EFFECTS OF FUNCTIONAL MOTOR TRAINING ON POST-SURGICAL REHABILITATION OF ANTERIOR CRUCIATE LIGAMENT

EFEITOS DO TREINO FUNCIONAL MOTOR NA REABILITAÇÃO PÓS-CIRÚRGICA DO LIGAMENTO CRUZADO ANTERIOR

EFECTOS DEL ENTRENAMIENTO FUNCIONAL MOTOR EN LA REHABILITACIÓN POSTQUIRÚRGICA DEL LIGAMENTO CRUZADO ANTERIOR

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ABSTRACT

Introduction: Anterior cruciate ligament injury is one of the most common sports injuries. There has been a rapid upward trend in its incidence in recent years. If treatment is not carried out early, irreversible impairment of joint stability may occur, even leading to degeneration. Objective: Investigate the effects of functional exercise training during rehabilitation on motor function after anterior cruciate ligament surgery. Methods: 52 cases were selected and randomly divided into traditional rehabilitation training group (n=20) and exercise rehabilitation training group (n=15). The first group had the affected limb fixed in the fully extended position for one week, performing ankle flexion and extension activities in bed every day. The rehabilitation program for the second group was based on progressive muscle training. Physical training contents were added to promote rehabilitation and increase the benefits of individual rehabilitation according to each patient's living and working needs. Results: The difference in time to balance in orthostatic position with unipodal support in the rehabilitation group by functional training was less than in the traditional rehabilitation group; the group that received functional exercise training also achieved a greater distance in the jump. Conclusion: Functional exercise training is effective and safe in promoting muscle strength, range of motion, joint stability, proprioception, balance, and lower limb stability. The presented protocol demonstrated improved rehabilitation effectiveness in a shorter rehabilitation period. ***Evidence Level II; Therapeutic Studies – Investigating the results.***

Keywords: Sports; Knee Injuries; Sports Injuries.

RESUMO

A lesão do ligamento cruzado anterior é uma das lesões esportivas mais comuns. Houve uma rápida tendência de aumento em sua incidência nos últimos anos. Caso o tratamento não seja efetuado no estágio inicial podem ocorrer comprometimentos irreversíveis na estabilidade articular levando até mesmo a sua degeneração. Objetivo: Investigar os efeitos do treino com exercício funcional em fase de reabilitação na função motora pós-cirúrgica do ligamento cruzado anterior. Métodos: 52 casos foram selecionados e divididos aleatoriamente em grupo com treino de reabilitação tradicional (n=20) e grupo de treino com reabilitação por exercício funcional (n=15). O primeiro grupo teve o membro afetado fixado na posição totalmente estendida por uma semana, realizando atividades de flexão e extensão do tornozelo no leito todos os dias. O programa de reabilitação do segundo grupo foi baseado no treino muscular progressivo. Foram adicionados conteúdos de treinamento físico para promover a reabilitação e aumentar os benefícios da reabilitação individuais de acordo com as necessidades de vida e trabalho de cada paciente. Resultados: A diferença do tempo para equilíbrio em posição ortostática com apoio unipodal no grupo de reabilitação por treino funcional foi menor que no grupo de reabilitação tradicional; o grupo que recebeu o treino com exercícios funcionais também alcançou uma maior distância no salto. Conclusão: O treino com exercício funcional é eficaz e seguro na promoção de força muscular, amplitude de movimento, estabilidade articular, propriocepção, equilíbrio e estabilidade dos membros inferiores. O protocolo apresentado demonstrou melhora na eficácia da reabilitação num menor período de reabilitação. ***Nível de evidência II; Estudos Terapêuticos - Investigação de Resultados.***

Descritores: *Esportes; Traumatismos do Joelho; Lesões do Esporte.*

RESUMEN

Introducción: La lesión del ligamento cruzado anterior es una de las lesiones deportivas más comunes. En los últimos años ha habido una rápida tendencia a aumentar su incidencia. Si el tratamiento no se lleva a cabo en una fase temprana, pueden producirse daños irreversibles en la estabilidad de la articulación, llegando incluso a la degeneración. Objetivo: Investigar los efectos del entrenamiento con ejercicios funcionales durante la rehabilitación en la función motora tras la cirugía del ligamento cruzado anterior. Métodos: Se seleccionaron 52 casos y se dividieron aleatoriamente en el grupo de entrenamiento de rehabilitación tradicional (n=20) y el grupo de entrenamiento de rehabilitación con ejercicios (n=15). El primer grupo tuvo la extremidad afectada fijada en posición totalmente

extendida durante una semana, realizando actividades de flexión y extensión del tobillo en la cama todos los días. El programa de rehabilitación para el segundo grupo se basó en el entrenamiento muscular progresivo. Se añadieron contenidos de entrenamiento físico para promover la rehabilitación y aumentar los beneficios de la rehabilitación individual según las necesidades vitales y laborales de cada paciente. Resultados: La diferencia en el tiempo de equilibrio en posición ortostática con apoyo unipodal en el grupo de rehabilitación mediante entrenamiento funcional fue menor que en el grupo de rehabilitación tradicional; el grupo que recibió el entrenamiento con ejercicios funcionales también logró una mayor distancia en el salto. Conclusión: El entrenamiento con ejercicios funcionales es eficaz y seguro para promover la fuerza muscular, la amplitud de movimiento, la estabilidad articular, la propiocepción, el equilibrio y la estabilidad de los miembros inferiores. El protocolo presentado mostró una mejora en la eficacia de la rehabilitación en un periodo de rehabilitación más corto. ***Nivel de evidencia II; Estudios terapéuticos - Investigación de resultados.***

Descriptores: *Deportes; Traumatismos de la Rodilla; Lesiones en Deportes.*

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INTRODUCTION

Anterior cruciate ligament injury of the knee is one of the most common injuries in sports injuries, its incidence has been rising rapidly in recent years, if standard treatment is not carried out in the early stage, it is easy to cause the stability of the knee joint to decrease, speed up the degeneration of the knee joint.[1] The importance of the anterior cruciate ligament is gradually accepted by people, at present, knee arthroscopic anterior cruciate ligament reconstruction has become the gold standard for the treatment of anterior cruciate ligament injuries.[2] The reconstructed ligament can basically replace the function of ACL. Now the surgical technique of ligament reconstruction is gradually mature, although minimally invasive techniques using arthroscopic assisted treatment have been widely promoted.[3] The trauma of the operation is getting smaller and smaller, the functional recovery of the knee joint after surgery has also been greatly improved compared with before, but due to the violent factors that cause ACL damage, the severe trauma of the knee joint and the destruction of the bone structure by the operation itself, knee joint in the acute phase after injury and after surgical treatment, because the symptoms of pain and swelling can lead to limited movement of the knee joint for a certain period of time and even joint immobilization, this inevitably causes adhesion and stiffness of the knee joint of the affected limb, at the same time, it is accompanied by disuse atrophy and decreased muscle strength of the affected limb muscles, reduced joint movement and contracture of surrounding soft tissues, will adversely affect the functional recovery of the knee joint.[4] Some patients need to undergo a longer period of functional rehabilitation exercises after surgery, but it is difficult to restore the muscle strength of the affected limb, even causing imbalances on both sides of the limbs, eventually affect the stability of the knee joint.[5]

METHOD

General information

Case selection: Simple rupture of the anterior cruciate ligament, 52 cases of semitendinosus and gracilis tendon reconstruction under arthroscopy, they were randomly divided into the traditional rehabilitation training group (group A, 20 cases) and the sports rehabilitation training group (group B, 15 cases).

Traditional rehabilitation training group: There were 10 males, 10 females, 10 left and 10 right. Age 31.55±11.59 years old, cause of injury: There were 10 cases of sports injuries, 6 cases of traffic accident injuries, and 4 other cases.

Sports rehabilitation training group (group B): There were 8 males, 7 females, 8 left and 7 right, age 32.73±16.64 years old. Causes of injury: 8 cases of sports injuries, 4 cases of traffic accident injuries, and the other 3 cases.

Arrangement of postoperative rehabilitation training

Traditional rehabilitation training group

Fix the affected limb in a fully extended position for a week, contract and relax quadriceps and flexion and extension ankle joint activities on the bed every day. On the second day after surgery, you can go to the ground with crutches, do not bear weight on the affected limb. 2-6 weeks after the operation, continue to use the brace to fix the knee joint in a fully extended position while resting. Gradually start straight leg raising exercises. Support the crutches to move down the ground without weight-bearing, 4 weeks later, start the knee joint 0°-30° flexion and extension exercises.[6] 6-10 weeks after surgery, wear protective gear, but it is not completely restricted to the straight position. Start passive flexion and extension activities at the bedside step by step; Combination of passive buckling and active buckling, increase the flexion angle by 3°-5° every day; At 10 weeks postoperatively, the flexion angle reached 120°. Gradually transition to single crutches and non-weight-bearing walking, and can perform non-weight-bearing joint flexion exercises.11-12 weeks after the operation, under the protection of the brace, the knee joint can be flexed and extended to the maximum extent on the bed. 3-6 months after surgery, strengthen knee extension exercises, straighten the affected side in line with the healthy side. And to protect the full squat and other exercises.[7]

Functional training rehabilitation group

The functional rehabilitation group rehabilitation program is based on the progressive muscle training rehabilitation program, according to the different life and work requirements of patients, increase functional training content, in order to promote recovery and improve rehabilitation benefits. The content of functional training needs to be adjusted at any time based on the results of the functional test.

RESULTS

The principle of balanced comparability based on control factors

That is, at the original level of the two groups of patients, under the condition that the test content, time and other conditions are basically the same, start the test, in order to obtain comparable results. Therefore, this test first made a comparative analysis of the natural conditions of the two groups of patients. (Table 1)

The gender composition ratio of the two groups of patients is basically the same, there was no statistical difference in average age, weight-to--height ratio, and average time from injury to surgery (P>0.05). It can be considered that the original level of the two groups of patients is basically the same, according to the principle of balanced comparability of control factors, the homogeneity comparison is achieved, and the test results are reliable and effective.[8]

Exercise ability assessment

Balance ability test

As shown in Figure 1, there was no significant difference in the preoperative balance standing time difference of one leg between the two groups of patients (P>0.05). The difference in the balance standing time on one leg after the operation of the patients in each group was significantly lower than that before the operation, P<0.01. The postoperative functional rehabilitation training group was significantly lower than the traditional rehabilitation group (P<0.05). At 6 months after surgery, the functional rehabilitation training group was lower than the traditional rehabilitation group (P>0.05). The test data at 12 and 18 months after surgery showed that, the functional rehabilitation training group was significantly lower than the traditional rehabilitation group (P<0.01).

Jump test

As shown in Figure 2, the postoperative and preoperative comparison, there was a significant difference in the jumping distance between the two groups of patients, P<0.01. Data analysis shows: The difference in the distance of three consecutive jumps after the operation of each group of patients was significantly reduced, P<0.01; At 6 months after surgery, the difference in the distance of three consecutive jumps showed a significant difference at 12 months after surgery (P<0.01).

Stability test of core area

As shown in Table 2, data analysis shows that: The preoperative core stability scores of patients in each group were all Grade II, shows that the core stability is poor, but does not affect the movement.[9] The score of the stability test of the core area decreased significantly after the operation (P<0.05). Comparison between the two groups after surgery, the functional rehabilitation training group was lower than the traditional rehabilitation group (P<0.05). 6 months after surgery, there was no significant difference in the core area stability score between the functional rehabilitation training group and the traditional rehabilitation group (P>0.05). The test data at 12 months after the operation showed that, the stability score of the core area in the functional rehabilitation training group was significantly decreased

Table 1. Comparative analysis of the height-to-weight ratio, age, and time from injury to surgery between the two groups.

Grouping	Traditional Rehabilitation Group	Functional rehabilitation training group
Age	30.45±12.01	31.76±15.45
1.76 weight to height ratio	0.5±0.57	0.51±0.04
Time from injury to surgery (months)	4.89±2.54	4.32±2.14

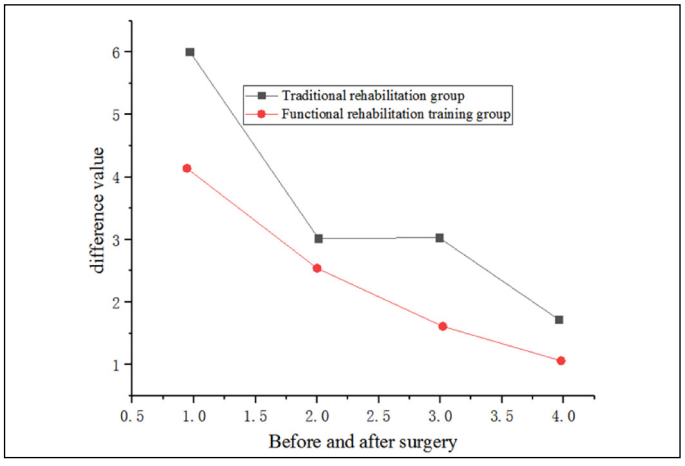

Figure 1. The effect of two different rehabilitation programs on the difference of the patient's balance standing time on one leg.

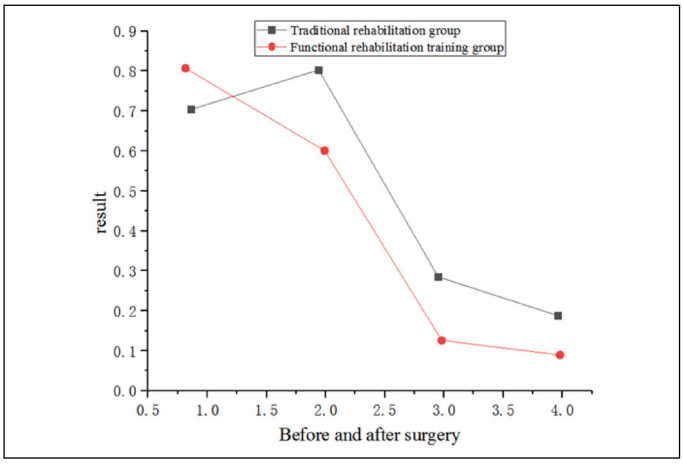

Figure 2. The effect of two different rehabilitation programs on the results of the patient's three consecutive jump tests.

Table 2. The impact of three different rehabilitation programs on the results of the stability test of the patient's core area.

Grouping	Traditional Rehabilitation Group	Functional rehabilitation training group
Before surgery	61.88±8.99	56.08±9.01
6 months after surgery	58.33±9.61	26.39±4.10
12 months after surgery	61.77±7.99	12.65±1.84
18 months after surgery	32.01±4.15	8.24±1.98

(P<0.01), and the traditional rehabilitation group was at the second level. 18 months after the operation, the test data showed that, the stability score of the core area of the two groups of patients decreased significantly, reaching the third level (P<0.05).

DISCUSSION

From the lateral surface of the femoral intercondylar fossa, it ends in front of the tibial intercondylar crest, and connected to the lateral meniscus is the anterior cruciate ligament, the most powerful ligament of the knee joint.[10] According to the starting and ending points and the walking morphology of the ligament fiber bundles in the current academic circles, the anterior cruciate ligament is divided into the anterolateral bundle and the posterior medial bundle. Since there is no self-repair ability, it must be reconstructed surgically after the injury, in order to restore the original function. Otherwise, the front and back stability of the knee joint will be destroyed, cause secondary damage to other structures of the knee joint, the most serious of these is to cause knee osteoarthritis, the motor function of the knee joint was severely impaired.[11] The ultimate goal of trauma therapy is the recovery of limb function. Clinical medical staff have been working on researching how to deal with anterior cruciate ligament injuries, it can maximize the recovery of knee joint function. At present, it is generally believed that the simplest and most effective method is to perform anterior cruciate ligament reconstruction surgery under arthroscopy. However, the ultimate effect of knee joint function recovery after anterior cruciate ligament injury, it not only depends on the superb technique of the surgeon and the successful implementation of the operation, more important is the rehabilitation training arrangement of the postoperative scientific system. This research shows that, as the specific rehabilitation stage division, rehabilitation exercise methods and content, exercise intensity and training volume of various programs are different, different rehabilitation training programs bring different short-term and long-term clinical effects to patients. How to scientifically choose a rehabilitation plan suitable for patients is an important issue to be solved and must be solved.

CONCLUSION

Exercise recovery training can efficiently and safely improve the abilities of the patient's affected limb muscle strength, joint range of motion, joint stability, proprioception, balance, and core stability after surgery. Especially in terms of restoring the exercise ability of the affected knee joint, improving the efficiency of rehabilitation, and shortening the recovery period, the advantages are obvious.

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