COMPARATIVE ANALYSIS OF KNEE MUSCLE DAMAGE OF DIFFERENT ATHLETES

ANÁLISE COMPARATIVA DE DANOS NO MÚSCULO DO JOELHO EM DIFERENTES ATLETAS

ANÁLISIS COMPARATIVO DE DAÑOS EN EL MÚSCULO DE LA RODILLA EN DIFERENTES ATLETAS

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ABSTRACT

Introduction: The knee joint is the most complex weight-bearing joint in the human body. An athlete's knee joint is prone to injury in competitive sports; it is one of the most common injuries and, in some sports, severe meniscus and cruciate ligament injuries occur frequently as, for example, in handball and soccer, and can even end the career of an elite athlete. Objective: To explore the comparison of knee flexion and extension force injury in different athletes. Methods: The characteristics of the flexor and extensor muscle of the knee joint in handball, football and cycling were studied with the isokinetic technique. Results: The role of the knee joint in different types of sports played by athletes is obviously different, which leads to the different requirements of the flexor and extensor muscle in the knee joint. Conclusions: The key to improving the conditions of superior strength and preventing sports injury is to develop the features of specific strength reasonably. ***Level of evidence II; Therapeutic studies - investigation of treatment results.***

Keywords: Arthroplasty; knee; Anterior cruciate ligament reconstruction.

RESUMO

Introdução: A junta do joelho é uma das articulações de suporte de peso mais complexos no corpo humano. A junta do joelho de um atleta é suscetível a lesões em esportes de competição; é uma das lesões mais comuns e, em alguns esportes, lesões do menisco e do ligamento cruzado ocorrem com frequência como, por exemplo, em handebol e futebol, e pode inclusive levar ao fim da carreira de um atleta de elite. Objetivo: Explorar a comparação entre lesões por força de flexão e extensão do joelho em diferentes atletas. Métodos: As características dos músculos flexor e extensor da junta do joelho no handebol, futebol e ciclismo foram estudadas através da técnica isocinética. Resultados: O papel da junta do joelho em diferentes tipos de esporte praticados por atletas é obviamente diferente e leva a diferentes exigências dos músculos flexor e extensor na junta do joelho. Conclusões: O essencial para a recuperação das condições de força máxima e a prevenção de lesões nos esportes é desenvolver as características de forças especificas de forma razoável. ***Nível de evidência II; Estudos terapêuticos – investigação de resultados de tratamento.***

Descritores: *Artroplastia; Joelho; Reconstrução do ligamento cruzado anterior.*

RESUMEN

Introducción: La articulación de la rodilla es una de las articulaciones de soporte de peso más complejas en el cuerpo humano. La articulación de la rodilla de un atleta está susceptible a lesiones en deportes de competición; es una de las lesiones más comunes y, en algunos deportes, lesión del menisco y del ligamento cruzado ocurren con frecuencia, como, por ejemplo, balonmano y fútbol, y puede incluso llevar al fin de la carrera de un atleta de élite. Objetivo: Explorar la comparación entre lesiones por fuerza de flexión y extensión de la rodilla en diferentes atletas. Métodos: Se estudiaron las características de los músculos flexor y extensor de la articulación de la rodilla en el balonmano, fútbol y ciclismo a través de la técnica isocinética. Resultados: El papel de la articulación de la rodilla en diferentes tipos de deporte practicados por atletas es obviamente diferente y lleva a distintas exigencias de los músculos flexor y extensor en la articulación de la rodilla. Conclusiones: El esencial para la recuperación de las condiciones de fuerza máxima y la prevención de lesiones en los deportes es desarrollar las características de fuerzas específicas de forma razonable. ***Nivel de evidencia II; Estudios terapéuticos – investigación de resultados de tratamiento.***

Descriptores: *Artroplastia; Rodilla; Reconstrucción del ligamento cruzado anterior.*

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INTRODUCTION

With the development of world football, fast, high antagonism and uncertainty have become an indispensable part of football projects. Therefore, football has become a high-risk sport for sports injury. In the injury of football, knee joint, class joint injury, muscle strain occupies a large proportion. Although knee joint injury is not the most common sports injury in football, it will have a serious impact on athletes because of its long recovery time and difficult recovery.[1]

Knee joint is one of the most complex joints in the human body plays an important role in many sports. As the knee flexion and extension

movement of the main original muscles, muscle quadriceps and posterior femoris muscle group strength on the completion of technical movement and create good sports results have a very important impact. Therefore, studies at home and abroad continue. Misook H, Han D. et al. verified the muscle mechanical properties of different knee flexor and extensor muscles and the mutation signals (table) in the isokinetic concentric mode of flexor and extension at different angular velocity, in order to provide some scientific basis for sports training and injury rehabilitation.[2]

In this study, three sports, handball, bicycle and football, were selected to explore the characteristics of different strength quality of knee flexor and extensor muscle group. In order to evaluate the strength of knee flexor and extensor muscle group of athletes in specific sports and diagnose the weak links of strength quality, and the prevention of some sports injuries and the formulation of isokinetic strength training programs to provide scientific reference basis.[3]

METHOD

Test Objects

A total of 28 athletes, including 8 cyclists, 8 handball players (excluding the goalkeeper) and 12 football players (excluding the goalkeeper), were selected as the research objects. The basic information of the athletes is shown in Table 1. All the selected athletes have no history of knee disease (the evaluation criteria are no swelling, pain or limitation of movement in the knee joint and the anterior and posterior muscle groups), and the range of motion of the knee joint is normal.

Testing Instruments

The isokinetic muscle strength testing instrument was the Cybex-Norm isokinetic muscle strength testing and rehabilitation system (Cybex International,Inc. Ronkonkoma,New York), and the test results were automatically processed and printed by the computer.[4]

Pre-test preparation and test process

Before the test, participants were required to perform 15min preparation activities, including bilateral knee flexion and extension activities and stretching exercises, and to exercise at sub-extreme strength for 3 times at the test angular velocity, so as to be familiar with the whole test process. For the isokinetic muscle strength testing system, the instrument system calibration, zero adjustment and other mechanical routine calibration were carried out, and the range of joint motion was set. The range of joint motion was required to be the same for all testers, ranging from 0° to 100.[5] During the test, the subject was seated with his thighs perpendicular to his trunk, and his upper body and thighs were fastened with a wide belt. His hands were placed naturally on the handles on both sides. The resistance pad connected to the dynamometer was fixed at 3cm above the subject's lateral ankle, and the rotation axis of the power head was aligned with the external femoral condyle and connected in a straight line with the external femoral condyle. According to foreign scholars' classification criteria for testing maximum strength quality below 120°/s and rapid strength quality above 120°/s , combined with the characteristics of sports events, 90°/s and 300°/s were selected as the active angular velocities of isokinetic test to reflect the maximum strength quality and fast strength quality characteristics of flexor and extension muscle group of knee joint of athletes. The number of tests is 90°/s×5 times and 300°/s×20 times, represents maximum strength quality and fast strength quality, respectively. The interval time between the two muscle strength tests is 20s, the test sequence of both knee joints was random, and the test interval was 5-8min. Each subject was given sufficient verbal encouragement during the test.[6,7]

Table 1. Basic information of athletes.

	Handball (N=8)	The bicycle (N=8)	Football (N=12)
Age (y)	23.6±2.2	21.3±1.8	26.0±3.9
Height (cm)	176.0±3.6	170.3±2.6	167.9±3.9
Weight (kg)	67.8±4.4	62.3±4.3	57.6±4.0

RESULTS

Comparison and analysis of maximum strength quality of flexor and extensor muscles of knee joint during slow exercise

The data in Table 2 and 3 are the characteristic parameters that mainly reflect the maximum strength quality of knee flexor and extensor muscle group of athletes in different sports. According to the role of bended knee muscle group in different sports events and combined with the data in Table 2, it was found that although there was no significant difference in bended knee muscle group among athletes in the three sports of absolute maximum strength quality ($P > 0.05$), however, the maximum flexion muscle strength of football players was significantly worse than that of cyclists ($P < 0.01$).[8]

According to the technical and joint function characteristics of the three kinds of sports, the extensor knee muscles are all active muscles, but the requirements for strength quality are different. As shown in Table 2, although there was a significant difference in absolute maximum strength of the extensor knee muscle group ($P < 0.05$), handball was the largest, followed by cycling and football, when body weight was taken into account, there was no significant difference in relative maximum strength (P BBB 0 0.05), it shows that the effect of extensor knee muscle group is similar in the three kinds of sports, so the relative maximum strength should be used for comparative analysis in practice. As can be seen from the data in Table 3, the peak torque angles of knee flexion and extension muscles at the occurrence of maximum force are significantly different ($P < 0.01$), and the knee flexion and extension peak torque angles of cyclists are the smallest, followed by football and handball.[9]

DISCUSSION

Comparison and analysis of the strength quality of flexor and extensor muscles of knee joint during rapid exercise

As shown in Table 2 and 4, with the increase of exercise speed, the peak torque ratio of flexor and extensor muscles of the knee joint

Table 2. Comparison and analysis of peak torque under slow motion.

90°/S	Handball	The bicycle	Football	X2	P
Knee peak moment (Nm)	93.3±16.2	101.9±12.8	93.7±11.0	4.674	0.097
Relative buckling moment(%BW)	47.4±7.0	57.9±6.1	56.0±6.3	17.849	0.000
Knee extension peak moment (Nm)	154.4±17.0	140.5±22.2	137.2±19.9	7.611	0.022
Relative peak torque (%BW)	76.8±8.5	78.9±4.3	80.9±9.7	1.865	0.394
Ratio of flexion and extension peak moments (%)	61.8±7.5	73.2±7.7	69.2±9.9	11.094	0.004

Table 3. Comparative analysis of peak torque Angle under slow motion.

	Handball	The bicycle	Football	X2	P
Knee peak torque Angle (°)	31.4±9.0	20.4±9.1	29.4±6.3	13.446	0.001
Knee extension peak torque Angle (°)	7.3±5.8	61.8±3.8	62.0±4.4	11.227	0.004

was increased in all events except the cycling event. There was no difference in the peak torque ratio of flexor and extensor muscles of knee joint in the three types of sports. Cyclists in a large speed range (90°/s ~ 300°/s) show the relative stability of the peak torque ratio of flexor and extensor muscles of the knee joint, which ensures the stability and coordination of the knee joint in sports, so there are less sports injuries of the knee joint, while football and handball events are on the contrary.[10-11]

Correlation analysis of two kinds of strength qualities in different sports

As can be seen from the data in Table 5, for handball events, there is no significant correlation between absolute maximum strength and fast strength due to the need to overcome one's own weight during the exercise, however, there was a significant correlation between the relative maximum strength and fast strength, in which the flexion muscle group was highly correlated ($r=0.86$, $P < 0.01$), the extensor knee muscle group was moderately correlated ($r=0.62$, $P < 0.01$).[12]

Table 4. Comparison and analysis of peak torques under fast motion.

300°/S	Handball	The bicycle	Football	X2	P
Knee peak moment (Nm)	56.7±10.2	65.7±8.4	51.9±8.7	14.811	0.001
Relative buckling moment(%BW)	26.3±9.1	35.5±4.7	32.4±5.6	10.167	0.006
Knee extension peak moment (Nm)	73.1±10.4	83.2±8.0	68.6±9.5	18.406	0.000
Relative peak torque(%BW)	33.9±9.6	45.0±4.2	42.6±3.5	20.858	0.000
Ratio of flexion and extension peak moments (%)	77.6±10.0	77.8±6.3	75.5±5.8	1.208	0.547

Table 5. Correlation analysis of the two kinds of strength qualities.

Strength/Project		Handball		The bicycle		Football	
		Buckling	Straight	Buckling	Straight	Buckling	Straight
Absolute power	r	0.353	0.356	-0.706	-0.307	0.090	0.236
	p	0.090	0.088	0.001	0.247	0.338	0.133
The relative strength	r	0.864	0.623	0.198	0.231	0.547	-0.005
	p	0.000	0.005	0.420	0.052	0.003	0.490

CONCLUSION

A method of constant velocity force measurement technology is presented in this paper. The concrete contents of this method 1. Comparison and analysis of the maximum strength quality of flexor and extensor muscle group of knee joint during slow movement; 2. Comparison and analysis of the strength quality of flexor and extensor muscles of knee joint during rapid exercise; 3. Correlation analysis of two kinds of strength qualities in different sports; It is observed through experiments that the role of knee flexor and extensor muscles in sports and the specificity of strength components of knee flexor and extensor muscles in athletes of different events are obviously different, and the strength quality of knee flexor and extensor muscles in athletes of dominant events of upper and lower limbs is easy to be ignored. The main manifestations were weak flexion muscle strength, increased peak torque Angle and small ratio of flexion and extension peak torque. Thus affect the stability of the knee joint in sports, and then prone to knee joint and flexor and extensor group of motor injuries. This method proved that different sports have different specific requirements on the strength quality of flexor and extensor muscle group of knee joint, and it is the key to improve the special strength quality and prevent sports injuries to develop different strength quality components reasonably according to the special characteristics.

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