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Serve Volume

How Important is it?



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Natalie is a doctoral candidate in the department of Rehabilitation Sciences at the University of Kentucky, and works as a research assistant for the Shoulder Center of Kentucky in Lexington. She earned a Bachelor of Science in Athletic Training degree from Elon University and a Master of Science in Athletic Training degree from California University of Pennsylvania. Natalie's research interests are in the performance, treatment and rehabilitation of overhead athletes. More specifically, she is interested in the mechanics of the tennis serve and how the serve influences performance and injury.

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Tim is a Professor in the Department of Rehabilitation Sciences, Division of Athletic Training at the University of Kentucky and Director of the Musculoskeletal Laboratory. He received his bachelors in health science from the University of Kentucky in physical therapy and a Masters' degree in kinesiology from the University of Michigan. He completed his doctorate in sports medicine from the University of Virginia. Tim's research interests are in musculoskeletal assessment and rehabilitation with particular interests in neuromuscular control and shoulder function.

The serve is the most predominant stroke during the service game and is considered by many to be the most important shot in tennis, as it initiates each point.¹ The serve is used as a weapon to dictate the point between opponents. The execution of a perfect serve requires dynamic function of the entire human kinetic chain, allowing for the transfer of energy from the lower limbs to the upper limbs. Energy transfer is established in a period lasting approximately one second, with the resulting serve speed reaching up to 130 mph in elite players.² Insufficient energy and force transfer through the kinetic chain can place a significant amount of load on the trunk and upper limb.^{3,4} The loads at the trunk and shoulder are high and have implications on performance and injury. Consequently, sports science professionals have categorized the motion as a violent maneuver to which proper power and acceleration are essential for optimized performance and diminished risk of injury.²

You may be wondering how often a player serves during a match or set. The answer is not well known in tennis, but in other sports, like baseball, this issue is closely monitored. Youth baseball research has suggested that there is a relationship between shoulder and elbow injuries with pitch volume.⁵ Baseball coaches use pitch counts to help them prepare their athletes for peak performance and injury prevention. Tennis serve volume is important to consider, as it can help coaches estimate the loads per tournament or over a season, and helps prepare players for individual competition. It can also help athletes gradually return to game readiness when resuming play following an injury.

Until recently, limited evidence was available on the number of serves that occur during a typical tennis match. We conducted a study in association with the USTA to identify the typical serve volume for elite level players (Table 1).⁶ These data showed that the average 'dose' of serves was around 40 per set. Further breakdown showed that the ratio of first serves to second serves was 3:1 (for every four serves, three should be first serves and one should be a second serve). Additionally, these data were then used to construct a volume-based interval serve training program for elite level tennis players.

Table 1 demonstrates the average ± standard deviation of serve volume during a match and per set for males and females at two different competitive levels.

Table 1

Level of Play	Males	Females
Serves during a match		
Professional Players	157±42	96±26
Junior Players	94±26	86±24
Serves per set		
Professional Players	43±8	42±7
Junior Players	40±8	38±8

Note: Data were collected from the 2013 and 2014 US Open and the 2014 Orange Bowl. Professional players included 135 males and 122 females in the Top 200. Junior data included 134 males and 136 females between the ages of 13 and 18.

The serve volume data is very helpful to allow coaches to know the typical demands being placed on elite level tennis players. This information can be used to develop training programs to prepare athletes for competition. Furthermore, tennis players returning to play after an injury or after a period of rest and recovery, need to have a conditioning program to return to the highest level of competition with the lowest risk of injury. Conditioning programs most often include strength, agility and cardiovascular training, but frequently lack a progression of number of serves hit in anticipation for actual match competition.

There are five basic principles that should be considered when developing an interval training program.

1. Intensity

- a. Intensity defines the amount of effort a player should invest in a training program or during a particular session.
- b. The Borg Scale for perceived exertion can be used to help quantify intensity during training (Table 2).⁷

2. Frequency

- a. Frequency refers to the number of training sessions per week.
- b. Frequency allows the body to go through a process of recovery to replenish its energy reserves.
- c. Frequency of training should be individualized based on level of competition, perceived level of soreness, and past injury history.

3. Volume

- a. Volume refers to the quantity of a specific exercise (and in the case of this review, service hits).
- b. Volume of service training should be sport specific and mimic a similar load that a player would encounter during match play.

4. Undulation (progression without overload of volume)

- a. Undulation refers to the changing of training intensity and volume.
- b. Undulating the volume and intensity of a program may diminish muscular fatigue and promote appropriate recovery periods.
- c. Avoid increasing the intensity and volume in unison.

5. Rest

- a. Rest may be the most important principle to any training program. Training too frequently and too intensely prohibits the body to recover and adapt.

Table 2 - The Borg Scale

Percentage of Maximum Heart Rate	Perceived Exertion and Effect	Expression of Exertion
90-100%	Maximum Improves anaerobic capacity	
80-90%	Very Hard Super effective to improve and develop cardiovascular system	
70-80%	Hard Very effective to improve and develop cardiovascular system	
60-70%	Moderate Basic endurance is developed	
<60%	Light Low training effects	

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Serve Volume

With these principles in mind, we developed a training program specifically for progressing the serve in conjunction with standard strength training programs conducted by strength and conditioning specialists. This 20 step progression can be incorporated into practice play where players mimic game like scenarios (Figure 1). For example, during Step 10, players are expected to hit 16 serves. The player would compete in four games, with two of those four representing service games. In each service game, the player would hit in total eight serves while maintaining ground-stroke rallies until the point is won by one of the two opponents. This approach allows for sport specific training, while diminishing the risk of boredom by eliminating the redundancy of serving 16 times in a row. This tactic can be used in Steps 10-20.

The program is divided into three phases. Each phase incorporates specific goals.

Steps 1-5

Phase 1 Goal

- Intended to assist players in the return to sport following an injury that has removed the player from overhead activity for an extended period of time.

Steps 6-10

Phase 2 Goals

- Helps to build strength and endurance necessary for match play
- Can be used as an accelerated return to play for an individual who has been out for a short period of time
- May be used by coaches working on developing a young player who is preparing for their first competition or to incrementally increase a player's endurance

Steps 11-20

Phase 3 Goals

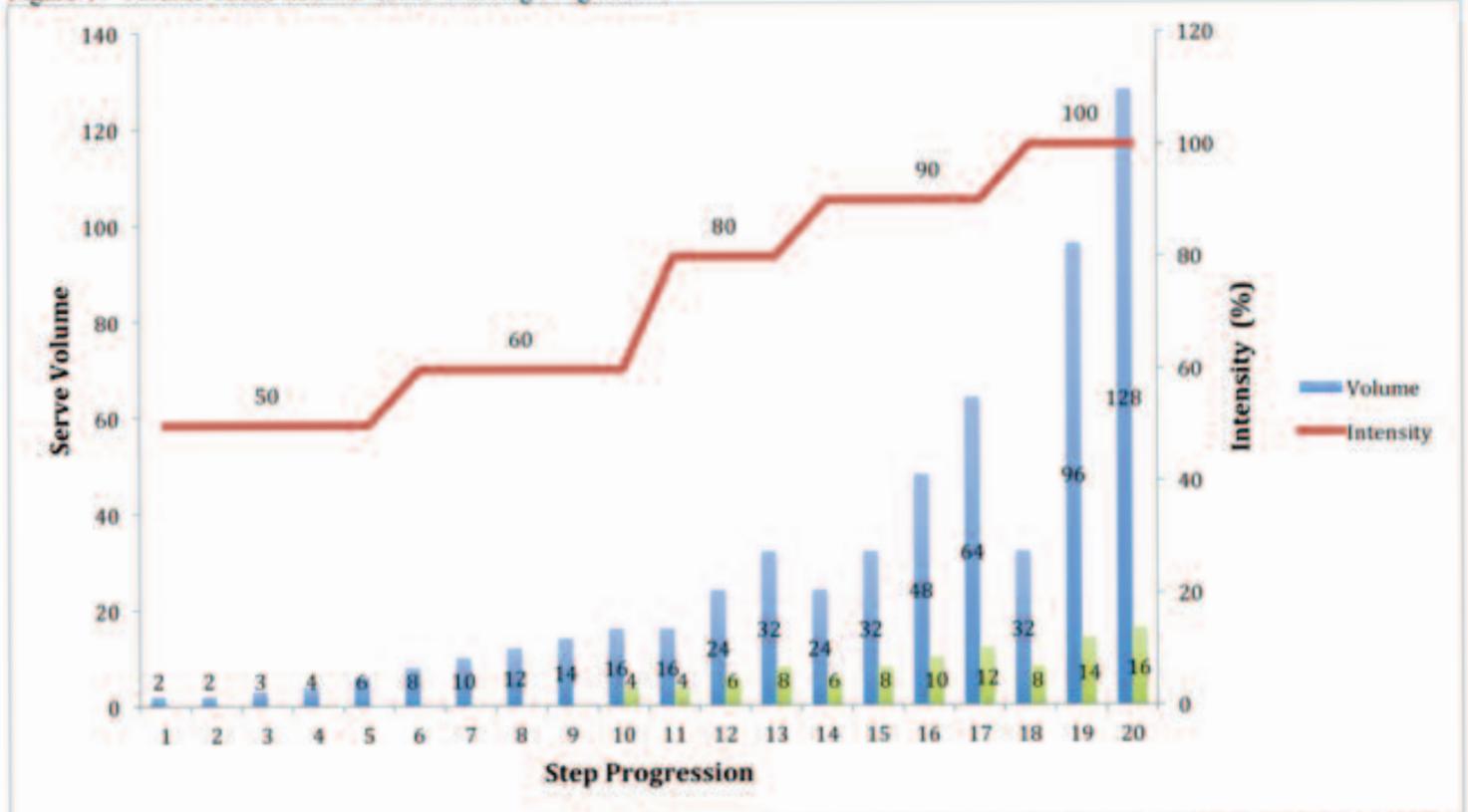
- Concentrates on power and endurance necessary for match play
- Can be used by coaches as a progressive training tool during a competitive season

Each player should be sufficiently warm before attempting any step within this progression program.

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Figure 1. Volume-based Interval Serve Training Progression



Starting at step 10, the green bars within the figure denote actual game play within the training progression. For example during step 15 a player would play 8 games, 4 being return games while the other 4 would be service games in which the player would hit 8 serves per game