

KINEMATIC ANALYSIS OF THE FORWARD DOUBLE STEP TECHNIQUE IN BOXERS FROM THE EXPERIMENTAL AND CONTROL GROUPS

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Introduction. In modern boxing, the speed and accuracy of foot movements are among the key factors determining an athlete's technical and tactical advantage. In particular, the forward double step technique plays a crucial role in approaching the opponent for a punch, changing position, and executing defensive movements swiftly. A kinematic analysis of this technical movement enables the identification of boxers' movement coordination, joint movement amplitude, and velocity indicators. This study scientifically evaluates the differences in the execution of the forward double step technique between athletes in the experimental and control groups.

Research Objective: To study and improve the forward double step technique in boxers' training through kinematic analysis.

Research Tasks:

- To study the forward double step technique;
- To analyze the identified errors and shortcomings, and to develop appropriate guidelines and recommendations.

Results and Discussion

In modern sports training, the perfection of movement technique directly affects an athlete's performance. This is especially true in sports like boxing, which require high levels of coordination, speed, and explosive power. In such disciplines, footwork technique is one of the primary factors that define a boxer's technical and tactical advantage. The boxer's movements in the ring, quick position changes, and offensive and defensive maneuvers all directly depend on the accuracy and stability of foot movements.

Developing and improving footwork technique among student boxers requires a specific and targeted approach. At this stage, athletes not only enhance their general physical preparedness, but also aim to consciously control movements, master techniques thoroughly, and reinforce sport-specific reflexes through specialized training.

This study investigated the effectiveness of a specially developed method for improving footwork technique in student boxers. The proposed training system

was aimed at improving movement balance and agility, as well as accelerating the standardization and assimilation of technique, thereby demonstrating its practical and scientific validity.

The kinematic analysis of the forward double step technique in the boxers from the experimental and control groups yielded the following results: The average step frequency in the control group was 183.2 ± 19.1 steps/min, while in the experimental group it was 182.1 ± 20.3 steps/min. The coefficient of variation was 10.42% for the control group and 11.14% for the experimental group. No statistically significant difference was found between the two groups in this regard.

After the pedagogical intervention, a 3D motion analysis was conducted to assess changes in footwork technique among the boxers. The results showed that the step frequency in the control group decreased to 174.2 ± 18.2 steps/min, while in the experimental group it significantly decreased to 147.7 ± 16.7 steps/min. The difference between the groups was statistically significant ($t=5.14$; $p<0.001$), indicating that the footwork technique in the experimental group had undergone substantial changes. These results confirm the effectiveness of the applied pedagogical methods and training program.

When evaluating the forward double step technique in terms of movement speed (m/s), the average speed in the control group was 0.91 ± 0.11 m/s and 0.93 ± 0.12 m/s in the experimental group. The step speed in the control group was 0.86 ± 0.14 m/s, while in the experimental group it was 0.76 ± 0.14 m/s. The statistically significant difference between these values indicates a noticeable slowdown in movement among athletes in the experimental group. This demonstrates that the pedagogical influence affected both the quality and speed of technical movements.

According to the findings, the duration of the right foot's support phase in the control group was $46.4 \pm 4.8\%$, and in the experimental group, it was $45.3 \pm 5.24\%$. These results were very close, and no significant difference was observed in the relative share of the support phase within the overall movement cycle. This suggests that the structural integrity of the support phase remained stable despite experimental influence.

In terms of the relative share of the support phase for the right foot, the control group showed an average of $37.2 \pm 4.5\%$, while the experimental group recorded $30.2 \pm 4.3\%$. This difference was statistically significant ($t=3.18$; $p<0.001$), indicating that the footwork technique in the experimental group underwent meaningful changes. These outcomes confirm the effectiveness of the methodological approach and training program implemented during the experiment.

The duration of the propulsion (push-off) phase for the right foot was $53.5 \pm 6.4\%$ in the control group and $54.3 \pm 6.7\%$ in the experimental group. These results were similar and no statistically significant difference was observed in the relative share of the propulsion phase in the movement cycle. This suggests that, regardless of experimental conditions, this component of the movement mechanism remained stable.

On the other hand, the duration of the right foot's support phase averaged $60.6 \pm 7.7\%$ in the control group and $69.7 \pm 7.9\%$ in the experimental group. This difference was statistically significant ($t=2.37$; $p<0.05$), indicating meaningful and qualitative improvements in footwork technique among athletes in the experimental group. These results further confirm the high effectiveness of the pedagogical approach and sports training methodology used during the study.

The experimental results also showed that the duration of the left foot's support phase was $56.8 \pm 6.3\%$ in the control group and $57.1 \pm 6.1\%$ in the experimental group. These values were quite close, with no significant statistical difference between them. This indicates that the stability of the left foot's movement mechanism was preserved despite the influence of the experimental training.

Additionally, the duration of the right foot's support phase averaged $51.2 \pm 6.7\%$ in the control group and $46.4 \pm 5.4\%$ in the experimental group. The difference between these parameters was statistically significant ($t=2.37$; $p<0.05$), confirming that notable changes occurred in the footwork technique of athletes in the experimental group. These results show that the innovative educational-methodological approach and the structured organization of training sessions applied during the experiment were highly effective in improving movement technique.

CONCLUSION

Based on the conducted experimental research, it was determined that the proposed specialized training methodology effectively contributed to the improvement of footwork technique in student boxers. In the experimental group, significant positive changes were observed in step frequency and the duration of the support and propulsion phases. Statistically significant differences were identified, confirming the high effectiveness of the pedagogical approach and methodology applied during the experiment. The results highlight the importance of a scientifically grounded approach in developing athletes' movement techniques.

LIST OF REFERENCES

1. Бернштейн Н.А. Очерки по физиологии движений и физиологии активности. — М.: Медицина, 1966. — 450 с.
2. Платонов В.Н. Система подготовки спортсменов в олимпийском спорте. — Киев: Олимпийская литература, 2010. — 808 с.
3. Лях В.И., Зданевич А.А. Теория и методика физического воспитания. — М.: Академия, 2006. — 384 с.
4. Рубан А.В. Биомеханика в спорте: учебное пособие. — М.: Советский спорт, 2009. — 264 с.
5. Zatsiorsky V.M. Kinematics of Human Motion. — Champaign, IL: Human Kinetics, 1998. — 363 p.
6. Knudson D. Biomechanical Principles of Human Movement. — New York: Springer, 2007. — 210 p.
7. Арутюнян Г.Г. Биомеханика спорта: Учебник. — М.: Физкультура и спорт, 2004. — 432 с.
8. Сучилин А.А. Совершенствование техники передвижения боксеров на основе биомеханического анализа. // Теория и практика физической культуры. — 2015. — №5. — С. 42–44.