THE DIFFERENT RELEASE TECHNIQUES IN HIGH LEVEL ARCHERY: A COMPARATIVE CASE STUDY

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Olympic archers use different hook techniques like upper and lower two-finger hook. So, the purpose of this study is to compare three different hook techniques in archery by using kinetic and kinematic methods. A high level archer (FITA scores > 1300) volunteered to participate in this study. The subject engaged in a single test session consisting of 6 shots. Nine forearm and shoulder girdle muscles activation were quantified. The finger hook affected isometric contraction before the snap of the clicker causing sudden contraction of extensors and gradual relaxation of flexor muscles. This finding support earlier finding in the literature. Results showed that three finger hook strategy can be used in the drawing arm with success, as it may avoid causing a lateral deflection of the bowstring.

KEY WORDS: muscular contraction-relaxation, EMG, force, COP sway.

INTRODUCTION: Archery can be described as a comparatively static sport requiring strength and endurance of the upper body, in particular the forearm and shoulder girdle (Mann & Littke, 1989). Skill in archery is defined as the ability to shoot an arrow to a given target in a certain time span with accuracy (Leroyer, Hoecke, & Helal, 1993). The discipline is described as a six-phase movement. Each of these phases represents a stable sequence of movements and is ideal for studying the motor control and skill acquired during this voluntary kinetic and kinematic process (Nishizono, Shibayama, Izuta, and Saito, 1987). An archer pushes the bow with an extended arm, which is statically held in the direction of the target, while the other arm exerts a dynamic pulling of the bowstring from the beginning of the drawing phase, until the release is dynamically executed (Leroyer et al., 1993). The release phase must be well balanced and highly reproducible to achieve desired results in a competition (Nishizono et al., 1987). There are some different hook techniques in archery like upper and lower two-finger hook. Because of that different hook approaches, the purpose of this study is to compare three different hook techniques in archery by using kinetic and kinematic methods.

METHODS: A high level archer volunteered to participate in the study. Before taking of measurements, the subject was informed about the possible risks associated with the experiment and signed and informed consent. The participant was injury free at the time of testing and reported no previous injury history to his upper or lower limbs. The experimental procedures conformed to the Declaration of Helsinki and were approved by the local ethics committee.

Before starting the test session, the participant performed a 15-minute warm-up without any interference by researchers for shoulder girdle, elbow, wrist and finger joints. The participant engaged in a single test session consisting of 6 shots. Prior to the shootings, the isometric maximum voluntary contraction (MVC) was obtained of M. Flexor Digitorum Superfacialis (MFDS), M. Extensor Digitorum Communis (MEDC), M. Deltoid Anterior (MDA) M. Deltoid Middle (MDM), M. Deltoid Posterior (MDP), M. Upper Trapezius (MUT), M. Middle Trapezius (MMT), M. Lower Trapezius (MLT), M. Pectoralis Major (MPM) (Rota et al., 2013).

EMG data collection and analysis: EMG activity of the nine muscles studied MED, MFDS, MDA, MDM, MDP, MPM, MUT, MMT and MLT were recorded using surface electrodes (DELSYS Wireless Trigno Electromyography (EMG) 16-channel system). The band pass of the EMG amplifier, sampling rate, maximum intra-electrode impedance and CMMR were 20–500 Hz, 2000 Hz, 6 kOhms and 95 dB, respectively. The snap of the clicker triggered a 5V Transistor Transistor Logic (TTL) signal, which was registered simultaneously with the myoelectric signals. According to the rise of the TTL signal, muscular activation 400ms

before and 800ms after were identified as pre-clicker and post-clicker intervals. The respective EMG data sets of each of the 6 shots were full-wave rectified and filtered (a moving filter with a 100ms time-window).
Postural control analysis: Anterio-posterior (fy) and Medio-lateral (fx) force and centre of pressure (COP) sway values during the successful shots towards the target from a distance of 18 m, which is a standard Olympic indoor distance, were analysed. A Kistler (Germany, 600x400x100 mm) 9281EA force platform was used. Force data were sampled at 2000 Hz and normalized in accordance with body weight. All data are expressed as mean±SD. The force plate was placed 18 m away from the target. The imagery line from the centre of the target to shooting line was set to 90^0. So that fx direction represented anterio-posterior and the fy direction represented medio-lateral sway (Figure 1).

Figure1: The schematic view of shooting direction

RESULTS: Muscular Activation Strategies: The muscular activation values MED, MFDS, MDA, MDM, MDP, MPM, MUT, MMT and MLT were compared in relation with three different hook techniques applied by an elite archer. The analyses of forearm flexor muscles have shown that three-finger hook demonstrated on isometric contraction before the snap of the clicker and gradual relaxation just after the clicker's fall. However, the hook made by second and third fingers has a different contraction\relaxation strategy compared with three-finger hook. In upper two-finger hook, there is a sudden contraction\relaxation of the flexor muscles just before the snap of the clicker. On the other hand, lower two finger hook has a contraction before the release and gradual relaxation after the snap.
As for the forearm extensor muscles finger placement techniques created different muscular involvement strategies just after the fall of the clicker, extensor muscles have a sudden contraction to open three-finger hook, which maybe resulted in the forward moment of bowstring. Upper and lower two finger hook techniques created extensor contraction just before the snap of the clicker. Bowstring holding position also affected deltoid anterior muscular contraction strategy similar to the forearm muscles. In the two-finger hook, deltoid anterior muscle has almost no contraction before the snap and a gradual contraction just after the snap of the clicker.
Postural control strategies: The highest COP sway level has been reached by upper two-finger hook technique. The three finger-hook technique illustrated a backward lean with the lowest value and was closest to zero. Before and after the snap of the clicker, upper and lower two finger-hook showed a sharp increase in body sway in the anterior-posterior directions. The highest sway values were demonstrated by lower two finger hook technique as compared with upper two finger hook and three finger hook technique. Three finger-hook techniques had the least sway. Three different hook technique's mean COP sway value was lower than both finger hook techniques and demonstrates the closest level to zero.

DISCUSSION: Archery release is one of the most difficult fine motor abilities, which has a high impact on the archery performance. Earlier findings have shown that before the snap of the clicker, forearm flexor and extensor muscles contract almost equally to stabilize the range of motion in interphalengeal joints. In other words, archers have isometric contraction before the clicker's fall. Findings revealed that with different finger placement techniques on the bowstring, archers need to create three-finger hooks to reach proper balance between forearm flexor\extensor muscles. The finger hook has affected isometric contraction before the snap of the clicker and caused sudden contraction of extensor, gradually relaxation of flexor muscles. This forearm extensor sudden contraction, which maybe related with the release of the weight, the upper and lower two finger hook techniques had totally different strategies which may not related with earlier findings with archery release strategy. Kinesiology analyses of archery shooting during draw, full draw, aiming and release phases need horizontally abduction of arm, which is carried by deltoid middle and posterior. Deltoid middle has stable contraction slope before and after the snap of the clicker. In middle and posterior deltoid muscles three finger hooks has contributed the whole archery phases in synchronised with the other acting muscles. Deltoid posterior was very active before the snap of the clicker and gradually relaxation has started just before the snap of the clicker.

CONCLUSION: The most proximal joint is the scapular joint in archery shooting and it is the centre of the kinetic chain. During the full draw, aiming and release techniques scapular joint is supposed to retract and depress to reach a proper shooting technique in archery (McKinney and McKinney, 1997). By interpreting the findings of the current study, the most proper usage of scapular joint occurred during three-finger hook technique.

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