MUSCLE ACTIVATION BY OLYMPIC FEMALE ARCHERS AT DIFFERENT RELEASING RHYTHMS

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INTRODUCTION

Archery is a comparatively static sport requiring strength and endurance of the upper body, in particular of the forearm and shoulder girdle [1]. Through analysis of muscle activation of the shoulder girdle and forearm, stability and accuracy for archers can be evaluated [2,3]. However, archery conducted outside with disturbance from the environment disturb archers during the process of arrow release, and archers must utilize different releasing rhythms within a time limitation. Little is known about optimal release rhythms and variation in muscle activation with faster rhythms. Thus, the purpose of this study was to analyze muscle activation patterns of archers' forearm and shoulder for both normal and fast releasing rhythms and to find an effective index to assess release performance.

METHODS

Two female archers from the 2004 Olympic Chinese archery team were involved in this study. They were characterized as elite (awarded Fourth in Olympic Games 2004) and subelite archers (Fifty-fifth in Olympic Game 2004). Measurements were made under simulated Olympics game conditions on outdoor courts. Each participant completed two trials of 24 successful shots to get acquainted with measurement conditions. Timing of the anchor and release moments were determined with an electronic trigger controlled by the coach. Surface electrodes were placed on the central portion of principal muscles with Biovision EMG System (Wehrheim, Germany). Electromyographic activity of the shoulder and trunk muscles (i.e., M. extensor digitorum, trapezius muscle, and deltoid muscles) were recorded at a sampling frequency of 1000 Hz using synchronized electronic signals for a total of 24 shots by each participant. EMG activity amplitudes were determined during the anchoring phase to the time of release, and the reduction in level of muscle activity at release, were derived to evaluate release skill from the 0.1 s duration prior to (X) and after release (Y) from the following equation:

$$\text{Reduction in muscle activity} = 1 - Y/X \quad (1)$$

Mean scores and SD's (standard deviation) in amplitude and reduction level for back and shoulder muscles were calculated for each subject's shots under both fast and normal releasing rhythms. T-*tests* assuming independent samples were used for each participant to assess differences between the two release rhythms. A probability of α=0.05 was selected to indicate statistical significance.

RESULTS AND DISCUSSION

For the elite archer, the electromyographic amplitude of right upper trapezius and left deltoid activity from anchoring to release was significantly different between fast and normal releasing rhythms (Table 1). The elite archer used more of the right upper trapezius in drawing the bow, and less of the left deltoid controlling the bow in fast releasing. For the subelite archer, the left lower trapezius, left deltoid, and right upper trapezius were significantly between the two releasing rhythms. The subelite archer used more muscle activity from the holding hand to supply sufficient power for fast release. Only the right deltoid of the elite archer was significantly between the two releasing rhythms. Overall, there was no strong difference in the reduction level of muscle activity between the two releasing rhythms (Table 2).

Table 1 The amplitude of muscle activity during anchoring for archers using two different releasing rhythms.

Fast VS Normal	Left lower Trapezius	Right Lower Trapezius	Left Deltoid	Right Deltoid	Right Upper Trapezius	Right Wrist Extensor
Elite Archer	none	none	*(N>F)	none	*(F>N)	none
Sub Elite Archer	*(F>N)	none	*(F>N)	none	*(F>N)	none

α<.05 (F=Fast; N=normal)

Table 2 Reduction level of muscle activation at release for archers using two different releasing rhythms

Reduction level (F Vs N)	Left lower Trapezius	Right Lower Trapezius	Left Deltoid	Right Deltoid	Right Upper Trapezius	Right Wrist Extensor
Elite Archer	none	none	none	*(F>Nl)	none	none
Sub Elite Archer	none	none	none	none	none	none

α<.05 (F=Fast; N=Normal)

CONCLUSIONS

Compared to the subelite archer, the elite archer presented a greater reduction in muscle activation at release and a more consistent pattern adaptation when using the fast releasing rhythm. The amplitude and reduction level can be useful indices to quantify release skill. These experiments have monitored differences of muscle activation for elite female archers for different releasing rhythm, and also supplied a guide for fast releasing training.

REFERENCES

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