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Retraction

Retracted: Application of Nanoscaffold Material Combined with Exercise Rehabilitation Therapy in the Treatment of Athletes with Hip Injuries

Journal of Nanomaterials

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

In addition, our investigation has also shown that one or more of the following human-subject reporting requirements has not been met in this article: ethical approval by an Institutional Review Board (IRB) committee or equivalent, patient/participant consent to participate, and/or agreement to publish patient/participant details (where relevant).

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] M. Xiang, F. Cao, J. Peng, and G. Bai, "Application of Nanoscaffold Material Combined with Exercise Rehabilitation Therapy in the Treatment of Athletes with Hip Injuries," *Journal of Nanomaterials*, vol. 2022, Article ID 6582511, 12 pages, 2022.

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Research Article

Application of Nanoscaffold Material Combined with Exercise Rehabilitation Therapy in the Treatment of Athletes with Hip Injuries

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A nanoscaffold is a porous scaffold. It injects antibiotics, cells, and polymer particles into damaged cavities in the form of injectables and forms hydrogels after the molecules self-assemble at the injection site. Sports rehabilitation is a new frontier field integrating sports, health, and medicine, also known as physical therapy. It is the use of various sports methods for the injured or disabled, so that they can fully recover their physical functions and spirits, and can make them reintegrate into society. It mainly studies the relationship between sports and health. Among the tissue engineering scaffolds used as seed cell carriers, nanomaterials are playing an increasingly important role in the study of joint injury and repair due to their unique effects such as cell adhesion and proliferation. The purpose of this paper is to study a reliable nanoscaffold material for the treatment of patients with hip injuries in athletes and to observe its actual effect in combination with sports rehabilitation therapy. In this paper, an electrospinning method was proposed to prepare nanoscaffold materials, and the nanoscaffold materials were applied to the exercise rehabilitation process of two groups of hip patients, and the data of the patients' rehabilitation were calculated. The results showed that the OD value of the cells in the exercise rehabilitation therapy using nanofiber scaffolds increased significantly, and the average daily growth rate of the OD value was 0.112. And the rehabilitation after 5 months was 19.8 points higher in hip range of motion score, 11.3 points higher in overall function score, and 6.2% lower in complication rate compared with ordinary exercise rehabilitation therapy. Therefore, it can be concluded that the therapy of the nanofiber scaffold material combined with exercise rehabilitation can more efficiently help patients with hip joint injury to recover, and the probability of complications is lower compared with the traditional exercise rehabilitation therapy.

1. Introduction

With the development of science and technology, nanomaterials have become important materials used in many fields, including the production of materials for medical equipment. Because athletes are too intense in the process of exercise, they often cause joint damage, especially for the hip joint. The hip joint is the most critical part of the movement of the lower limbs of the human body, and the treatment of the hip joint is particularly important. Although traditional exercise rehabilitation therapy can help patients recover to a certain extent, its efficiency is not high, and it is more dependent on the exercise method of physician medical treatment, so it is necessary to propose a more efficient exercise rehabilitation therapy. In this way, hip patients can relieve hip pain and restore normal movement of the hip joint as soon as possible. With the advancement of the pathological research of hip joint injury, some progress has been made in the mechanism of treatment of hip joint injury. Many factors combined with exercise rehabilitation therapy can promote the effect of treatment. However, these are only some single substances that promote treatment. How to integrate these accelerators to better improve the expression of nutritional factors, and whether there will be countermeasures, need to be explored and studied. In addition to expressing neurotrophic factors to repair hip joint injury, the treatment of hip joint injury can also regulate the expression of genes, which can play a role in repairing damaged tissue.

The innovation of this paper is that (1) an electrospinning method was proposed to prepare nanoscaffold materials, and the nanoscaffold materials were applied to the exercise rehabilitation process of two groups of hip patients, and the data of the patients' rehabilitation were calculated. (2) Using the control method, the OD value of the cells and the postoperative rehabilitation effect of the two groups of patients were compared. (3) Conduct in-depth theoretical research on the subject content, and analyze the research status of the subject-related content of this paper.

2. Related Work

Regarding the research on exercise rehabilitation therapy, many scholars in China have carried out related research. Among them, Buckthorpe et al. described how the properties of water support the functional recovery process after ACLR (anterior cruciate ligament reconstruction). Buckthorpe et al. recommended that if the main properties of hydrotherapy (density, hydrostatic pressure, buoyancy, and viscosity) are properly applied to rehabilitation practice, then it can be used to achieve the six main goals after ACLR, namely, (1) help reduce pain and swelling, (2) support gait recovery, (3) support the maintenance and/or development of cardiovascular health, (4) help accelerate and optimize movement pattern retraining, (5) allow earlier introduction of plyometric and strength training, and (6) support the relationship between session recovery and optimal load management [1]. Li et al.'s study employed an effective motion measurement method based on inertial sensor networks to measure children's motor abilities to verify the effectiveness of systemic CP rehabilitation. Li et al. proposed a new skeletal vector-based dynamic model to reconstruct the posture of children during exercise training to evaluate the effect of exercise rehabilitation. An Extended Kalman Filter (EKF) is used to fuse sensor signals to measure the motion of body parts, the accuracy of which is verified by the OptiTrack optical system. Li et al. used statistical analysis methods to analyze the motor function rehabilitation of SD children. The results are reassuring, and the lower extremity motor function of some children has been improved after rehabilitation training [2]. Flaherty provided research-based evidence to support the use of these modalities in pain management and to reduce the use of pain medications, including opioids. Mechanisms of action, applications, contraindications, and adverse effects of cryotherapy, pulsed electromagnetic field therapy, transcutaneous electrical nerve stimulation, and laser therapy are reviewed. It has been shown that adding one or more of these therapies to an anaesthetic pain management regimen can improve outcomes and reduce potential drug side effects [3]. Temkin-Greener et al. conducted data surveys based on methods such as minimal data set assessments, vital statistics, nursing home comparison websites, LTCFocus, and district health resource files. Findings suggest that facilities with for-profit missions and more therapists may be more motivated to maximize treatment utilization, even among the sickest residents [4]. They evaluated the therapeutic techniques and rehabilitation used by physical therapists in the treatment of patients with plantar fasciitis. Based on a retrospective review, Fraser et al. concluded that although plantar fasciitis is a common musculoskeletal disorder, a small proportion of patients with plantar fasciitis are treated by a physical therapist. Most patients evaluated by a physical therapist received manual therapy and supervised rehabilitation sessions as part of their care plan [5]. Murray et al.'s study systematically assessed the evidence supporting the efficacy, prescribing, and progression patterns of vestibular rehabilitation therapy (VRT) in concussion patients. Nine of the studies reported improved outcomes. However, level I evidence from only 1 study showed that when VRT (in combination with cervical treatment) was compared with usual care, heterogeneity in study type and outcome precluded meta-analysis. Eight studies used habituation and adaptation exercises, 9 studies used balance exercises, and there was a lack of standardization in prescribing and progression patterns. It was then concluded that there is currently limited evidence on the optimal prescribing and efficacy of VRT in patients with mTBI/concussion. The available evidence, though weak, shows promise in this population. This requires further high-level studies to evaluate the effect of VRT in patients with mTBI/concussion with vestibular and/or balance dysfunction [6]. The research of the above scholars has promoted the application of sports rehabilitation therapy to a certain extent and, at the same time, has done some practical tests, but most of them are based on theoretical research. And the joint nanoscaffold material for sports rehabilitation treatment of patients with hip joint injury is also less involved, so the research in this paper is of pioneering significance.

3. Exercise Therapy Based on Hip Joint Nanoscaffold Materials

3.1. Nanoscaffold Materials. Nanomaterials are materials that have at least one dimension in three-dimensional space on the nanometer scale (1-100 nm) or are the basic units built around them. This corresponds to a dense scale of about 10 to 1000 atoms. Nanomaterials are an important part of nanotechnology. Nanotechnology refers to the general term for manufacturing technologies whose processing precision reaches the limit value of one order of processing size, and its crystal lattice spacing is about 1 to 100 nanometers [7, 8].

Since the advent of nanoparticle materials in the 1970s, the development process can be divided into three stages in terms of research connotation and characteristics. The first stage (before 1990) mainly explored the preparation of nanoparticle powders or synthetic blocks of various materials by various methods in the laboratory, studied the methods for evaluating and characterization, and explored the special properties of nanomaterials that are different from ordinary materials. The research objects are generally limited to single materials and single-phase materials, which are usually referred to as nanocrystalline or nanophase materials internationally. The second stage (1990~1994). The focus of attention is how to use the physical and chemical properties of nanomaterials to design nanocomposite materials. The synthesis and physical property exploration of composite materials once became the dominant direction of nanomaterial research. The third stage (1994-present). Nanoassembly systems and artificially assembled nanostructured material systems are becoming a new hotspot in nanomaterial research. Internationally, such materials are called nanoassembled material systems or nanoscale patterned materials. Its basic connotation is that nanoparticles and their nanowires and tubes are the basic units assembled in one-dimensional, two-dimensional, and three-dimensional spaces to form a system with nanostructures.

Nanomaterials can be divided into nanofilms, nanopowders, nanofibers, nanoblocks, and nanoceramics according to their material properties, as shown in Figure 1.

Nanostructure is a new system constructed or constructed according to certain rules on the basis of nanoscale material units. It includes a nanoarray system, mesoporous assembly system, and thin-film mosaic system. Research on nanoarray systems has focused on binary systems formed by the alignment of metal nanoparticles or semiconductor nanoparticles on an insulating substrate. The nanoparticle and mesoporous solid assembly system has some new effects due to the characteristics of the particle itself and the coupling with the matrix at the interface.

Nanomaterials can be divided into nanocomputers, nanosensors, nanobiomaterials, nanosemiconductor materials, and other fields according to their application scope, as shown in Figure 2.

Nanobiomaterials can also be divided into two categories, one is the nanomaterials that are suitable for the interior of the organism, such as various nanosensors, which are suitable for disease monitoring, early diagnosis, and later treatment. These nanoscale mechanical systems can quickly identify the location of the disease and can accurately guide the drug into the diseased location without damaging other normal body parts or clearing the deposits in fat and removing the thrombus in the cardiovascular and cerebrovascular. At the same time, they can also be used to kill viruses and eliminate cancer cells [9, 10].

The preparation methods of nanomaterials include (1) the evaporation condensation method under inert gas. It is usually formed by high pressure forming of particles with a particle size of 1-100 nm with a clean surface, and nanoceramics also need to be sintered. A variety of nanosolid materials has been successfully developed abroad by the abovementioned inert gas evaporation and vacuum in situ pressurization methods, including metals and alloys, ceramics, ionic crystals, amorphous, and semiconductor nanosolid materials. This method has also been successfully used in China to make nanomaterials such as metals, semiconductors, and ceramics. (2) Chemical method: (i) hydrothermal methods, including hydrothermal precipitation, synthesis, decomposition, and crystallization, are suitable for the preparation of nanooxides; (ii) hydrolysis methods include sol-gel method, solvent volatilization decomposition method, latex method, and evaporation separation method. (3) Comprehensive method. A preparation method is formed by combining the physical vapor method and chemical deposition method. Other methods generally include ball milling and jet processing.

A nanoscaffold is a porous scaffold. It injects antibiotics, cells, and polymer particles into damaged cavities in the form of injectables and forms hydrogels after the molecules self-assemble at the injection site. Figure 3 shows the use process of the nanoscaffold material. It is now believed that this type of fine particle can be assembled by combining traditional controlled release systems with surface engineering and self-organization via growth factors and other signaling molecules. Superior biomimetic scaffolds, especially biopolymer self-assembled hydrogels, are formed for this purpose. Nanoscaffolds have great prospects for drug control and regenerative medicine [11, 12].

Nanotechnology basic theoretical research and new material development and other applied research have developed rapidly and have been widely used in traditional materials, medical equipment, electronic equipment, coatings, and other industries. With the increasing investment in nanotechnology application research in various countries, the process of industrialization of new nanomaterials will be greatly accelerated, and the market size will increase in volume. Several products such as nanocalcium carbonate, nanozinc oxide, and nanosilicon oxide in nanopowder materials have formed a certain market scale. Nanopowder widely used nanoceramic materials, nanotextile materials, nanomodified coatings, and other materials have also been successfully developed, and industrial production has been initially realized. The application of nanopowder particles in medical diagnostic preparations and microelectronics is shifting from experimental research results to industrialized production of products.

3.2. Exercise Rehabilitation Therapy. Sports rehabilitation is a new frontier field integrating sports, health, and medicine, and it mainly studies the relationship between sports and health. Particularly for some adult hip bones, the damage is mostly caused by high-energy violence. This kind of high-energy violence also often causes damage to the distal articular surface of the hip bone and the surrounding tissues, ligaments, skin and soft tissues, nerves, blood vessels, and other injuries. Fractures are prone to redisplacement after manual reduction, and it is difficult to restore the integrity of the articular surface. External fixation of the elbow joint is required in the early stage after manual reduction, which may easily lead to the loss of elbow joint function. Strong internal fixation provides a prerequisite for the early postoperative functional rehabilitation training of patients [13, 14]. Immobilization of the affected limb for too long can easily lead to obstruction of lymphatic and venous return, fibrin deposition, and serous fibrous exudation in the tissues around the joint. This can cause fibrous adhesions, edema of the joint capsule and surrounding muscles, fibrosis, and

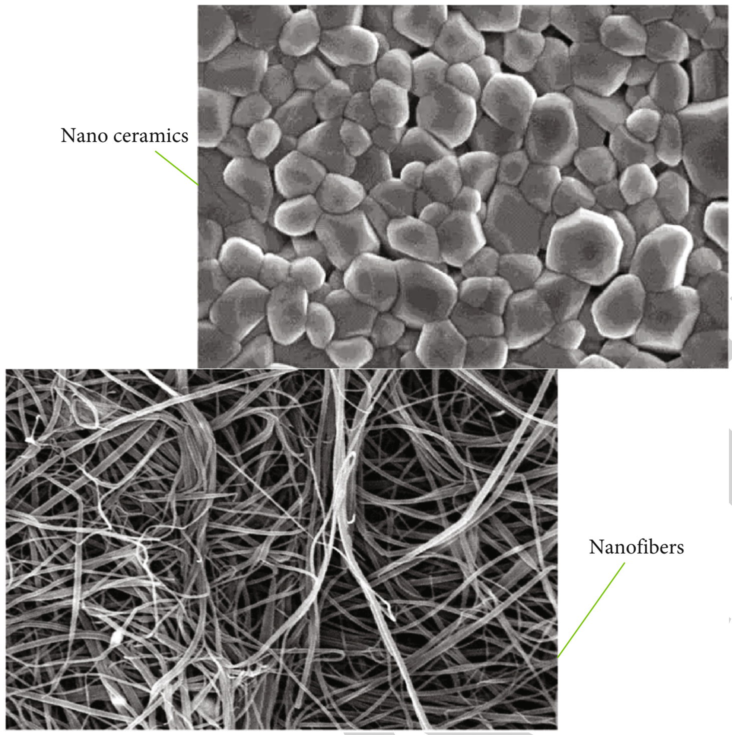

Figure 1: Nanomaterials.

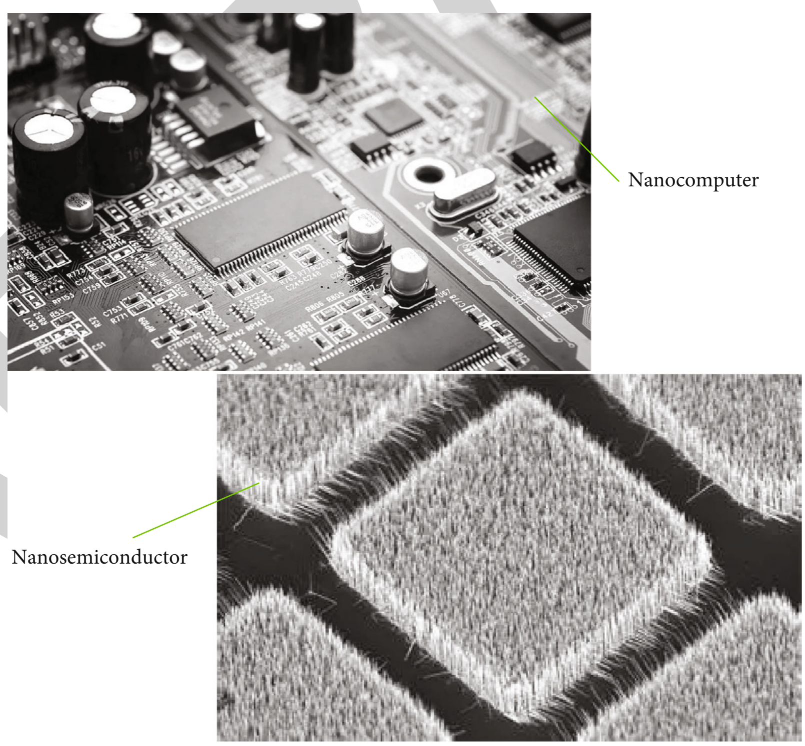

Figure 2: Applications of nanomaterials.

contractures, resulting in impaired elbow mobility, resulting in elbow stiffness.

The soft tissues around the hip joint, such as fascia, muscle bonds, and muscles, determine the high lateral stability of the hip joint. However, the sagittal flexion and extension range of motion is also larger, and while improving its flexion and extension range of motion, it is also necessary to pay attention to strengthening its lateral stability.

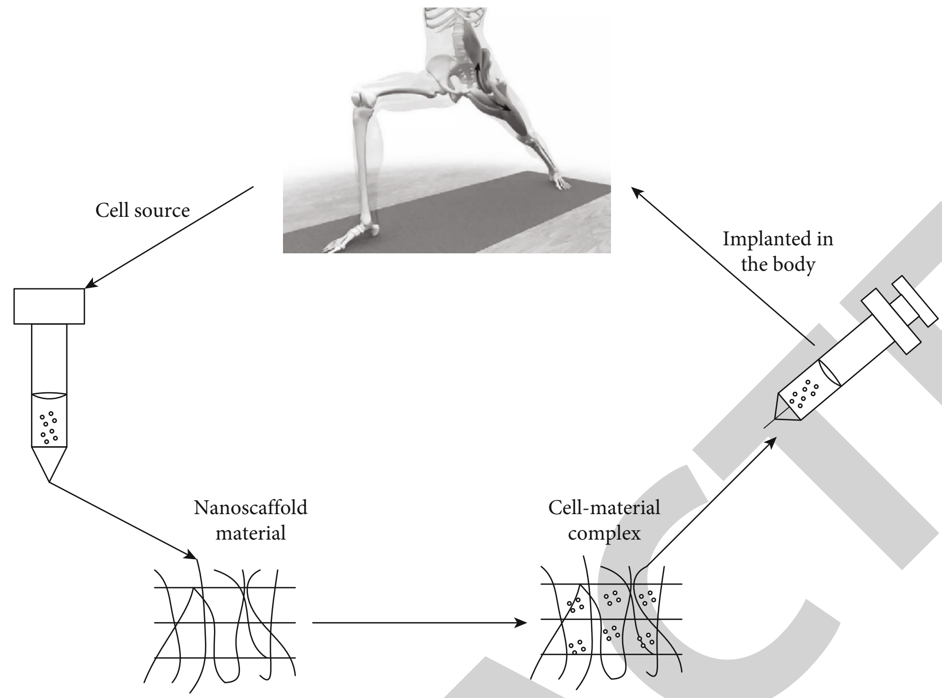

Figure 3: Application process of nanoscaffold materials.

Sports rehabilitation therapy: 3-5 days after surgery, perform leg movement, lift, and leg contraction training. After 2-4 weeks, begin to perform hip flexion and extension exercises. After 6-8 weeks, traditional functional rehabilitation training with muscle strength training for the affected limb is the main method.

Commonly used traditional sports rehabilitation equipment includes training beds, stationary bicycles, and suspension frames, as shown in Figure 4.

Table 1 shows the safety assessment scale of sports rehabilitation for fracture patients. Evaluate the patient's rehabilitation exercise score, and formulate a personalized rehabilitation prescription based on the score. The table has a total score of 100. Rehabilitation exercise is safer for more than 60 points; 40-60 minutes of rehabilitation exercise should be cautious and closely observed; 0-40 points are mainly muscle isometric contractions, and early isotonic contractions are not suitable.

3.3. Patients with Hip Injury. With the aging of the population, the incidence of hip diseases in the elderly will also increase significantly, such as femoral head necrosis, fractures, and femoral arthritis. The pain and joint dysfunction caused by it have become an important factor affecting the quality of life in the elderly. At the same time, due to trauma and improper lifestyle, the incidence of hip disease among young people has increased. Particularly for athletes who have been doing leg exercises for a long time, the use of the hip joint is more frequent, and various injuries of the hip joint are more likely to occur [15, 16]. The emergence of these hip diseases makes more and more patients have to accept hip treatment. The specific parts of the hip joint are shown in Figure 5.

The main causes of hip injury are trauma; vascular plunger, deformity, and tumor of the hip; hip compression; hip inflammation; and others such as deformity, demyelinating degenerative diseases. The pathological process mainly includes primary injury and secondary injury. The final result will have a large negative impact on the physiological function of the hip joint due to neuronal and glial cell death, axonal degeneration and formation of myelin sheaths, cystic cavities, etc. The specific situation is shown in Figure 6.

Common treatments for hip injuries include decompression therapy with surgery or prevent the use of large doses of drugs. This method has a neuroprotective effect on acute hip injury. Expression of factors that inhibit axon regeneration can be blocked. There is rehabilitation through exercise, or injection of neurotrophic factors to repair damaged myelin. At present, the use of nanoscaffold materials combined with exercise rehabilitation therapy to treat hip joint injury is a new hot research direction [17, 18]. Table 2 shows the evaluation method of functional rehabilitation after hip injury.

At present, the mechanism of bone marrow mesenchymal exercise rehabilitation therapy in the treatment of hip injury is not very clear. It is known that the characteristics of bone marrow mesenchymal cells are as follows: self-replication ability, asymmetric division ability to differentiate into other cells, surface markers with primitive cells, and homing. With these characteristics, the treatment of hip joint injury can have better results by selecting the appropriate exercise rehabilitation therapy approach and

(a) Training bed (b) Stationary bike

(c) Suspension frame

Figure 4: Commonly used sports rehabilitation equipment.

Table 1: Exercise rehabilitation safety evaluation form.

Score	Fixed reliability	Integrity of soft tissue
60 to 80	Strong immobilization for immediate weight bearing	
40 to 60	Postoperatively with the help of	Reasonable surgical approach (less trauma)
20 to 40	Brace function active movement	The ligament solution is fixed and repaired firmly
1 to 20	Can resist body gravity but not resistance	The ligament of the joint is sutured, and the tension is partially resisted during the operation
0 marks	To maintain alignment, external fixation, traction, etc.	The ligaments of the joint are sutured, and the tension cannot be resisted during the operation

the appropriate time. The pathological mechanism of hip joint injury is mainly the damage of the hip joint barrier caused by the hip joint injury, which leads to the entry of some bacteria into the hip joint injury site. And because of cytotoxicity, ischemia and hypoxia-induced apoptosis are initiated.

The biggest problem with sports rehabilitation therapy for hip injury lock is that the details of its operation are not fully understood. According to the current research, it may be derived from the following aspects: exercise rehabilitation therapy can migrate to the injured site autonomously and differentiate into nerve cells; the mediating role of exercise rehabilitation therapy; exercise rehabilitation therapy can inhibit the activation of certain apoptosis factors. However, the specific causal mechanism remains to be studied. The research trend of exercise rehabilitation therapy in the treatment of hip injuries will develop towards the synergistic effect of multiple factors. That is to say, the effect of simple exercise rehabilitation therapy is not ideal, and various promoting factors need to be integrated, and the target gene that can promote axonal repair should be transfected into the hip joint. Although there are still many problems to be solved, with the deepening of research, the details of sports rehabilitation therapy for hip injuries will eventually be fully understood. At that time, more treatment methods will also be applied in the clinic, and by combining various methods and taking advantage of their advantages, a convenient, stable, and less traumatic treatment method will surely be found, so as to overcome the problem of repairing hip joint injury [19, 20].

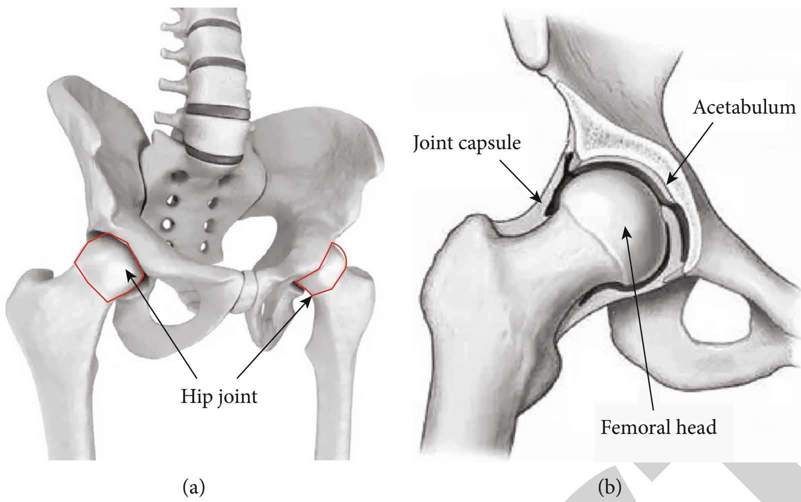

FIGURE 5: Hip joint.

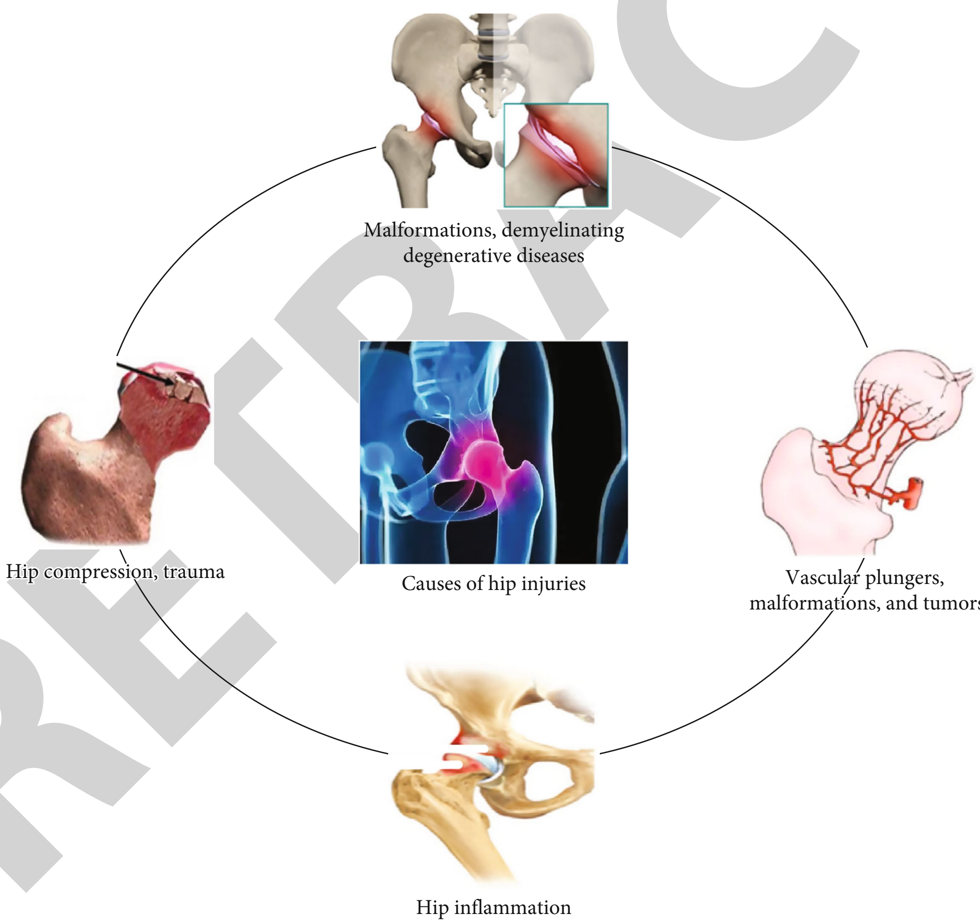

FIGURE 6: Causes of hip injuries.

4. Test of the Assisted Rehabilitation Effect of Nanoscaffolds

4.1. Exercise Rehabilitation Efficacy Algorithm. In order to facilitate the calculation of the movement process, this paper establishes the coordinate system of the lower limbs of the human body as shown in Figure 7. The hip joint is the key driving part of the movement of the entire lower limb, which is the origin of the coordinate system, and the hip joint and the knee joint are regarded as articulations.

For the motion process of the thigh system, set the angle in the horizontal direction and its corresponding angular

Table 2: Hip joint function evaluation table.

Flexion	Pain and dysfunction	Score
Loss of extension < 15°, flexion > 130°	No pain and functional impairment	Excellent
Loss of extension < 30°, flexion > 120°	Mild functional impairment	Good
Loss of extension < 40°, flexion > 90°	Pain with activity, moderate functional impairment	Generally
Loss of extension < 40°, flexion > 90°	Frequent pain, severe functional impairment	Not good

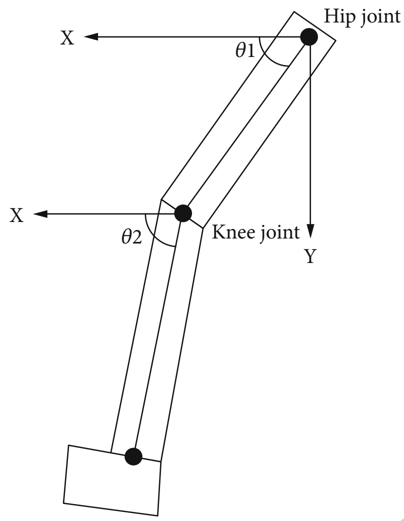

Figure 7: Human lower limb coordinate system.

velocity and angular acceleration to x_{1i}, x_{2i}, and x_{3i}; then, the motion equation is

$$\begin{aligned} x_{1i}(k) &= \theta_1, \\ x_{2i}(k) &= \dot{\theta}_1 = w_1, \\ x_{3i}(k) &= \ddot{\theta}_1 = \dot{w}_1 = \beta_1. \end{aligned} \tag{1}$$

Among it, k represents the kth motion situation.

$$\begin{cases} \theta_1(k+1) = \theta_1(k) + w_1(k)t_s, \\ w_1(k+1) = w_1(k) + \beta_1(k)t_s, \\ \beta_1(k+1) = \beta_1(k). \end{cases} \tag{2}$$

The equation of state can be obtained:

$$\begin{cases} x_{1i}(k+1) = x_{1i}(k) + x_{2i}(k)t_s, \\ x_{2i}(k+1) = x_{2i}(k) + x_{3i}(k)t_s, \\ x_{3i}(k+1) = x_{3i}(k). \end{cases} \tag{3}$$

Output equation:

$$\begin{cases} y_{1i}(k) = g \cos x_{1i}(k) + x_{3i}(k)d_1, \\ y_{2i}(k) = -g \sin x_{1i}(k) - x_{2i}{}^2(k)d_1. \end{cases} \tag{4}$$

In the equation, g is the acceleration of gravity.

Similarly, for the movement process of the calf system, let its variable be x_{12}, x_{22}, and x_{32}.

$$\begin{aligned} x_{12}(k) &= \theta_2, \\ x_{22}(k) &= \dot{\theta}_2 = w_2, \\ x_{32}(k) &= \ddot{\theta}_2 = \dot{w}_2 = \beta_2. \end{aligned} \tag{5}$$

The equation of state is

$$\begin{cases} x_{12}(k+1) = x_{12}(k) + x_{22}(k)t_s, \\ x_{22}(k+1) = x_{22}(k) + x_{32}(k)t_s, \\ x_{32}(k+1) = x_{32}(k). \end{cases} \tag{6}$$

Output equation:

$$\begin{cases} y_3(k) = g \cos x_{1i}(k) + x_{3i}(k)(l + d_2), \\ y_4(k) = -g \sin x_{1i}(k) - x_{2i}{}^2(k)(l + d_2). \end{cases} \tag{7}$$

According to the Kalman filter principle, the Kalman filter is a linear minimum variance filtering algorithm. By making certain assumptions about the statistical characteristics of the input signal and noise, the state space method is used to describe the system. According to the current measured value and the estimated value of the previous moment, the signal can be processed in real time through recursive calculation. It can not only process stationary random signals but also process multidimensional and nonstationary random signals. It is an important method for solving state estimation and filtering problems in various dynamic systems. The nonlinear state-space model is obtained:

$$\begin{aligned} X_k &= f(X_{k-1}, k-1) + W_{k-1}, \\ Z_k &= h(X_k, k) + V_k. \end{aligned} \tag{8}$$

Among them, X_k is the multidimensional state set, Z_k is the multidimensional observation set, and W_k and V_k are the noise state set and observation set. h represents a nonlinear function.

Expand h by Taylor series, leaving only the first-order term, then:

$$Z_k = h\left(\hat{X}_{k,k-1}, k\right) + \left.\frac{\partial h}{\partial X_k}\right|_{\hat{X}_{k,k-1}} \left(X_k - \hat{X}_{k,k-1}\right) + V_k. \tag{9}$$

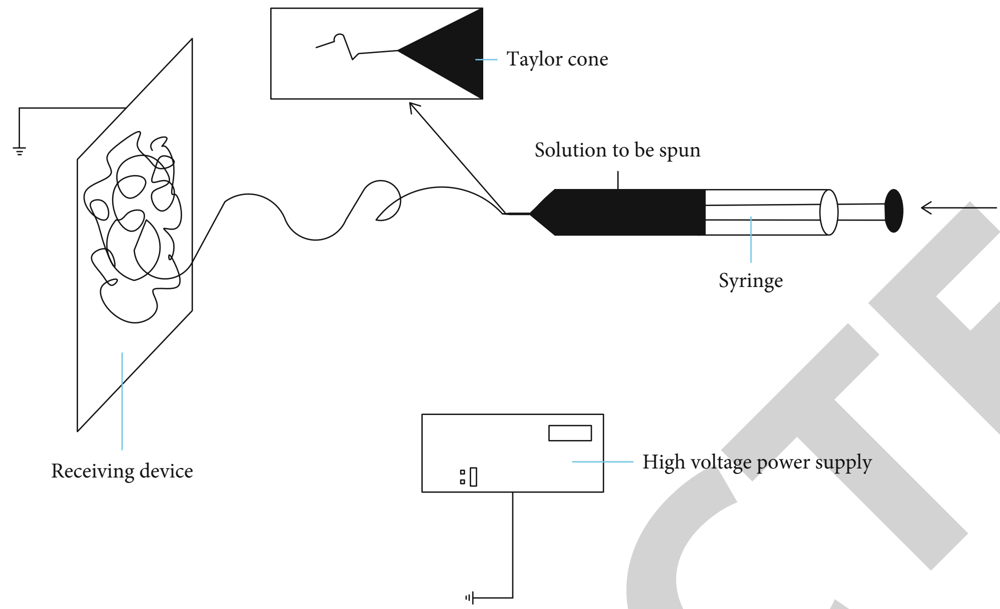

Figure 8: Electrospinning method.

Assume:

$$\left.\frac{\partial h}{\partial X_k}\right|_{\widehat{X}_{k,k-1}} = H_k,$$
$$y_k = h\left(\widehat{X}_{k,k-1}, k\right) - \left.\frac{\partial h}{\partial X_k}\right|_{\widehat{X}_{k,k-1}} \widehat{X}_{k,k-1}. \quad (10)$$

Then, the equation can be observed as

$$Z_k = H_k X_k + y_k + V_k. \quad (11)$$

The status update method is

$$\widehat{X}_{k,k-1} = f\left(\widehat{X}_{k,k-1}, k-1\right). \quad (12)$$

Observe the update method:

$$K_k = P_{k,k-1} H_k^T \left[H_k P_{k,k-1}\right]^{-1},$$
$$P_{k,k} = \left[I - K_k H_k\right] P_{k,k-1}. \quad (13)$$

In the equation, P represents the variance and $\widehat{X}_{k,k-1}$ represents the filtered mean.

A signal is the carrier of information, a function of time or space that transmits information. In the process of signal detection and transmission, it is inevitable to be disturbed by external environment and internal noise. In order to obtain the desired signal, it is necessary to filter the signal and suppress other signals to obtain the desired signal. Filtering refers to a method or technique of extracting a specific desired signal from an interfering signal. Different filtering methods and means are selected according to the nature of the signal, the criterion of estimation, and the way of observing the information.

Table 3: Main experimental instruments.

Laboratory apparatus	Type
SEM	Zeiss AURIGA FIB, DE
TEM	Zeiss, DE
FTIR	Perkin-Elmer, USA
Universal tensile testing machine	Instron USA

4.2. Preparation of Nanoscaffold Materials. The research and development of nanoscaffold materials have been practical for a period of time, and its preparation methods have also begun to diversify. Among them, the typical preparation method of nanoscaffold materials is electrospinning. Electrospinning is a special form of electrostatic atomization of polymer fluids. At this time, the atomized and split substances are not tiny droplets, but tiny jets of polymer, which can travel a considerable distance and eventually solidify into fibers. Electrospinning is a special fiber manufacturing process in which a polymer solution or melt is jet-spun in a strong electric field. Under the action of the electric field, the droplet at the needle will change from spherical to conical (namely "Taylor cone"), and fiber filaments are obtained by extending from the tip of the cone. In this way, polymer filaments with nanometer diameters can be produced. The method is specifically shown in Figure 8.

Electrospinning nanofibrous materials can effectively control the fine structure of fibers. Combining substances with low surface energy, materials with superhydrophobic properties can be obtained. It has high specific surface area and porosity, which can increase the action area between the sensing material and the detected object and can greatly improve the performance of the sensor.

The main process of electrospinning is dispersed and continuous phases that can be prepared separately. In order to

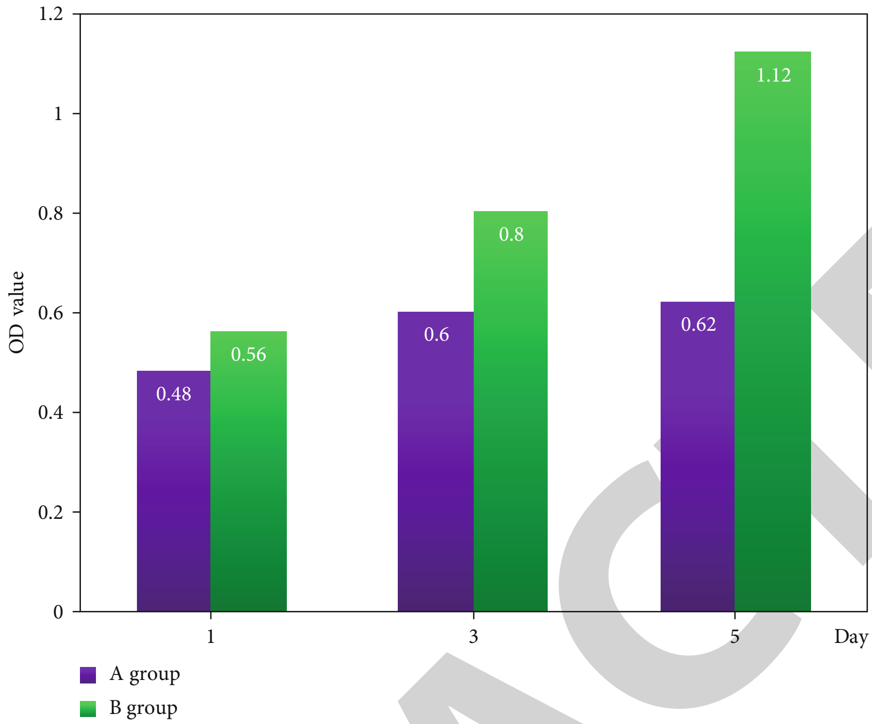

Figure 9: Hip joint cell proliferation.

form the desired solution state, the solution can be configured. The resulting solution is subjected to an electrospinning process under specific conditions, obtaining functional nanofibrous scaffolds.

Cell growth is affected by the surrounding environment and responds differently to different substrate environments. The ultrasmall size of the nanoscaffolds promoted cell adhesion but limited cell infiltration. In this experiment, microfibers were introduced into nanofibers to prepare micronanofiber scaffolds, combining the advantages of microfibers and nanofibers [21].

4.3. Testing through Experiments. In this experiment, 50 patients with hip joint injury from two groups A and B were selected for exercise rehabilitation therapy after surgery. Among them, group A was ordinary exercise rehabilitation therapy, and group B was nanofiber scaffold combined with exercise rehabilitation therapy. Other parameters are as follows: the voltage is 17 kV, the drum speed is 300 r/min, and the selected experimental instruments are shown in Table 3.

4.4. Experimental Analysis and Results. According to the observation of the SEM microscope, the proliferation of hip joint cells in the two groups of patients was obtained, as shown in Figure 9.

As can be seen from Figure 9, the OD value of group A was 0.48 on the first day, the OD value of group B was 0.56, the OD value of group A on the second day was 0.6, and the OD value of group B was 0.8. On the third day, the OD value of group A was 0.62, and the OD value of group B was 1.12. The average growth rate of OD value in group B was 0.112 per day, while that in group A was only 0.028. Therefore, it can be seen that the cell proliferation ability of group B was significantly higher than that of group A.

Table 4: Hip joint function recovery.

Item	A group	B group
Knee range of motion	73.8	93.6
General hip function	85	96.3
Knee complication ratio	16.1%	9.9%

According to the observation, the hip function recovery of the two groups of patients after 5 months is shown in Table 4.

As can be seen from Table 4, compared with the exercise rehabilitation of the two groups of hip patients after 5 months, the hip mobility score of group A was 73.8. Group B was 93.6, and group B was 19.8 points higher than group A. Group A's overall hip function score was 85, group B was 96.3 points, and group B was 11.3 points higher than group A. The complication probability in group A was 16.1%, while group B was only 9.9%, and group B was 6.2% lower than group A. Therefore, it can be concluded that the therapy of the nanofiber scaffold material combined with exercise rehabilitation can more efficiently help patients with hip joint injury to recover, and the probability of complications is lower compared with the traditional exercise rehabilitation therapy.

5. Discussion

In the experimental process of this study, although many valuable data have been obtained, there are still some problems that need to be further explored. Therefore, we can also explore from the following aspects:

(1) In the process of preparing nanoscaffold materials by electrospinning, we can try to optimize the process parameters to prepare bimodal fiber scaffolds with shell-core structure

(2) In the process of electrospinning, try to mix electrospinning PCL with good mechanical properties and biological macromolecular proteins (such as silk fibroin) and growth factors (such as MGF) with biological functions. One-step methods can then be utilized in order to prepare excellent biomaterials with special functions

(3) In the comparison of the two groups of experiments, the amount of data detection is relatively small, and the frequency of data collection should be increased to make the data more reliable

6. Conclusions

In the abstract, this paper firstly summarizes the overall content of the full text, then introduces the background of exercise rehabilitation therapy in the introduction, introduces the role of nanomaterials, and summarizes the innovations of this paper. In the related work section, some related studies are listed to understand the current situation of the related content studied in this paper. Then, in the theoretical research part, the definition, characteristics, classification, and application fields of nanomaterials are firstly introduced, and then, the related content of sports rehabilitation therapy is introduced, including its concept, specific therapy, training equipment, and evaluation method. Then, the related content of hip joint injury is introduced. Finally, an electrospinning method was proposed to prepare nanoscaffold materials, and the nanoscaffold materials were applied to the exercise rehabilitation process of two groups of hip joint patients, and the data of the patients' rehabilitation were calculated. It is concluded that the therapy of the nanofiber scaffold material combined with exercise rehabilitation can more efficiently help patients with hip joint injury to recover, and the probability of complications is lower compared with the traditional exercise rehabilitation therapy.

Data Availability

No data were used to support this study.

Disclosure

We confirm that the content of the manuscript has not been published or submitted for publication elsewhere.

Conflicts of Interest

There are no potential competing interests in our paper.

Authors' Contributions

All authors have seen the manuscript and approved to submit to your journal.

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