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Article

The Effect of Rehabilitation Training on Rotator Cuff Injury of Table Tennis Players

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Abstract: Objective: This study aimed to systematically evaluate the clinical efficacy of structured rehabilitation training in the treatment of rotator cuff injuries among elite table tennis players. Methods: A total of 37 professional table tennis players with clinically diagnosed rotator cuff injuries were enrolled between May 2019 and January 2020. Participants were randomly assigned to either a control group (n = 19) receiving conventional therapy (e.g., pulsed magnetic therapy, short-wave therapy) or an observation group (n = 18) receiving conventional therapy combined with a four-stage rehabilitation training protocol. Primary outcomes included pain scores, shoulder function scores, active flexion range, flexion strength, and subjective satisfaction, assessed at 2, 8, and 16 weeks post-intervention. Results: At 2 weeks, no significant differences were observed between groups ($p > 0.05$). By 8 and 16 weeks, the observation group demonstrated superior improvement in all metrics compared to the control group ($p > 0.05$). For example, pain scores in the observation group increased from 6.13 ± 2.93 to 9.98 ± 1.74, indicating significant pain reduction, while shoulder function scores improved from 6.08 ± 2.65 to 9.56 ± 1.38. Conclusions: Rehabilitation training significantly enhances functional recovery and pain relief in table tennis players with rotator cuff injuries, supporting its integration into standard treatment protocols.

Keywords: rehabilitation training; table tennis players; rotator cuff injury; clinical effect

1. Introduction

Rotator cuff injuries are a prevalent orthopedic condition among athletes engaged in overhead sports, particularly table tennis players. Due to the repetitive shoulder abduction and rotation required during training and competition, these athletes are at high risk of rotator cuff tears, tendinitis, and related pathologies [1]. The author of this study has 12 years of experience as a competitive table tennis player and personally suffered from rotator cuff injuries, which motivated her to pursue physical therapy studies at Shanghai University of Traditional Chinese Medicine. Under the guidance of Associate Professor Tang Weijun at Foresea Insurance Guangxi Hospital, this research was conducted to address the gap in targeted rehabilitation protocols for table tennis athletes. Conventional treatments for rotator cuff injuries, such as anti-inflammatory medication and physical modalities, often fail to restore full functional capacity [2]. Rehabilitation training, however, emphasizes progressive loading and neuromuscular re-education, which aligns with the principles of sports-specific recovery [3]. This study innovatively designs a phased rehabilitation program tailored to the biomechanical demands of table tennis, providing empirical evidence for its clinical application.

2. Materials and Methods

2.1. Participant Characteristics

All 37 participants were professional table tennis players diagnosed with rotator cuff injuries via MRI and arthroscopy. Inclusion criteria included: (1) age 20–40 years; (2) ≥5 years of professional training; (3) unilateral rotator cuff injury. Exclusion criteria included: (1) previous shoulder surgery; (2) systemic musculoskeletal diseases. The control group (n = 19) had a mean age of 25.68 ± 1.47 years (11 males, 8 females), while the observation group (n = 18) had a mean age of 32.14 ± 2.06 years (13 males, 5 females). No significant baseline differences existed ($p > 0.05$).

2.2. Intervention Protocol

(1) Control Group: Received conventional therapy for 18 weeks, including:
- Pulsed magnetic therapy (20 min/session, 3 sessions/week);
- Short-wave therapy (15 min/session, 3 sessions/week);
- Non-steroidal anti-inflammatory drugs (NSAIDs) as needed.

(2) Observation Group: Received conventional therapy plus a four-stage rehabilitation program:
Stage 1 (Weeks 1–3): Brake rehabilitation. Passive range-of-motion exercises within pain-free limits, using slings to avoid strain.
Stage 2 (Weeks 4–8): Protective training. Assisted active exercises with pulleys, sticks, and shoulder ladders; scapular stabilization drills.
Stage 3 (Weeks 9–12): Strength training. Resistance band exercises for rotator cuff muscles; closed-chain scapular movements.
Stage 4 (Weeks 13–16): Sport-specific functional training. Simulated table tennis strokes with gradual resistance increases; proprioceptive and weight-bearing drills.

2.3. Outcome Measures

Primary outcomes were assessed using:

(1) Visual Analog Scale (VAS)for pain (0–10 points);
(2) Constant-Murley Shoulder Scorefor function (0–100 points);
(3) Goniometryfor active flexion range;
(4) Dynamometryfor flexion strength;
(5) Patient-Specific Functional Scale (PSFS)for subjective satisfaction.

2.4. Statistical Analysis

Data were analyzed using SPSS23.0. Continuous variables were expressed as mean ± standard deviation. Between-group comparisons used independent t-tests, while within-group changes were assessed with repeated-measures ANOVA. Significance was set at $p < 0.05$.

3. Results

3.1. Longitudinal Changes in Outcomes

The observation group showed progressive improvement across all metrics, with statistically significant gains at 8 and 16 weeks (Table 1).

Table 1. Comparison of Shoulder Function and Pain Scores Between Groups**.**

Group	Indicator	2 Weeks	8 Weeks	16 Weeks
Observation	Pain (VAS)	6.13 ± 2.93	7.57 ± 1.59 *	9.98 ± 1.74 *
	Function (Constant-Murley)	6.08 ± 2.65	7.14 ± 1.68 *	9.56 ± 1.38 *
	Active Flexion (°)	3.18 ± 1.42	5.56 ± 1.93 *	5.97 ± 1.74 *
Control	Pain (VAS)	6.12 ± 2.79	6.89 ± 1.84	9.02 ± 1.59
	Function (Constant-Murley)	5.96 ± 2.43	6.29 ± 1.36	8.63 ± 1.94
	Active Flexion (°)	3.06 ± 1.22	4.43 ± 1.74	5.13 ± 1.67

* $p < 0.05$ vs. control group.

3.2. Key Findings

(1) Pain Reduction: The observation group's VAS scores improved by 62.8% at 16 weeks, versus 47.4% in the control group.
(2) Functional Recovery: Constant-Murley scores in the observation group increased by 57.2%, which significantly higher than the 44.8% improvement in controls.
(3) Strength and Mobility: Flexion strength in the observation group reached 5.05 ± 1.34 kg vs. 3.62 ± 1.29 kg in controls ($p < 0.05$).

4. Discussion

4.1. Mechanistic Insights

The superior outcomes in the observation group align with previous studies emphasizing neuromuscular adaptation and tissue remodeling through phased rehabilitation [4]. For table tennis players, the integration of sport-specific drills (e.g., simulated strokes) in Stage 4 likely enhanced motor pattern reinstatement, reducing re-injury risk [5].

4.2. Clinical Implications

This study provides a validated framework for tailoring rehabilitation to overhead athletes. Future protocols should incorporate kinetic chain assessments and psychological support to address kinesiophobia [6].

4.3. Limitations and Future Directions

Sample size limitations and single-center design may affect generalizability. Multicenter trials with long-term follow-ups are warranted.

5. Conclusions

Rehabilitation training significantly improves pain relief, functional recovery, and subjective satisfaction in table tennis players with rotator cuff injuries. Clinicians should adopt structured, sport-specific rehabilitation protocols to optimize athlete recovery.

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Author Contributions

Writing—original draft, X.L. (Xiuxian Liu) and X.L. (Xilong Liu); writing—review and editing, X.L. (Xiuxian Liu) and X.L. (Xilong Liu). All authors have read and agreed to the published version of the manuscript.

Institutional Review Board Statement

Not applicable.

Informed Consent Statement

All participants were informed of the study's objectives, procedures, and potential risks, and were assured of the confidentiality and anonymization of their data. They provided explicit consent for their anonymized data to be used for research purposes and publication, including in preprint and subsequent peer-reviewed formats.

Data Availability Statement

All data supporting the findings of this study are available within the paper and its Supplementary Information.

Conflicts of Interest

The authors declare no conflict of interest.

Reference

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