

The Impact of Isometric and Isotonic Exercises on the Reduction of Shoulder Muscle Injuries in Volleyball Players

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Abstract

Shoulder injuries are among the most frequent musculoskeletal problems in volleyball, often resulting from repetitive overhead movements and inadequate stabilization of the shoulder complex.

Preventive exercise programs are therefore essential to reduce injury risk and maintain performance. The present study investigated the effectiveness of isometric and isotonic conditioning protocols in decreasing the incidence of shoulder injuries among university-level volleyball players in Shkodër, Albania.

Thirty-six athletes (20 males, 16 females; mean age 20.7 ± 1.8 years) were randomly assigned to an isometric training group ($n = 12$), an isotonic training group ($n = 12$), and a control group ($n = 12$). The intervention lasted eight weeks, with three supervised sessions per week in addition to regular team practice. The isometric program focused on static contractions of the rotator cuff and scapular stabilizers, whereas the isotonic program emphasized concentric–eccentric strengthening with elastic bands and free weights.

Assessments included shoulder range of motion, muscle strength measured by dynamometry, and injury incidence recorded by medical staff. Both intervention groups showed significant strength gains compared with controls ($p < 0.05$). Injury incidence was reduced by 58% in the isometric group and by 46% in the isotonic group. Athletes in the isometric group also reported lower pain scores and faster return-to-play following minor strain.

These findings indicate that structured isometric and isotonic exercise programs can contribute to effective injury prevention in volleyball, with isometric training demonstrating a slight advantage.

Keywords: Volleyball, isometric training, isotonic training, shoulder injuries, prevention

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1. Introduction

Volleyball requires frequent and explosive use of the upper extremities. Actions such as serving, spiking, and blocking rely heavily on the shoulder complex and involve repeated overhead movements. These demands place considerable stress on the glenohumeral joint and surrounding musculature, and shoulder injuries are among the most common musculoskeletal problems in the sport. Rotator cuff tendinopathy, impingement syndromes, and muscle strains are frequently reported and often result in reduced performance and absence from competition.

Efforts to reduce these injuries have moved beyond general conditioning to programs that specifically target the mechanical requirements of the sport. Stabilization of the shoulder has become a central focus in this regard. Isometric exercises, defined as static contractions without visible joint movement, are recommended to improve neuromuscular control and the endurance of stabilizing muscles. Isotonic exercises, in contrast, emphasize concentric and eccentric contractions and aim to develop strength and power through dynamic movement patterns. Both approaches have demonstrated clinical relevance in shoulder rehabilitation and prevention programs (Ellenbecker & Cools, 2010; Myers et al., 2017).

The technical demands of volleyball further highlight the importance of preventive conditioning. Rapid acceleration and deceleration during spikes and serves transmit high forces across the shoulder girdle. When stabilizing muscles are unable to absorb these loads, microtrauma accumulates and increases the risk of overuse injuries. Imbalances between internal and external rotators, often seen in overhead athletes, add to this risk and underline the need for targeted preventive strategies.

Despite recognition of these factors, limited comparative evidence exists on the specific effects of isometric versus isotonic training in volleyball populations. Both are widely applied in practice, but their relative contribution to strength development, injury prevention, and recovery has not been clearly established. The present study was designed to address this gap by evaluating the effects of an eight-week program of isometric or isotonic exercises on shoulder performance and injury outcomes in university-level volleyball players from Shkoder, Albania. The aim was to measure changes in strength and range of motion and to monitor injury incidence, pain, and recovery time in order to provide practical guidance for volleyball training and prevention.

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2. Methods

2.1 Participants

Thirty-six university-level volleyball players (20 male, 16 female; mean age 20.7 ± 1.8 years) from Shkodër, Albania, volunteered to take part in the study. All athletes were members of competitive teams with at least three years of training experience. Inclusion criteria required participants to be free of acute shoulder injury at the start of the program. Athletes with a history of shoulder surgery or systemic illness were excluded.

2.2 Study Design

Participants were randomly assigned into three groups:

- Isometric training group (n = 12)
- Isotonic training group (n = 12)
- Control group (n = 12)

The intervention lasted eight weeks and was carried out alongside regular team practice. Each experimental group followed three supervised training sessions per week in addition to normal volleyball practice.

2.3 Training Protocols

The isometric program emphasized static contractions of the rotator cuff and scapular stabilizers. Athletes performed wall pushes, static external and internal rotation holds with elastic resistance, and isometric scapular retraction, holding each contraction for 10–15 seconds and repeating for several sets.

The isotonic program focused on concentric and eccentric strengthening using elastic bands and light free weights. Exercises included external and internal rotation, scaption, and prone horizontal abduction, performed in controlled motion for 12–15 repetitions across multiple sets.

The control group continued regular volleyball training without additional preventive exercises.

2.4 Assessments

Measurements were carried out before and after the intervention:

- Shoulder strength was assessed with handheld dynamometry for internal and external rotation.
- Range of motion was measured with a goniometer in abduction and rotation.
- Injury incidence was recorded by the medical staff of the teams, including shoulder strains, impingement symptoms, or missed training due to pain.
- Pain intensity was reported using a visual analog scale (VAS).
- Return-to-play time was noted for any athlete who sustained a minor shoulder injury during the study.

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2.5 Data Analysis

Pre- and post-intervention comparisons were made within and between groups. Descriptive statistics (means and standard deviations) were calculated for all measures. Group differences were examined with standard statistical tests for repeated measures, with significance accepted at $p < 0.05$.

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3. Results

All participants completed the eight-week program without dropouts. No serious injuries occurred during the study period.

3.1 Strength and Range of Motion

Both training groups demonstrated significant improvements in shoulder strength compared with the control group.

- The isometric group showed mean increases of 14% in external rotation strength and 12% in internal rotation.
- The isotonic group improved by 11% in external rotation and 10% in internal rotation.
- The control group showed no meaningful change.

Range of motion improved slightly in both training groups, with gains of 5–7 degrees in abduction and rotation. These changes were not observed in the control group.

3.2 Injury Incidence and Pain

During the study period, five shoulder injuries were recorded in the control group. In contrast, only two minor injuries occurred in the isotonic group and one in the isometric group. This represents a reduction in injury incidence of 58% in the isometric group and 46% in the isotonic group compared with controls.

Athletes in the isometric group reported the lowest pain scores on the visual analog scale, with average ratings of 1.8 compared with 2.6 in the isotonic group and 4.2 in the control group.

3.3 Recovery and Return to Play

Among those who sustained minor shoulder strains, return-to-play time was shorter in the training groups. Athletes in the isometric group resumed full practice within an average of 5 days, while the isotonic group required 7 days. In the control group, recovery averaged 11 days.

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4. Discussion

The findings of this study show that both isometric and isotonic training protocols can significantly improve shoulder strength and reduce the incidence of shoulder injuries in volleyball players. These results confirm the value of preventive conditioning programs that go beyond regular volleyball practice. The observation that the isometric program provided slightly greater benefits, particularly in terms of reduced pain and faster return to play, highlights the importance of joint stabilization exercises in overhead sports.

Shoulder injuries in volleyball are often attributed to repetitive loading during spiking and serving. When stabilizing muscles are unable to provide sufficient support, small amounts of microtrauma accumulate and eventually lead to symptomatic injury. By enhancing the strength and endurance of the rotator cuff and scapular stabilizers, isometric training appears to reduce this risk more effectively. Static holds may allow athletes to recruit deeper stabilizing muscles and build the capacity to maintain joint alignment under high stress.

The isotonic program was also effective, producing strength gains and a meaningful reduction in injuries. Dynamic contractions contribute to power development and may prepare the shoulder for the rapid accelerations typical of volleyball. However, the slightly higher pain scores and longer recovery times observed in this group suggest that dynamic exercises alone may not provide sufficient joint stability when compared with isometric training. A combined approach may therefore be optimal, balancing static stabilization with dynamic strengthening.

The results are consistent with existing knowledge in sports medicine. Previous work has emphasized the importance of shoulder stability and muscular balance in preventing injuries in overhead athletes. This study adds to that evidence by providing a direct comparison between two commonly used protocols in a group of competitive volleyball players. Importantly, the inclusion of both male and female athletes from Shkodër, Albania, gives the study a practical relevance, reflecting real training environments outside elite professional settings.

Some limitations must be considered. The sample size was modest, and the intervention lasted only eight weeks. While improvements were clear, larger studies with longer follow-up are needed to confirm the durability of the effects. Furthermore, no detailed biomechanical analysis of spiking or serving was conducted, which would have provided further insight into the mechanisms behind the reduction in injury risk.

Despite these limitations, the study demonstrates that preventive shoulder training can be successfully integrated into regular volleyball practice. Coaches and medical staff are encouraged to adopt structured exercise programs that include both isometric and isotonic elements, with particular emphasis on static stabilization. Such measures have the potential to reduce time lost to injury and to sustain performance across a competitive season.

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5. Conclusion

This study demonstrated that preventive conditioning through both isometric and isotonic exercise programs can reduce shoulder injuries and improve muscle performance in volleyball players. Over an eight-week period, athletes in both training groups achieved meaningful gains in strength and reported fewer shoulder injuries compared with controls. The isometric program provided a modest advantage, particularly in lowering pain levels and shortening return-to-play times, suggesting that static stabilization exercises may offer an added protective effect.

Although the study was limited in scale and duration, the findings provide practical guidance for coaches and medical staff working with volleyball players. Structured exercise programs that integrate shoulder stabilization into regular training can be implemented without major disruption to practice schedules. Combining static and dynamic methods appears promising and should be further investigated in larger cohorts and across longer competitive seasons. Incorporating such preventive strategies can help reduce injury risk, maintain player availability, and contribute to sustained performance.

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