Conservative Interventions for Triangular Fibrocartilage Complex (TFCC) Injury: A Systematic Review

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Abstract: This systematic review explored the most current literature regarding pain mitigation through conservative therapeutic interventions for people suffering from a triangular fibrocartilage complex injury (TFCC) pre- and post-operatively and patient outcomes.

Importance: Triangular fibrocartilage complex (TFCC) provides support and stability to the outer (ulnar) aspect of the wrists and damage to that complex structure may cause wrist pain/weakness, impaired grip strength, and reduced range of motion (ROM), making it difficult to complete activities of daily living (ADLs).

Objective: To identify, evaluate, and synthesize the current literature concerning TFCC to determine the efficacy of conservative interventions for pain management.

Data Sources: A literature search occurred between May 9, 2024 and May 30, 2024. Databases included Academic Search Complete, EBSCO, CINAHL, and MEDLINE using Hawai'i Pacific University's online library databases. Search terms included triangular fibrocartilage complex, TFCC, conservative treatment, pain, as well as combinations of these terms.

Study Selection and Data Collection: This systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Published studies on pain mitigation through conservative therapeutic interventions for TFCC were included in the systematic review. Data from presentations, non-peer reviewed literature, and dissertations were excluded.

Findings: Seven studies were included: one Level II, four Level III and two Level IV studies according to the American Occupational Therapy Association's Levels of Evidence. The outcomes of these studies indicate that orthosis and sensorimotor rehabilitation are effective in reducing pain and increasing weight-bearing tolerance in clients with TFCC injuries

Conclusion and Relevance: Orthoses and sensorimotor rehabilitation are effective and improve pain for people with TFCC injuries.

What This Systematic Review Adds: There are limited high quality studies that evaluate TFCC injuries. This systematic review provides a starting point for evaluating the efficacy of TFCC injuries in OT practice. More research is needed to create a conservative intervention protocol for pain management with TFCC.

Key words: Acute injury, brace, chronic pain, conservative, hand therapy, wrist injury, non-surgical, occupational therapy, pain management, pain mitigation, rehabilitation, splinting, taping, TFCC, triangular fibrocartilage complex

Introduction

The triangular fibrocartilage complex (TFCC) helps stabilize the ulnar aspect of the radiocarpal and the distal radioulnar joint (DRUJ) and provides load bearing capabilities to the joint (Chen, 2021). Injury to the TFCC can occur overtime or in an acute incident. This injury affects weight-bearing activities, impacts grip strength, limits wrist movement, and causes pain, all of which can be limiting factors for participation in daily activities. Both surgical and non-surgical interventions exist.

Non-surgical interventions to address pain and rehabilitation in those with TFCC injuries may increase functional use of the wrist during activities of daily living. These interventions are not yet standardized and lack evidence. Pain mitigation with TFCC is a topic of research that would benefit from better interprofessional collaboration. This systematic review compiles evidence on conservative interventions for the pain management of individuals with TFCC injuries and identifies future areas for research.

Method

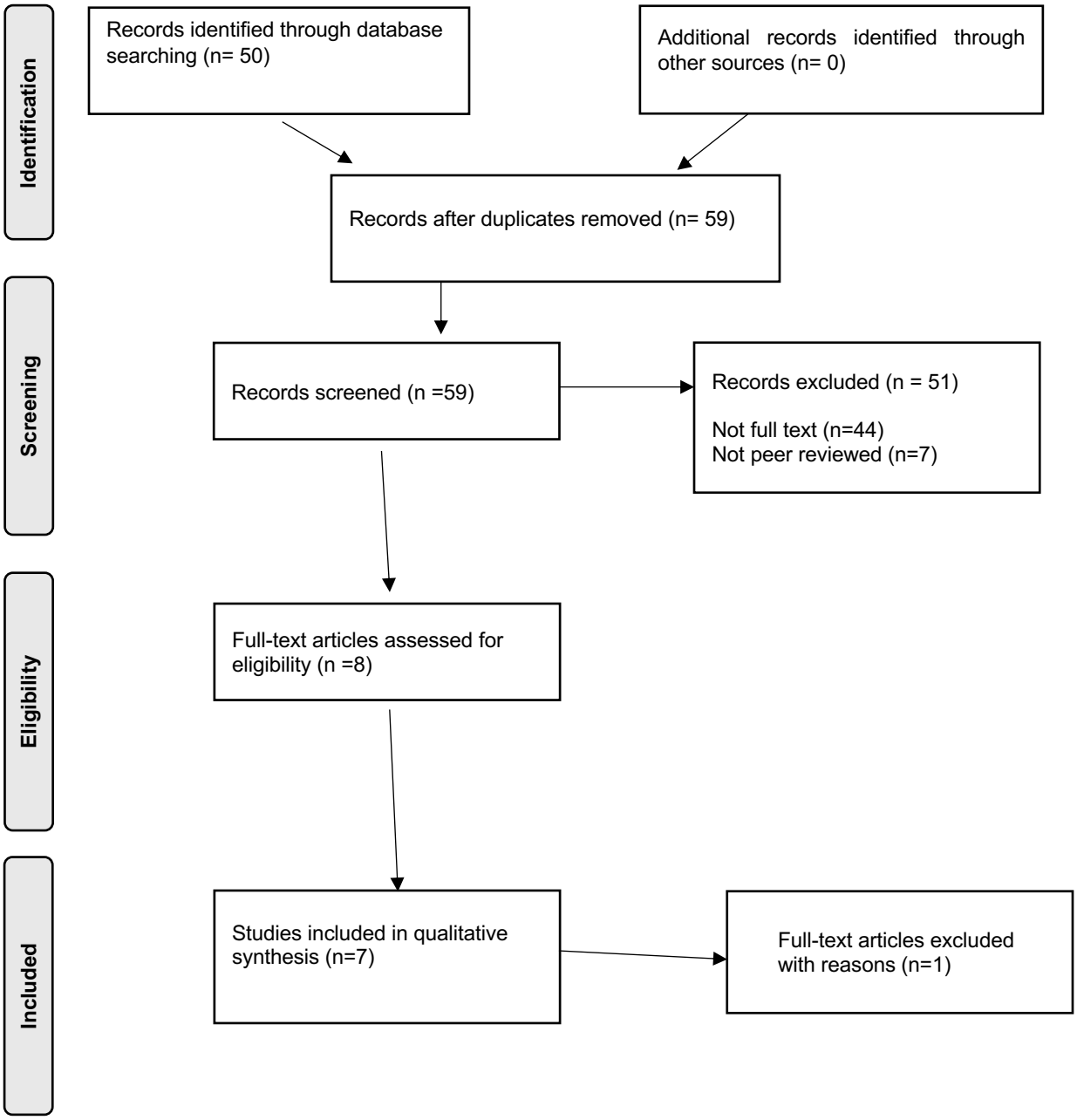
The systematic review adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines and incorporated recommended processes for conducting a systematic review. The guiding research question for this systematic review was: What conservative interventions mitigate pain for people with a triangular fibrocartilage complex (TFCC) injury?

A broad search of the literature occurred between May 9, 2024 and May 30, 2024. The inclusion criteria for studies in this systematic review were as follows: peer-reviewed, published in English, and dated between 2014-2024. Exclusion criteria, in addition to those studies that did not meet the inclusion criteria, included articles that were systematic reviews, scoping reviews, dissertations, and presentations. A search for relevant literature was completed using electronic databases: Academic Search Complete, EBSCO, CINAHL, and MEDLINE through Hawai'i Pacific University's online library database. Search terms included triangular fibrocartilage complex, TFCC, conservative treatment, pain, as well as combinations of these terms. Appendix A provides an extensive list of all search terms used for this systematic review. The initial search included 59 articles related to the research topic (Figure 1). Four independent reviewers completed the screening and selection of the studies, assessed their quality, and extracted the data.

Figure 1

PRISMA flow diagram

Flow Diagram



Results

Seven studies met the inclusion criteria. The articles were assessed according to their risk of bias, level of evidence, and quality. This systematic review included seven studies that contained relevant information regarding conservative/pre-surgical interventions for patients with Triangular Fibrocartilage Complex (TFCC) injury. The information from these articles was divided into two themes: orthosis and sensorimotor rehabilitation. An evidence table is provided in Appendix B. The Cochrane risk-of-bias guidelines were used to assess each article and are provided in Appendix C.

Orthoses

Four of the seven studies on TFCC conservative interventions discussed efficacy of orthoses. Two of these studies were Level III B studies and two were a Level IV study (see Appendix B). All studies provided evidence that orthoses are effective and potentially beneficial.

In a study conducted by Asmus et al. 2022, dynamic weight-bearing capacities were measured and compared with the use of the orthotic, WristWidget. Populations included in this retrospective cross-sectional case series and analysis were individuals who experienced a traumatic injury to the TFCC and degenerative lesions. Three of the twenty-three participants had arthroscopic surgical intervention due to significant lack of stability of the radioulnar joint. Pre and postoperative weight-bearing measurements were taken of the surgical candidates. Both surgical and non-surgical patients demonstrated an increase in the ability to bear weight on the affected wrist when using the WristWidget orthosis. The results indicate that the use of an orthosis with TFCC traumatic injuries and degenerative lesions benefit from the use of the WristWidget when engaging in occupations.

Similarly, Barlow (2016) conducted a study examining weight-bearing tolerance with and without a novel brace (WristWidget). This single-subject study included a 45-year-old male with a confirmed TFCC tear via MRI. The participant was asked to test his weight-bearing tolerance by pressing his unaffected palm on a scale in full wrist extension and repeated with the affected palm. He was also instructed to wear the novel brace daily until wrist pain resolves. The DASH questionnaire was administered at his initial evaluation and at the end of his 12-week therapy session. Results showed that the participant returned to full weight-bearing tolerance, and his DASH score improved from 40 to 0, which meant he had no disability.

Sanders' (2021) study of TFCC conservative treatments included 33 participants with TFCC that were treated either conservatively (orthoses, medication, and PT) or surgically (arthroscopic debridement and follow-up orthoses) and evaluated for pain, ROM, DASH, grip strength, Modified Mayo Wrist Score (MMWS), and Purdue Pegboard test. Motion pain and pain at rest improved significantly with both methods. Both conservative treatments including orthoses and surgical treatment using orthoses yielded comparable results with great improvement.

In Woitzik et al. (2015), three participants with ulnar impaction syndrome were evaluated by a chiropractor and then treated either conservatively or surgically. Orthoses were used following surgical procedures and during conservative management approaches. Researchers

concluded that treatment needs to be very individualized and that there is currently not enough research on conservative treatments for TFCC injury and pain management.

Limitations of the studies on orthoses include small sample sizes (Barlow, 2016; Sanders et al, 2021; Woitzik et al., 2014) limited outside research (Woitzik et al., 2014), lack of control group (Barlow, 2016; Sanders et al.,2021), subjective self-reporting (Barlow, 2016; Sanders et al., 2021), and retrospective analysis (Sanders et al., 2021)

Sensorimotor Rehabilitation

Two of the seven TFCC conservative interventions discussed the efficacy of the sensorimotor rehabilitation for pain management. One of these studies was Level IIIB and the other was a Level IIA study (see Appendix B). All studies provided evidence that sensorimotor rehabilitation is effective and potentially beneficial.

In Chen (2021), a sensorimotor rehabilitation program was implemented with ten participants to assess the impact of a wrist sensorimotor rehabilitation program (WSRP) on pain in patients with TFCC. The program utilized home exercise with the same exercises also performed in the clinic for evaluation and then modified appropriately for continued use at home. WSRP had two phases, one focused on pain control with protected exercises and the other worked on balance and reactive exercises. The study focused on pain related to motion and no pain was reported to increase during exercises in part due to careful observation and modification of exercise techniques. Results of the study included one hundred percent improvement in pain and seventy percent improvement in patient rated wrist hand evaluation (PRWHE) (Chen, 2021).

In Tse et al. (2023), researchers created a rehabilitation program to study the effectiveness of orthoses and ROM exercises in pain reduction and functional improvement for patients with a confirmed TFCC injury via a quasi-experimental study. Thirty-two subjects participated in a 15-week program that included a 5-phase rehab protocol to perform daily activities for 30 minutes to assess the following outcome measures: pain scale, hand grip strength, wrist ROM, distal radioulnar joint instability (DRUJ) stability grade, ADL performance and patient-rated wrist evaluation (PRWE). The 5-phase rehab protocol aimed to decrease pain and increase ROM and function in the affected upper extremity in five phases with the intent of reaching a goal before moving on to the next phase (Tse et al., 2023). Results of this rehabilitation program showed a decrease in numeric pain rating scale (NPRS) from 5.3/10 to 0.5/10, restoration in hand and wrist functions, and improvement in functional outcomes.

Limitations for the studies related to sensorimotor rehabilitation included a lack of control group and blinding of participants (Chen, 2021; Tse et al., 2023), and lack of randomization to groups (Chen, 2021; Tse et al.,2023). Limitations specific to the Chen (2021) study also included no reliable diagnosis of TFCC in participants and no defined treatment duration.

Discussion

The results of this systematic review suggest that orthoses and sensorimotor rehabilitation are effective to improve weight-bearing for people with TFCC injuries (Asmus et al., 2022;

Barlow, 2016). Regardless of pre- or post-surgical interventions, pain reduction during weight-bearing with the use of motor skills was reported in every study listed above with orthoses.

One study incorporated the use of an orthosis in the therapeutic rehabilitation process, specifically for clients with significant ulnar instability during sensorimotor rehabilitation integration (Chen, 2021). None of the studies above combined the conservative rehabilitation approaches of sensorimotor integration and orthoses unless instability was present in patients affected by lesions in the TFCC secondary to degenerative lesions or traumatic injuries. Instability always required the use of an orthosis or surgical intervention.

Studies that focused solely on sensorimotor rehabilitation and integration to reduce reported pain with exercises in a clinical setting, continuation of HEP, exercise modifications as needed to reduce pain during exercise, and evaluations to measure the decrease of pain of the affected complex were effective in restoring functional mobility (Chen, 2021). To better understand the most effective conservative rehabilitation for confirmed TFCC instability, degeneration, or traumatic injuries pre and postoperatively, more research needs to be done to understand if sensorimotor rehabilitation integration or the use of an orthosis is more effective for this population. Furthermore, it is important to investigate whether the combined use of the above interventions may produce better clinical outcomes as it relates to a decrease in reported pain and an increase in functional mobility.

Limitations

All studies had small population sizes and some treated TFCC injuries based on symptoms commonly seen without a definitive diagnosis. Additionally, some studies that were relevant to the systematic review may have been missed due to the systematic review timeline and search process.

Implications for Occupational Therapy Practice

Occupational therapists can have a significant impact on a patient's outcome through conservative therapeutic interventions for TFCC injuries. Mitigation of pain and increasing the ability to bear weight on the affected wrist can have a remarkable effect on a client's ability to engage in meaningful activities of daily living. Our research validates the need for OT services treating this population. Additional research regarding contextual factors and environmental adaptation for people with pain because of this injury is needed, as well as the impact of OT to increase independence of clients while recovering from TFCC injury.

Conclusion

Studies included within this systematic review provide evidence on the effectiveness of conservative therapeutic interventions for TFCC injuries. Additional research is necessary to explore other alternative non-operative treatment options before advancing to surgical interventions. Conservative interventions, which included sensorimotor rehabilitation and the use of orthoses, was effective in reducing pain, and improving weight-bearing tolerance, DASH scores, and joint stability for individuals with TFCC injuries.

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Appendix A

Search Terms

Triangular fibrocartilage complex or TFCC **AND** Conservative treatment or conservative management or conservative or non-surgical or non-operative **AND** Pain

Appendix B

Evidence Table

Evidence Table Supporting Conservative Interventions for TFCC Injuries to Address Pain and Weight-Bearing Tolerance					
Author/Year	Level of Evidence Study Design Risk of Bias	Participants Inclusion Criteria Study Setting	Intervention and Control Groups	Outcome Measures	Results
Asmus et al. (2022)	Level 3B Retrospective cross-sectional case series and retrospective analysis *Risk of Bias* Moderate	N = 23 (14 females, 9 males)	Twenty-three patients had an arthroscopically confirmed TFCC lesion. We compared preoperative dynamic weight-bearing capacity of both hands with and without a commercially available wrist brace (WristWidget). Subgroup analysis was performed for stability of the distal radioulnar joint and etiology of the TFCC lesion. The dynamic ulnar variance was measured in a modified weight bearing test. We used parametric tests for normally distributed values.	Dynamic Weight-Bearing Capacity Relative Load Increase Hand Grip Strength ROM Dynamic Ulnar Variance Disabilities of the Arm, Shoulder, and Hand (DASH)	Ten of 16 patients with a traumatic lesion and two of seven with a degenerative lesion had an unstable DRUJ. The relative load of the affected hand with a traumatic TFCC lesion compared to the control hand increased from 40% (CI 26-53, SD 26) to 51% (CI 36-66, SD 28), the load of the hand with a degenerative lesion from 68% (CI 49-87 SD 21) to 78% (CI 58-98, SD 21). Static ulnar variance was not associated with traumatic or degenerative lesions in our sample (n = 23, P= .193, Fisher's exact).
Barlow (2016)	Level 4 Single subject research study	Participant(s) N= 1 (45-year-old male)	Intervention: Subject was asked to press his unaffected palm onto a scale with elbow wrist in full	Return to normal weight-bearing tolerance with an improved DASH	After 12 weeks, client returned to normal weight-bearing capacity and his DASH score improved from 40 to 0, meaning no dysfunction.

	Risk of Bias Low	Inclusion criteria TFCC injury Study setting Outpatient clinic	extension to test weight-bearing tolerance. The amount of pressure placed was measured. Test was then repeated with the affected extremity, with and without the WristWidget (novel brace). Weight-bearing test repeated with affected upper extremity every 14 day, while wearing novel brace. On the 12th week, weight-bearing test was performed with brace, then without. DASH questionnaire was also administered during initial examination and at the end 12 weeks.	outcome measure score	
Chen (2021)	Level 3B A single group pre-post experimental design *Risk of Bias* Moderate	Participant(s) N= 10 (21-65, 6 females, 4 males)) Inclusion criteria TFCC injury Injury sustained within a year of study	Intervention: Wrist sensorimotor rehabilitation program (WSRP). A pain directed program that utilized home exercise with the same exercises performed in clinic during sessions, assessed and then progressed. WSRP had two phases, one focused on pain control with protected exercises and the other	Pain during motion Grip strength Proprioception Weight-bearing Wrist function using the Patient Rated Wrist Hand	70% of patients demonstrated clinical improvement greater than the MCID in PRWHE, grip strength and weight bearing. 100% of patients had improvement greater than MCID for pain.

		Study setting Outpatient clinic	worked on balance and reactive exercises No control group	Evaluation (PRWHE)	
McCarron et al. (2023)	Level 3B Cross-sectional descriptive study; one cohort *Risk of Bias* Moderate	Participant(s) N= 135 AHTs Inclusion criteria OTs and PTs with AHT credential at time of survey and licensed in Australia	Intervention An online survey containing 10 questions (three dichotomous and seven multiple choice) was sent to 135 AHTs to answer based on the provided hypothetical clinical scenario.	Rehab recommendations following TFCC repair surgery	Significant findings Recommendations for immobilization use, duration and type varied between AHTs
Sander et al. (2021)	Level 3B Retrospective analysis performed on a cohort of patient *Risk of bias* *Moderate*	Participant(s) N= 33 (mean=41 years of age; 16 patients treated conservatively, 17 treated with arthroscopic debridement) Inclusion criteria TFCC lesion	Intervention <u>Conservative treatment</u> Participants in this group had forearm orthosis applied for 2 weeks, ensure wrist was in slight extension. After 2 weeks, orthosis was recommended to be applied at night. Full weight-bearing allowed after 6 weeks. Three subjects received corticosteroid and anesthetic injection. *Note: conservative treatment also included NSAIDs and PT	Pain symptom ROM Grip strength DASH and MMWS score	Comparatively, results were not significant. Average pain in the conservative group was 0.1 and the 1.3 in the arthroscopic group post op. Average ROM was 99% for wrist extension and 100% for flexion pronation/supination in the conservative group, compared to 96% for wrist extension and

		Positive provocative test Stable DRUJ Conservative treatment or arthroscopic debridement as chosen treatment	<u>Arthroscopic debridement</u> Participants in this group had arthroscopic debridement performed under regional or general anesthesia and received corticosteroid and local anesthesia injection. Forearm cast was applied post op for 2 weeks, ensure wrist was in slight extension. After 2 weeks, forearm orthosis was recommended at night. Full weight-bearing allowed after 6 weeks.		flexion, and 100% pronation/supination in the arthroscopic group. Grip strength was 88% in the conservative group compared to 89% in the arthroscopic group. In the conservative group, DASH score was 16.8 and MMWS was 94.3, compared to 22.1 and 87.2 in the arthroscopic group.
Tse et al. (2023)	Level 2A Quasi-experimental study *Risk of bias* Moderate	Participant(s) N= 32 (15 female; 18 males; mean age 36 years of age) Inclusion criteria Patients presenting with TFCC injury, MRI confirming diagnosis	Intervention Subjects participated in a 15 week, 5-phase rehab program and instructed to perform daily exercises for 30 minutes. Progress was monitored every 3 weeks.	Numeric pain rating scale (NPRS) ADL pain score and performance score Wrist ROM Patient-rated wrist evaluation (PRWE) Power grip and distal radioulnar joint (DRUJ) instability grade	NPRS decreased from 5.3/10 to 0.5/10 ADL pain score improved from 10/20 to 19.1/20 Wrist ROM in flexion/extension, supination/pronation improved by 35%. Functional ADL performance score improved from 21/40 to 38/40 PRWE improved from 49.5/100 to 14.6/100. Power grip increased by 59.5% and DRUG stability improved.

		Study setting Outpatient rehab program			
Woitzik et al. (2014)	Level 4 Case series *Risk of bias* Low	Participant(s): N= 3 (ages 17, 26 and 27) Inclusion criteria Ulnar impaction syndrome TFCC injury Study setting Sports chiropractic clinic	Intervention Three athletes diagnosed with ulnar impaction syndrome presented to a sports chiropractor for evaluation and treatment. Treatment methods included conservative management and surgical procedures (arthroscopic repairs or ulnar shortening osteotomy).	Healing potential Return to play Long-term health concerns and well-being	More evidence is required when comparing symptom durations and immobilization between arthroscopic debridement and USO. When treating a client with ulnar impaction syndrome, the diagnosis, treatment and rehab regimen should be specific to that individual's case. Research is limited in conservative management for TFCC injuries in athletes.
Note. [Define any acronyms used] TFCC = Triangular Fibrocartilage Complex, AHT = Accredited Hand Therapist, MCID (minimal clinically important differences), PRWHE (Patient Rated Wrist Hand Evaluation), VAS (visual assessment pain scale), DASH (Disability of arm, shoulder and hand), USO = ulnar-shortening osteotomy, DRUJ = Distal radial ulnar joint, MMWS = Modified Mayo Wrist Score, NSAIDs (nonsteroidal anti-inflammatory drugs)					

Appendix C

Risk-of-Bias Table

Risk-of-Bias Table: Randomized Controlled Trial (RCT) and Non-RCT										
	Selection Bias (Risk of bias arising from randomization process)			Performance Bias (effect of assignment to intervention)		Detection Bias		Attrition Bias	Reporting Bias	Overall risk-of-bias (low, moderate, high
Citation	Random Sequence Generation	Allocation Concealment (until participants enrolled and assigned)	Baseline difference between intervention groups (suggest problem with randomization?)	Blinding of Participants During the Trial	Blinding of Study Personnel During the Trial	Blinding of Outcome Assessment: Self-reported outcomes	Blinding of Outcome Assessment: Objective Outcomes (assessors aware of intervention received?)	Incomplete Outcome Data (data for all or nearly all participants	Selective Reporting (results being reported selected on basis of the results?)	
Barlow, S. (2016)	+	+	+	+	+	+	+	+	+	Low
Sander et al. (2021)	+	+	+	-	-	-	+	+	+	Moderate
Tse et al. (2023)	+	+	+	-	-	-	+	+	+	Moderate
Woitzik et al. (2014)	+	+	+	+	+	+	+	+	+	Low

Note. Categories for risk of bias are as follows: Low risk of bias (+), unclear risk of bias (?), high risk of bias (–). Scoring for overall risk of bias assessment is as follows: 0–3 minuses, low risk of bias (L); 4–6 minuses, moderate risk of bias (M); 7–9 minuses, high risk of bias (H).

Citation. Table format adapted from Higgins, J. P. T., Sterne, J. A. C., Savović, J., Page, M. J., Hróbjartsson, A., Boutron, I., . . . Eldridge, S. (2016). A revised tool for assessing risk of bias in randomized trials. Cochrane Database of Systematic Reviews 2016, Issue 10 (Suppl. 1), 29–31. https://doi.org//10.1002/14651858.CD201601

Risk-of-Bias Table (cont.)

Risk of Bias for Before-After (Pre-Post) Studies with No Control Group												
Citation	Study question or objective clear	Eligibility or selection criteria clearly described	Participants representative of real-world patients	All eligible participants enrolled	Sample size appropriate for confidence in findings	Intervention clearly described and delivered consistently	Outcome measures pre-specified, defined, valid/reliable, and assessed consistently	Assessors blinded to participant exposure to intervention	Loss to follow-up after baseline 20% or less	Statistical methods examine changes in outcome measures from before to after intervention	Outcome measures were collected multiple times before and after intervention	Overall risk of bias assessment (low, moderate, high risk)
Asmus et al. (2022)	Y	Y	Y	N	Y	Y	Y	N	N	Y	N	Moderate
Chen (2021)	Y	Y	Y	N	N	Y	Y	NR	NR	Y	NR	low
McCarron et al. (2023)	Y	Y	N	N	NR	NR	N	N	NR	N	N	low

Note. Y = yes; N = no; NR = not reported. Scoring for overall risk of bias assessment is as follows: 0–3 N, Low risk of bias (L); 4–8 N, Moderate risk of bias (M); 9–11 N, High risk of bias (H).

Citation. Table format adapted from National Heart Lung and Blood Institute. (2014). Quality assessment tool for before–after (pre–post) studies with no control group. Retrieved from https://www.nhlbi.nih.gov/health-topics/study-quality-assessment-tools