

# MOVEMENT PATTERN AND MUSCLE ACTIVATION DIFFERENCES BETWEEN TYPES OF VOLLEYBALL SETS

Bailey Ann French, Katy Ranes, Marco Avalos, Noelle Tuttle, and Young-Hoo Kwon  
Texas Woman's University, School of Health Promotion & Kinesiology  
Email: \*[bfrench1@twu.edu](mailto:bfrench1@twu.edu)

## INTRODUCTION

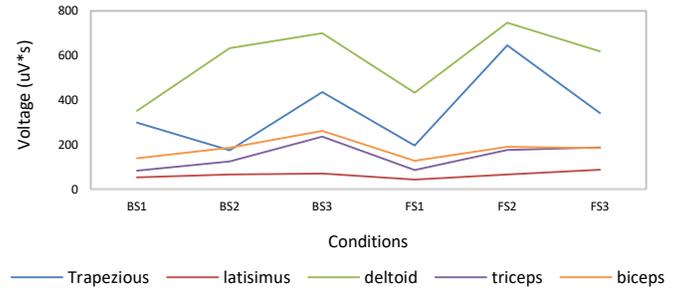
There is limited research available that specifies the training techniques and procedures for setters in a volleyball game. The only research found specific to volleyball indicates that all volleyball players should squat more than any other type of lifting [1] and this is not position specific. The reason for the lack of information for position directed training is due to the absence of information about muscle activity and movement patterns during setting performance. Determining this information could assist coaches in the development of appropriate strength training programs to improve the athlete's performance at their position and to reduce possible injuries.

## METHODS

Five female volleyball setters (age =  $16 \pm 0.7$  years, height =  $168.8 \pm 6.2$  cm, weight =  $67.3 \pm 8.1$  kg) were recruited for participation. This study utilized five electromyography (EMG) electrodes located on the right upper limb (i.e., biceps, triceps, anterior deltoid, latissimus dorsi, trapezius), a volleyball, and a 46 marker whole body model. Participants were asked to perform a series of volleyball sets with two changing parameters, the distance for the set and the direction of the set (i.e., front and back). The distances represented typical distances to be set in volleyball games and included three front set distances (2 m [FS1], 5.5 m [FS2], 8 m [FS3]) and three back set distances (1.65 m [BS1], 4.1 m [BS2], 7.65 m [BS3]). Three trials for each of the conditions were collected for a total of 18 setting trials, and three events were identified (i.e., start [arms at chest height, S], ball contact [BC], and end [hands back to chest height, E]). EMG data was collected with Delsys Trigno System and motion capture data was collected with Qualisys 3D motion capture. After collection, data was processed through a MATLAB Code and Kwon3D 5.1. MATLAB was used to identify the muscle burst on- and offset for each trial; integrated EMG (iEMG), timing of on- and offset in relation to the ball contact event, and peak activity were identified from these bursts. For the motion data, Kwon 3D 5.1 focused on the orientation angles (spine, shoulder, elbow, and wrist). For both analyses, the three trials per condition were averaged for each participant to create a representative trial. Finally, ensemble average patterns were created from these representative individual trials.

## RESULTS AND DISCUSSION

The main result found regarding the muscle activation during setting is that the deltoid presented with the highest muscle activity, while the latissimus dorsi showed the least amount and time of activity in all conditions (Fig 1). Exploring the joint angles data showed that after BC, in the BS there was more shoulder flexion and wrist extension, with decreased kyphosis and elbow extension compared to the FS condition. The shorter distances showed less range of motion than the longer distances in both directions (Table 1).



**Figure 1:** Muscle integrated burst activity for each condition. Acronyms: BS = back set, FS = front set, 1 = short distance target, 2 = medium distance target, 3 = long distance target.

**Table 1:** Average maximum and minimum joint orientation angles

	Conditions					
	BS1	BS2	BS3	FS1	FS2	FS3
<b>Shoulder min flex</b>	37.4	31.4	45.6	42.8	43.0	44.6
<b>Shoulder max flex</b>	149.5	155.0	153.2	135.0	137.0	131.5
<b>Elbow min flexion</b>	51.5	36.3	34.4	48.4	28.9	31.3
<b>Elbow max flexion</b>	119.2	121.2	116.8	121.1	119.7	121.5
<b>Wrist min extension</b>	5.9	8.0	3.5	7.0	3.3	-1.4
<b>Wrist max extension</b>	66.9	60.6	58.9	54.3	46.5	44.6
<b>Kyphotic max angle</b>	202.3	202.6	202.4	203.9	202.0	202.2
<b>Kyphotic min angle</b>	192.5	191.8	191.6	195.6	194.3	195.1

From our results, we can deduce that the shoulders are an important component in setting, which could relate to the number of injuries in female volleyball athletes. During back setting, there is more range of motion with less muscle activity compared to front setting. Therefore, with back setting, the athlete uses more body momentum than during front setting.

## SIGNIFICANCE

Our findings support resistance training for the upper body, focusing specifically at the shoulders. Current training programs are designed to improve vertical jump height and promote fast, sudden movements, lacking resistance training that can reduce the incidence of injuries and contribute to more successful setting. Early appropriate exercise prescriptions can increase the competitive longevity and success of setters. These training programs can be implemented in the Junior High and High School levels. Lifting weights stimulates muscle fibers to grow and allows athletes to produce more force at faster rates. In relation to setters, training the muscles that are activated the most during a set will improve a setter's overall strength and ability to perform the skill.

## REFERENCES

[1] Clutch, D., et al. (1983). *Res Q Exercise Sport*.