

# Increasing Explosive Power of the Shoulder in Volleyball Players

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**IN VOLLEYBALL, RALLY-POINT** scoring to break a tie is part of the new rules (FIVB, 1998) and has had considerable impact on offensive strategy. In the past, losing a rally only meant losing the serve. Today, however, it means that the opponent not only wins the serve, but also gains a point. This change

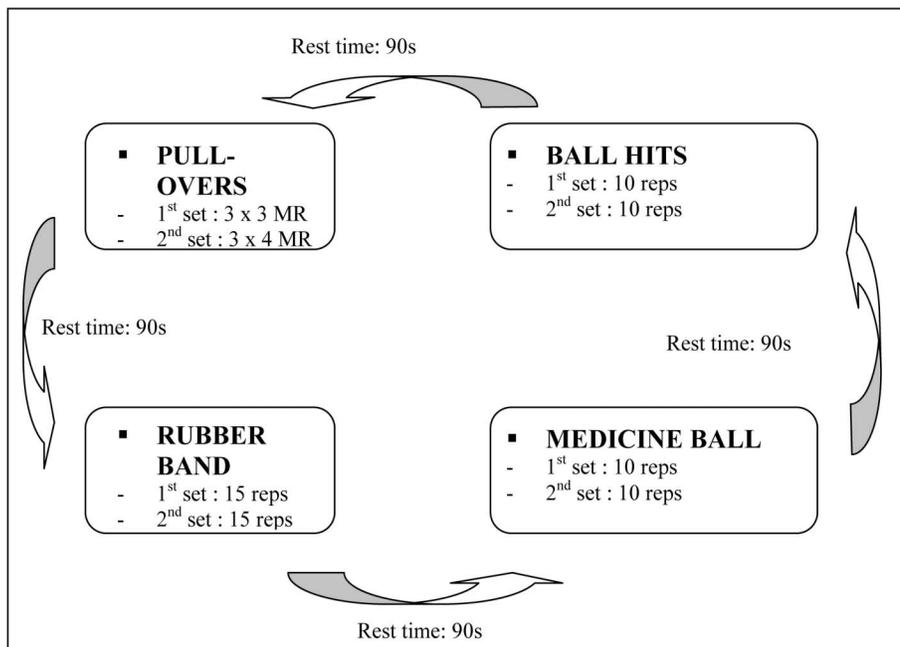
in the rules places much more importance on 2 offensive techniques: the serve and the spike.

Volleyball performance can be improved primarily by developing better technique and greater explosive power. Both the serve and the spike require explosive activity from the shoulder muscles to en-

sure maximum speed to the ball at the moment of contact. Resistance training is frequently employed by strength coaches, as greater strength enhances technique, and the final result is better performance. This paper presents a training program designed to increase the speed of the ball in the volleyball spike by increasing the explosive power of the musculature involved.

## ■ Prevention of Injuries

One of the major objectives of this strengthening program is to prevent training-related injuries. In high-level volleyball players, the techniques of the game force the shoulder muscles to work under heavy constraints. These muscles need to be particularly strong to ensure their stability. By meeting this condition, not only will performance be improved, but also the number and severity of injuries may be reduced. Modifying injury risk is a priority since a volleyball player injured through training errors will be unable to continue training effectively, to the ultimate detriment of competitive performance. Because of the



**Figure 1.** Description of the specific exercises. MR = Maximum repetition.

long-range effects on performance over a season and even an entire career, the modification of injury risk is fundamental to this program.

### ■ Improving Performance

The second objective of this program is to improve competitive performance. An effective spike is a function of the player's speed

and strength and the height of the hit, and each of these 3 criteria can be improved with strengthening programs. Specific programs to improve performance have been based on the studies of Butler et al. (1) and Simmons et al. (6), whose work focused on both a general preparation for competition and the prevention of injuries. These authors used strengthening exercises to develop the muscles of the upper limbs to prevent injuries and the muscles of the lower limbs to improve jump height.

### ■ Strategy to Increase Explosive Muscle Power

The explosive muscle power seen in the moves and jumps of volleyball are determinant to success. "Hypertrophic" strengthening, however, may increase body weight and may decrease jump height. The current program of "explosive" power-building, on the other hand, improves muscular coordination and intramuscular synchronization. This approach to strengthening minimizes the hypertrophic effect. It is based on 1 repetition maximum (1RM), which is defined as the highest load lifted in 1 repetition. The work intensity for this program is established between 85% and 95% of the 1RM (4).

### ■ Program Design for Arm and Shoulder Muscles

Kinesiological analysis of the volleyball spike (2) revealed that the major actions of the joints involved in the acceleration phase (including the hit) are arm extensions and medial rotators of the shoulder and arm. EMG analysis (5) provided further data that permitted a detailed description of the activity of each shoulder muscle and its functions during the spike (see description of the attack-hit in Table 1).

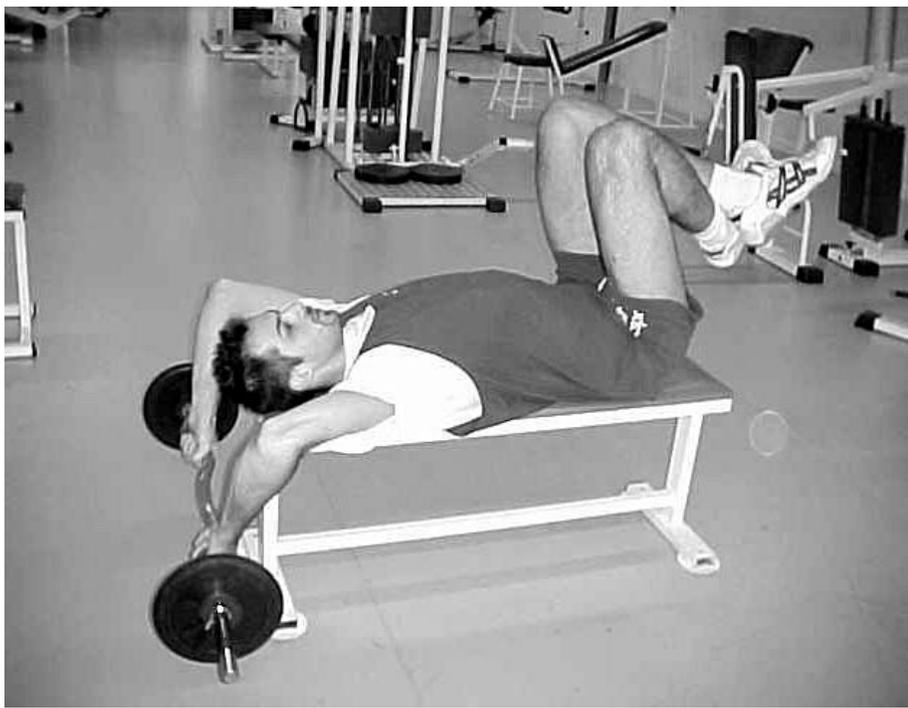


Figure 2a-b. Pull-over.

### Training

The training phase is programmed over 5 weeks, with 3 strengthening sessions per week (15 sessions for the whole program). The volleyball players are evaluated once a week to determine 1RM values and follow the individual progression.

### Warm-up

A rubber band is used for the warm-up, with the volleyball players performing 2 sets of 30 arm extensions. After stretching the shoulder muscles, they then carry out 2 circuits of 4 exercises.

### Specific Exercises

After the warm-up, the players complete a circuit of 4 exercises that follow the same logic of movement as employed for volleyball techniques (Figure 1). This circuit is completed twice per session, respecting the order established in Figure 1.

The first exercise, the pull-over, is the only one with additional loads: this exercise thus



Figure 3a-b. Rubber band pull.

**Table 1**  
**Major Muscles Used in the Attack-Hit**

| Muscles  | Actions  |
|--|--|
| Shoulder and arm muscles of the hitting arm    |  |
| Serratus anterior                              | Protraction and stabilization of the scapula         |
| Anterior deltoid                               | Internal rotation and extension of the arm           |
| Pectoralis major                               | Extension of the arm                                 |
| Triceps brachii                                | Extension of the arm and forearm                     |
| Latissimus dorsi                               | Extension, adduction, and medial rotation of the arm |
| Teres major                                    | Extension, adduction, and medial rotation of the arm |
| Subscapularis                                  | Medial rotation of the arm                           |
| Shoulder and arm muscles of the nonhitting arm |  |
| Anterior deltoid                               | Extension of the arm                                 |
| Pectoralis major                               | Extension of the arm                                 |
| Triceps brachii                                | Extension of the arm                                 |
| Latissimus dorsi                               | Extension and abduction of the arm                   |
| Teres major                                    | Extension and abduction of the arm                   |

Note: Sources: Cisar and Corbelli (2) and Rokito et al. (5).



**Figure 4.** Medicine ball throw.

may change in terms of load over the course of the program as a function of each individual's competition performance (Figures 2a and 2b).

The first circuit starts with the players doing 3 sets of 3 pull-over lifts. After this first exercise, they rest for 90 seconds. This rest time is the same between all exercises. For the second exercise, the players do 15 rubber band pulls with the arms (Figures 3a and 3b).

For the third exercise, the volleyball players throw a medicine ball 10 times toward the bottom of a wall from a distance of 5 m, much like a throw-in in soccer (Figure 4).



**Figure 5.** Ball hits.

For the last exercise, the players perform 10 self-attacks toward the bottom of a wall from a distance of 8 m (Figure 5).

The second circuit is composed of the same exercises in the same order. The only change in this circuit is the pull-over: the players do 3 sets of 4.

At the end of each session, the volleyball players take 10 minutes to stretch their shoulder muscles.

### **Competition**

This strengthening program can be integrated into the regular training schedule at any time in the season. For example, it can be

used on a regular basis throughout the training year or it can be specifically introduced for the preparation of particularly important or difficult matches in a championship. During the competition season, however, both players and trainers need to take into account the time needed to recover from the fatigue it generates when adding it to the general training program. In fact, the schedule of weekly competitions in volleyball was taken into consideration in the development of this program.

### **Conclusions**

Specific programs to increase the explosive power of muscles have become important in volleyball, as it is clear that explosive power is crucial to optimal performance. Our program is suitable for players who are insufficiently offensive. It is important to keep in mind, however, that the program is particularly fatiguing and thus demands some minimal adaptation for integration into the general training program (3). ▲

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