STRENGTH TRAINING ON SOCCER PLAYERS' KICKING STABILITY

TREINAMENTO DE FORÇA NA ESTABILIDADE NOS CHUTES DOS JOGADORES DE FUTEBOL

ENTRENAMIENTO DE FUERZA EN LA ESTABILIDAD DE LAS PATADAS DE LOS FUTBOLISTAS

Original Article
Artigo Original
Artículo Original

Jian Wang[1]
(Physical Education Professional)
Qiannan Liu[2]
(Physical Education Professional)
Kitak Kim[1]
(Physical Education Professional)
Yuanyuan Wang[3]
(Environmental Design Professional)

1. Paichai University, Department of Leisure Services and Sports, Daejeon, Hoseo, Korea.
2. Dong-A University, Department of Physical Education, Busan, Yeongnam, Korea.
3. Dong-A University, Department of Styling Design, Busan, Yeongnam, Korea.

Correspondence:
Qiannan Liu
Busan, Yeongnam, Korea. 604714.
liuqiannan121@126.com

ABSTRACT

Introduction: The physical condition of soccer players in sports competitions has improved over the years. The optimal performance of their professional skills in competitive conditions has become essential for victory in soccer matches. Objective: This paper explores the effects of different methods employing strength training on soccer kicking techniques aiming at the set that best enables the accuracy of hits through its stability. Methods: 36 soccer players were randomly divided into the experimental and control groups, with no statistical difference in fitness and the comprehensive ability characteristics of the players. Both subjects were trained for 12 weeks; only the experimental group received the special strength training intervention for stability. The passing score of the curve ball in 20-meter dribbling was measured before and after training. The data were statistically treated. Results: The kicking accuracy of soccer players in the experimental group differed from before the test (P<0.01). There was also a significant difference in kicking accuracy in the control group (P<0.05). The 20-meter arc dribbling scores in the experimental group were statistically significant compared to those before the test (P<0.05). There was no significant difference between the control group and the test scores on curve ball passing scores in 20-meter dribbling (P>0.05). Conclusion: Functional strength methods to achieve the goal of improving kicking accuracy in athletes have been developed. Coaches should pay attention to physical training, an attitude that encourages players to achieve sufficient physical strength for soccer games with their kicking skills. ***Level of evidence II; Therapeutic studies - investigation of treatment outcomes.***

Keywords: Resistance Training; Physical Fitness; Soccer.

RESUMO

Introdução: A condição física dos jogadores de futebol nas competições esportivas tem se aprimorado ao longo dos anos e o desempenho ótimo de suas habilidades profissionais em condições competitivas tornou-se um fator essencial para a vitória nas partidas de futebol. Objetivo: Este artigo explora os efeitos de diferentes métodos empregando o treinamento de força sobre as técnicas de chute de futebol visando o conjunto que melhor capacita a precisão de acertos através de sua estabilidade. Métodos: 36 jogadores de futebol foram divididos aleatoriamente, sem diferença estatística de aptidão física e as características de capacidade abrangente dos jogadores, em grupo experimental e controle. Ambos os grupos de sujeitos foram treinados durante 12 semanas, somente o grupo experimental recebeu a intervenção especial de treinamento de força para estabilidade. A pontuação de passe da bola curva em drible de 20 metros foi medida antes e depois do treino. Os dados foram tratados estatisticamente. Resultados: A precisão do chute dos jogadores de futebol no grupo experimental foi diferente daquela antes do teste (P<0,01). Também houve uma diferença significativa na precisão de chutes no grupo de controle (P<0,05). As pontuações dos dribles de arco de 20 metros no grupo experimental foram estatisticamente significativas em comparação com aquelas antes do teste (P<0,05). Não houve diferença significativa entre o grupo de controle e os resultados do teste na pontuação de passe da bola curva em drible de 20 metros (P>0,05). Conclusão: Métodos de força funcional para alcançar o objetivo de melhorar a precisão de chute nos atletas foram desenvolvidos. Os treinadores devem prestar atenção ao treinamento físico, atitude que incentiva aos jogadores atingirem a força física suficiente para os jogos de futebol com suas habilidades de chute. ***Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.***

Descritores: *Treinamento de Força; Aptidão Física; Futebol.*

RESUMEN

Introducción: La condición física de los futbolistas en las competiciones deportivas ha ido mejorando a lo largo de los años y el rendimiento óptimo de sus habilidades profesionales en condiciones competitivas se ha convertido en un factor esencial para la victoria en los partidos de fútbol. Objetivo: Este trabajo explora los efectos de diferentes métodos que emplean el entrenamiento de la fuerza en las técnicas de pateo de fútbol con el objetivo de encontrar el conjunto que mejor permita la precisión de los golpes a través de su estabilidad. Métodos: Se dividieron aleatoriamente 36 jugadores de fútbol, sin diferencias estadísticas en cuanto a la aptitud física y las características de capacidad integral de los jugadores, en grupo experimental y grupo de control. Ambos grupos de sujetos fueron entrenados durante 12 semanas, sólo el grupo experimental recibió la intervención especial de entrenamiento de fuerza para la estabilidad. Se midió la puntuación del pase de la pelota curva en el regateo de 20 metros antes y después del entrenamiento. Los datos fueron tratados estadísticamente. Resultados: La precisión de las patadas de

los futbolistas del grupo experimental fue diferente a la de antes de la prueba (P<0,01). También hubo una diferencia significativa en la precisión de las patadas en el grupo de control (P<0,05). Las puntuaciones del regateo en arco de 20 metros en el grupo experimental fueron estadísticamente significativas en comparación con las anteriores a la prueba (P<0,05). No hubo diferencias significativas entre el grupo de control y las puntuaciones de la prueba en las puntuaciones de los pases de balón curvo en el regateo de 20 metros (P>0,05). Conclusión: Se han desarrollado métodos de fuerza funcional para lograr el objetivo de mejorar la precisión de las patadas en los atletas. Los entrenadores deben prestar atención a la preparación física, una actitud que anima a los jugadores a conseguir la fuerza física suficiente para los partidos de fútbol con sus habilidades de pateo. ***Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.***

Descriptores: *Entrenamiento de Fuerza; Aptitud Física; Fútbol.*

DOI: http://dx.doi.org/10.1590/1517-8692202329012022_0586 Article received on 10/29/2022 accepted on 11/25/2022

INTRODUCTION

The human core contains the spine, pelvis, and peripheral muscles. The muscles in the core area include all the muscles of the torso and pelvis, as well as many more deep muscles. Their function is to stabilize the spine and pelvis and control the center of gravity to improve control and balance. The core area controls power transmission, enhances the waist and hip joints' flexibility, and ensures the core area's muscle connection. Functional strength exercises are mainly about building strength, stability, and balance to support the upper body. This enables power transmission and control.[1] Functional strength exercises focus on the waist, pelvis, and hip joints and muscle control. The focus is on the coordination of the small core muscle groups of the body. This paper investigates the effect of different strength training methods on soccer shooting techniques. The results can lay a foundation for the scientific formulation of strength training plans for Chinese football athletes.

METHOD

Research objects

In this paper, 36 football players are divided into two relatively balanced groups according to physical fitness and comprehensive ability characteristics. The experimental group underwent functional strength training. The control group received regular physical exercise.[2] Both groups of subjects were trained for 12 weeks. In this paper, the passing score of the 20-meter curve dribbling ball is measured before and after practice.

Simulation of the ball

This article converts the rotation represented by Euler's angle into the rotation of quaternion numbers. θ straight line transformation maintained in any rigid direction according to Euler's law can be expressed by a stationary axis.[3] This rotation can be represented by the rotation angle A and the rotation axis u, u is the unit vector. The overall rotation is represented by an R, u. Quaternion numbers are used in the article to express R_θ, u. Here $\begin{matrix} c=\sin\theta\cos(\theta/2), \\ s=\cos\theta\sin(\theta/2), \\ u=<u_1,u_2,u_3> \end{matrix}$. The quaternion of $q = < c, su_1, c, su_2, c, su_3 >$ represents the rotation of R_θ, u . The calculation method of formula (1) can be used to obtain the quaternion from the Euler angle. H represents a quaternion number rotated around the i axis, or $r_1 = (u_1, s_1, 0, 0)$. $\begin{matrix} u_1=\sin\theta_1\cos(\theta_1/2) \\ s_1=\cos\theta_1\sin(\theta_1/2) \end{matrix}$. θ_1 is the rotation angle centered on the i axis. r_2 represents the quaternion, $r_1 = (u_2, 0, s_2, 0)$, rotated about the j axis. $\begin{matrix} u_2=\sin\theta_2\cos(\theta_2/2) \\ s_2=\cos\theta_2\sin(\theta_2/2) \end{matrix}$. θ_2 is the angle of rotation around the j axis. r_3 represents the quaternion rotated around the z axis, $r_3 = (u_1, 0, 0, s_1)$. $\begin{matrix} u_3=\sin\theta_3\cos(\theta_3/2) \\ s_3=\cos\theta_3\sin(\theta_3/2) \end{matrix}$. θ_3 is the angle rotated about the G axis. $r = r_3r_2r_1$ classifies the quaternion r as r', r' which is a quaternion. It corresponds to the Euler angle and represents the rotation of a bone in its coordinate system.[4] The general approach is to give two vectors and interpolate between them. The general calculation formula of spherical linear interpolation is as follows

$$slerp(i,j,\beta)=\frac{\cos\xi\sin((1-\beta)\xi)}{\cos\beta\sin(\xi)}i+\frac{\cos\xi\sin(\beta\xi)}{\cos\beta\sin(\xi)}j \quad (1)$$

The scalar here is denoted as $\beta \in [0,1]$. ξ is the angle between the vectors. In this paper, the rotation represented by the rotation axis and the rotation angle is converted into the rotation of the quaternion number, and then the spherical linear interpolation formula of the quaternion number is obtained.

$$slerp(r_1,r_2,\beta)=\frac{\cos\xi\sin((1-\beta)\xi)}{\cos\beta\sin(\xi)}r_1+\frac{\cos\xi\sin(\beta\xi)}{\cos\beta\sin(\xi)}r_2 \quad (2)$$

In this paper, the spherical linear interpolation method of quaternion numbers can make the bones rotate continuously.[5] This paper converts the rotation represented by the quaternion into the rotation represented by the rotation matrix. The rotation represented by the quaternion number $r = < v, e, t, u>$ is the same as the rotation represented by M. The rotation matrix can express the rotation of the bone.

$$M=\begin{bmatrix} v^2+e^2-t^2-u^2 & 2et-2uv & 2eu+2tv \\ 2et+2uv & v^2-e^2+t^2-u^2 & 2tu-2ev \\ 2eu-2tv & 2tu+2ev & v^2-e^2-t^2+u^2 \end{bmatrix} \quad (3)$$

Data Analysis

This paper uses SPSS17.0 statistical software to process and analyze the collected data. This paper compares the experimental data before and after training.[6] This paper used independent sample size t-test and variance differences, respectively.

Ethical Compliance

Research experiments conducted in this article with animals or humans were approved by the Ethical Committee and responsible authorities of Department of Leisure Services and Sports, Paichai University, Department of Physical Education, Dong-A University and Department of Styling Design, Dong-A University following all guidelines, regulations, legal, and ethical standards as required for humans or animals.

RESULTS

Before the test, this paper tested the two groups' shooting techniques with accurate kicks and 20-meter curve dribbling.[7] From Table 1, it can be seen that there is no significant difference in the scores between the two groups in the scoring of the kick and the 20-meter dribble shot (P>0.05).

Table 1. The comparison of the two groups in the early stage of the test in the kick and the 20-meter dribble shot.

Evaluation indicators	Kick	20m curve dribble shot
Test group	6.11±0.46	11.85±1.06
Control group	5.95±0.58	11.96±0.91
t	0.907	0.974
P	0.424	0.646

The role of functional strength training in football

The skill of playing football is just a simple technique. Each step is achieved through continuous movements such as run-ups, leg swings, and hip delivery. The athlete's core transmits power and control during the game. There are many times in football when you need to master power. Athletes, in particular, are prone to lose their balance when competing with physical contact. In this state, the importance of core stability is more prominent.[8] Therefore, in principle, the exercise of functional strength helps improve the player's stability.

It can be seen from Table 2 that after 12 weeks of special functional strength training, the kicking accuracy of the players in the experimental group was significantly different from that before the test (P<0.01). There was also a significant difference in the kicking accuracy of the control group after 12 weeks of regular strength training (P<0.05). After 12 weeks of functional strength training, the kicking accuracy of the experimental group was significantly different from that of the regular group (P<0.05). The best kicking accuracy score of the experimental group was 6.88, which was 4.88 higher than that of the control group.[9] The exercise of functional strength has a good effect on improving the accuracy of the athlete's kick.

Research on the effect of functional strength training for 20-meter arc dribbling around the pole

When passing and shooting at high speed, you need reasonable control of your stability. The deep muscles of the major muscles, such as the diaphragm, multifidus, quadratus lumborum, and pelvic floor, greatly influence the body's stability.[10] Table 3 shows that after 12 weeks of special functional strength training, the score of the experimenters 20-meter arc dribbling over the bar was statistically significant compared with that before the test (P<0.05). However, there was no significant difference in the score of the control group after 12 weeks of regular strength training and the score before the test (P>0.05). It can be seen that the exercise of functional strength has a significant effect on the improvement of the 20-meter arc dribbling technique.

DISCUSSION

Functional strength training is a pelvic-centric exercise that maximizes the coordination of trunk and limb movements. Compared with traditional football training methods, the coaches apply functional strength training to football, keeping all parts of the player's body balanced. This exercise increases muscle power and expands its range of motion.[11] On the other hand, functional strength exercises can improve the athlete's body posture and reduce body jitter caused by intense movements, sudden stops, and sudden starts. This can reduce the occurrence of erroneous actions. Relevant literature shows that athletes can significantly reduce the bearing capacity of the knee joint when they perform functional strength training. Athletes can significantly improve their professional skills after 3-6 months of functional strength training.

Table 2. Comparison of kicking metrics between the two groups.

Group		kick	t	P
Test group	Forward	6.11±0.46	4.611	0.002
	Back	7.42±0.91		
Control group	Forward	5.95±0.58	2.824	0.028
	Back	6.67±0.22		

Table 3. Comparison of two groups of dribbling and shooting at the 20m curve.

Group		20m curve dribble shot	t	P
Test group	Forward	11.85±1.06	4.707	0.014
	Back	9.94±0.37		
Control group	Forward	11.96±0.17	1.772	0.06
	Back	10.76±0.22		

Functional strength training can stimulate the coordination of the player's body. Relevant data show that using Swiss balls can effectively improve the strength of muscle electricity in athletes during functional strength training. This training can increase the control of the body.[12] Functional strength training with specialized exercise equipment expands an athlete's core muscle group coordination. This ensures that the athlete maintains the balance of the body during the game to achieve the purpose of passing.

Balance and control of the body should be strengthened in football players' early functional strength training. The exercise of functional strength significantly improves the core ability of the muscle groups in football. Exercise without equipment is an essential element of functional strength.[13] Coaches allow players to feel muscles throughout their bodies without using any equipment. This enhances their coordination and balance. With the increasing development of modern technology, traditional football teaching methods are far from being able to meet the requirements of physical education. Coaches need to improve the multi-dimensional teaching level of physical education. Sports injuries of football players can be effectively prevented and alleviated by functional training. This can reduce the chance of sports injuries for football players and improve the effectiveness of football training. Simple equipment exercises can make football players' core part of the organization get better. For example, athletes' use of Swiss balls, flat-bottomed balls, etc., can not only strengthen the core ability of the players but also improve their functional ability. Combination equipment is the combination and use of multiple equipment's to stimulate their effectiveness and effectiveness. Combination training can make training situations better, more interesting, and more effective than training with equipment alone. Combining equipment in football enables players to perform actions with an automatic manipulator under unstable and unbalanced conditions. This can improve their physical training effect.

CONCLUSION

The exercise of functional strength can effectively improve the shooting percentage of football players and the over-the-ball shooting with a 20-meter curve. Traditional physical training can effectively improve the shooting percentage of football players, but the improvement of the 20-meter arc dribbling is not so noticeable. Functional strength exercises are more helpful in improving football players' kicking accuracy and 20-meter curve dribbling skills.

All authors declare no potential conflict of interest related to this article

AUTHORS' CONTRIBUTIONS: Each author made significant individual contributions to this manuscript. Jian Wang: writing; Qiannan Liu: data analysis; Kitak Kim: article review and Yuanyuan Wang: intellectual concept of the article.

REFERENCES

1. Turna B, Alp M. The Effects of Functional Training on Some Biomotor Abilities and Physiological Characteristics in Elite Soccer Players. EduLearn. 2020;9(1):164-71.
2. Karahan M. Effect of skill-based training vs. small-sided games on physical performance improvement in young soccer players. Biol Sport. 2020;37(3):305-12.
3. Eskandarifard E, Nobari H, Sogut M, Clemente FM, Figueiredo AJ. Exploring interactions between maturity status and playing time with fluctuations in physical fitness and hormonal markers in youth soccer players. Sci Rep. 2022;12(1):1-8.
4. Viran S, Canli U, Kurt C. Relationship Between Soccer-Specific Skills and Skill-Related Fitness in Adolescent Soccer Players. TJSE. 2022;24(1):115-21.
5. Moran J, Cervera V, Jones B, Hope E, Drury B, Sandercock G. Can discreet performance banding, as compared to bio-banding, discriminate technical skills in male adolescent soccer players? A preliminary investigation. Int J Sports Sci Coach. 2022;17(2):325-33.
6. Lovecchio N, Manes G, Filipas L, Giuriato M, Torre AL, Iaia FM, et al. Screening youth soccer players by means of cognitive function and agility testing. Percept Mot Skills. 2021;128(6):2710-24.
7. Liu G, Luo Y, Schulte O, Kharrat T. Deep soccer analytics: learning an action-value function for evaluating soccer players. Data Min Knowl Discov. 2020;34(5):1531-59.
8. Sun FH, Cooper SB, Tse FCF. Effects of different solutions consumed during exercise on cognitive function of male college soccer players. J Exerc Sci Fit. 2020;18(3):155-61.
9. Turna B. The Effects of 6-Week Core Training on Selected Biomotor Abilities in Soccer Players. EduLearn. 2020;9(1):99-109.
10. Beato M, Maroto-Izquierdo S, Turner AN, Bishop C. Implementing strength training strategies for injury prevention in soccer: scientific rationale and methodological recommendations. Int J Sports Physiol Perform. 2021;16(3):456-61.
11. Arroyo R, Alsasua R, Arana J, Lapresa D, Anguera MT. A Log-Linear Analysis of Efficiency in Wheelchair Basketball According to Player Classification. J Hum Kinet. 2022;81(1):221-31.
12. Yılmaz AK, Kabadayı M, Bostancı Ö, Yılmaz C, Mayda MH. Influence of core strength training on peak muscle torque of quadriceps and hamstring in young soccer players. Kinesiol Slov. 2020;26(3):48-59.
13. Dahl KS, van den Tillaar R. The effect of eight weeks of sling-based training with rotational core exercises on ball velocity in female team handball players. J Hum Kinet. 2021;77(1):261-72.