

# AQUATIC SPORTS REHABILITATION ON FUNCTIONAL RECOVERY OF KNEE JOINT INJURY



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REABILITAÇÃO ESPORTIVA AQUÁTICA NA RECUPERAÇÃO FUNCIONAL DE LESÃO DO JOELHO

REHABILITACIÓN DEPORTIVA ACUÁTICA EN LA RECUPERACIÓN FUNCIONAL DE LESIÓN DE LA RODILLA

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## ABSTRACT

**Introduction:** Knee joint injury is a common sports injury and how to speed up the recovery process is a concern for all athletes. **Objective:** Determine whether aquatic sports rehabilitation nursing can accelerate the rehabilitation process of knee joint injuries. **Methods:** Thirty patients with knee ligament or meniscal injury were divided into an aquatic sports group and a control group. The control group assumed general recovery measures, while the aquatic exercise group was added another 8 weeks of rehabilitation nursing with aquatic exercises. The evolution of the degree of knee joint pain, knee joint range of motion, knee joint muscle strength and other indicators before and after the experiment were compared. **Results:** After 8 weeks of intervention, pain and activities of daily living in the aquatic exercise group improved significantly compared with those before the experiment; the degree of recovery from knee joint injury in the aquatic exercise group was significantly better than that in the control group, and knee joint flexion range of motion, flexor and extensor muscle strength, and other indicators in the aquatic exercise group were significantly better than those in the control group. **Conclusion:** Aquatic rehabilitation exercise can accelerate the recovery process of patients with knee joint injuries. **Level of evidence II; Therapeutic studies - investigation of treatment outcomes.**

**Keywords:** Water Sports; Knee Joint; Physical and Rehabilitation Medicine.

## RESUMO

**Introdução:** A lesão articular do joelho é uma lesão esportiva corriqueira e a maneira de acelerar o processo de recuperação é uma preocupação para todos os atletas. **Objetivo:** Determinar se a enfermagem de reabilitação esportiva aquática pode acelerar o processo de reabilitação das lesões nas articulações do joelho. **Métodos:** Trinta pacientes com lesão ligamentar ou meniscal do joelho foram divididos em grupo de esportes aquáticos e grupo de controle. O grupo de controle assumiu medidas gerais de recuperação, enquanto ao grupo de exercícios aquáticos acrescentou-se mais 8 semanas de enfermagem de reabilitação com exercícios aquáticos. Comparou-se a evolução do grau de dor na articulação do joelho, a amplitude de movimento da articulação do joelho, a força muscular da articulação do joelho e outros indicadores antes e depois da experiência. **Resultados:** Após 8 semanas de intervenção, a dor e as atividades das atividades de vida diária no grupo de exercícios aquáticos melhoraram significativamente em comparação com aquelas antes do experimento; o grau de recuperação da lesão da articulação do joelho no grupo de exercícios aquáticos foi significativamente melhor do que o do grupo controle, e a amplitude de flexão da articulação do joelho, a força muscular flexora e extensora e outros indicadores no grupo de exercícios aquáticos foram significativamente melhores do que os do grupo controle. **Conclusão:** O exercício de reabilitação aquática pode acelerar o processo de recuperação de pacientes com lesões articulares no joelho. **Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.**

**Descritores:** Esportes Aquáticos; Articulação do Joelho; Medicina Física e Reabilitação.

## RESUMEN

**Introducción:** La lesión de la articulación de la rodilla es una lesión deportiva común y acelerar el proceso de recuperación es una preocupación para todos los atletas. **Objetivo:** Determinar si la enfermería de rehabilitación deportiva acuática puede acelerar el proceso de rehabilitación de las lesiones articulares de rodilla. **Métodos:** Treinta pacientes con lesiones de ligamentos o meniscos de rodilla se dividieron en un grupo de deportes acuáticos y un grupo de control. El grupo de control asumió medidas generales de recuperación, mientras que al grupo de ejercicios acuáticos se le añadieron 8 semanas adicionales de enfermería de rehabilitación con ejercicios acuáticos. Se comparó la evolución del grado de dolor de la articulación de la rodilla, la amplitud de movimiento de la articulación de la rodilla, la fuerza muscular de la articulación de la rodilla y otros indicadores antes y después del experimento. **Resultados:** Tras 8 semanas de intervención, el dolor y las actividades de la vida diaria en el grupo de ejercicio acuático mejoraron significativamente en comparación con los anteriores al experimento; el grado de recuperación de la lesión de la articulación de la rodilla en el grupo de ejercicio acuático fue significativamente mejor que el del grupo de control, y la amplitud de la flexión de la articulación de la rodilla, la fuerza muscular flexora y extensora y otros indicadores en el grupo de ejercicio acuático fueron significativamente mejores que los



## INTRODUCTION

In recent years, with the widespread development of nationwide fitness activities, more and more people gradually realize that healthy body is the fundamental guarantee for daily work and life, but scientific and reasonable sports can improve physical fitness, and wrong sports posture and unreasonable exercise intensity and methods will cause sports injuries.<sup>1</sup> Sudden running and stopping in the process of sports, taking off when maintaining the knee joint's flexion position and wrong step posture are all very easy to cause sports injuries to the knee joint. According to the survey, in the process of engaging in basketball, football, track and field and other sports, there will be varying degrees of knee injuries.<sup>2</sup> Even if some sports events are not too violent, they will also cause knee joint injuries due to improper body movement during the exercise. After knee joint injury, traditional rehabilitation treatment methods are common, such as weight bearing and leg lifting training, but there is a lack of unified quantitative standards and greater randomness. In the process of land sports rehabilitation, some people with knee joint injuries may be afraid of carrying out rehabilitation training due to obvious swelling and pain of the knee joint, thus affecting the recovery of knee joint function.<sup>3</sup> However, sports rehabilitation in the water environment can often reduce or even avoid the occurrence of this phenomenon. In the field of sports, water sports rehabilitation technology has been internationally recognized and widely used, but it has been developed late in China and is not fully developed.<sup>4</sup>

Water sports rehabilitation refers to a rehabilitation treatment method that makes use of the temperature, buoyancy.<sup>5</sup> Compared with land sports rehabilitation, it has its unique advantages: it can promote muscle relaxation and improve joint range of motion; Accelerate blood circulation, improve muscle strength and endurance, and then avoid muscle atrophy; Improve body balance and stability. Exercise rehabilitation for patients with knee joint injuries in water.<sup>6</sup> The warm effect of water can relieve the pain degree of the knee joint, the buoyancy of water can reduce the load on the joint, and the resistance of water provides a natural resistance environment for athletes, which is conducive to improving the effect of muscle strength training and enhancing the stability of the knee joint. Hydrostatic pressure of water is conducive to blood circulation and plays a role in eliminating edema.<sup>7</sup> At present, the application of water sports rehabilitation in patients with knee osteoarthritis is more and more popular, but the effect is not clear. The indicators for evaluating the effectiveness of rehabilitation are also worth discussing.<sup>8</sup> This paper aims to explore whether water sports rehabilitation treatment can bring more improvement to patients compared with conventional rehabilitation treatment, and provide a basis for the application and promotion of water sports rehabilitation in the rehabilitation of patients with knee injuries.

## Research objects and research methods

### Common types of knee joint injuries

The knee joint is composed of the lower end of the femur, the upper end of the tibia and the patella. It is one of the largest and most complex joints in the human body. Its main accessory structures include the meniscus, tendons, ligaments, such as anterior and posterior cruciate

ligaments, and internal and external collateral ligaments. Its main forms of motion are flexion and extension, and small rotation. Knee joint injuries can be divided into acute and chronic injuries. Acute injuries mainly include acute arthritis, ligament sprain, joint dislocation and separation; Chronic injuries mainly include meniscus injury, patellar chondropathy, fat pad injury, bursitis, etc. The National Institute of Physical Education and the Institute of Sports Medicine of Peking University conducted an epidemiological survey of sports injuries among 6810 athletes in 49 sports events in 29 national, provincial and municipal sports teams, 18 industry sports associations from 1991 to 1996. It was found that the knee joint sports injuries accounted for the first place in sports injuries of all parts of the body, accounting for 19.57%, followed by 9.11% of the ankle joint and 8.61% of the shoulder joint Wrist 6.21%, elbow 3.81%. Hip joint 0.09%.

### Evaluation index and rehabilitation goal after knee joint injury

Several commonly used evaluation methods mainly include: clinical test evaluation method, knee scoring method, IAC Lennox test evaluation method and Marshall test method), radiological examination and motor function evaluation (joint range of motion and knee isokinetic muscle strength test). Some scholars put forward that the rehabilitation assessment of knee joint after injury mainly includes the following: (1) pain assessment (such as single leg squat, squat load test, etc.). (2) Evaluation of knee joint range of motion: Measure the range of motion of knee joint during flexion and extension with goniometer. (3) Evaluation of knee joint muscle function: generally, manual muscle strength test or isokinetic muscle strength tester are used.<sup>9</sup> Whether it is meniscus injury of the knee joint or ligament, articular cartilage or cruciate ligament injury, the goal and principle of rehabilitation are to not only let the injured tissue structure heal, but also not lose the stability of the knee joint. The rehabilitation methods of knee joint injuries in different stages and periods can be roughly divided into muscle strength training, joint range of motion training, balance ability training and proprioception training. The effect of comprehensive rehabilitation methods is more obvious than that of single rehabilitation methods. Therefore, for the patients with knee joint injuries, the first step is to restore the range of motion and muscle function of the knee joint, and then transition to the functional training centered on proprioception and motor sense, and finally carry out the training of daily living ability.

## Teaching experiment design

### Experimental methods and rehabilitation program design

This study mainly discusses the related issues of "the effect of water sports rehabilitation on the functional recovery of knee joint injury patients". The test indexes mainly include the measurement of the range of motion of the lower limb knee joint of the subject; Knee joint isokinetic muscle strength test and thigh circumference test reflecting knee joint muscle strength of subjects; One foot standing test with eyes closed to reflect the balance ability of the subjects.

### Water sports rehabilitation program for knee joint injury

During the experimental period, the control group did not carry out relevant types of rehabilitation training and maintained the original activities of daily living. The article "Consensus of Spa Rehabilitation Technology Experts", jointly prepared by senior domestic spa experts,

proposed that: at present, there are different classification methods for spa technology, which can be divided into three categories according to the treatment form: immersion bath method, flushing bath method and water sports treatment.<sup>10</sup>

## Experimental results and analysis

### Purpose and object of the experiment

A total of 30 patients with knee ligament injury or meniscus injury meeting the experimental requirements were recruited through WeChat promotion and online registration, including 14 boys and 16 girls. Because the experimental cycle was in the epidemic period, the recruitment of subjects was dominated by college students and young office workers. In order to ensure the consistency of injury type and degree of each group, 30 subjects were divided into water sports group, land sports group and control group by pairing method, with 10 people in each group. (Table 1)

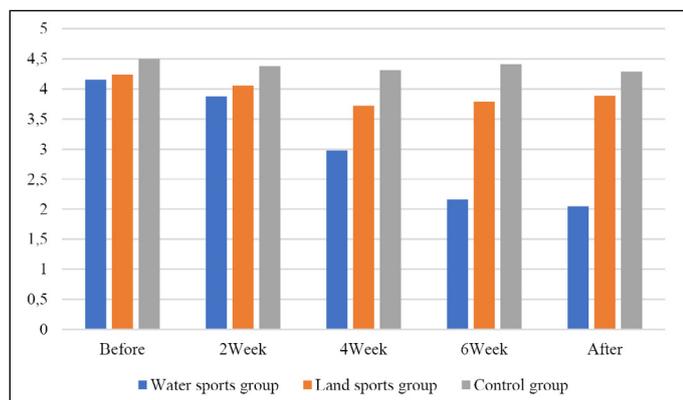
### Analysis of experimental results

Effect of different forms of exercise rehabilitation on VAS pain score of subjects. The test results before, 2 weeks, 4 weeks, 6 weeks and after the experiment showed that, after 8 weeks of water sports rehabilitation intervention, except for no significant difference in VAS pain score indicators in the second week ( $P>0.05$ ), the VAS pain score indicators of the subjects in the other 3 tests were significantly lower than before the intervention, and the VAS pain score indicators after the intervention were 2.11 cm lower than before the intervention, The P values were 0.004, 0.003 and 0.007 respectively, showing a very significant difference ( $P<0.01$ ). This shows that 8 weeks of water exercise rehabilitation can effectively reduce the VAS pain score of patients with knee ligament or meniscus injury, thereby significantly reducing the pain symptoms of such patients. The VAS pain score indexes of the onshore control group had no difference compared with those before the intervention ( $P>0.05$ ). This shows that the 8-week land exercise rehabilitation is effective in improving the pain of patients in the short term, but there is no significant change in the improvement of pain symptoms in the later period. (Figure 1)

After comparing the data between the water exercise group and the land exercise group, it was found that the VAS pain score index also showed a very significant difference ( $P<0.01$ ), and the test P value was

**Table 1.** Basic Information of Subjects.

Grouping	Gender (male/female)	Number	Age	Height	Weight
Water sports group	4/6	2	22.5±2.66	173.4±11.1	71.4±9.7
Land sports group	5/5	10	23.2±3.09	168.6±9.68	69.5±15.1
Control group	5/5	10	23.6±1.57	173.2±5.83	66.4±8.39



**Figure 1.** VAS pain scores of three groups in different forms of exercise rehabilitation.

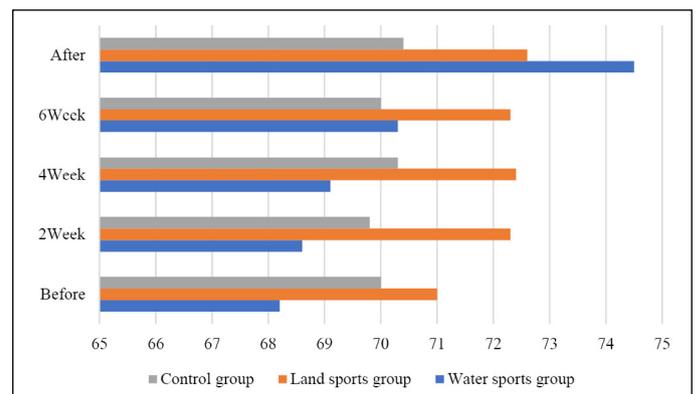
0.004 ( $P<0.01$ ). The comparison between the two groups showed that the water exercise group improved VAS pain score more significantly than the land exercise group. Compared with the control group, the land sports group has no significant difference in data ( $P>0.05$ ). The above results show that water sports rehabilitation has a significant effect on reducing the pain level of patients with knee ligament or meniscus injury, and land sports rehabilitation has an effect on improving the pain status of patients in the short term, but there is no significant difference in the improvement of pain symptoms in the later period, and the effect of water sports rehabilitation is better than that of land sports rehabilitation.

Effects of different forms of exercise rehabilitation on knee function scores of subjects. The test results before, 2 weeks, 4 weeks, 6 weeks and after the experiment showed that the Lysholm knee joint function score of the subjects after 8 weeks of water sports rehabilitation intervention was significantly different from that before the intervention ( $P<0.05$ ), the mid intervention was also significantly different from that before the intervention ( $P<0.05$ ), and the post intervention was significantly different from that during the mid intervention (4 weeks) ( $P<0.01$ ). The Lysholm knee joint function score increased by 6.3 points on average compared with that before intervention, and the test P value was 0.033 ( $P<0.05$ ). It can be seen from Table 1 that after 8-week water exercise rehabilitation intervention, the symptoms, pain, quality of life and activities of daily living options in the KOOS scale of the subjects were significantly different from those before the intervention ( $P<0.01$ ), with an average increase of 16.42 points, 19.73 points, 13.12 points and 9.7 points compared with those before the intervention, respectively. The tested P values were 0.000, 0.000, 0.008 and 0.001 ( $P<0.01$ ). (Figure 2)

The pain and quality of life options in the KOOS scale in the water exercise group were significantly different from those in the land exercise group ( $P<0.01$ ), and the tested P values were 0.001 and 0.000 respectively ( $P<0.01$ ). The options of sports and entertainment ability in the KOOS scale in the water sports group were significantly different from those in the land sports group ( $P<0.05$ ), and the tested P value was 0.033 ( $P<0.05$ ). The comparison between the two groups shows that the water sports group is more obvious than the land sports group in improving Lysholm knee function score and KOOS scale pain, sports and entertainment ability and quality of life score. The above results show that although both water sports rehabilitation and land sports rehabilitation can increase the knee joint function score of patients with knee ligament or meniscus injury, the effect of water sports rehabilitation group is better than that of land sports rehabilitation in terms of improving benefits and increasing range.

## CONCLUSIONS

Compared with land sports rehabilitation, water sports rehabilitation can accelerate the relief of knee joint pain of people with knee ligament



**Figure 2.** Lysholm knee function scores of three groups under different forms of exercise rehabilitation.

or meniscus injuries, accelerate the improvement of knee joint range of motion, knee joint muscle strength and knee joint function score of such patients, that is, faster than land sports rehabilitation, thus shortening the rehabilitation process, and helping people with knee ligament or meniscus injuries recover their daily life ability and return to work as soon as possible. Although both water sports rehabilitation and land sports rehabilitation can improve the knee joint flexion range, muscle strength and knee joint function score of patients with knee ligament or meniscus injury, in terms of improvement range, the improvement effect of water sports rehabilitation group is more significant, and the effect of water sports rehabilitation is better than that of land sports rehabilitation.

Water sports rehabilitation for people with knee ligament or meniscus injuries should be carried out in the remission or recovery period, not in the acute period. For the people with knee ligament or meniscus injury to perform sports rehabilitation in water, a targeted training plan should be designed according to individual differences, and the time, frequency and intensity of exercise should be gradually increased. Proper water temperature can relax the body of the athlete, and then achieve better rehabilitation effect.

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

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