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Article

Evaluation and optimization of the effectiveness of intelligent devices in athletic injury rehabilitation training

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Abstract: People are prone to injuries during exercise, and effective rehabilitation training is crucial for restoring tissue function, reducing pain, and preventing further injuries. To more scientifically assist the injured in rehabilitation training, wearable intelligent devices can be used to assist the injured in diagnosing the sites of the injury, developing rehabilitation training plans, or providing training reminders. Firstly, the sites of the injuries are measured through sensors. Then, by inputting individual differences such as individual characteristics and physical health status into the device, a unique rehabilitation training plan is generated. Finally, the injured are urged and reminded through equipment to ensure that they can complete their rehabilitation plan on time and in the required amount. This can not only help the injured generate a scientific rehabilitation training plan in a timely and accurate manner, but also ensure the quality of rehabilitation training. Compared with traditional rehabilitation training, the score of using intelligent devices to assist the injured in rehabilitation training is higher than the score of traditional rehabilitation training, and the average score of rehabilitation training combined with intelligent devices is higher than 90 points. Intelligent devices can help injured individuals generate more scientific and effective rehabilitation training plans, while also supervising the execution of the plans. Intelligent devices have played a positive role in athletic injury rehabilitation training, helping injured individuals recover their health.

Keywords: injury rehabilitation training; athletic injury; sensor information collection; intelligent rehabilitation training equipment; individual differences

1. Introduction

More and more people are paying attention to exercise and physical health, but due to improper exercise [1,2] or incorrect exercise posture [3], people may experience some degree of athletic injuries during exercise. Traditional rehabilitation training requires going to professional hospitals for rehabilitation training, which is not convenient and slow for the injured, bringing many disadvantages to people, which may reduce their motivation to exercise. Sports injury rehabilitation training has received widespread attention in recent years, but it still faces some challenges. Existing rehabilitation training methods mostly rely on traditional physical therapy and manual guidance, lacking personalization and real-time monitoring. Although the introduction of smart devices has improved the efficiency and accuracy of training, there are still certain difficulties in technology integration, equipment convenience and user acceptance.

The most important aspect of athletic injury rehabilitation [4,5] training is the development and implementation of rehabilitation training plans [6]. During the implementation of the plan, failure to complete the training plan according to the required quantity may lead to slow recovery, and non-standard training actions may result in secondary injuries. Therefore, a comprehensive and scientific training plan and professional guidance are essential, and intelligent equipment [7,8] provides new choices for the injured. Tan et al. [9], believed that traditional conventional rehabilitation training has limited effectiveness. Exoskeleton rehabilitation robot [10] technology is a wearable mechanical technology that integrates sensing, control, information fusion, and mobile computing. It can dynamically adjust the pressure and tension of joints during movement, effectively assisting patients in completing limb movements. Virtual reality [11] treadmill training can assist in correcting gait by capturing patient motion parameters, guiding patients to master the correct limb movement posture, and has a positive impact on promoting the recovery of limb movement function. Ba [12] proposed a deep learning system for athletic injury medical rehabilitation based on magnetic resonance imaging (MRI) image analysis [13]. Preparation activities are various purposeful physical exercises conducted before physical education classes, training, and competitions. The preparation period is a transitional stage of the human body from a static state to a moving state. Preparation activities can enhance the excitability of the central nervous system, enhance the ability of the cerebral cortex to analyze and judge movements, thereby making movements more coordinated and accurate. Preparation activities can also improve respiratory and circulatory system function, reduce muscle and ligament adhesiveness, increase the speed and strength of muscle contraction, in order to maximize the body’s ability to exercise and prevent athletic injuries. Therefore, it is crucial to use MRI images for numerical analysis of the above tasks. This article integrates deep learning models and proposes a novel image enhancement and recognition model to undertake the task of medical exercise rehabilitation training.

At present, the development of motion sensors [14,15] combined with intelligent devices has been widely applied in athletic injury rehabilitation training. Sensors can accurately locate the injured area, and wearable smart devices can help generate professional rehabilitation training plans and help the injured adjust their posture during training. Noomen et al. [16], believed that artificial intelligence (AI) has the potential to develop in the field of sports medicine. It can identify injury risks and develop personalized prevention plans by analyzing the performance data, biomechanical factors, and physiological indicators of athletes, thereby improving prevention capabilities. Similarly, artificial intelligence can improve training strategies by analyzing data and performance indicators to create personalized and precise training plans, optimize intensity and duration, and avoid overtraining. In addition, artificial intelligence can provide real-time feedback and customize therapies based on individual rehabilitation. Pu et al. [17], believed that traditional football player injury cycle management and monitoring systems are not only insecure in data storage, but more importantly, lack intelligent analysis of the collected data. Blockchain technology [18] is commonly used to collect, store, clean, mine, and visualize the full cycle data of football player injuries, and machine learning can be used to provide intelligent solutions for football players’ injury recovery. The above studies have combined intelligent analysis to plan rehabilitation training for the injured, but have not paid enough attention to the problems of non-standard movements and changes in physical conditions that may occur during the specific training process, and the collection of physical data for the injured is not sufficient and scientific enough. This article uses wearable smart devices to standardize the movements of the injured during retraining, preventing secondary injuries caused by improper movements. At the same time, the devices can timely remind the injured to undergo rehabilitation training, and by combining sensors, they can provide scientific and accurate data support for formulating training plans.

Research in the field of sports injury rehabilitation has increasingly focused on the application of intelligent algorithms in recent years. These algorithms can improve the efficiency and personalization of the rehabilitation process and help patients recover faster and more accurately. Intelligent algorithms, especially machine learning [19,20] and artificial intelligence algorithms [21,22], have played an important role in sports injury assessment, training planning, and progress monitoring. Data collection and analysis are the basis of intelligent rehabilitation systems. Sensor technology is widely used in sports injury rehabilitation to monitor patients' movement status, muscle activity, joint angles and other data in real time [23,24]. These data are processed and analyzed through intelligent algorithms to provide scientific evaluation and feedback. The movement pattern recognition algorithm based on deep learning can identify abnormal behaviors in patients' movements in real time, such as excessive load or improper posture during exercise, so that the rehabilitation plan can be adjusted in time to avoid secondary injuries. Machine learning models have significant advantages in the personalized development of rehabilitation plans. Traditional rehabilitation training relies on expert experience and fixed programs, while intelligent algorithms can flexibly adjust training intensity and content based on the patient's physical condition and recovery progress. Analyze patient rehabilitation data through algorithms such as support vector machines or random forests to predict the best training plan and recovery time. In addition, deep learning algorithms such as convolutional neural networks [25,26] and long short-term memory networks [27,28] are also used to process complex time series data and optimize the dynamic adjustment of rehabilitation training. Sensor-based data is combined with intelligent algorithms through a real-time feedback system to continuously track the patient's recovery progress. The intelligent algorithm can analyze the patient's rehabilitation effect, evaluate the gap between it and the predetermined rehabilitation goal, and adjust the treatment strategy in real time. This adaptive control allows patients to receive more precise rehabilitation support and reduces treatment lag and errors in traditional methods. The introduction of intelligent algorithms not only makes sports injury rehabilitation training more personalized and intelligent, but also improves the scientificity and effectiveness of treatment. With the continuous development of sensor technology, machine learning and deep learning, intelligent algorithms will play a more important role in sports injury rehabilitation and promote the development of rehabilitation treatment in a more precise and efficient direction.

2. Sensor systems and intelligent analysis technologies

2.1. Sensor technology

Sensor types include accelerometers, gyroscopes, electromyography sensors, and pressure sensors. Their working principle is based on the measurement of physical quantities, such as acceleration, angular velocity, and muscle electrical activity. These sensors provide accurate feedback through real-time monitoring in sports injury rehabilitation, helping to customize personalized rehabilitation plans and ensure safe and effective training.

2.2. Intelligent analysis technology

Intelligent analysis [29,30] is an intelligent pattern that utilizes technologies such as artificial intelligence and machine learning to analyze a large amount of data and find patterns from it. Through this mode, intelligent decision-making or prediction can be made. Intelligent analysis technology helps to achieve more efficient resource utilization and management, providing intelligent decision-making and operation.

This article uses intelligent analysis technology to analyze and organize the information collected by sensors, ultimately resulting in a scientifically effective rehabilitation training plan. Through the application of intelligent analysis technology, personalized development of rehabilitation plans can be achieved, while the rehabilitation process can be intelligentized, thereby achieving real-time improvement of rehabilitation training plans and improving the efficiency of rehabilitation of the injured. Intelligent analysis technology can not only generate personalized rehabilitation plans based on the individual situation and rehabilitation needs of the injured, but also track the rehabilitation situation of the injured and adjust the rehabilitation plan in a timely manner to ensure the scientific formulation and smooth progress of the rehabilitation plan.

This paper adopts an intelligent analysis algorithm based on support vector machine to identify the movement status and rehabilitation progress of the injured through real-time collection and analysis of sensor data. The movement data of the injured is obtained through sensors, and then the support vector machine model is used for classification and regression analysis to identify different rehabilitation stages. According to the individual situation and movement characteristics of the injured, a personalized rehabilitation training plan is automatically generated, and the training plan is adjusted in real time to ensure the optimization and scientificity of the rehabilitation effect.

3. Experimental data

3.1. Data collection

According to data from the World Health Organization, the latest research shows that the number of athletic injuries in China is huge, with a total of over 300 million people. Another report shows that the athletic injury rate has reached around 15%, which means that almost everyone may experience athletic injuries in their lifetime.

After analyzing and summarizing the data from the World Health Organization, athletic injuries are classified according to their sites, and the types and causes of injuries are analyzed to improve the data on athletic injuries for further exploration.

Classifying the injured sites helps to make targeted rehabilitation training plans more quickly. After classifying athletic injuries, detailed classification and data are shown in **Table 1**.

Table 1. Classification and proportion of athletic injuries, sports and behaviors causing injuries, and common types of injuries.

Site of injury	Sports and behaviors that can cause injury	Proportion of athletic injury	Common types of injury
Knee	Running, cycling, swimming, football, basketball	30%	Abrasions, sprains, contusions, dislocations, fractures
Shoulder	Tennis, weightlifting, volleyball, baseball	20%	Misalignment, sprains, strains
Ankle	Football, basketball, volleyball	13%	Sprains
Elbow	Tennis, golf	7%	Elbow tendon injuries
Muscles	Insufficient warm-up for most sports	20%	Strains
Waist	Cycling, golf, baseball	3%	Sprains
Shin	Running and jumping on hard ground	1%	Pains in the shins
Brain	Football, skiing, basketball	2%	Concussions
Achilles tendon	Running and jumping events	4%	Tears or ruptures of achilles tendon

3.2. Data preprocessing

Due to the large amount of data, it is not possible to conduct experiments on everyone. Therefore, a volunteer recruitment method is used to collect statistics on the athletic injury sites of different volunteers. The numbers of volunteers with various sites of the injury are different. To ensure the rationality of the experiment, volunteers are grouped and treated with intelligent devices-assisted therapy and traditional conventional therapy respectively.

4. Generation of rehabilitation training plans

4.1. Obtaining data through sensors

The main improvement in athletic injury rehabilitation training is the application of high-tech sensors, which can provide real-time motion data feedback, help formulate rehabilitation training plans, and help correct training postures. The working framework of the sensor is shown in **Figure 1**:

Firstly, the physical information of the injured person is collected through sensors, and the injured areas are detected to determine the degree of injuries. The data is sent to the smart devices, which processes and analyzes the data to develop a rehabilitation training plan.

During rehabilitation training, sensors provide real-time feedback on the physical data of the injured, collect their movement data, joint pressure, and other data through sensors, and transmit them to smart devices in real-time. Intelligent devices compare the collected data with professional guidance actions to correct the movements of the injured, which can help prevent secondary injuries caused by non-standard movements while undergoing rehabilitation training.

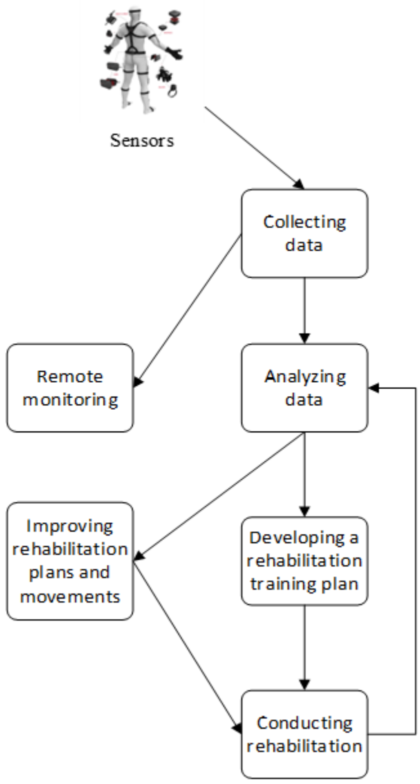

Figure 1. Working content of the sensor.

Sensors can also be used to remotely monitor the injured, allowing family members to understand their physical condition. The data from sensors can help evaluate the rehabilitation effect, compare the performance of the injured before and after rehabilitation training, quantify rehabilitation progress, and timely modify rehabilitation plans, thereby helping to train intelligent models to further optimize rehabilitation training methods and theories.

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4.2. Generating solutions with intelligent analysis technology

By combining intelligent analysis technology, athletic injury rehabilitation training can be improved to achieve precise, personalized and efficient rehabilitation training. The framework diagram of intelligent analysis is shown in **Figure 2**:

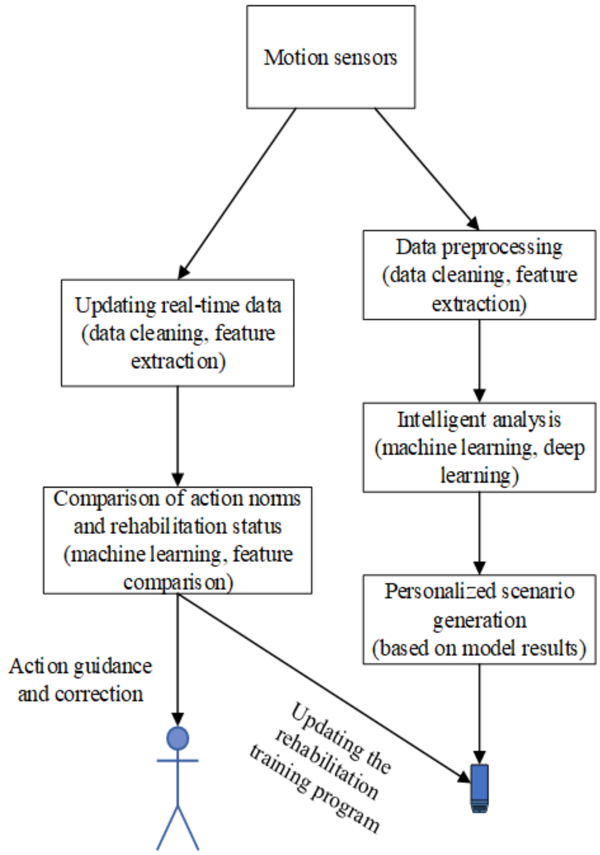

Figure 2. Framework of intelligent analysis.

After data collection, the data is transmitted to the intelligent analysis system. After data cleaning [31] and feature extraction [32], intelligent analysis is performed, and personalized evaluation and rehabilitation training plans are generated. Intelligent analysis technology is used to analyze the injured person's movement ability, injury situation, rehabilitation needs, and other aspects of the data. Based on the evaluation results, targeted rehabilitation training plans are designed. At the same time, real-time detection of the physical data of the injured [33] and continuous updates are made, and the rehabilitation training plan is adjusted in a timely manner based on the data, providing more effective rehabilitation training for the injured. The rehabilitation training movements of the captured injured are compared with the standard movements to provide timely feedback and guidance to the injured, thus helping them adjust their exercise posture, control training intensity, enhance rehabilitation training effectiveness, and prevent secondary injuries.

The rehabilitation plan development process includes the following steps: assessing the patient's injuries and physical condition; setting rehabilitation goals based on the assessment results; selecting appropriate rehabilitation methods and training content; developing a specific timetable and intensity for the training plan; regularly tracking the patient's rehabilitation progress and adjusting the plan in real time based on feedback to ensure maximum rehabilitation effectiveness.

5. Experimental results and analysis

5.1. Experimental preparation

Due to the large sample size of experimental data and the varying degrees of athletic injuries among different volunteers, the number of injured sites also varies. Volunteers are divided into 9 categories based on the injured areas, and the 9 categories of volunteers are divided into 2 groups for traditional rehabilitation training and intelligent device-assisted rehabilitation training. The grouping situation is shown in **Table 2**:

Table 2. Grouping of rehabilitation training volunteers.

Site of injury	Number of people with traditional rehabilitation training	Number of people with rehabilitation training assisted by intelligent devices	Total number of people
Knee	50	50	100
Shoulder	43	43	86
Ankle	26	26	52
Elbow	7	7	14
Muscles	30	30	60
Waist	11	11	22
Shin	5	5	10
Brain	6	6	12
Achilles tendon	8	8	16

The experimental steps include: selecting samples that meet the following criteria: aged between 18 and 60 years old, diagnosed with sports injuries without serious complications, and rehabilitation period of no more than 3 months. The samples must agree to participate in data collection and analysis. Data collection methods include using inertial sensors, force sensors, and electromyography sensors to record the movement parameters of the injured during rehabilitation training, such as joint angles, muscle activity, and applied force. After each training cycle, the data is collected and preprocessed to ensure the accuracy and completeness of the data, and then sent to the intelligent analysis system for processing and model training, and finally output rehabilitation suggestions. In the experimental design, in order to consider the impact of individual differences on the rehabilitation effect, a combination of random grouping and average grouping was used to preliminarily classify the samples according to factors such as gender, age, and injury type, and then different rehabilitation interventions were evenly distributed in each group. When analyzing the data, covariance analysis was used to control individual differences, evaluate the impact of different rehabilitation training on each group, ensure the universality and accuracy of the results, and further improve the effect of personalized rehabilitation intervention.

Evaluation indicators

To better evaluate the effectiveness of rehabilitation training, this article uses two indicators, rehabilitation time and recurrence rate, to score the rehabilitation effect. The dimensions of two indicators and assign weights are unified to ensure the accuracy of the evaluation. The process is shown in **Figure 3**:

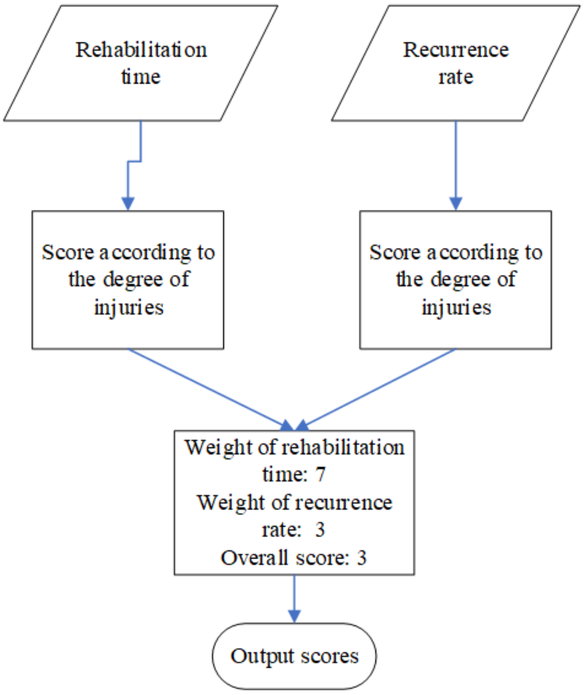

Figure 3. Scoring process.

After obtaining the rehabilitation time and recurrence rate, the two indicators are scored and quantified first. Firstly, the score is divided into three evaluations: excellent (81–100), good (61–80), and poor (0–60). Athletic injuries are classified into minor, moderate, and severe based on their severity. The rehabilitation time for minor injuries is based on 20 days to 1 month, with scores below 20 days being excellent, scores above 1 month being poor, and scores within 20 days to 1 month being good. The standard for moderate injuries is 3 months to 6 months, and for severe injuries, it is 7 months to 1 year. Afterwards, the recurrence rate is scored. Minor injuries are scored at 5%–10%, with scores below 5% being excellent, scores above 10% being poor, and scores between 5%–10% being good. The standard for moderate injuries is 10%–15%, and for severe injuries it is 20%–30%. After obtaining the corresponding score, the final score is obtained by weighting the scores of rehabilitation time and recurrence rate based on the data from the International Federation of Sports Medicine as a reference.

To ensure the accuracy and reliability of experimental data, a third-party independent laboratory was used to verify the data to ensure the fairness of the data collection and processing process. Cross-validation technology was used to split the data set for multiple verifications to reduce bias. The consistency of the results was verified by comparing with existing literature or standard databases. Multiple experimental groups were set up and tracked for a long time to ensure the stability and repeatability of the data and improve the credibility of the experimental conclusions.

5.2. Analysis of experimental results

After categorizing volunteers according to the degree of injury, each type of the injured is divided into two groups. The two groups of volunteers receive rehabilitation training combined with intelligent devices and traditional rehabilitation training, and their scores are based on the effectiveness of rehabilitation training. The average score of each group is taken. The comparison of rehabilitation training scores between two groups of volunteers with minor injuries is shown in **Figure 4**:

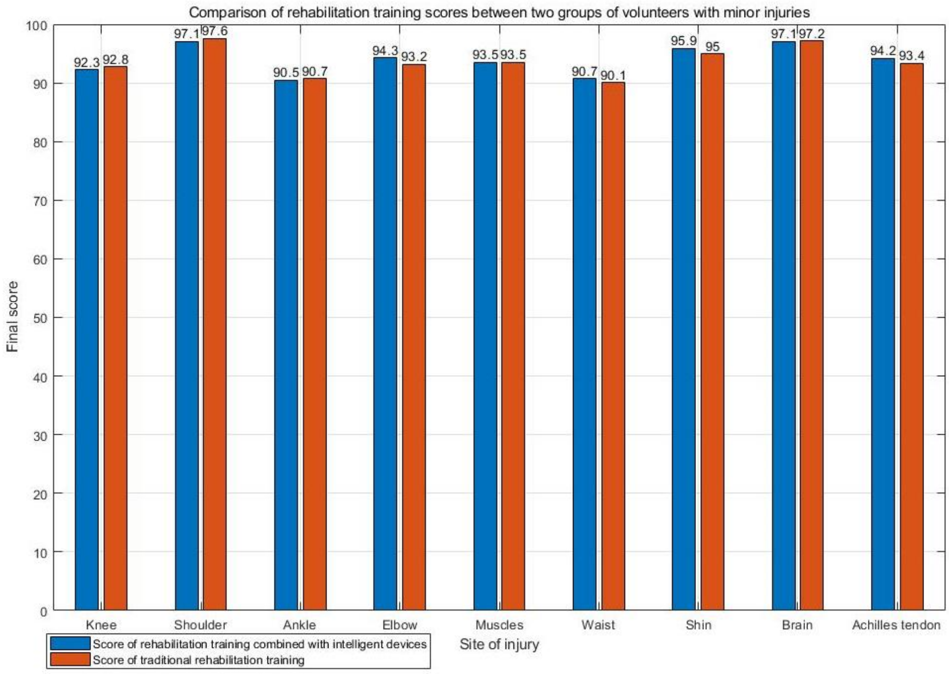

Figure 4. Comparison of rehabilitation training scores between two groups of volunteers with minor injuries.

From **Figure 4**, it can be seen that the scores of the two types of rehabilitation training are similar in the case of minor injuries, with little difference, both above 90 points. Therefore, in the rehabilitation treatment of minor injuries, the use of traditional methods and the combination of intelligent devices have almost the same effect. In the rehabilitation training of shoulder injuries, the method with the combination of intelligent devices and the traditional method both achieve rehabilitation training scores of over 97 points. The two methods can achieve good results in minor injuries, but it is difficult to highlight the characteristics and advantages of smart devices.

The rehabilitation training scores of volunteers with moderate injuries are shown in **Figure 5**:

From **Figure 5**, it can be seen that in the rehabilitation training scores for volunteers with moderate injuries, the combination of intelligent device score above 90 points, while the highest score for the traditional method is only 87.7 points. It can be concluded that the use of intelligent device performs better than the traditional method in the case of moderate injuries. In rehabilitation training for moderate injuries, there is a significant gap between the method with the combination of intelligent device and the traditional method in the scoring of shoulder treatment. The combination of intelligent device scores as high as 95.3 points, while the traditional method only scores 81.7 points. In cases of moderate injuries, although the effectiveness score of using rehabilitation training methods combined with intelligent devices decrease, compared to the traditional method, the method combined with intelligent device has a higher score. Therefore, in moderate injury situations, the use of rehabilitation training methods combined with the intelligent device is superior to the traditional method.

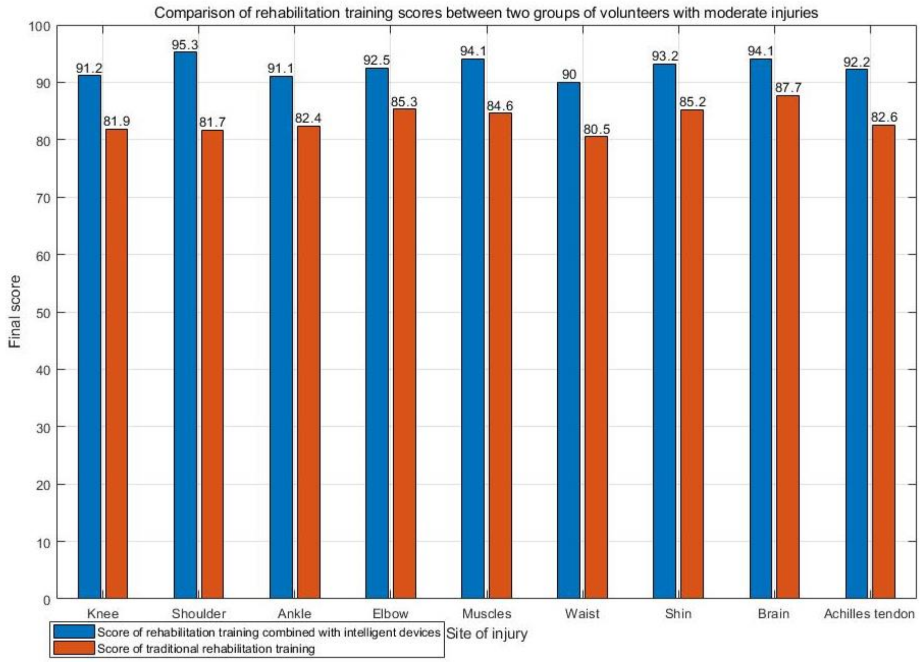

Figure 5. Comparison of rehabilitation training scores between two groups of volunteers with moderate injuries.

The rehabilitation training scores of severely injured volunteers are shown in **Figure 6**:

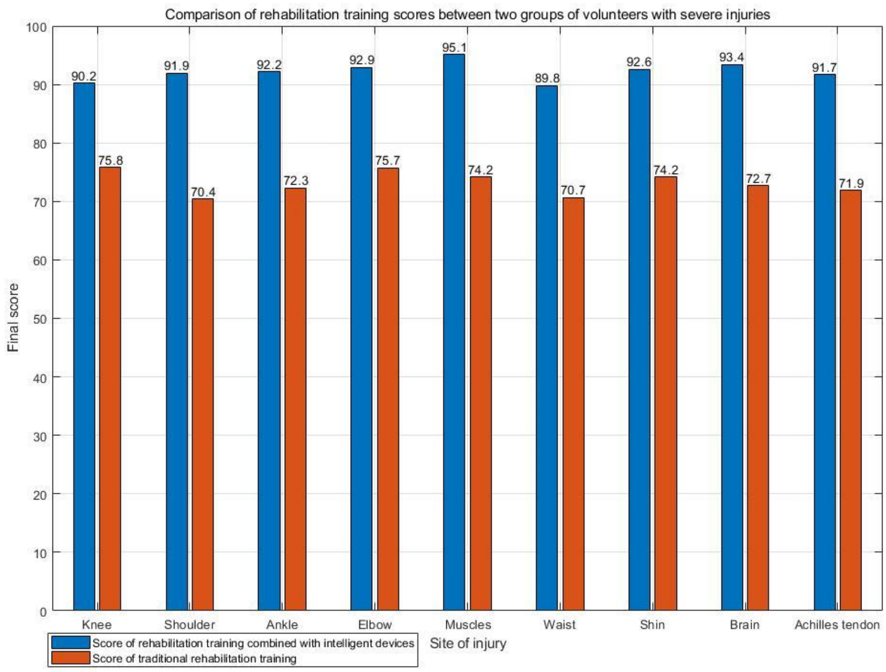

Figure 6. Comparison of rehabilitation training scores between two groups of volunteers with severe injuries.

From **Figure 6**, it can be seen that in the case of severe injuries, although the score of rehabilitation training combined with intelligent devices slightly decreases, it still remains around 90 points. However, the highest score of rehabilitation training using the traditional method is only 75.8 points, which is significantly different from the method combined with the intelligent device. In the rehabilitation training score of the shoulder, the difference between the two training methods is even greater. The rehabilitation training score combined with intelligent device is 91.9 points, while the rehabilitation training score of the traditional method is only 70.4 points, indicating a significant difference between the two. From this, it can be concluded that in the case of severe injuries, the rehabilitation training method combined with the intelligent device is far superior to the traditional method.

Combining **Figures 4–6**, it can be seen that there is not much difference between the two methods in the case of minor injuries. However, as the degree of injuries increases, the effectiveness of traditional methods deteriorates, while the method combined with intelligent devices remain stable. Therefore, the greater the degree of athletic injuries, the better the effect of using rehabilitation training methods combined with intelligent devices [34].

Psychological support is essential in the rehabilitation process of sports injuries. During the rehabilitation process, patients may experience negative emotions such as anxiety and depression due to pain, slow recovery or inability to participate in daily activities. Therefore, psychological support includes emotional communication with patients, providing psychological counseling, helping them build confidence and actively face the rehabilitation process. In addition, combined with appropriate psychological interventions, such as cognitive behavioral therapy or meditation exercises, it can reduce patients' stress, promote them to maintain a positive attitude, and improve rehabilitation effects.

The application of smart devices in rehabilitation training does have certain risks, such as data leakage, equipment failure and privacy issues. In order to prevent data leakage, it is necessary to ensure that data transmission is encrypted and use a strong authentication mechanism to protect user information. Equipment failure can be prevented through regular maintenance and remote monitoring to ensure stable equipment operation. In addition, user education should be strengthened to improve patients' awareness of privacy protection, ensure that smart devices comply with relevant laws and regulations, and protect patient data security and privacy.

6. Optimization direction

6.1. Optimization of measurement methods for body data

At present, traditional sensors have limited ability to collect body data and cannot collect enough data to generate personalized training plans. Additionally, there is limited feedback on body data during later training, which cannot help the injured recover further.

As the latest sensor for detecting athletes' body data, flexible wearable sensors [35] have improved the shortcomings of traditional sensors such as single function, poor wearing comfort, and low detection sensitivity. By combining new technologies such as artificial intelligence, flexible wearable sensors have made great progress and development, gradually becoming miniaturized, integrated, intelligent, and diversified.

Flexible wearable sensors detect various types of physiological signals generated by the human body during movement, such as biological posture signals, electrophysiological signals, biochemical signals, and other biological signals that reflect specific physiological characteristics. This helps to achieve an objective evaluation of the effectiveness and physical condition of human training, build a complete system of the body data of the injured, and help them develop scientific and reasonable rehabilitation training plans. At the same time, it can help to standardize the technical movements of the injured and reduce the probability of injury recurrence.

After using flexible wearable sensors, the comfort and adaptability of the wearer can be improved, making it suitable for long-term wear. Flexible wearable sensors have multiple detection functions that can real-time detect physiological indicators related to the movement status of the injured. These data help monitor the activity of the injured in daily life, evaluate and adjust the rehabilitation effect, and ensure the safety and effectiveness of rehabilitation training.

In terms of smart device applications, there have been many actual cases proving its effectiveness. In the case of using wearable sensors for sports injury rehabilitation, the patient monitors gait and range of motion through a smart bracelet, and the data is transmitted to the doctor's platform in real time to facilitate personalized rehabilitation plan adjustments. Another case is that in the rehabilitation of spinal injuries, a smart vest was used to assist with exercise, helping the patient gradually return to normal posture, significantly improving the recovery speed. In addition, smart mattresses are used for rehabilitation management of long-term bedridden patients, effectively reducing complications and promoting recovery.

6.2. Generation and optimization of individualized differential training plans

The rehabilitation training plans generated through intelligent analysis technology still have certain stereotypes and cannot be personalized.

There are two optimization methods for generating personalized differential training schemes. Firstly, artificial intelligence [36] can be applied to assist in generating personalized rehabilitation training plans. Artificial intelligence can intelligently process and classify the information collected by sensors, thereby more accurately evaluating the rehabilitation progress of the injured and providing scientific data support for the generation of rehabilitation training plans. By combining artificial intelligence, deep learning and data mining can be carried out on the rehabilitation data of the injured, adjusting the intensity, frequency, and method of rehabilitation training according to the specific situation and personal needs of the injured, and improving the effectiveness of rehabilitation training. Secondly, personalized rehabilitation training plans can be generated through remote assistance from experts. Experts can make targeted modifications and adjustments to the training plan based on the detailed physical data and personal needs of the injured, providing them with a better rehabilitation experience and effectiveness. At the same time, it also provides more convenient and accurate rehabilitation management tools for professional medical staff.

Both ways of improvement can improve the efficiency of rehabilitation training. Combined with artificial intelligence, it is faster and more convenient to adjust the rehabilitation training plan in real time, but the personalized development of the training plan is not targeted enough. The combination of experts' remote assistance can generate targeted rehabilitation training plans based on the needs and personal factors of the injured, but it cannot adjust the training plan in a timely manner according to the real-time situation of the injured.

Combining two options, based on the experts' rehabilitation training plan, artificial intelligence can assist in adjusting the later stage, forming a method of combining experts with artificial intelligence, which can provide an efficient and scientific personalized rehabilitation training plan.

7. Conclusion

This article investigates the effectiveness evaluation and optimization of intelligent devices in athletic injury rehabilitation training. By improving traditional rehabilitation training, personalized rehabilitation training plans are generated and efficient execution is achieved. Through experiments, it has been found that combining intelligent devices for athletic injury rehabilitation training can effectively improve the effectiveness of rehabilitation training. Firstly, volunteers have been recruited. Volunteers were divided into two groups for rehabilitation training combined with intelligent devices and traditional rehabilitation training, and the training effects were scored. When analyzing the rehabilitation effect, in addition to the role of smart devices and sensor technology, other factors that affect the rehabilitation effect, such as nutrition and sleep, should also be considered. Nutrition is a key factor in the rehabilitation process. A reasonable diet can promote wound healing, increase physical recovery and immunity. Sleep quality also has an important impact on rehabilitation. Adequate sleep can promote body repair, reduce inflammatory response, and enhance recovery. Therefore, when formulating a comprehensive rehabilitation plan, nutritional support and good sleep habits should be combined to improve the rehabilitation effect. Future research should focus on the promotion and optimization of intelligent rehabilitation training systems in actual application scenarios, especially the adaptability in different clinical environments and diverse patient groups. Explore the accuracy and practicality of personalized intelligent analysis technology in sports injury rehabilitation, combined with real-time data monitoring and feedback, to further improve the rehabilitation effect. In addition, research should strengthen interdisciplinary cooperation, promote the deep integration of smart devices and clinical treatment, and realize the widespread application and popularization of intelligent rehabilitation systems.

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Conflict of interest: The author declares no conflict of interest.

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