

RANGE OF MOTION INDICATORS IN THE MAIN BODY JOINTS DURING THE EXECUTION OF THE FORWARD DOUBLE JUMP TECHNIQUE WITH THE LEFT LEG IN EXPERIMENTAL AND CONTROL GROUP BOXERS

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Introduction. The kinematic analysis of athletes' movements, especially in combat sports, is an important scientific and methodological tool for evaluating technical and physical preparedness. In boxing, the forward double jump technique performed with the left leg plays a crucial role in quick movement, achieving an optimal position for delivering punches, and executing defensive and counter-attacking actions. This technical movement requires complex balance, precise joint range of motion, and intermuscular coordination.

The main objective of this research is to identify and compare the range of motion indicators in body joints during the execution of the forward double jump technique with the left leg in boxers from the experimental and control groups. This analysis provides a scientifically grounded evaluation of technical preparedness. Such an approach contributes to improving the efficiency of movement, optimizing the training process, and developing individualized technical models for boxers.

Research Objective: To improve stepping technique by analyzing the range of motion in the main body joints during the execution of the forward jump performed with the left leg in boxers.

Research Tasks:

- To study the technique of forward stepping with the left leg;
- To identify joint involvement during this movement and conduct a kinematic analysis;
- To develop appropriate guidelines and recommendations based on the obtained results.

Results and Discussion

One of the key biomechanical factors ensuring the effectiveness of a boxer's movement is the coordination and amplitude of joint motion. This is especially important in complex coordinated movements such as the forward double jump,

where optimal mobility in the body's main joints (ankle, knee, hip, waist, shoulder, and elbow) plays a vital role in correct technique execution and maintaining stability.

In this study, the amplitude indicators of joint movement during the forward double jump performed with the left leg were analyzed in boxers from both the experimental and control groups. The influence of pedagogical interventions on movement mechanics was assessed.

The range of motion data for the major joints during the execution of the forward double jump with the left leg in the experimental and control group boxers were as follows:

Before the pedagogical intervention, the average pelvic flexion angle in the control group was $4\pm0.5^\circ$, with a coefficient of variation (CV) of 12.5%. In the experimental group, this indicator was also $4\pm0.7^\circ$, with a CV of 17.5%. Statistical comparison between the groups showed no significant difference ($t=0.62$; $p>0.05$).

At the end of the experimental study, conducted to evaluate the effectiveness of the author-developed training methodology, the following results were observed regarding pelvic flexion during the execution of the forward double step technique:

In the control group, the average flexion angle was $4\pm0.7^\circ$, with a CV of 15.56%. In the experimental group, the average flexion increased to $5\pm0.6^\circ$, with a CV of 12%.

Mathematical and statistical analysis of the results revealed that there was no statistically significant difference between the groups ($t=2.62$; $p<0.05$). This indicates that the amplitude of movement did not change significantly under the influence of the intervention. However, the decrease in the coefficient of variation in the experimental group suggests that the methodology positively contributed to stabilizing the technical movement.

Before the pedagogical experiment, the pelvic abduction range in the control group was $2\pm0.2^\circ$ with a coefficient of variation (CV) of 10.0%, while in the experimental group it was $2.4\pm0.3^\circ$ with a CV of 12.5%. After the pedagogical experiment, the control group showed a slight increase to $2.03\pm0.2^\circ$ (CV = 9.85%), whereas the experimental group showed a more notable increase to $3\pm0.4^\circ$ (CV = 13.33%). The statistical analysis revealed a significant difference between the groups ($t=2.45$; $p<0.05$). An increase in the pelvic abduction amplitude and a greater variety of technical movements were observed in the experimental group.

This suggests that the author-developed methodology used in the training process helped to expand the athletes' range of motion and improve movement control.

Throughout the study, the forward double jump technique performed with the right leg was thoroughly analyzed from a kinematic perspective. During this process, the range of motion in each athlete's joints was measured and compared across the control and experimental groups. The scientific evaluation was based on 13 specific biomechanical indicators.

Pelvic flexion range (°): In the control group, the flexion angle increased from 2.0° to 3.5°, representing a 20% increase; however, statistical analysis showed this change was not significant ($p > 0.05$). In the experimental group, the flexion range increased from 2.1° to 4.0°, a 28.57% increase, which was statistically significant ($p < 0.05$). This suggests that athletes in the experimental group performed pelvic flexion movements more effectively, indicating improved technical skills.

Pelvic abduction range: In the control group, the range increased from 2.1° to 2.5°, but this was not statistically significant ($p > 0.05$). In the experimental group, the range increased from 2.2° to 3.2°, and this change was statistically significant ($p < 0.05$), indicating more balanced and efficient abduction movements in the experimental group.

Pelvic rotation range: The control group showed an increase from 30° to 35.4°, but the change was not statistically significant ($p > 0.05$). In the experimental group, the range increased from 30.2° to 41°, a 12.68% increase, and this was highly significant ($p < 0.001$), demonstrating improved pelvic rotation capability that may positively impact punching power.

Hip flexion range: In the control group, an increase from 12° to 18.2° was observed, though not statistically significant ($p > 0.05$). In contrast, the experimental group showed an increase from 13.1° to 24°, which was statistically significant ($p < 0.005$), indicating more effective flexion and greater athlete flexibility.

Hip abduction range: The control group showed a rise from 17.1° to 21.1°, which was not statistically significant ($p > 0.05$). However, the experimental group increased from 17.5° to 24°, and this difference was statistically significant ($p < 0.05$), reflecting a higher level of physical preparedness.

Hip rotation range: The control group improved from 4° to 8.1°, but this was not statistically significant ($p > 0.05$). The experimental group increased from

5.4° to 22°, a statistically significant change ($p < 0.001$), indicating considerable development in the muscles and structures responsible for hip rotation.

Knee flexion range: In the control group, knee flexion increased from 8° to 16°, but the change was not statistically significant ($p > 0.05$). The experimental group saw an increase from 8° to 24°, which was statistically significant ($p < 0.001$), showing that knee movement range had doubled, with increased strength and speed resulting from training.

Knee abduction range: The control group's range decreased from 14° to 13.2°, indicating reduced movement. Similarly, the experimental group's range decreased from 14.1° to 11.2°, but this change was statistically significant ($p < 0.005$), reflecting improved control and elimination of unnecessary movement.

Knee rotation range: The control group increased from 9.12° to 14.5°, though not significantly ($p > 0.05$). The experimental group increased from 9.7° to 17°, with statistical significance ($p < 0.05$), indicating improved accuracy, speed, and stability.

Ankle flexion range: The control group increased from 23° to 24.2°, but this was not statistically significant ($p > 0.05$). In the experimental group, the range increased from 23.4° to 26°, a statistically significant change ($p < 0.05$), indicating increased speed and stability in movement.

Ankle abduction range: The control group decreased from 10.4° to 9.2° ($p > 0.05$), while the experimental group significantly decreased from 10.7° to 7.4°, a change that was statistically significant ($p < 0.05$). This suggests reduced excessive movement and improved control in the experimental group.

Ankle rotation range: The control group remained nearly unchanged (16° to 16.15°), whereas the experimental group increased from 16.12° to 18.2°, and this was statistically significant ($p < 0.05$), contributing to improved balance and movement accuracy.

Foot direction range: The control group increased from 11° to 15.24°, but this change was not statistically significant ($p > 0.05$). The experimental group showed a marked increase from 12.1° to 20.2°, a statistically highly significant change ($p < 0.001$), indicating improved ability to control and adjust strike direction quickly via the foot.

CONCLUSION

The results of the conducted research showed that during the execution of the forward double jump with the left leg, positive changes in the range of motion of the main body joints were observed in favor of the experimental group. In particular, balanced and efficient movements were noted in the flexion, abduction, and rotation ranges of the hip, thigh, knee, and ankle joints.

As a result of the applied methodological intervention, athletes demonstrated improvements in technique control, coordination, and the ability to manage strike direction. This confirms the formation of a biomechanically effective movement structure in the boxers' jumping technique. The findings justify the importance of applying individualized approaches and methods aimed at developing joint mobility in training.

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.