“Rotator Cuff Tendinosis”):ti,ab,kw OR (“Glenoid Labral Tear”):ti,ab,kw (Word variations have been searched) 1144

#24 (cuff):ti,ab,kw AND (rotator):ti,ab,kw (Word variations have been searched) 3000

#25 (Shoulder):ti,ab,kw AND (Milwaukee):ti,ab,kw (Word variations have been searched) 2

#26 (“cuff tear”):ti,ab,kw AND (arthropathy):ti,ab,kw (Word variations have been searched) 74

#27 (Injury):ti,ab,kw AND (Rotator):ti,ab,kw (Word variations have been searched) 2583

#28 (“Cuff Injury”):ti,ab,kw AND (Rotator):ti,ab,kw (Word variations have been searched) 1134

#29 ("tear"):ti,ab,kw AND ("Rotator cuff"):ti,ab,kw (Word variations have been searched) 1203

#30 (tendinitis):ti,ab,kw AND ("Rotator cuff"):ti,ab,kw (Word variations have been searched) 991

#31 (Glenoid):ti,ab,kw AND ("labral tear"):ti,ab,kw (Word variations have been searched) 13

#32 ("Glenoid labral"):ti,ab,kw AND (tear):ti,ab,kw (Word variations have been searched) 6

#33 #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24 OR #25 OR #26 OR #27 OR #28 OR #29 OR #30 OR #31 OR #32 4720

#34 #17 AND #33 32

Table 2: Reason of exclusion for each article

Author, Year	Title	Reason of exclusion in ti/ab screening	Reason of exclusion in full text screening
, 2020	Swiss Orthopaedics 80th Annual Meeting	conference abstracts	
, 2023	Simulator VR Rotator Double Row Cuff Repair Training Improves the Overall Ease of the Procedure: A Randomized, Controlled and Multicentric Transfer Validity Study	No rehabilitation	
S. Abdic, 2023	Mixed reality visualization in shoulder arthroplasty: is it better than traditional preoperative planning software?	No rahabilitaiotn	
Actrn, 2017	MoOVi-therapy: using illusory virtual reality exercises to treat neck pain	included	No rotator cuff repair
Actrn, 2018	Effectiveness of a external skeletal device for the rehabilitation of patients following stroke	No rotator cuff repair	
A. Alamri, 2010	AR-REHAB: An augmented reality framework for poststroke-patient rehabilitation	No rotator cuff repair	
F. M. Alfieri, 2022	Gamification in musculoskeletal rehabilitation	Review article	
Y. M. Aung, 2016	Augmented reality system for rehabilitation: new approach based on human interaction and biofeedback	No rotator cuff repair	
E. J. Avila Mireles, 2017	Skill learning and skill transfer mediated by cooperative haptic interaction	No rotator cuff repair	
A. Baldominos, 2015	An Approach to Physical Rehabilitation Using State-of-the-art Virtual Reality and Motion Tracking Technologies	included	No rotator cuff repair
A. Beletsky, 2020	Quantifying the Opportunity Cost of Resident Involvement in Academic Orthopaedic Sports Medicine: A Matched-Pair Analysis	No rehabilitation	
A. Berton, 2020	Virtual reality, augmented reality, gamification, and telerehabilitation: psychological impact on orthopedic patients' rehabilitation	Review article	
F. Blume, 2017	NIRS-based neurofeedback training in virtual reality/effects on behaviour and quality of life in children with ADHD	No rotator cuff repair	
K. Boland, 2021	Current concepts in the rehabilitation of rotator cuff related disorders	Review article	
A. Borresen, 2023	Comparison of in-person and synchronous remote musculoskeletal exam using augmented reality and haptics: A pilot study	included	Not specifing outcomes of rotator cuff repair patients
N. Brady, 2023	Physiotherapist beliefs and perspectives on virtual reality supported rehabilitation for the management of musculoskeletal shoulder pain: A focus group study	No rotator cuff repair	

P. Carlos Carvalho, 2021	Digitally assisted versus conventional home-based rehabilitation after Arthroscopic Rotator Cuff Repair: a randomized controlled trial	included	Included
A. Carnevale, 2022	Virtual reality for shoulder rehabilitation: Accuracy evaluation of oculus quest 2	included	Not specifing outcomes of rotator cuff repair patients
A. Carnevale, 2023	Performance Evaluation of an Immersive Virtual Reality Application for Rehabilitation after Arthroscopic Rotator Cuff Repair	included	No comparission
M. S. Carvalho, 2020	Effects of Exergames in Women with Fibromyalgia: A Randomized Controlled Study	No rotator cuff repair	
M. S. D. Carvalho, 2020	Effects of Exergames in Women with Fibromyalgia: A Randomized Controlled Study	No rotator cuff repair	
S. Chae, 2018	In vivo biomechanical measurement and haptic simulation of portal placement procedure in shoulder arthroscopic surgery	No rehabilitation	
W. K. Chang, 2022	Post-operative rehabilitation using a digital healthcare system in patients who had undergone rotator cuff repair: protocol for a single-center randomized controlled trial	Study protocol	
H. Chen, 2023	Application progress of artificial intelligence and augmented reality in orthopaedic arthroscopy surgery	Review article	
K. Chen, 2023	Task-Oriented and Imitation-Oriented Movements in Virtual Reality Exercise Performance and Design	No rotator cuff repair	
W. Chen, 2018	Virtual touch tissue imaging quantification in evaluation on elastic characteristics of supraspinatus tendon in normal adults	No rehabilitation	
S. Condino, 2019	Wearable augmented reality application for shoulder rehabilitation	included	Not specifing outcomes of rotator cuff repair patients
B. Cunha, 2023	Home-based rehabilitation of the shoulder using auxiliary systems and artificial intelligence: an overview	Review article	
M. Daher, 2023	Augmented reality and shoulder replacement: a state-of-the-art review article	Review article	
M. S. de Carvalho, 2020	Effects of Exergames in Women with Fibromyalgia: A Randomized Controlled Study	No rotator cuff repair	
B. Dejaco, 2023	The concurrent validity and reliability of virtual reality to measure shoulder flexion and scaption range of motion	included	No rotator cuff repair
D. Demirel, 2019	Partition-based optimization model for generative anatomy modeling language (POM-GAML)	No rotator cuff repair	

D. Demirel, 2022	Scoring metrics for assessing skills in arthroscopic rotator cuff repair: performance comparison study of novice and expert surgeons	No rehabilitation
D. Demirel, 2017	A hierarchical task analysis of shoulder arthroscopy for a virtual arthroscopic tear diagnosis and evaluation platform (VATDEP)	No rehabilitation
J. Dhillon, 2024	Virtual and Augmented Reality Simulators Show Intraoperative, Surgical Training, and Athletic Training Applications: A Scoping Review	Review article
F. Dinc, 2022	A New Set of Real-Time Performance Aware Algorithms for Virtual Reality Based Arthroscopic Rotator Cuff Surgery Simulation	No rehabilitation
F. Dupuis, 2021	Fatigue, induced via repetitive upper-limb motor tasks, influences trunk and shoulder kinematics during an upper limb reaching task in a virtual reality environment	No rotator cuff repair
F. Dupuis, 2021	The impact of experimental pain on shoulder movement during an arm elevated reaching task in a virtual reality environment	No rotator cuff repair
T. Dwyer, 2017	Performance Assessment of Arthroscopic Rotator Cuff Repair and Labral Repair in a Dry Shoulder Simulator	No rehabilitation
P. Eghbali, 2024	Glenohumeral joint force prediction with deep learning	No rehabilitation
S. El-Shamy, 2017	Effect of virtual reality versus conventional physiotherapy on upper extremity function in children with obstetric brachial plexus injury	No rotator cuff repair
J. Farmer, 2020	Systematic approach for content and construct validation: Case studies for arthroscopy and laparoscopy	No rehabilitation
J. Farmer, 2020	Virtual rotator cuff arthroscopic skill trainer: Results and analysis of a preliminary subject study	concference abstracts
H. Funao, 2021	Virtual reality applied to home-visit rehabilitation for hemiplegic shoulder pain in a stroke patient: a case report	No rotator cuff repair
B. Gobbato, 2023	DYNAMIC ANTERIOR STABILIZATION WITH MIXED REALITY NAVIGATION SYSTEM	No rehabilitation
B. Gobbato, 2023	MIXED REALITY MULTI-CAMERA SHOULDER ARTHROSCOPY	No rehabilitation
H. Graichen, 2000	Glenohumeral translation during active and passive elevation of the shoulder - a 3D open-MRI study	No rotator cuff repair
G. Grewal, 2022	Does critical shoulder angle predict abduction motion and acromion-tuberosity impingement in reverse shoulder arthroplasty?	No rehabilitation
W. Gu, 2021	Feasibility of image-based augmented reality guidance of total shoulder arthroplasty using microsoft HoloLens 1	No rehabilitation
P.-Y. Hsu, 2024	The evolution of augmented reality to augment physical therapy: A scoping review	Review article
Y. Hu, 2023	Bibliometric and visualized analysis of scientific publications on rehabilitation of rotator cuff injury based on web of science	Review article
A. Insel, 2009	The Development of an Objective Model to Assess Arthroscopic Performance	No rehabilitation

Irct20090301001722N, 2018	Comparison of the Effect of Virtual Reality training with conventional treatment in athletes with Functional Ankle Instability	No rotator cuff repair	
Isrctn, 2024	Effectiveness of immersive Virtual Reality in patients with neck pain after traffic accident	No rotator cuff repair	
K. Italia, 2022	Single-Stage Revision Reverse Shoulder Arthroplasty: Preoperative Planning, Surgical Technique, and Mixed Reality Execution	No rehabilitation	
H. E. Karas, 2022	The Effects of Virtual Reality on Upper Extremity in Patients with Obstetric Brachial Plexus Injury	Review article	
V. A. Kolyshenkov, 2022	Evaluation of the Effectiveness of the Virtual Reality Technologies Comprehensive Rehabilitation Program Application: a Prospective Cohort Study of 59 Patients with Rotator Cuff Injury	included	Not reporting their results correctly
J. M. Kopriva, 2024	Mixed-reality improves execution of templated glenoid component positioning in shoulder arthroplasty: a CT imaging analysis	No rotator cuff repair	
T. Kozak, 2021	An update on reverse total shoulder arthroplasty: current indications, new designs, same old problems	Review article	
W. Kwabla, 2023	Evaluation of WebRTC in the Cloud for Surgical Simulations: A case study on Virtual Rotator Cuff Arthroscopic Skill Trainer (ViRCAST)	No rehabilitation	
W. Kwabla, 2023	Evaluation of WebRTC in the Cloud for Surgical Simulations: A Case Study on Virtual Rotator Cuff Arthroscopic Skill Trainer (ViRCAST)	No rehabilitation	
H. Kwon, 2020	Usability tests with a virtual arthroscopic surgery simulator	No rehabilitation	
A. Lädermann, 2023	Innovations in the Realm of Shoulder Arthroplasty	Editorial	
A. Lakhani, 2021	E-rehabilitation solution for rotator cuff syndrome in COVID-19 pandemic era	included	No rotator cuff repair
C. Laverdière, 2019	Augmented reality in orthopaedics: a systematic review and a window on future possibilities	Review article	
K. S. Lee, 2024	Artificial intelligence- and computer-assisted navigation for shoulder surgery	No rehabilitation	
J.-Y. Lim, 2022	Postoperative Rehabilitation using Digital Healthcare System in Patients with Rotator Cuff Repair: A Randomized Controlled Trial	included	Included
H.-T. Lin, 2019	A scoping review of the efficacy of virtual reality and exergaming on patients of musculoskeletal system disorder	Review article	
J. Liu, 2011	Ultrasound elastography of supraspinatus tendon with real-time virtual sonography	No rehabilitation	

R. Lohre, 2020	Effectiveness of Immersive Virtual Reality on Orthopedic Surgical Skills and Knowledge Acquisition among Senior Surgical Residents: A Randomized Clinical Trial	No rehabilitation	
U. G. Longo, 2023	Immersive virtual reality for shoulder rehabilitation: evaluation of a physical therapy program executed with oculus quest 2	included	No rotator cuff repair
U. G. Longo, 2021	Personalized, predictive, participatory, precision, and preventive (P5) medicine in rotator cuff tears	No rehabilitation	
U. G. Longo, 2024	Metaverse, virtual reality and augmented reality in total shoulder arthroplasty: a systematic review	Review article	
S. I. Macías-Hernández, 2016	Proposal and evaluation of a telerehabilitation platform designed for patients with partial rotator cuff tears: a preliminary study	included	No comparission
W. D. Marley, 2022	A multicenter randomized controlled trial comparing gamification with remote monitoring against standard rehabilitation for patients after arthroscopic shoulder surgery	included	Not specifing outcomes of rotator cuff repair patients
C. L. McCarthy, 2014	Glenohumeral instability	No rehabilitation	
B. Menek, 2022	Investigation on the Efficiency of the Closed Kinetic Chain and Video-Based Game Exercise Programs in the Rotator Cuff Rupture: A Randomized Trial	included	Included
J. Nam, 2024	The Application of Virtual Reality in Shoulder Surgery Rehabilitation	Review article	
Nct, 2013	The Effect of Primary Delivery of the Anterior Compared With the Posterior Shoulder on Perineal Trauma: a Randomized Controlled Trial	No rotator cuff repair	
Nct, 2016	Comparing Gamification With Remote Monitoring Against Standard Rehabilitation, for Patients After Arthroscopic Subacromial Decompression Surgery	No rotator cuff repair	
Nct, 2018	Effectiveness of Armeo Spring Pediatric in Obstetric Brachial Plexus Injury	No rotator cuff repair	
Nct, 2019	Virtual Reality Approach in Subacromial Impingement Syndrome	No rotator cuff repair	
Nct, 2019	Utilizing Gaming Mechanics to Optimize Telerehabilitation Adherence in Persons With Stroke	No rotator cuff repair	
Nct, 2020	Rehabilitation Exercise Using Digital Healthcare System in Patients With Rotator Cuff Repair	No rotator cuff repair	
Nct, 2020	Effectiveness of Structured Closed Kinetic Chain and Video Based Game Exercise Program in Rotator Cuff Lesion	No rotator cuff repair	
Nct, 2020	Digital Versus Conventional Physical Therapy for Chronic Shoulder Tendinopathy	No rotator cuff repair	
Nct, 2021	HoloStream Study - Video Capture Device Usage	No rotator cuff repair	

Nct, 2022	Kinesio Taping Technique Versus Virtual Reality in Patients With Chronic Shoulder Impingement Syndrome	No rotator cuff repair	
Nct, 2024	Effect of Virtual Reality on Upper Extremity Function Post-operative Rotator Cuff Repair	included	study protocol
Nct, 2024	Effect of Scapular Stabilization Exercises Versus Virtual Reality Exercises in Basketball Players With Scapular Dyskinesia	No rotator cuff repair	
Nct, 2024	taVNS Application Timing During Robotic Sensorimotor Task	No rotator cuff repair	
D. M. Nekar, 2023	Effects of Pseudo-Weight Resistance Training Using Mixed-Reality Technology on Muscle Activation in Healthy Adults: A Preliminary Study	No rotator cuff repair	
R. A. Pedowitz, 2002	Evaluation of a virtual reality simulator for arthroscopy skills development	No rehabilitation	
N. O. Pekyavas, 2014	Effects of different exercise and kinesiotaping application on pain, flexibility, strength and range of motion in patients with subacromial impingement syndrome	No rotator cuff repair	
N. O. Pekyavas, 2017	Comparison of virtual reality exergaming and home exercise programs in patients with subacromial impingement syndrome and scapular dyskinesis: Short term effect	No rotator cuff repair	
B. Phil, 2013	Creating models for simulation to teach anatomy of the scapula to orthopaedic trainees	No rehabilitation	
B. Ponce, 2013	Surgical telementoring: Augmented reality in orthopaedic education	No rehabilitation	
B. A. Ponce, 2014	Telementoring: Use of augmented reality in orthopaedic education: AAOS exhibit selection	No rehabilitation	
M. O. Powell, 2020	Openbutterfly: Multimodal rehabilitation analysis of immersive virtual reality for physical therapy	included	No rotator cuff repair
S. Rahm, 2016	Validation of a virtual reality-based simulator for shoulder arthroscopy	No rehabilitation	
S. M. P. Rossi, 2022	Augmented reality in orthopedic surgery and its application in total joint arthroplasty: a systematic review	Review article	
S. Sadeqi, 2023	A Validated Open-Source Shoulder Finite Element Model and Investigation of the Effect of Analysis Precision	No rotator cuff repair	
M. Shaw, 2019	Proceedings #9: immersive Virtual Reality Rehabilitation for Patients with Multiple Sclerosis	No rotator cuff repair	
G. Y. Shim, 2023	A randomized controlled trial of postoperative rehabilitation using digital healthcare system after rotator cuff repair	included	Included
B. Steiner, 2020	Gamification in rehabilitation of patients with musculoskeletal diseases of the shoulder: scoping review	Review article	

W. B. Stetson, 2021	Augmented reality to teach arthroscopic shoulder surgery in developing countries	No rehabilitation	
G. A. Stirma, 2021	Arthroscopic Superior Capsule Reconstruction Using Three-Dimensional Preoperative Planning: Technique Description	No rotator cuff repair	
S. Subramanya, 2014	Reverse shoulder arthroplasty with patient-specific glenoid implant positioning guides	No rotator cuff repair	
P. Tokgöz, 2023	Virtual reality for upper extremity rehabilitation—A prospective pilot study	included	No rotator cuff repair
N. A. Trasolini, 2022	Editorial Commentary: Rotator Cuff Repairs Fail at an Alarmingly High Rate During Long-Term Follow-Up: Graft Augmentation and Biologics May Improve Future Outcomes	No rehabilitation	
R. S. Tubbs, 2022	“The student must be taught the kind of anatomy that he must know in his clinical work”	No rotator cuff repair	
G. Turini, 2019	Review of the Augmented Reality Systems for Shoulder Rehabilitation	Review article	
Umin, 2011	Evaluation for validity of Shoulder Virtual Reality Arthroscopic Trainer (VRAT). - Training using VRAT can improve the surgical skill of shoulder arthroscopy ?	No rehabilitation	
R. M. Viglialoro, 2019	Review of the augmented reality systems for shoulder rehabilitation	Review article	
R. von Eisenhart-Rothe, 2000	MR-based 3D-analysis of glenohumeral joint translation in patients with shoulder instability	No rehabilitation	
L. Wang, 2023	Effectiveness of a digital rehabilitation program based on computer vision and augmented reality for isolated meniscus injury: protocol for a prospective randomized controlled trial	Study protocol	
B. K. Wiederhold, 2006	Evaluation of virtual reality therapy in augmenting the physical and cognitive rehabilitation of war veterans	No rotator cuff repair	
M. A. Williams, 2020	Augmented reality in surgical training: A systematic review	Review article	
R. B. R. xgh3dd, 2021	Impact of a single session of virtual reality-based therapy associated with partial blood flow restriction in the blood circulation, the autonomic nervous system and the perception of elderly women: a randomized crossover trial	No rotator cuff repair	
C. Yaramothu, 2019	Proceedings #37: virtual Eye Rotation Vision Exercises (VERVE): a Virtual Reality Vision Therapy Platform with Eye Tracking	No rotator cuff repair	

J. Yu, 2023	The effect of neck and shoulder conditioning program using augmented reality on pain, muscle strength, and muscle endurance in young adults	No rehabilitation