

EFFECTS OF ACCELERATION ON SKILL LEVEL IN SKIERS

EFEITOS DA ACELERAÇÃO SOBRE O NÍVEL DE HABILIDADE EM ESQUIADORES

EFFECTOS DE LA ACELERACIÓN EN EL NIVEL DE HABILIDAD DE LOS ESQUIADORES



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ABSTRACT

Introduction: In a “U” shaped field, the skier must take off using snow slides in a determined territory, using the distribution of his body mass over his feet to control the direction, completing a variety of complex movements inherent to aerial sports. **Objective:** Study the effect of acceleration on skiers’ skill levels. **Methods:** Peak moment angle and range of motion were measured in 12 U-shaped cross-country snow ski athletes with an average training period of over 5 years. The isokinetic muscle strength test parameters were analyzed with the characteristics and abilities inherent to the sport. The corresponding range of motion and the angle of acceleration were determined. The results were confronted with a literature search and discussed afterward. **Results:** The peak torque and relative peak torque of the flexor and extensor muscle groups on both sides of the athletes’ hip and knee joints reduced with increasing angular velocity; the maximum peak torque of the extensors was significantly greater than that of the flexors at the same velocity ($P < 0.05$). The current scientific literature predicted this inversely proportional relationship, but the angles obtained had not been explored. **Conclusion:** Athletes should pay attention to improving cognitive ability and active adjustment ability to complete their technical movements, promoting the development of controlled acceleration required by snow sports. **Level of evidence II; Therapeutic studies - investigation of treatment outcomes.**

Keywords: Snow Sports; Motor Skills; Biomechanical Phenomena.

RESUMO

Introdução: Em campo em forma de “U”, o esquiador deve decolar utilizando deslizamentos de neve em um território determinado, utilizando a distribuição de sua massa corporal sobre os pés para controlar a direção, completando uma variedade de movimentos complexos inerentes aos esportes aéreos. **Objetivo:** Estudar o efeito da aceleração sobre o nível de habilidade dos esquiadores. **Métodos:** Aferiu-se o ângulo do momento de pico e a amplitude de movimento em 12 atletas de esqui na neve em campos em forma de “U” com um período médio de treinamento de mais de 5 anos. Foram analisados os parâmetros do teste de força muscular isocinético combinados com as características e habilidades inerentes ao esporte. Determinou-se a gama correspondente do movimento e o ângulo de aceleração. Os resultados foram confrontados com uma pesquisa bibliográfica e discutidos posteriormente. **Resultados:** O torque de pico e o torque de pico relativo dos grupos de músculos flexores e extensores em ambos os lados das articulações do quadril e joelho dos atletas reduziram com o aumento da velocidade angular; o torque de pico máximo dos extensores foi significativamente maior do que o dos flexores na mesma velocidade ($P < 0.05$). Essa relação inversamente proporcional foi prevista pela literatura científica vigente, porém os ângulos obtidos não haviam sido explorados. **Conclusão:** Os atletas devem atentar-se em melhorar a capacidade cognitiva e a capacidade de ajuste ativa para completar seus movimentos técnicos promovendo o desenvolvimento da aceleração controlada requerida pelos esportes na neve. **Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.**

Descritores: Esportes na Neve; Destreza Motora; Fenômenos Biomecânicos.

RESUMEN

Introducción: En un campo en forma de “U”, el esquiador debe despegar utilizando deslizamientos de nieve en un territorio determinado, utilizando la distribución de su masa corporal sobre los pies para controlar la dirección, completando una variedad de movimientos complejos inherentes a los deportes aéreos. **Objetivo:** Estudiar el efecto de la aceleración en el nivel de habilidad de los esquiadores. **Métodos:** Se midieron el ángulo de momento máximo y la amplitud de movimiento en 12 atletas de esquí de fondo en forma de U con un período de entrenamiento medio de más de 5 años. Se analizaron los parámetros de la prueba de fuerza muscular isocinética combinados con las características y habilidades propias del deporte. Se determinó la correspondiente amplitud de movimiento y el ángulo de aceleración. Los resultados se confrontaron con una búsqueda bibliográfica y se debatieron posteriormente. **Resultados:** El par máximo y el par máximo relativo de los grupos musculares flexores y extensores de ambos lados de las articulaciones de la cadera y la rodilla de los atletas se redujo con el aumento de la velocidad angular; el par máximo de los extensores fue significativamente mayor que el de los flexores a la misma velocidad ($P < 0.05$). Esta relación inversamente proporcional fue predicha por la literatura científica actual, pero los ángulos obtenidos no habían sido



explorados. **Conclusión:** Los atletas deben prestar atención a la mejora de la capacidad cognitiva y la capacidad de ajuste activo para completar sus movimientos técnicos promoviendo el desarrollo de la aceleración controlada que requieren los deportes de nieve. **Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.**

Descriptores: Deportes de Nieve; Destreza Motora; Fenómenos Biomecánicos.

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INTRODUCTION

Snowboard U-shaped field skiing is to take off with the help of landslides in the specified "U"-shaped field, use your body and feet to control the direction, complete a variety of difficult movements in the air sports.¹ At present, the difficulty factor of athletes' movements is close to the world's advanced ranks, but the success rate of movements is slightly lower than that of international players, in particular, due to the low quality of movement completion, there are many mistakes in the landing movement of the next link, which has become one of the reasons that restrict athletes from further improving their sports performance.² Although existing studies have analyzed the characteristics of difficult movements in U-shaped skiing, they have not been able to deeply explore the dynamic behavior characteristics of athletes in the process of completing difficult movements due to various factors. Research on athletes' competition behavior suggests that, athletes may have negative thinking due to the interference of internal and external environment during the gap time, correct operation procedures can control attention distribution, prevent the reduction of preparation activities and strengthen the automatic completion function.³ Some scholars have analyzed the movement and technical characteristics of skiers, it was found that the angular velocity of the elbow joint and hip joint extension has a greater influence on the skiing speed.^{4,5} In the existing research, there are few studies on the influence of technical characteristics of corners on sports performance, and in the sprint stage of skiing, the sports performance of downhill turns is closely related to the overall competition performance.^{6,7}

Therefore, correctly understand the deficiencies and influencing factors of snowboard U-shaped skiers in completing difficult movements, it will help to further optimize its technical movements, improve the success rate of completing difficult movements, and promote the rapid development of snowboard U-shaped field skiing, ensure your actual level of performance and correct behavior.

METHOD

Research object

There are 12 snowboard U-shaped field skill athletes, including 6 men and 6 women. The average training period is more than 5 years, and they are all active athletes above the national second level, among them, there are 10 people with the right foot (that is, the front foot) with the left foot, 2 people with the right foot, and 1 male and 1 female.

Research methods

Expert interview method

In the form of phone calls, visits, emails, etc., the professional coaches of the competitive sports school of the College of Sports, the relevant experts of the ice and snow teaching and research department, the muscle strength test laboratory personnel of the key laboratory, and the functional leaders of the second department of skiing of the State Sports General Administration are consulted. We extensively solicited their opinions and suggestions on the author's research ideas, research methods, test plans and design of details.⁸

Documentation Law

According to the research needs of isokinetic technology, the author consulted a large number of sports biomechanics, sports training, sports medicine related literature, in addition, the library of the Institute of Physical Education consulted the books and a large number of literature research results related to this research, used the computer to search the CNKI, and downloaded more than 100 relevant literature materials, the collected snowboard U-shaped venue skills project information has laid a solid theoretical foundation for the research. At the same time, read the works and related research literature on the theory and method of muscle strength training, special strength measurement and evaluation, and isokinetic strength test research, combined with the project characteristics of snowboard U-shaped field skill sports and the relevant literature on muscle strength assessment research, comprehensive investigation and inspiration are provided to provide theoretical and technical basis for the research.

Experimental method

Test parameter setting: When setting the parameters of the isokinetic muscle strength test, this study solicited the opinions of a number of active coaches and experimental experts with rich testing experience, combined with the characteristics of the snowboard U-shaped field skills project, and determined the corresponding range of motion and acceleration angle. Choose to do 5 sets of flexion and extension movements at a slow speed of 60°/s, 9 sets of flexion and extension movements at a medium speed of 120°/s, and 15 sets of flexion and extension movements at a fast speed of 180°/s for testing.

Mathematical Statistics

SPSS18.0 statistical analysis software and Microsoft Excel were used to conduct comprehensive statistics on the data obtained from the test, supplemented by charts, an independent sample t test was performed on each index of the flexor and extensor strength of the bilateral hip and knee joints of the tested athletes, with $P < 0.05$ as a significant difference, and $P < 0.01$ as a very significant difference.⁹

Ethical Compliance

Research experiments conducted in this article with animals or humans were approved by the Ethical Committee and responsible authorities of Qiqihar Medical University following all guidelines, regulations, legal, and ethical standards as required for humans or animals.

RESULTS

The test results and analysis of the peak torque angle and joint range of motion of the knee flexor and extensor muscles are shown in Figure 1 and Figure 2.

As shown in Figure 1, the angle change of the peak torque of the knee joint of the men's snowboard U-shaped field skill athletes showed the peak torque angle of the extensor muscle group, which was significantly higher than the peak torque angle of the flexor muscle group; Under the same test speed, the angles of peak torque of bilateral knee joints are basically the same; With the increase of angular velocity, the peak torque angle of the extensor muscles on both sides of the knee joint has

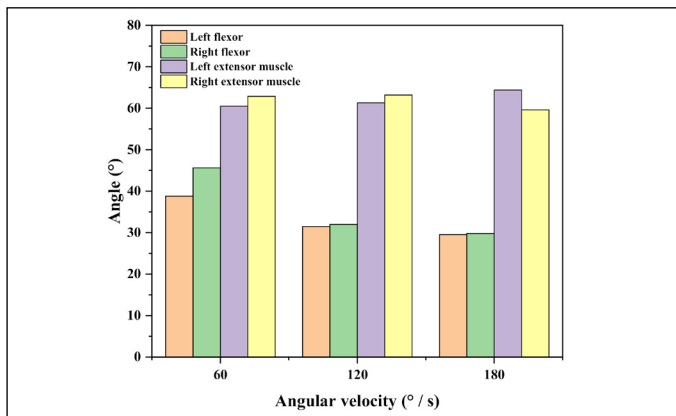


Figure 1. The relationship between the peak moment angle and angular velocity of bilateral knee joints of male snowboarders with U-shaped field skills.

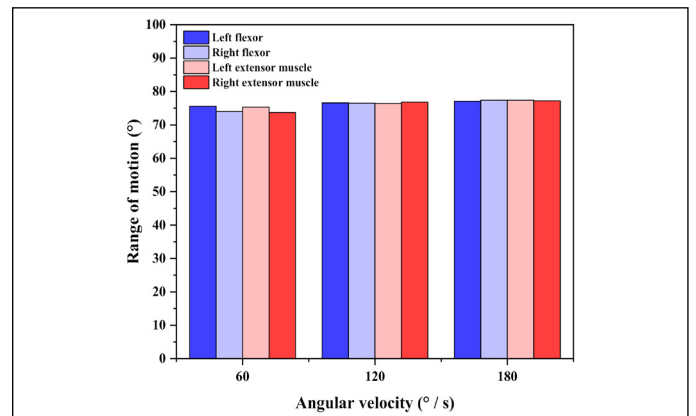


Figure 3. The relationship between the range of motion and angular velocity of bilateral knee joints in male snowboarders with U-shaped field skills.

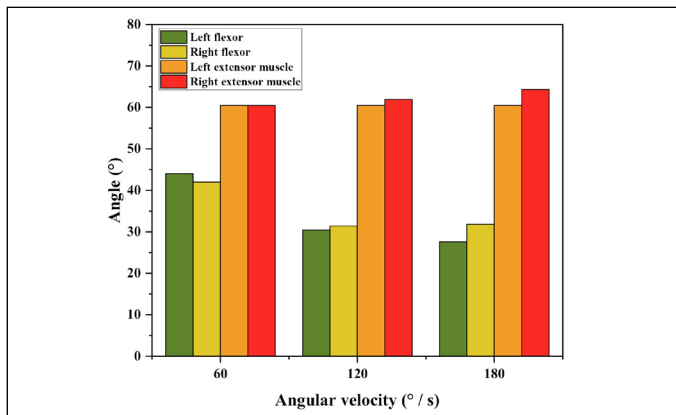


Figure 2. The relationship between the peak moment angle and angular velocity of bilateral knee joints of female snowboarders with U-shaped field skills.

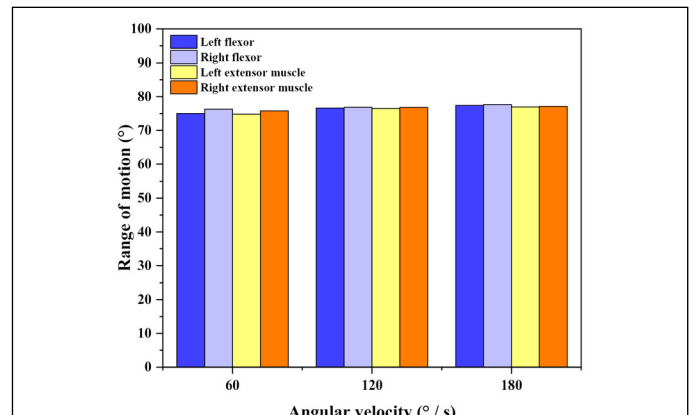


Figure 4. The relationship between the range of motion of bilateral knee joints and angular velocity of female snowboarders with U-shaped field skills.

no significant change, which indicates that there is a certain difference in the peak torque angle of the knee flexor and extensor muscles when completing a whole technical movement, the peak torque angles of the left and right flexors and extensors are basically the same.

As can be seen from Figure 2, the peak torque angle of the knee joint of the female snowboarder U-shaped field skill athletes also showed different trends in the flexor and extensor muscle groups, and the extensor muscle groups changed little under different angular velocities; The flexor muscles show the characteristics of rapid decline in the slow and medium speed environment, and deceleration and slow down from the medium speed to the fast environment. Compared with the male athletes, the left and right peak moment angles of the female athletes' knee joints are more balanced, the figure intuitively shows the obvious characteristics of the peak torque angle of the knee joint of female snowboarders, especially the extensor muscle group, the peak torque angle is generally concentrated between 59.4° and 64°.

As shown in Figure 3, the range of motion of the knee joint of male snowboarders with U-shaped field skills widens with the increase of angular velocity, and the range of motion of the flexor and extensor muscles of both knee joints is basically similar between 120°/s and 180°/s angular velocity, this point is consistent with the change characteristics of the hip joint, which reflects the U-shaped field skill movement of snowboard in fast sliding, special features with a wide range of motion.

As can be seen from Figure 4, the peak moment angle of the knee joint of female snowboarders with U-shaped field skills also widens with the increase of angular velocity, but compared with the hip joint, the range of motion of the knee joint is relatively small, and its flexibility needs to be further enhanced. Compared with male athletes, female athletes have a greater range of motion in the knee joint muscles.

DISCUSSION

The angle of the peak moment of the knee joint is the angle change of the knee joint when the angle between the thigh and the calf is 90 degrees as the starting position, if the knee angle is transposed, the knee angle = 90° + peak torque angle, overall, there is no significant difference in the peak torque angle of the extensor muscle groups on both sides of the knee joint, this shows that the peak moment angle of the left and right knees of the snowboard U-shaped field skills athletes is relatively consistent, which is conducive to the different lower limbs in the snowboard U-shaped field skills sports, coordinate the best technology. Previous studies have shown that, during fast concentric contraction, more fast twitch fibers are mobilized to generate torque, while in slow motion, slow twitch fibers are mainly mobilized, reflecting that when the knee joint performs flexion and extension, due to different angular velocity, the proportion of fast and slow muscles involved in contraction is also different, fast movement can mobilize more fast and slow fibers to participate, which is manifested in the minimum time and minimum angle to the peak muscle strength, this trend is most pronounced in the knee flexor muscle group.¹⁰

CONCLUSION

The completion of the technical movements of the veneer U-shaped field skiing depends on the athlete's sliding and acceleration; The behavioral performance of the three subprograms of execution action and landing end action in time and space, and the optimization of the behavioral program is the key to improving the success rate of the athlete's technical action. Focus on improving athletes' cognition of "fast" and "steady" within a certain reasonable threshold in time and

space. Seeking “fast” with “stable” means that it should be fast under the requirements that are conducive to the normal performance of the next link, and fast under the premise that it is conducive to the accurate completion of technical actions. At the same time, it is necessary to improve the ability of athletes to eliminate negative emotions in a timely manner, and to develop matching emotions in setback situations, so as to improve the ability of athletes to adapt to emotions and behaviors in different situations.

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REFERENCES

1. Stupina TA, Diuriagina OV, Mokhovikov DS, Stupina YA, Borzunov DY. Histomorphometric changes in the synovial membrane of the knee joint in combined use of the Ilizarov non-free bone plasty and the Masquelet technique (experimental study). *Genij Ortop.* 2021;27(2):249-53.
2. Li H, Cao Z, Xu D, Li H, Zhao B. Failure Mechanism of Recoil Device of Tank Gun Based On Technical Test Platform. *J Phys Conf Ser.* 2021;1744(2):022108.
3. Wang W, Lin T, He D, Li F, Wen S, Wang L, et al. Semi-Supervised Temporal Action Proposal Generation via Exploiting 2-D Proposal Map. *IEEE Trans Multimedia.* 2021;24:3624-35.
4. Udochkina LA, Grinberg EB, Galushko TG. Comprehensive Assessment of the Knee Joint Structures in Young Men and Men of the First Period of Adulthood Using Sonography. *J Anat Histopathol.* 2021;9(4):78-83.
5. Omondi W, Bett H, Njagi T. Influence of Collective Action Participation on Technical Efficiency among Smallholder Producers: A Case of Banana Farmers in Kisii and Nyamira, Kenya. *J Food Secur.* 2020;8(3):105-16.
6. Savaş K, Gökçe Y, Trigueros A, Yaras N. A simulation study on neuromuscular factors affecting consecutive motor unit action potential waveshape. *ESTUJST-A.* 2020;21(4):582-91.
7. Huang Q, Yao J, Li J, Li M, Pickering MR. Measurement of Quasi-Static 3-D Knee Joint Movement Based on the Registration from CT to US. *IEEE Trans Ultrason Ferroelectr Freq Control.* 2020;67(6):1141-50.
8. Song SK, Chae SB, Kang DW, Choi WK. Embolization for intractable spontaneous hemarthrosis of the knee joint in the elderly patient: Case report. *Medicine (Baltimore).* 2020;99(24):e20475.
9. Akhtyamov IF, Aidarov VI, Khasanov ER. Current methods of rehabilitation after arthroscopic reconstruction of the anterior cruciate ligament of the knee joint (review of literature). *Genij Ortop.* 2021;27(1):121-7.
10. Debnath S, Samuel AJ. Effect on dynamic postural stability after application of cold therapy to the knee joint: A pilot randomized controlled trial. *Physiother Q.* 2021;29(3):19-23.