

Research Article

Nanomaterials Combined with Sports Rehabilitation Therapy in the Treatment of Shoulder Arthritis of Volleyball Players

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Shoulder arthritis is one of the most common injuries of professional volleyball players. It needs shoulder force to buckle, block, and bounce, which leads to frequent shoulder injuries. In addition, the late rehabilitation treatment is not in place, which will seriously affect the performance of volleyball players' skills. Periarthritis of the shoulder is referred to as frozen shoulder, commonly known as congealed shoulder and fifty shoulder. The shoulder pain gradually develops, worse at night, and gradually increases, and the shoulder joint movement function is limited and increasingly aggravated. After reaching a certain level, it gradually relieves and finally fully recovers as the main manifestations of the shoulder joint capsule and its surrounding ligaments and tendons. Shoulder periarthritis is a common condition in which shoulder pain and inconvenience are the main symptoms. This paper studies the application of nanomaterials combined with sports rehabilitation therapy in the treatment of shoulder arthritis of volleyball players. We selected 50 volleyball players with shoulder arthritis injuries, randomly assigned nanomaterials combined with sports rehabilitation therapy as the experimental group and traditional sports rehabilitation therapy as the control group, 25 cases in each group. The experimental group was treated with nanomaterials combined with sports rehabilitation, while the control group was treated with traditional sports recovery methods for 5 weeks. Nanomaterials have a certain uniqueness. When the scale of matter is small to a certain extent, quantum mechanics must be used instead of traditional mechanics to describe its behavior. When the particle size of the powder is reduced from 10 microns to 10 nanometers, its particle size is 1000 times, and when converted into volume, it will be 10 times the 9th power, so there will be obvious differences in the behavior of the two. The physical examination of the two groups of volleyball players' shoulder joint visual analogue scale (VAS) pain score and shoulder joint isokinetic detection (including shoulder joint extension and adduction, shoulder joint flexion and extension, and shoulder joint movement to 90° shape) is compared. The results showed that the VAS score of the experimental group was significantly lower than that of the control group ($P < 0.05$), and the isokinetic test of the experimental group was better than that of the control group ($P < 0.05$). After exercise rehabilitation training for shoulder joint dysfunction, the average strength and activation of 10 muscles were improved, among which the lower trapezius, the middle trapezius, and the serratus anterior were significantly improved. It can be seen that as an effective treatment of shoulder arthritis, nanomaterials combined with sports rehabilitation therapy can not only accelerate the rapid recovery of volleyball players after injury but also effectively prevent the occurrence of arthritis symptoms, so that volleyball players can give full play to their skills on the court.

1. Introduction

Under coach Lang Ping's leadership, the Chinese women's volleyball team won the World Cup in 2015 and the Rio Olympics in 2016. In 2018, China once again dominated Asia and became the champion of the Jakarta Asian Games. It stands at the top of the world again, and Chinese volleyball has entered a new stage of development. Volleyball is a kind

of competitive sport which is dominated by technology [1]. It usually takes a long time and repeated training to improve skills. Long-term, high-load training is easy to make athletes' muscles and joints suffer from chronic injury or strain. If we do not pay attention to it, the condition will appear repeatedly or even worsen, and it will not be easy to cure completely. Sports training, competition practice, and sports injury are inseparable. Training can improve the athletes'

sports level. Competition is one of the standards to test athletes' sports ability. But at the same time, unreasonable, overload training or incorrect technical movements will also cause sports injury, affecting the normal training and the improvement of competition results. Therefore, it is one of the necessary conditions for volleyball players to know the common sports injuries, preventive measures, and rehabilitation means. Shoulder arthritis is very common in sports, especially in badminton, volleyball, swimming, baseball, and other items; because of the retrograde movement of athletes' upper limbs, it is easy to produce the symptoms of shoulder joint pain. In 2016, the National Training Bureau also carried out statistics on athletes' rehabilitation injuries. The main injuries of shoulder joint were subacromial impact syndrome, rotator cuff injury, and Meng lip injury.

Shoulder joint injury [2] is one of the most common injuries of volleyball players, which is an important reason to affect the training and competition performance of volleyball players. In volleyball, shoulder joint is used in defense, block, spike, and serve. Therefore, volleyball technique depends on the function of shoulder. In the process of spiking, the strength is transferred from the body, shoulder, elbow, and wrist to the end of the upper limb. When it is transferred to the end of the upper limb, it needs to reach a higher speed to catch a high-quality ball. When you swing your arm, you need to overcome a lot of resistance and a lot of spiking. Shoulder joint, as an important part of the upper limb and body power transmission, needs to bear high exercise load. Therefore, if the athletes continue to carry out high-load training under the condition of insufficient preparation or irregular technical movements, they may damage the shoulder joint. Shoulder joint is the largest and most flexible joint of the upper limb. The articular surface is large, the glenoid is shallow and small, the joint capsule is loose, and the ligament is weak. These physiological characteristics determine that the shoulder joint has good flexibility and poor stability. In the volleyball injury technique, the shoulder joint injury caused by impact is the most likely. The common cause of shoulder pain caused by shoulder joint injury is subacromial impact syndrome, and the nature of the injury is mainly chronic injury. In daily training and competition, due to the need for multiple swing arm strokes, high-intensity, long-term exercise on the shoulder is easy to make the impact of the coracoacromial arch, leading to subpeak mucositis, and more serious will lead to shoulder sleeve tissue degeneration or tear, leading to shoulder pain and obstacles. The method of adding vibration stimulation to conventional strength training can more effectively improve the effect of volleyball players' shoulder joint strength training.

When spiking the ball, the abduction angle of the upper arm is less than 120° , and the flexion of the arm to hit the ball forward and downward at a high speed is the most important factor leading to shoulder injury of the players. Secondly, because these young players started the college entrance examination for sports from the second and third year of high school, and the training time was tight, so the exercise load and amount of exercise were not reasonable enough. In recent years, semiconductor polymer nanoparti-

cles with strong near-infrared absorption and good biocompatibility have attracted people's interest in biosensors, fluorescence imaging, photoacoustic imaging, and photothermal therapy. There are three commonly used methods for preparing conjugated polymer nanoparticles: nanoprecipitation, microemulsion, and self-assembly. However, these conjugated polymer nanoparticles with hydrophobic surfaces are not stable in themselves, and their surfaces do not further couple the functional groups of biomolecules. In general, amphiphilic polymers or phospholipids can be coated on the surface of conjugated polymer nanoparticles to improve their biocompatibility and provide further modified functional groups. Therefore, most of the existing conjugated polymer nanoparticles have the problems of easy dissociation and poor structural stability, which hinder their application in biomedicine. In recent years, it has been reported that hydrophilic polyethylene glycol (PEG) [3] is grafted onto the main chain of semiconductor polymer to prepare nanoparticles with stable structure. However, the synthesis of amphiphilic semiconductor oligomers requires a time-consuming and laborious process. Each modification is specially designed for each different semiconductor-conjugated polymer. Therefore, it is necessary to prepare semiconductor polymer nanoparticles with stable structure, surface functional groups, excellent imaging, and therapeutic properties [4]. This paper studies the treatment of volleyball players' shoulder arthritis with nanomaterials combined with exercise rehabilitation therapy [5, 6]. Badminton is an indoor sport that uses a long-handled mesh racket to hit a small ball made of feathers and cork across the net. The badminton game is played on a rectangular field with a net in the middle of the field. The two sides use various techniques and tactics such as serving, hitting, and moving the ball to hit the ball back and forth on the net so that the ball does not fall within the effective area of its own side or make the opponent miss the ball to win.

In volleyball, serving and spiking are the two most lethal techniques in volleyball, and they are also the basic techniques that are mainly controlled by the shoulder joint, using the most and deepest techniques of the shoulder joint. The joints have certain physiological and anatomical weaknesses, and if they are not well adjusted in the teaching and training, sports injuries will be caused. Shoulder injury will not only disrupt the daily training rhythm of volleyball players but also reduce their competitive level and performance and even end their career in advance. On this basis, this study compared the characteristics of athletes with or without shoulder arthritis in the school of education, Nanjing University of Physical Education, and the observation of shoulder pain, the impact of stability and flexibility syndrome peak, and the peak of power sequence and arm swing to complete the mobilization and recruitment of dynamic chain muscle strength are different from the normal shoulder joint function of athletes. On the one hand, through the timely evaluation and detection of the shoulder function of volleyball players, functional training is carried out for the weak points of the shoulder to prevent injuries. On the other hand, after the occurrence of mild injury, timely targeted training should be carried out to find and correct wrong

movements, strengthen weak muscle strength, reduce the chance of injury recurrence, and improve sports performance and competitive ability. Through the application of nanomaterials combined with sports rehabilitation therapy in the experimental group and the traditional treatment in the control group for 5 weeks, respectively, the physical examination of the two groups of volleyball players' visual analogue scale (VAS) pain score and shoulder joint isokinetic test (including shoulder joint extension and adduction, shoulder joint extension and adduction, and shoulder joint isokinetic test) was carried out. The results show that the viewpoint put forward in this paper is conducive to the recovery of shoulder arthritis [7]. The results can provide a reference for the scientific training and rehabilitation of volleyball players and provide suggestions for the treatment and prevention of shoulder arthritis of volleyball players. Visual analogue scale (VAS) is a simple method for measuring pain intensity in clinical practice. The basic method is to use a walking scale about 10 cm long, with 10 scales on one side, and two ends, respectively. Among them, the "0" score indicates no pain, and the "10" score indicates the most severe pain, which is unbearable. In clinical use, turn the scale side away from the patient and let the patient stand on the ruler; the corresponding position that can represent the degree of pain is marked on the top, and the doctor assigns the score according to the position marked by the patient. In daily training and competition, volleyball players with subacromial impact syndrome will have pain in their shoulder when they repeatedly serve and spike for a long time, which will negatively affect their shoulder function, competitive ability, and psychological state.

2. Preparation of Conjugated Polymer Nanomaterials

The conjugated polymer system [8] of the molecular main chain contains large delocalized π bond. The most important characteristics of them are that they have three unsaturated carbon bonds, double space carbon bonds, or single structure bonds intersecting with aromatic rings. This property is conducive to the delocalization of free electrons and carriers in the polymer. The delocalization and delocalization polarization of the internal structure of the conjugated polymer directly affect the luminescence of the conjugated polymer. Because of the long-range shift and large π bond, the gap between the molecular energy level becomes smaller and smaller, and the free electron can move freely along the main chain of the main chain-conjugated polymer, that is, the so-called "molecular line" effect. Conjugated polymers have excellent electrical signal conductivity, excellent energy transfer rate can achieve the effect of signal amplification, and fluorescence resonance energy transfer (FRET) [9] can achieve significant enhancement of fluorescence signal. Nanomaterials refer to materials that have at least one dimension in the three-dimensional space at the nanometer size (1-100 nm) or are composed of basic units, which are approximately equivalent to the scale of 10 to 1000 atoms tightly packed together.

2.1. Synthesis Methods of Common Conjugated Polymer Nanomaterials

2.1.1. Suzuki Coupling Reaction. The early Suzuki coupling reaction [10], sometimes called Suzuki Miyagi coupling reaction, was named after scientists Suzuki Chang and Miyagi. Suzuki's reaction mechanism consists of three steps in the catalysis and circulation, which has been widely used at present.

The first step is oxidation addition reaction. As a catalyst, LNPD and electrophilic RX have oxidative addition, and the product is a transition compound. The first step is the most important. PEG is a series of products that are non-toxic, nonirritating, and slightly bitter in taste, have good water solubility, and have good compatibility with many organic components. They have excellent lubricity, moisture retention, dispersibility, adhesive, antistatic agent and softener, etc. and are widely used in cosmetics, pharmaceuticals, chemical fibers, rubber, plastics, paper, paint, electroplating, pesticides, metal processing, and food processing. There are a wide range of applications in the industry.

The second step is transfer metallization. Under the action of alkaloids, organic borides are first transformed into negatively charged substances and then metallized with the products.

The third step is reduction and elimination of reaction. Product R is formed by transfer metallization and elimination process $R_1 - R_2$. The FLIR E40 touchscreen user interface is designed to be intuitive, taking full advantage of the full 3.5-inch display and providing easy access to all analytical tools. The 3 movable detection points can accurately and perfectly analyze three-phase electrical problems. By viewing the automatically calculated temperature difference, you can instantly grasp the crux of the problem. The temperature range and image can be fine-tuned. Various suitable color palettes are available to enhance detection. Thermal images are superimposed with visible light images for easy and clear positioning.

2.1.2. Heck Reaction [11]. Palladium is used as catalyst to catalyze the cross-coupling reaction of halogenated aromatics, haloalkenes, and vinyl compounds, which is called Heck reaction. It is worth mentioning that β -hydrogen, a free halogenated hydrocarbon, can also trigger the ghost alkylation reaction.

First of all, halogenated products have oxidation and replenishment; the matrix is coordination and transfer, carbon bond rotation, palladium and β hydrogen removal sequence, and catalyst deoxidation and elimination cycle.

2.1.3. Sonogashira Cross-Coupling Reaction. The synthesis of aryl halides and alkenyl halides with palladium or copper as catalyst under the catalysis of terminal alkynes is called the Sonogashira cross-coupling reaction. Transition metal catalysis is one of the most commonly used methods for the synthesis of carbon triple bonds. The Sonogashira reaction is widely used in material synthesis, natural material purification, active intermediate catalysis, and other fields. Due to the high price of palladium, copper catalyst is usually used.

The Sonogashira coupling reaction has been developed and improved by a large number of chemical researchers. On the one hand, the cost of the reaction process is low and the conditions for chemical synthesis are mild. On the other hand, a large number of novel green reaction conditions are used in the Sonogashira cross-coupling reaction, which has far-reaching significance in the field of chemistry and great potential in the development and application of real life. At present, the main problem is that the activity of copper salt as catalyst is not enough, and no efficient and cheap copper salt ligand has been found.

2.1.4. Glaser Polymerization. The oxidative stress polymer reaction with copper as catalyst is called the Glaser polymer reaction. The Glaser coupling reaction is also an important reaction to construct C-C single bond, which plays a key role in the synthesis of natural compounds, drugs, and optoelectronic information materials. In recent years, there are many reports about catalytic coupling reactions, mainly focusing on the search for new catalysts, new ligands, and new catalytic systems.

In recent years, the coupling reaction between polyethylene glycol and ionic liquid has been widely used in chemical industry. At present, polyethylene glycol and ionic liquid are the green media studied by many researchers. Compared with the Glaser reaction method using traditional organic solvent, the first two methods have simple conditions and high yield. On the other hand, reactants can be recycled and reused, thus greatly improving the utilization of atoms from the point of view of atoms in the chemical synthesis process. In addition, the odor of traditional basic organic amines can be rejected in the reaction process. In the process of chemical synthesis of Glaser in the medium of PEG, the effects of different molecular weight of PEG, different catalysts, different copper ligands, and different temperatures on Glaser reaction were studied. The best reaction conditions were selected, and the catalytic coupling of terminal alkynes with different properties was realized under the best reaction conditions. RX reacts with a non-transition metal-organic compound RM under the catalysis of transition metal complexes to form carbon-carbon bonds. The cross-coupling reaction has high efficiency, good selectivity, and mild reaction conditions and is an effective means of modern organic synthesis.

2.2. Preparation of Instruments. The distribution of nanomaterials in the cells and the production of ROS were studied by fluorescence imaging of Olympus IX81 laser scanning confocal microscope [12]. The cytotoxicity test and analysis were carried out by Casey cell count, enzyme-linked immunosorbent assay, and Sch RFE system. The temperature change of photothermal test was monitored by FLIR E40 thermal infrared imager; PerkinElmer used the new K-series III small animal internal imager to image the human shoulder.

2.3. Preparation Method of Polymer Nanoparticles. At present, the three methods most widely used in the field of con-

jugated polymer nanoparticles are nanoprecipitation, microemulsion, and self-assembly.

2.3.1. Nanoprecipitation Method. Nanoprecipitation is also called reprecipitation. The main step is to inject the hydrophobic conjugated polymer organic solution into the weak solvent represented by ultrapure water under the condition of ultrasound with certain power intensity. Under the hydrophobic action, the solubility of conjugated polymer in two solvents is very different. Once the conjugated polymer molecules extend in organic solvent, they will gradually agglomerate in ultrapure water and finally form spherical nanoparticles. In addition to the coupling polymer itself, the size of nanoparticles is also affected by their high concentration in the initial organic solution. Then, the organic solvent and excess water were removed by rotary evaporation apparatus, and finally, the conjugated polymer nanoparticles with good stable distribution were obtained.

2.3.2. Microemulsion Method. Compared with the nanoprecipitation method, the biggest difference between the microemulsion method is that the solvent phase is composed of acetone, dichloromethane, tetrahydrofuran, and other organic solvents and is insoluble in water. The most important thing is to add surfactants as stabilizers in the process of microemulsion preparation. The main function of surfactants is to prevent the aggregation of conjugated polymers. Firstly, the organic semiconductor polymer is dissolved in the organic phase and then injected into the super pure water mixed system containing surfactant. In the high-power water bath ultrasonic state, the organic phase in the conjugated polymer is dispersed slowly in the aqueous phase, and finally, the emulsion is formed. Finally, we can turn on the rotary evaporator, evaporate the excess organic solvent and ultrapure water, and finally form the nanosolution we need. In this process, the emulsion forms four conjugated polymer nanoparticles through nucleation, coalescence, agglomeration, and heat treatment. Microemulsions typically consist of surfactant, cosurfactant, solvent, and water (or aqueous solution). In this system, two immiscible continuous media are divided into tiny spaces by surfactant amphiphilic molecules to form a microreactor, the size of which can be controlled in the nanometer range, and the reactants react in the system to form solid phase particles. Because microemulsion can precisely control the particle size and stability of nanomaterials, it limits the nucleation, growth, agglomeration, and other processes of nanoparticles. The resulting nanoparticles are coated with a layer of surfactant and have a certain amount of condensed matter structure.

2.3.3. Self-Assembly Method. Compared with the former two methods, the self-assembly method is relatively simple. Its main step is to suspend or completely dissolve the conjugated polymer and coassembly materials with positive and negative charges in ultrapure water. They vibrate violently in a certain proportion, and then, we can directly get the nanoparticles we need through the centrifugal process at a certain speed.

3. Research on the Combination of Nanomaterials and Rehabilitation Therapy of Shoulder Joint Injury

3.1. Causes of Shoulder Joint Injury. The shoulder joint injuries of 75 volleyball majors in the Nanjing Institute of Physical Education were investigated by questionnaire and observation. It is found that the key to shoulder joint injury in volleyball is serve and spike. The main reason for the injury is that the athlete's technical mastery is not comprehensive and the standard and warm-up are not enough. Excessive shoulder abduction angle is the key to shoulder injury. The average abduction angle of attacker with shoulder joint injury was 146.51° and that without injury was 117.23° . The results show that the optimum temperature range is between 105° and 130° . In addition, the reason of shoulder injury is that the swing sequence of the upper limb is not the swing time and the front limb is too long. When smashing, the abduction angle of the upper arm is less than 120° . At the same time, the arm bends to hit the ball forward and down at high speed, which is the most important factor leading to the shoulder injury of small players. Because of the structural attribute of shoulder joint and the high requirement of hitting speed due to the action range and explosive force in volleyball match, students are easy to cause shoulder joint injury under the premise of nonstandard and uncoordinated volleying. The second important reason is the shoulder injury caused by the difference of preparation and physical fitness. In addition to the weakness of the anatomical results of the shoulder joint itself, the technical links leading to the shoulder joint injury include the following: due to the rigidity of the limbs, unable to understand the flogging action, directly press the upper arm down to hit the ball; the force sequence is wrong, and the elbow joint is dominant; the shoulder is not relaxed enough, and the arm is in the leading stage; the whole body lacks the process of coordination force, and the coordination force is just the local force of the shoulder; the jump time is not correct, and the ball is not buckled or missed.

To sum up, the causes of shoulder injury of volleyball players can be started from internal and external factors. The internal reason is that the shoulder joint is composed of humeral head and scapula, which is a typical ball and socket joint. The joint capsule is thin and loose, the joint basin is shallow, and the shoulder joint is flexible but unstable. Its stability mainly depends on the dynamic balance of shoulder joint muscle strength. If the amplitude and speed of the upper limb movement are too large and too fast, the imbalance of muscle strength between the protomyo and the antagonistic muscles is easy to cause damage. The external reason is in all volleyball techniques, serve and spike are the two techniques with the highest score. If the team wants to win, they will do these two exercises over and over in their daily training. Jumping and spiking refers to that when the human body is in the air, the strength of the trunk is transferred to the shoulder to drive the arm to swing and hit the ball. The damage caused in this process can be divided into two situations: one is that there is a mistake in the take-off process, and then, the ball is hit into the air; the other is that

the technical action at the moment of hitting is not standardized, which is easy to cause shoulder damage.

3.2. Sports Rehabilitation Therapy for Shoulder Joint Injury.

It has been reported that Bobath handshake weightlifting training is mainly used for active and passive sports, lasting for 10-20 minutes, 4-6 times a day; the second is the centripetal winding method, 3-4 times a day. The research adopts a group of dumbbell strength training methods, which consist of eight movements, including shoulder bending 90° degrees and 180° degrees, 90° degrees abduction, push up, rotation, neck rear arm flexion and extension, and neck rear arm flexion and extension+rotation of the forearm internal and external rotation, easy to pull, basically including most of the shoulder joint function training mode; each group of dumbbell maintains 10 weeks through weekly incremental training. Rehabilitation training program is designed for patients with rotator cuff injury 3 weeks after surgery, with a total of four stages: in the first stage, shoulder joint fixation, elbow bending and expansion function, hand grip strength, wrist, rowing, and other exercises. The intensity of training develops gradually according to the patient's bearing range. The shoulder muscles perform long contraction movement, and the shoulder joints perform passive movement. In the second stage, the movement pain should be avoided as much as possible. The shoulder joint should carry out active and passive activities, just as it is assisted by pulley, shoulder ladder, and other equipment. The range of motion is controlled under the scapula to ensure no pain; while performing isometric contraction exercise, the muscles at different angles start to exercise the hand resistance function scapula movement, 20 times/time, 2 times/day. In the third stage, the glenohumeral joint and scapula are trained, and the stability of tendon sleeve training is ensured. According to the adaptation, the shoulder abduction activity plan is made by me. Gradually, return to the normal range of activity and continue to carry out posture correction training; muscle strength increased. Attach a low weight sandbag to the arm to enhance the stability of the joint, 40 times/time, 3 times/day. In the fourth stage, the resistance training should continue to recover the upper limb movement function, increase the strength training of the rotator cuff muscles as much as possible, then expand the rotation muscle tension, and enhance the muscle strength, proprioception, and flexible coordination training, which can improve the throwing, skills, and other training methods, 40 minutes/time, 3 times/day.

Some scholars have designed similar rehabilitation training programs: the first stage lasts for one week, mainly using grip strength training, elbow flexion and extension training, joint capsule tension training, neck extension training, and vertical swing training; the second stage lasts for five weeks, mainly using shoulder bending movement, external and internal rotation movement, and cuff muscle tissue, 10 times/group of exercise load. In the third stage, horizontal bending, large external rotation, shoulder bending forward, back pulling towel, and straight arm lifting were used. The results show that the rehabilitation training program can accelerate the relief of pain, shoulder joint movement

limitation, and other symptoms, reduce the dependence of anti-inflammatory analgesic drugs and local block drugs, and significantly improve the shoulder joint movement function.

There are also scholars who have studied a rehabilitation training program for excellent high-level volleyball players with shoulder arthritis. Rehabilitation training emphasizes the accuracy of the movement, based on the principle of small intensity and multiple times. Exercises include the following: (1) strengthening the stability of shoulder muscle group, upper limb stability exercise, and ball holding stability exercise of locking power chain, which are 30-40 seconds/group and 3 groups/day, respectively. (2) The weight was small (3kg), 20 times/group, 3 groups/day for the whole pot exercise, straight elbow rowing exercise, bird bending exercise, dumbbell shoulder turning exercise, shrug exercise, and dumbbell resistance exercise. (3) Elastic belt strength exercise includes abduction pull-up, forward pull-up, back pull, chest extension, front pull, forearm internal rotation, and forearm external rotation, 20-30 times/group, 3 groups/day. (4) The elastic rope mimics the forehand and backhand movements. The results showed that after 4 weeks of rehabilitation training, the angle expansion increased significantly, the pain of expansion and kidnapping disappeared, the strength of rotating muscle increased, the strength and stability of shoulder increased significantly, there was no pain, no soft feeling, fear disappeared, and no need for muscle paste protection.

3.3. Nanomaterials and Rehabilitation Therapy for Shoulder Joint Injury. Phototherapy with conjugated polymer nanomaterials is mild and will not cause obvious damage to normal tissue cells. Because the light source is absorbed by the photosensitizer gathered around the shoulder cells by the external light source, the external light source should have strong tissue penetration ability, and the near-infrared light is generally selected as the external light source [13]. At present, photodynamic therapy mainly includes PDT [14] and PTT [15]. Photodynamic therapy uses photosensitizers to capture light sources and then act on oxygen to produce monooxygen or reactive oxygen radicals. It uses the strong oxidation of singlet oxygen or reactive oxygen radicals to cause irreversible damage to biological cells and kill the pathogenic cells. Photodynamic therapy is a kind of treatment method that photosensitizers absorb near-infrared light to penetrate biological tissues, convert light energy into heat energy, and make the inflammatory cells of local shoulder joint reach high temperature and then kill the inflammatory cells.

- (1) Photodynamic therapy (PDT) [16] is a kind of treatment method that uses photosensitizers to absorb light, produce single oxygen or reactive oxygen free radicals, kill inflammatory cells of shoulder joint, and treat shoulder injury. The basic reaction process is that when the photosensitive substance in biological tissue is illuminated, it absorbs photon energy and changes from ground state (S₀) to excited state (S₁). The excited photosensitive material is very

unstable, and it will emit energy back to the ground state (S₀) by emitting fluorescence or system crossing into the three states (T₁). Generally speaking, most photodynamic reactions involve the triplet state of photosensitizer. Triplet photosensitizers transfer the light of oxygen molecules under the condition of energy and produce singlet oxygen (type II). Photodynamic therapy (PDT) is a method that uses photosensitizer molecules to gather in the inflammatory cells of shoulder joint and then irradiates the inflammatory cells of shoulder joint with external light source to produce singlet oxygen or active oxygen free radicals, killing the inflammatory cells of shoulder joint. Photodynamic therapy has been widely used in the treatment of skin diseases and superficial tissue diseases because of its mild conditions and no damage to normal tissue cells

- (2) Photothermal therapy [17] is a therapeutic method to kill inflammatory cells of shoulder joint by using heat generated by photothermal converter. The main working principle of photothermal therapy is as follows: under the action of photothermal conversion agent, the near-infrared light which has good penetrability to biological tissue is used as the excitation light source to improve the local temperature, so as to achieve the treatment method of killing inflammatory cells of shoulder joint. This kind of local treatment is simple and effective without obvious side effects. In recent years, photothermal therapy has been greatly developed, because light source and photosensitizer only need two basic conditions. However, because these photosensitizers need to penetrate tissues, they also need to have good ability to absorb near-infrared light. In addition, PTT can be used for deep treatment of shoulder inflammation because of its strong tissue-penetrating ability

Conjugated polymer nanomaterials combined with sports rehabilitation therapy can effectively cure the athlete's shoulder arthritis, relieve the athlete's pain, and quickly treat and prevent the recurrence of inflammation. In the case of conjugated polymer nanomaterials, photodynamic therapy or photothermal therapy can reduce the pain of patients with shoulder joint inflammation.

4. Results and Discussion

4.1. Comparison of Gender, Age, and VAS Score before Treatment between the Two Groups. Shown as Table 1, there were 50 volleyball players with shoulder arthritis. During the follow-up, 4 cases were excluded and 2 cases were dropped. Finally, 23 cases in the experimental group and 21 cases in the control group were followed up. There were 13 males and 10 females in the experimental group and 9 males and 12 females in the control group. There was no significant difference in gender between the two groups ($P > 0.05$).

Shown as Table 2, there was no significant difference in age between the two groups ($P > 0.05$).

TABLE 1: Comparison of gender differences between the two groups.

	Total/case	Male/case	Female/case
Experience group	23	13	10
Control group	21	9	12
χ^2		0.004	
P		0.963	

TABLE 2: Comparison of age distribution between two groups ($\bar{x} \pm s$, year).

	Number/case	Age
Experience group	23	59.36 \pm 4.35
Control group	21	62.27 \pm 5.84
t		1.237
P		0.238

TABLE 3: VAS score before treatment in two groups ($\bar{x} \pm s$, min).

	Number/case	Age
Experience group	23	5.35 \pm 0.35
Control group	21	6.34 \pm 1.34
t		0.446
P		0.563

TABLE 4: Comparison of VAS scores of two groups at different time points after operation ($\bar{x} \pm s$).

	12 h	24 h	48 h
Experience group	3.02 \pm 1.27	2.23 \pm 0.65	2.79 \pm 0.54
Control group	4.53 \pm 0.84	3.61 \pm 0.26	3.02 \pm 0.82
t	-1.271	-1.029	-0.472
P	0.324	0.023	0.628

Shown as Table 3, there was no significant difference in VAS score between the two groups before treatment ($P > 0.05$).

4.2. Comparison of VAS Scores of Two Groups in Different Time Periods. Shown as Table 4, there was no interaction between time and group in repeated measurement of variance statistical analysis; VAS scores of the two groups at different time points had time effect; VAS scores of the two groups at different time points had group effect. It can be seen from Table 4 that the pain score of the experimental group is better than that of the control group at 12 h, 24 h, and 48 h, but the difference is not statistically significant ($P > 0.05$).

Shown as Figure 1, VAS scores of the two groups had grouping effect at different time points. As shown in Figure 1, there may not be any change at the beginning,

but after the method of the experimental group, the VAS score began to produce a qualitative change. The pain score of the experimental group was better than that of the control group at 3 weeks, 6 weeks, and 12 weeks, and the difference of VAS score from 4 days to 3 weeks was statistically significant ($P < 0.05$).

Shown as Figure 2, the number of compressions between the test group and the control group was 0-12 h, 12-48 h, 48-96 h, and 96-156 h, and the average number of compressions in the four time periods in the experimental group was smaller than that in the control group, with statistical difference ($P < 0.05$).

4.3. Adverse Effects of Analgesia in the Experimental Group within Two Days. Shown as Figure 3, the incidence of adverse reactions in the experimental group was 23.0%, among which nausea accounted for 30% and dizziness and headache accounted for 30%. The incidence of adverse reactions in the control group was 36.4%, including 4 cases of nausea, 2 cases of vomiting, and 5 cases of dizziness and headache. The incidence of adverse reactions in the experimental group was significantly lower than that in the control group ($P < 0.05$).

4.4. Shoulder Isokinetic Test. Shown as Figure 4, there was no interaction between the two groups through repeated measurement of variance statistical analysis; there was time effect in the constant Murley score of the two groups; there was grouping effect in the constant Murley score of the two groups. There was no significant difference in pronation and abduction scores between the two groups, but there was significant difference in the scores of 1 week and 3 weeks ($P < 0.05$). At 6 weeks, the scores of entropion and abduction in the experimental group were slightly higher than those in the control group, but the difference was not statistically significant ($P > 0.05$).

5. Conclusion

The stability and flexibility of the shoulder joint and the muscle control ability of the shoulder joint are decreased in patients with shoulder joint dysfunction. It is easy to cause injury; the activation sequence of shoulder muscles for those with shoulder joint dysfunction is inconsistent with the requirements of the volleyball spiking action, which is easy to cause injury and affect the spiking effect. The biological structure of human shoulder joint is complex. It consists of muscle group, skeleton, ligament, tendon, surrounding soft tissue, and skin. There are nerves and blood vessels in the muscle structure of the shoulder joint, which provide power for the movement of the shoulder joint. Volleyball players need to spike, serve, and release the ball in training and competition engineering, which is easy to cause shoulder injury and inflammation. In order to catch the ball with quality and strength, it is necessary to overcome the huge resistance when swinging the arm. If the shoulder causes sports injury, it will seriously affect the play of skills on the field, resulting in the decline of competition results. In order to avoid the occurrence of such events, this paper proposes the

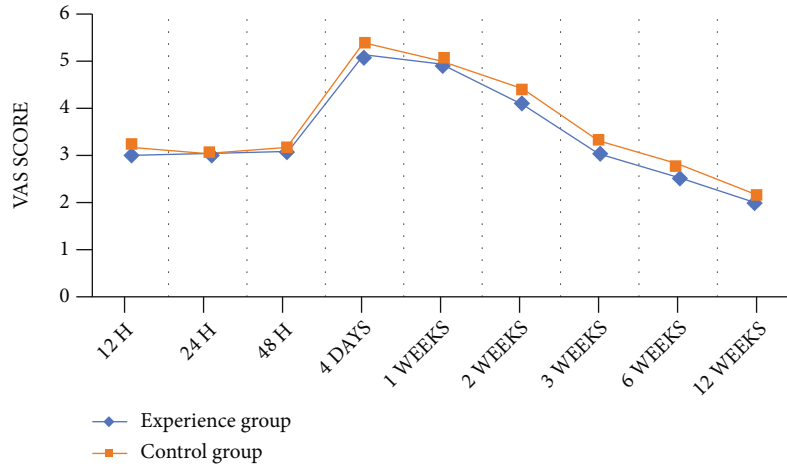


FIGURE 1: VAS score trend chart of two groups at different time points after operation.

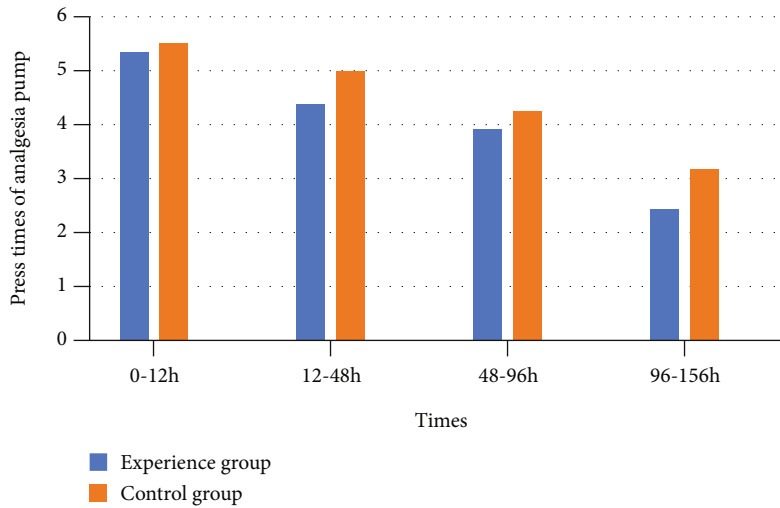


FIGURE 2: Comparison of compression times of analgesia pump between the two groups in different time periods within two days after operation ($\bar{x} \pm s$).

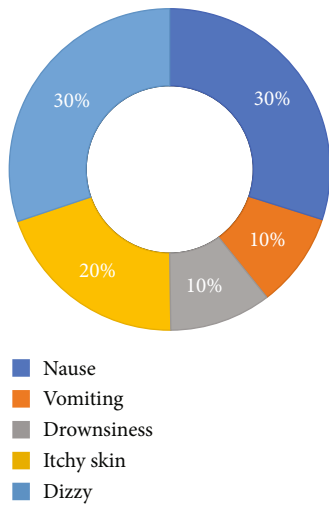


FIGURE 3: Comparison of analgesic adverse reactions between the two groups within two days after surgery.

application of nanomaterials combined with sports rehabilitation therapy in the treatment of volleyball players' shoulder arthritis. Firstly, the preparation of conjugated polymer nanomaterials is studied, which can be used in photodynamic therapy or photothermal therapy to treat the shoulder inflammation of volleyball players. Therefore, the experimental group and the control group are divided into different treatment methods. The results show that the experimental group is better than the control group in VAS pain analysis, and the pain score is significantly lower than the control group. The number of times of the experimental group and the control group are the same as the control group in the comparison of the number of times of pressing. The adverse reaction rate of the control group is 36.4% in the test of adverse reactions of analgesia; the score of varus and abduction in the experimental group was slightly higher than that in the control group. It can be seen that the nanomaterials combined with sports rehabilitation therapy proposed in this paper have a very good effect on

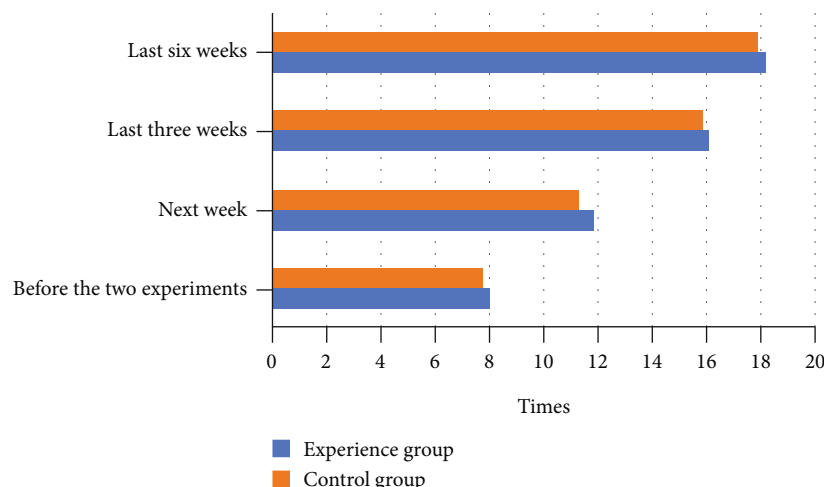


FIGURE 4: Perioperative abduction scores were obtained before and after surgery at 3, 6, and 12 weeks ($\bar{x} \pm s$).

the shoulder arthritis of volleyball players, and there is a great market space in the future. Exercises to improve shoulder mobility are suggested to be added to the preparatory activities for daily training. During the intensive spike training week, more attention should be paid to activating weak small muscle groups and improving their strength, so as to keep the strength of the shoulder muscles balanced, so as to prevent shoulder joint injuries and improve sports performance.

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Conflicts of Interest

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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