Effects of Different Running Modes on Facial Cartilage of Knee Joint

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Abstract. In order to understand the effect of different exercise modes on articular cartilage, to provide theoretical basis for the treatment of articular cartilage injury by exercise therapy, and to provide a reference for the selection of exercise mode in the daily exercise of the general population. In this paper, we use computer to search the Chinese knowledge Network, Wei pu Journal, Wan fang data, consult the library of the school, collect the works related to the influence of different movement ways on articular cartilage, and analyze the influence of different exercise modes on articular cartilage. According to the process mechanism of cartilage wear, the bio-mechanical analysis of knee joint under different exercise modes and the change of cartilage composition of knee joint face are introduced, and the effects of different exercise modes on articular cartilage in treadmill exercise are summarized.

Preface

Treadmill is one of the most popular aerobic exercise equipment. Treadmill has better buffer function, but long-term improper exercise is prone to knee injury. The choice of exercise mode is closely related to the effect of exercise and the injury of articular cartilage. The speed and slope of the treadmill can be adjusted to control the intensity of movement, but if the control is unreasonable, the load on the knee joint is large, and it is easy to cause cartilage injury in the knee joint in the long run. Many experimental studies mainly control the intensity of motion by adjusting the speed, and the slope is another cause of knee joint injury. The structure of the knee joint is very complex, and the load on the lower extremity motion is very great. The structure of cartilage attached to the articular surface is very fine and scientific, which is of great significance to the movement of the joint. The research on the influence of different sports modes on the articular cartilage of the knee joint has developed gradually in the last decade, and the amount of Chinese papers on the influence of running on the knee joint on the cartilage is also increasing. The effect of exercise on the injury and repair of articular cartilage is one of the important research contents of osteoarthritis. In this paper, by analyzing the research results of cartilage injury caused by exercise at home and abroad in the last 10 years, we will review the effects of different exercise modes on the articular cartilage of the knee joint, and provide a reference for runners. Promote the common people to use the treadmill correctly, reasonable and scientific and effective exercise.

Knee-Joint

The Structure of the Knee Joint

The knee joint between femur and tibia mainly contains three bones of femur tibia and patella. There are meniscus winglike fold suprapatellar capsule and other auxiliary structures in the joint to deepen the reinforcement of the joint and the outer ligament to reinforce the joint and restrict the joint movement. The structure of knee joint is complex, but it is the main bearing joint of lower extremities, so it is very easy to be injured.

Kinematic Characteristics of Knee Joint

The knee joint mainly moves around the coronal axis and slightly around the vertical axis.When the knee joint is fully stretched, the intercondylar eminence of the tibia is embedded in the femoral inter-condylar fossa, and the knee joint cannot be rotated. When the knee joint is flexion, The posterior part of the medial and lateral condyle of the femur enters the articular fossal, and the femoral tibial joint can rotate slightly around the vertical axis [1].[Knee joint is one of the most important joints with lower extremity transmission and load. If the movement mode is not correct, it is very likely to cause acute injury of knee joint, and the accumulation of long-term injury may also lead to osteoarthritis of knee joint.

Bio-Mechanical Analysis of Knee Joint

The average peak value of the reaction force of the knee joint was 2.8 times of the body weight, 4.3 times of the body weight when walking fast, 3.7 times and 4.4 times of the body weight on the up and down slope, respectively. Times [2]. Some studies have found that the maximum amplitude of knee joint flexion is between 111.30and 122.5 °in static state, the maximum motion range of extension is between 8.0 °and 11.0 °, and the maximum amplitude of knee joint flexion is between 131.4 °and 142.0 °in dynamic state. Thambgah et al found that when the depth flexion of knee joint exceeds 120 °, the joint contact pressure increases by 80%, and it is easy to cause cartilage injury [4]. The pressure on the knee joint is not only related to the angle of knee bend, but also to the inclination of the body such as trunk and calf. When running on the platform, the angle from foot to torso will change with the change of slope, and the stress on the knee joint will be different. In the early phase of support, the tension of patellar ligament and tibial plateau increased first and then decreased with the increase of slope. The tension of patellar ligament increased from 2 °to 5 °at the later stage of support, and then increased from 50to 80. The tension of patellar ligament decreased significantly at 0 °to 2 °, increased at 2 °to 5 °, and decreased at 5 °to 8 °. The results indicated that the tension of tibial plateau decreased from 2 °to 5 °. The injury of articular cartilage was less.

Articular Cartilage

Cartilage Composition

Articular cartilage is a smooth interface covering the relative bone surface of the active joint, which has the functions of absorption, cushioning stress and reducing joint friction. It consists mainly of chron-drocytes, fibers and matrix, and the perichondral membrane. Articular cartilage is only a few fibrocartilage, mostly hyline cartilage. 50% of cartilage is collagen, the main component is acidic glycosaminoglycan (glycosaminoglycans,GAG), forming cartilage matrix. Collagen plays an important role in the growth and development of bone. Type II collagen is produced by chondrocytes.

Mechanism of Articular Cartilage Injury

Matrix Metalloproteinase (MMPs) and Metalloproteinase (ADAMTAS-5).

Matrix metalloproteinases (matrix metalloproteinases,MMPs) are classified into MMP1-MMP20,. Matrix metalloproteinase 3 (MMP3) is a kind of matrix lysin, mainly secreted by chondrocytes. It can degrade many kinds of matrix proteins, such as polyproteoglycan, II collagen and elastic fiber, which lead to the degradation and synthesis imbalance of extracellular matrix, and eventually lead to the death of chondrocytes. Matrix metalloproteinase inhibitor (TIMPs) can inhibit the expression of matrix metalloproteinase. Local MMPS and TIMPS formed a dynamic balance to maintain the normal function of cartilage [6]. Similar to MMPs, metalloproteinases (ADAMTAS-5) can degrade polyproteoglycan, resulting in the loss of cartilage matrix.

Cell Factor.

These include catabolic cytokines and synthetic cytokines, which are in a dynamic balance and regulate the synthesis and catabolism of cartilage matrix. When its balance is out of balance, it may

cause excessive expression of decomposing cytokines and lead to degradation of cartilage matrix. Many studies have focused on interleukin (Interleukin, IL-1) and tumor necrosis factor (Tumor necrosis factor,TNF (TNF- (Tumor necrosis factor,TNF). IL-1 can stimulate chondrocytes to produce MMPs, and promote the degradation of chondrocytes.

Stress Magnitude.

When the knee joint lacks movement, the articular surface cartilage is not pressed enough, and its nutrition is short, which results in the accumulation of fine cartilage damage for a long time. The ability of articular cartilage to bear stress is limited, its distribution is uneven, or the value is too large. When the knee joint exercise load is too large, the stress of articular cartilage is more than it can bear, which cause cartilage will wear. When the stress continues to increase and is transmitted to the subchondral bone, it may result in the fracture of the subchondral bone.

Effects of Different Exercise Modes on Articular Cartilage

Effects of Different Intensity Exercise on Articular Cartilage

When the motion of different intensity is carried out, the condition of the knee joint is different, the influence of the articular surface cartilage is different, the wear of the normal cartilage can be caused, and the repair of the damaged cartilage can be facilitated. The tissue morphology of the cartilage is directly observed, This conclusion shows that the content of GAG is obviously increased after the low-intensity exercise, and it is clear that this result is different from the earlier experimental results. The experiments of the two experiments showed that the two experiments were used to exercise the different intensity of the rats, and after the exercise, the articular surface cartilage of the knee joint of the rats was used for the red-O staining. But in the latest experimental study, rats were given electrical stimulation during the exercise of different intensities to ensure the rat's continuous movement. the electrical stimulation may also have an effect on the results of the experiment, and it is also possible that the physical constitution of the rat in the experiment is different, the environmental conditions at the time of the exercise are different, but a conclusion can be obtained, The high-intensity sports meet causes the concentration of matrix metalloproteinase-3 (MMP-3) to increase, resulting in a reduction of the type II collagen structure and the gly cosaminoglycan (GAG), resulting in the destruction of the articular surface cartilage, The low-intensity exercise has a positive effect on the cartilage, or it can cause the damage of the cartilage to be further explored.

Effect of Different Intensity Exercise on Repairing Defect Cartilage

Based on the influence of exercise training on the cartilage of articular surface, many experts and scholars have been studying the effect of exercise training on repairing defect cartilage in recent years. Early experiments showed that the concentration of matrix metalloproteinase 3 (MMP-3) and matrix metalloproteinase-1 (TIMP-1) increased after exercise training, but the ratio of TIMP-1/MMP-3 concentration decreased. The total effect on articular cartilage was destruction, and the ratio of high intensity exercise was lower than that of middle and low intensity exercise, and the content of glycosaminoglycan (GAG) in cartilage was also lower. It is suggested that early exercise is not conducive to repair of damaged articular cartilage [1213]. In addition, it was confirmed that the concentration of protein-matrix degrading enzyme (MMP13,ADAMTS4,ADAMTS5) increased after running, which accelerated the degradation and calcification of articular cartilage matrix [14]. Therefore, for the patients with articular cartilage injury, we should try to avoid heavy exercise in early rehabilitation to prevent further injury and aggravate the condition of injured cartilage, and early articular cartilage injury can be as much as possible bed rest, reduce exercise. However, recent studies have found that the concentration of MMP-3,TIMP-1 is higher than that before exercise, and the contents of MMP-3,TIMP-1 and glycosaminoglycan after moderate intensity exercise are higher than those after low intensity exercise and high intensity exercise. The content of TIMP-1 and glycosaminoglycan, which indicated that moderate intensity exercise, might promote the repair of

articular surface cartilage defect

Effects of Different Gradient Exercise on Articular Cartilage

When running on different slopes including flat land and up and down slopes, the intensity of motion will be different, and the stress of knee joint will be different, which will result in different effects of facial cartilage of knee joint. Exercise will bring certain changes to their weight, their weight load will also have a certain impact on the knee joint. The expression of II type collagen mRNA and Aggrecan mRNA in articular cartilage decreased after exercise, and the expression of II type collagen in cartilage matrix after uphill exercise was lower than that in plate exercise, and the expression of Aggrecan in plate exercise was lower than that in downhill exercise. The results showed that the injury of articular cartilage caused by uphill slope exercise was greater than that by plate exercise, and that by downhill exercise on articular surface cartilage [16]. The expression of TNF-Q,IL-l BmMMP-3 mRNA in knee articular cartilage increased after exercise, especially after uphill exercise, which proved that the incidence of cartilage injury in uphill exercise was higher than that in downhill exercise. The injury of upper slope motor cartilage appeared earlier [17]. In the actual exercise, there is no downhill mode on the treadmill, and in order to increase the amount of exercise and few people adopt downhill exercise, the study of downhill exercise has certain significance for rehabilitation treatment of knee joint injury patients.

Effects of Persistent Passive and Active Motion on Articular Cartilage

In the exercise therapy of knee osteoarthritis, there are two ways of active and passive motion, and the therapeutic effect is different. It is proved that both early passive motion and active movement are beneficial to the repair of articular cartilage, but passive exercise has a better effect on the repair of articular cartilage [18]. Articular cartilage injury patients are active because they control the active contraction of muscles, which can stimulate their own repair function. Because the load of joint stimulates the secretion of synovial fluid, it is beneficial to the metabolism of nutrients in articular cartilage, but there are differences in the subjective feeling and the understanding and control of the movement of the patients themselves. Studies have shown that continuous passive exercise can stimulate the transformation of cartilage mesenchymal cells into chondrocytes, thus promoting the synthesis of extracellular matrix. Balance the synthesis and degradation of extracellular matrix and promote the recovery of cartilage injury [20]. It can be seen that the braking after joint injury needs control time, and the joint should be in a certain intensity of movement at the right time. Continuous passive exercise for 8 hours per day for 8 hours a day for articular cartilage injury was the best for repair of articular cartilage [21]

Conclusion

The patients with articular cartilage injury should choose the exercise mode reasonably and can be rehabilitated by continuous passive exercise at the suggestion of the doctor. The intensity of exercise should be controlled reasonably during exercise. The injury of articular cartilage caused by high intensity exercise and moderate and low intensity treadmill exercise had relatively little effect on articular surface cartilage. When the general population uses treadmill to exercise, adjust the speed to control the intensity of the movement, if it is necessary to adjust the gradient, should use a smaller gradient (recommended between 20 to 50), In order to prevent the knee joint stress is too large and cause articular cartilage injury. To study the effect of different exercise modes on articular cartilage is helpful to the treatment of joint injury such as osteoarthritis, but the effect of exercise treatment may be different because of the difference of individual constitution and disease. But it is worth noting that it is important for healthy people to determine the mode of exercise which can reduce the injury of articular cartilage.

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