

Comparative analysis of running technique of university sprinters Russia and USA

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Introduction. Optimal parameters of sprint running technique for athletes can be determined by means of biomechanical modeling. However, firstly, musculoskeletal system of human is very complicated and data of biomechanical modeling need to be checked, secondly, biomechanical models ignored psychical features of athletes, so changes in running technique can lead to another results than projected in the biomechanical model, due to the inability rapid destruction of the motor skill. In this regard, additional information can be obtained from the comparing of technique's characteristics and running speed between different sprinters.

So **the aim** of this investigation was to compare running techniques and speed of running between university's sprinters of Russia and the USA.

Method. Five Russian sprinters (three from Kuban State University of Physical Education, Sport and Tourism and two from Adyghe State University) took part in the experiment (age 19.3 ± 2.0 years, body mass 71.5 ± 8.5 kg, height 182.8 ± 7.2 cm, 100 metres best $11,23 \pm 0,25$ s). The data about ten sprinters from the Brigham Young University, Provo, Utah, USA were taken from Master's Thesis of Tyler D. Bushnell [2]. All Russian and American athletes had the personal best results at the level of Candidate Master of Sports – first category due to Unified Sports Classification System of Russia.

The system 3-D video analysis Qualisys was used for determine measures of running step of Russian sprinters. Six special video cameras ProPe-flex were used, the information from which was transferred to the computer. Shooting speed was 120 Hz. Each participant had run the distance 50 m at top speed twice. The data of best attempt were taken into consideration. Shooting took place on the 38-42 meter of distance.

Kinematic measures of American sprinters' running were determined with the help of 2-D video analysis Peak Motus System, shooting speed is 180 Hz. Each subject sprinted approximately 60 m, with the timing lights and camera set between the 40 m and 50 m marks [2].

To compare running technique were taken by following characteristics: speed of running, minimum knee angle, minimum hip angle, knee extension at toe-off, contact time, stride length. Speed of running evaluated as speed of movement of athlete's general center of mass. One-way analysis of variance was used to examine statistical differences of data between Russian and American university sprinters.

Results and discussion. As shown results of comparing of running technique's characteristics of university sprinters of Russia and USA both groups of athletes showed approximately equal speed of running (Table 1, $p>0,05$). At the same time, as it follows from the analysis data of the table 1, some measures have significant differences between sprinters from Brigham Yang University and Russian university sprinters. So, USA sprinters had significantly smaller minimum knee angle and minimum hip angle (Table 1, $p<0,05$).

Table 1

Mean (\pm S.D.) of running technique's characteristics of university sprinters Russia and USA [1]

| Characteristics | Russia | USA [1] | p |
|---------------------------------|-----------------|-----------------|-------------------------------|
| Speed (m/s) | 9.43 \pm 0.42 | 9.40 \pm 0.51 | $p>0.05$ |
| Minimum knee angle (deg) | 47 \pm 12.8 | 32 \pm 7.5 | $p<0.05$ |
| Minimum hip angle (deg) | 122 \pm 5.4 | 102 \pm 8.4 | $p<0.05$ |
| Knee extension at toe-off (deg) | 148 \pm 9.2 | 151 \pm 7.6 | $p>0.05$ |
| Contact Time (s) | 0.10 \pm 0.01 | 0.11 \pm 0.01 | $p>0.05$ |
| Double Step Length (m) | 4.46 \pm 0.20 | 4.45 \pm 0.22 | $p>0.05$ |

Figure 1 illustrates differences of angles in hip joint of some examined groups sprinters.

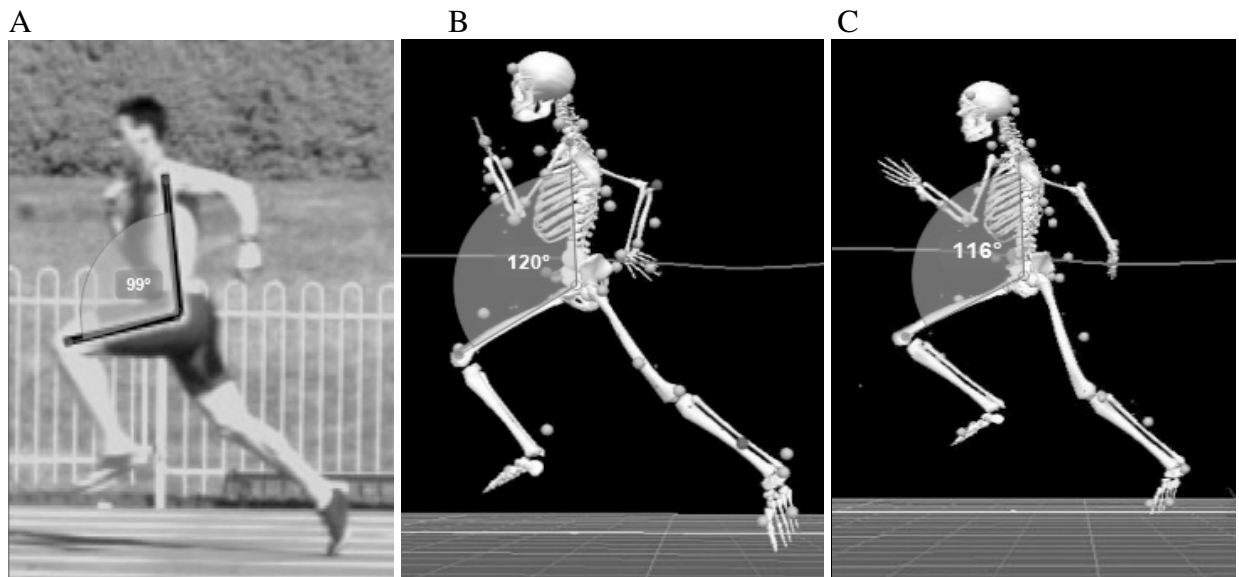


Figure 1. Minimum hip angle (deg). (A- USA runner [2], B – Adyghe runner, C- Krasnodar runner)

Figure 2 shows noticeable differences among angles in knee joint in sprinters of Russia and USA.

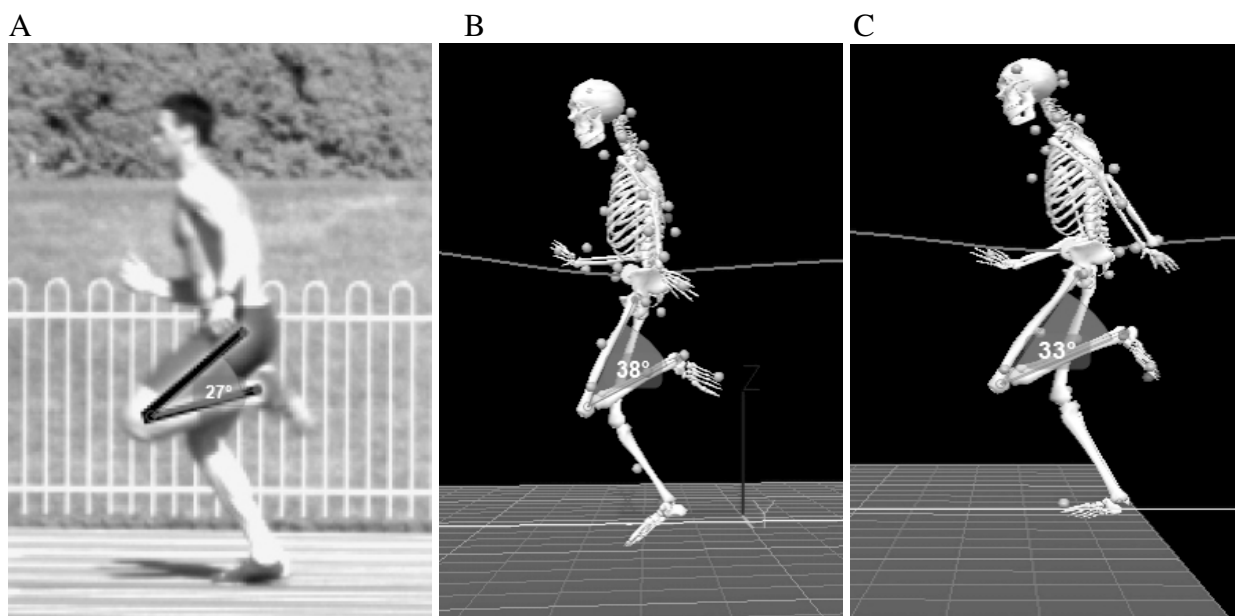


Figure 2. Minimum knee angle (deg). (A- USA runner [2], B – Adyghe runner, C – Krasnodar runner)

Note that though Russian athletes had significantly larger angles in knee joint and hip joint, this fact did not affect on such characteristics as

knee extension at toe-off, double step length, contact time and, what's the main, on the speed of running (Table 1).

Conclusion. Surveyed USA university sprinters significantly higher lift hip at toe-off than Russia university sprinters. However, this doesn't lead to an increase in the step length or running speed as you might expect.

Limitations. We haven't height data of American university sprinters, so we can to compare only absolute value of step length among Russian and American athletes. Perhaps significantly largest value of minimum hip angle in Russian sprinters may be cause of significantly less value of step length normalized relative athlete's height.

References

1. Bushnell, T. & Hunter, I. Differences in technique between sprinters and distance runners at equal and maximal speeds // Sports Biomechanics. – 2007. – Vol. 6. – N. 3. – P. 261-268.
2. Bushnell, T.D. A biomechanical analysis of sprinters vs. distance runners at equal and maximal speeds: master's thesis / Department of Exercise Sciences Brigham Young University. – 2004. – 60 p.