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Asymmetry of bioelectric activity of back muscles during bow drawing in the aspect of keeping "a stiff construction" of the body among national archery team members.

Introduction

Keeping "stiff construction" of the body at the moment of drawing the arc is one of the basic conditions of its accuracy (Carella, 1996). Selective involvement of muscle actons is needed to fulfill this condition.

Symmetrical work of back muscle is of great importance especially among high-class competitors Axford (1996). It allows to protect the arc arm from snatching away during bowstring releasing stage. Considering high powers of bowstring tightening used in nowadays archery, competitions must have very good technical and strength preparation to come up to requirements, (Trzaskama, 1975).

In record- seeking archery different methods of measuring were applied in order to look for most favorable biomechanical conditions for accurate and repeated shoots Vingrackij et al (2002).

In order to analyze the problem in a complex way, there is a need to apply simultaneous monitoring of "a stiff construction" of the body and bioelectrical activity of back muscles at the moment of the string releasing.

It is a good way to control the level of competitor preparation for making practice effort. It lets minimalise the risk of contusion and guarantee accurate and repeated shooting.

Methods

Moreover, the measurement of strength ability of competitors was conducted on the measurement speed which enabled to stay at the position of shooting.

On this spot the real power of string tightening, also associated with "bow stiffness" or hardness was stated on these basis the indicator of a level of movement system weighting characterizing contribution of string tightening power to maximum power abilities of the competitors registered on the tensometical dynamometer was stated.

At each of examined four series of five following shoots on the distance of 25 m were registered, taking notes of the results achieved-keeping the same time, the rhythm of shooting natural for each competitor.

Results

Average differences of functional biopotentials of back muscles that were examined and diffusion of individual results are shown at the diagram below.

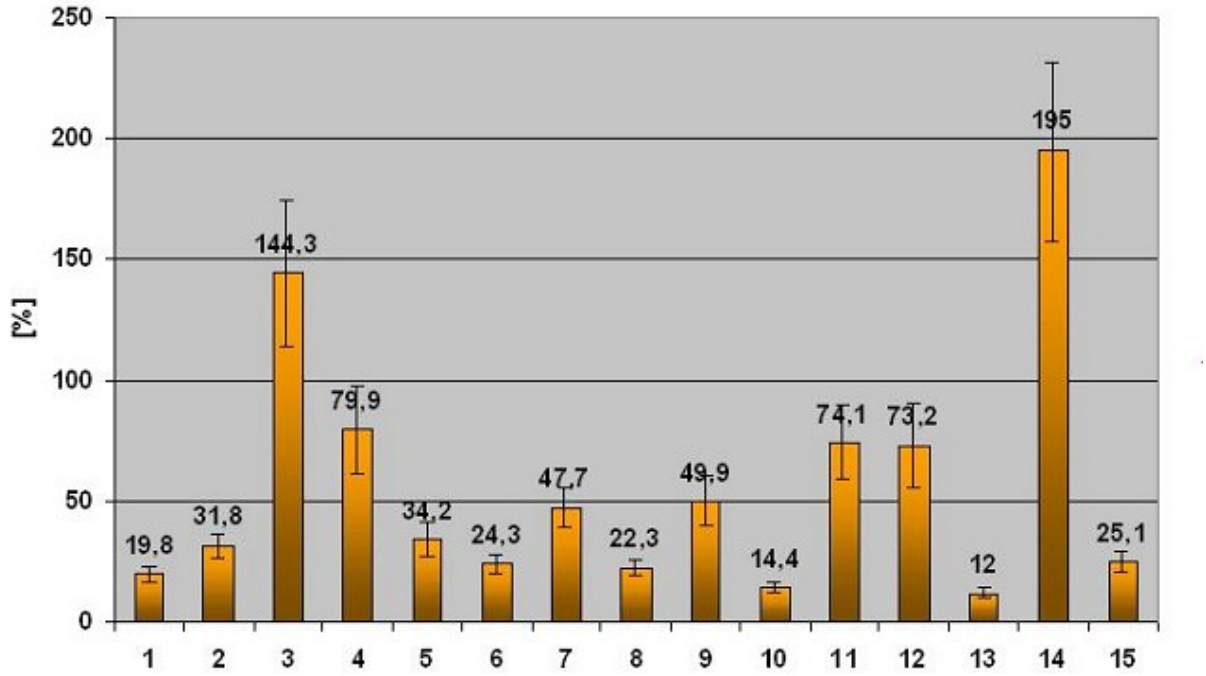

Fig. 1. Difference of functional biopotentials of back muscles (parallelogram muscle and middle action of quadrilateral muscle) on the string and the arc side

The results presented distinctly differ among themselves for different competitors. In the level of 100% of asymmetry. Six of the people examined achieved good symmetry of back muscles and the indicator of differences didn't relative coefficient of bow strength.

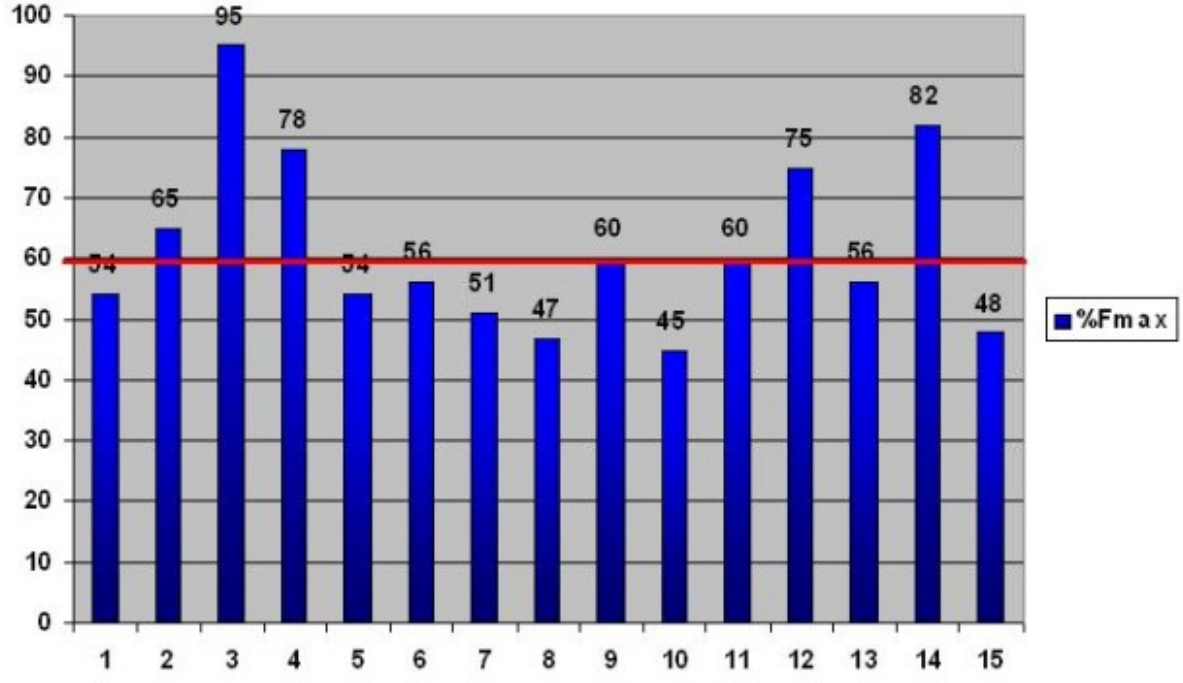

Fig. 2. Relative coefficient of motor system load

From the diagram presented it is evident that people with high level of asymmetry of back muscles tension have high level of "bow hardness" coming even up to 95% maximum strength abilities diag. 1 and diag. 2. Most of examined people (10 competitors) achieved result below bottom limit of 60% their actual strength abilities witch created good conditions of strength potential usage in every particular shooting.

Among 5 competitors the coefficient motor system head exceeded considerably the level of 60% maximum strength abilities which is a distinctive circumstance indicating too "hard bow" usage.

Parameters enquired have been analyzed statistically as for as intensity of relation using of Pearson's line correlating coffined.

p<0,05	Difference bioel. aktivity. %	%Fmax
% Fmax	0,84	
Result	-0,89	-0,82

Difference of bioelectrical activity % - relative difference bioelectrical activity of back muscles on the sting and the arc hand side,
% F max - a relative coefficient relating to "bow hardness" proportion comparing to actual strength abilities of competitors,
Result - result achieved on the distance of 25 meters.

Tab. 1. The intensity of correlation between biomechanical parameters analyzed

All pairs of variables characterized high level of correlation intensity, exceeded absolute value of r = 0,8. In two cases the coefficient was minus. It

means the bigger the level was achieved by a competitor the similar correlation appeared between the use of maximum strength abilities level in each shooting and the result achieved.

Discussion

Researcher dealing with archery competition issues often highlight a role of back muscles in balancing the power of string tightening. More and more often interesting publications concerning archery appear. They are usually books Ruis (2003), Engh (2004) Linsin (2004), Haywood (2005), not articles fulfilling scientific criteria. That is why there is the obvious need to tackle this important problem on the scientific research dimension in order to provide experimental rudiments.

A competitor who is on the high technical level uses these muscle groups witch enables a proper reaction of motor system of bursting the power of a bow at the moment of string releasing. In this short time lasting depending on the level a competitor from 0,5 to 0,05s (carell1996) the accuracy of a shoot is being decided. In that moment most often the shoot snatches away under the influence of resultant power which may change a trajectory of the arrow which is still in its influence zone. So it seems to be crucial to keep a firm body position while string releasing. In archery it is called "stiff body construction" (Carella 1996).

It includes important spots of motors system within three main body triangles creating "stiff construction". Chwała et al. (2004)

Therefore, both these elements keeping firm body position and symmetrical back muscle work are of crucial importance in the aspect of shoot accuracy.

The results of researching indicate this fact clearly. Competitors whit low level of muscle tension asymmetry were able to oppose snatching away of the spots of motor system within "stiff construction" system and did better on the target. Person's line correlation coefficient within these variables was $r = 0,89$ which indicates that competitors with little asymmetry of back muscle's work had better results while shooting.

The results of the research conducted indicate the high relation between the research conducted indicate the high relation between the level of asymmetry of functional biopotential of back muscles and results achieved while shooting. Among higher levels of asymmetry (over 40%) minor dislocation of bone spots wore identified at the area that determined the "firm construction". It happened most often at high level of relative coefficient motor system loud which indicated too high strength capabilities of the person examined. It had a direct influence on shooting accuracy and the results on the target.

Conclusions

Competitors presenting high level of muscles asymmetry had problems with keeping "stiff construction" of the body.

The reason of this high level of back muscles asymmetry is inappropriately chosen strength of the string tightening in relation to competitors strength capability.

The most accurate shoots were given by minor level of asymmetry of back muscles and keeping optimum biomechanical body position at the same time.

References

1. Allard P., Stokes I.A.F., Blanchi J.P. [1995]: Three – dimensional Analysis of Human Movement, *Human Kinetics*, New York.
2. Axford R. [1996]:Archery Anatomy: An Introduction to Techniques for Improved Performance. *Souvenir Press*.
3. Carella R,F. [1996]: Równowaga dynamiczna, techniczna strona formy łucznika oraz specyfika treningu na formasterze w: *Biuletyn szkoleniowy PZŁ- ucz* nr 4, Warszawa.
4. Chwała W., Baściuk J., Lach J. [2004]: Trójwymiarowa ocena techniki oddawania strzału i aktywności bioelektrycznej mięśni u zawodniczek kadry narodowej W: *Proces doskonalenia treningu i walki sportowej*, t1,114-119,AWF Warszawa.
5. Engh D. [2004]:Archery Fundamentals (Sports Fundamentals Series). *Human Kinetics Publishers*.
6. Hamm J.[2000]The Traditional Bowyer's Bible, *Lyons Press*, Volume 1.
7. Haywood K.M.[2005]:Archery: Steps to Success. *Human Kinetics Publishers.*
8. Linsin M. [2004]:Archery Strong. *JME Publishing*.
9. Nagórny A. [2003]: Trójwymiarowa analiza techniki strzelania z łuku u zawodniczki o wysokim poziomie mistrzostwa sportowego. *Praca magisterska*. AWF Kraków.
10. Ruis S. [2003]:Precision Archery. *Human Kinetics Publishers*.
11. Trzaskoma Z. [1975]: Ocena skuteczności techniki i treningu siłowego w łucznictwie. *Praca doktorska*. AWF Warszawa.
12. Vinograckij B., Mihajliszin W., Romaniszin I. [2002]: Akcelerometriczeskaja systema kontrolia kaczestwa łuka, Lwów, 38-44.