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Article

Application of sports rehabilitation training in mobile edge computing to treatment of patients with knee arthritis

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Abstract: According to the data of the National Bureau of Statistics, in 2019, the proportion of elderly people aged 65 and above in the total population reached 12.6%, and with the acceleration of the aging process, the incidence of knee osteoarthritis has increased significantly. According to the Chinese Journal of Orthopedics, the number of patients with knee osteoarthritis is growing at a rate of 6% every year, and there are more than 100 million patients with knee osteoarthritis in China, which significantly affects the quality of life of middle-aged and elderly people. This paper uses mobile edge computing technology and nanotubes to cooperate with reasonable sports to study the rehabilitation of patients with knee arthritis in the rehabilitation stage. The subjects of the study were 60 patients with knee arthritis, and the 60 patients were divided into 4 groups: group A used nanotubes and exercise rehabilitation training; group B used nanotubes but no exercise rehabilitation training; group C did not use nanotubes Tube, but sports rehabilitation training after the operation; D does not use nanotubes, and does not perform sports rehabilitation training after the operation. The 4 groups of patients performed routine exercises on the basis of rehabilitation exercise care. The study lasted for six months, with the 60 patients assessed monthly on their self-care ability, knee function and quality of life. Self-care ability was assessed by the Barthel Index (BI), knee function was assessed by the Knee Score Scale (KSS), and quality of life was assessed by the SF-36 Health questionnaire. The experimental results showed that all indexes of group A were higher than those of group B, KSS value was 2 higher than that of control group, ADL (activities of daily living) comprehensive value was 0.4 higher than that of control group, and SF-36 (The Short-From-36 Health Survey) value was 0.8 higher than that of control group. The self-care ability and health status of patients who performed balance exercises were significantly higher than those who did not perform balance exercises. The quality of life of patients who used nanotubes was significantly higher than that of those who did not. Therefore, the method of using nanotubes in combination with exercise rehabilitation training can restore the function of patients with knee arthritis and promote high quality of life.

Keywords: mobile edge computing; Nano-Drug targeted therapy; sports rehabilitation training, knee arthritis treatment; Nano materials

1. Introduction

Nowadays, more and more patients are in need of bone transplantation. The appearance of nano tissue engineering materials makes up for the shortcomings of traditional implant materials in pressure resistance and inconvenient preparation of special shapes. Therefore, it has become a popular subject in bone tissue materials research. Medical nano-materials can promote the innovation of clinical diagnosis technology, and to a certain extent can further improve the level of treatment. Many nano-devices have been recognized by the medical community and are on the market.

Nowadays, there are more and more patients suffering from knee osteoarthritis, and most of the affected groups are elderly patients over 60 years old. Therefore, relevant departments have also strengthened the clinical treatment effect research on knee osteoarthritis. The mobile edge computing technology can be effectively applied to the rehabilitation training of knee arthritis [1,2].

Due to the aging of the social structure of our country in recent years, bone and joint diseases are also slowly appearing, so knee arthroplasty is more and more widely used in clinical practice. In recent years, the technical foundation and application research of nanotubes has also been highly valued worldwide. Ghahremani S proposed that nanotubes can be used as new alternative materials because of their special zero-shaped structure and stable resistance to pressure. Especially, drug-loaded nanoparticles can have many smart groups attached to them. However, the research did not pay attention to the shortcomings of nanotubes as a new alternative material [3]. Robertson PA found in his research that drug-loaded nanoparticles can remove dioxin and can be used for cleaning many items [4]. Bai Y et al. studied the ability of purified and unpurified carbon nanomaterials to discharge foreign matter, and found that the specific surface area of drug-loaded nanoparticles is relatively low, generally around 250 m^2/g, which is much lower than the value of activated carbon, which has become one of the main factors restricting their application [5]. Ji J's research shows that, given the advantages of drug-loaded nanoparticles and activated carbon, if the two are effectively assembled and combined, they will show more excellent overall performance [6]. Nakata K proposed that nano-gelatin-based activated carbon is a product obtained by carbonization and activation of gelatin. It has the characteristics of high specific surface area, low cost and stable structure [7]. In addition, nano-gelatin is a kind of natural polymer material with abundant sources. The surface contains abundant amino functional groups, which can be combined with the hydroxyl and carboxyl functional groups on the surface of functionalized drug-loaded nanoparticles to improve the binding force of gelatin and drug-loaded nanoparticles. The dispersion of drug-loaded nanoparticles in a gelatin matrix.

In terms of materials, Fojt J proposed that hydroxyapatite is the closest implant material to bone tissue composition, but pure hydroxyapatite has poor strength and toughness and greater brittleness. These shortcomings limit its applicability [8]. However, the composite material of drug-loaded nanoparticles and hydroxyapatite has superior osteogenic properties. The growth of bone tissue is the result of the interaction between osteoblasts and osteoclasts. Boyer C implanted carbon nanotube composites into the back of mice and found that drug-loaded nanoparticles can inhibit the differentiation of osteoclasts and promote the reproduction of osteoblasts. Make the bone density around the carbon nanotube composite material significantly higher than the control group [9]. Elizaveta Kon et al. systematically reviewed the application of nanotechnology in the treatment of knee osteoarthritis (OA) in recent years, with a particular focus on nanodrug delivery systems. The study found that these nano materials significantly improved histological features, reduced joint inflammation, and improved patient clinical scores. The authors believe that nanotechnology shows great potential in the treatment of knee arthritis and is expected to provide new treatment methods and strategies [10]. Drug-loaded nanoparticles can play a role in regulating the proliferation and division of brain stem cells. A recent study by Shaki H showed that drug-loaded nanoparticles will be a smart human body material that does not repel the human body [11]. Al-Bashir A K uses nHA/type I collagen polylactic acid-glycolic acid copolymer as a substitute for human bone, uses colloidal sodium as an important support part of polyamide, and uses the same formaldehyde as the solvent meson. The results show that the scaffold has a good microstructure, no cytotoxicity and good cell compatibility, but the disadvantage is that it lacks in vivo tests to verify its effectiveness [12].

In this paper, through experiments, the role of mobile edge computing technology and nanotube joint sports rehabilitation training association in patients after knee arthroplasty is studied, and observe the different effects of whether to use nanotubes and whether to perform sports rehabilitation training federations within 6 months. On the basis of daily care, two groups of patients used nanotubes, one group of patients performed balance exercises, the other two groups did not use nanotubes, and one group also performed balance exercises. KSS (Knee Score Scale) and other indicators are regularly evaluated, and the impact of nanotubes and sports rehabilitation training federation on patients after knee arthritis treatment is evaluated according to the patient's health status.

2. Nanotube technology and medical treatment

2.1. Drug-loaded nanoparticle technology

As an intelligent tissue material on the human body, drug-loaded nanoparticles have a certain electrical conductivity. They can be connected and fused with the cell membrane of human brain cells. It is different from traditional metal electrodes because traditional electrodes only integrate with the human body as a whole. Nanotubes can be precisely linked to designated nerve endings and the shortest part [13]. Drug-loaded nanoparticles can be used as a new material for the treatment of central nervous system trauma, and carbon nanoelectrodes can also replace conventional conductors for induction treatment of the inner brain, such as Parkinson's Disease [14]. Nowadays, more and more patients need bone transplantation. The emergence of nano-tissue engineering materials makes up for the shortcomings of traditional implant materials and has become a hotspot in bone tissue materials research. Hydroxyapatite is the implant closest to the composition of bone tissue, but pure hydroxyapatite has poor strength and toughness and is very brittle. These shortcomings limit its applicability [15]. However, due to its fullerene structure (spherical), it has a large number of carbon atom layers, and the surface is highly hydrophobic in nature, but their surface has a strong tendency to react with other molecules and atoms. At present, non-covalent and covalent Functional groups modify the surface of CNTs (Carbon nanotubes) to varying degrees. Through the attachment of organic, inorganic or organometallic groups, the synthesized surface functionalization successfully shows the unique properties of CNTs [16]. The combination of drug-loaded nanoparticles and stem cells can be used as nerve regeneration scaffolds to treat nervous system diseases. Drug-loaded nanoparticles can finely regulate the growth and differentiation of neural stem cells at the single-cell level [17]. In addition, drug-loaded nanoparticles can also be used for human makeup. They have nanoparticles and human skin surface cells similar to human tissues. Due to the high specificity of human immunity, nanomaterials can be made into cosmetic drugs with targeted effects. A designated part of the human body will deliver the drug to the designated part without an immune response [18]. Nanotubes can also deliver drugs to the site of tumor growth. Nanotubes carry anticancer drugs around cancer cells to directly kill cancer cells, so they can be used for the treatment of cancer patients [19]. Although drug-loaded nanoparticles are nanomaterials, the composite material of drug-loaded nanoparticles and solid lime has very special osteogenic properties. Such tissue growth is the result of the interaction between osteoblasts and small bone cells. The carbon nanotube composite material is implanted in the back of the human body. Drug-loaded nanoparticles can inhibit the differentiation of osteoclasts and promote the reproduction of osteoblasts. Therefore, drug-loaded nanoparticles the bone density around the composite group was significantly higher than that of subjects without carbon nanocomposite [20]. Covalent functionalization depends on the conjugation reaction between carbon atoms of CNTs and hydrophilic organic molecules on the surface of CNTs. Due to the production process of drug-loaded nanoparticles, defective structures such as pentagons and pentagons appear on the ends or sidewalls of drug-loaded nanoparticles. The edge-shaped carbon ring provides favorable conditions for the functionalization of the “ends and defects” and “sidewalls” of the drug-loaded nanoparticles, and the former is more specific and reactive than the latter [21].

Drug-loaded nanoparticles have good physical properties. Its compressive strength can reach 100 to 150 atmospheres, which is 80 times stronger than common steel materials, but its density is much lower than steel. The elasticity of drug-loaded nanoparticles is also very good, equivalent to three times that of diamond and about 10 times that of alloy materials [22]. In addition, drug-loaded nanoparticles are also very flexible and can change their shape in a wide range. The use of drug-loaded nanoparticles with other materials can demonstrate the characteristics of both to a certain extent, achieving higher physical strength and elastic properties. Since the S electrons of the C atoms on the drug-loaded nanoparticles form composite electrons, which are similar to the physical structure of graphite, the drug-loaded nanoparticles have special electrical properties. Drug-loaded nanoparticles have relatively good thermal conductivity. Because of the large radius ratio of drug-loaded nanoparticles, the thermal conductivity along the lateral direction is very high, while the thermal conductivity in the vertical direction is relatively low [23]. By adding drug-loaded nanoparticles to various materials in a suitable direction, conductive materials with different heat conduction capabilities can be prepared. Drug-loaded nanoparticles have strong mechanical properties, electrical conductivity and heat conductivity. The addition of drug-loaded nanoparticles to polymers can prepare various high-performance materials with carbon-containing composite properties. Therefore, using drug-loaded nanoparticles as a performance-enhancing engine to improve the performance of composite materials has become a hot topic. However, the performance of drug-loaded nanoparticles/carbon-containing polymers depends not only on the drug-loaded nanoparticles themselves, but also largely by the dispersibility of drug-loaded nanoparticles in other substances and the combination of other substances. Impact. Moreover, for drug loaded nanoparticles, storage is a problem, dispersion and stability in human body is a problem, targeting is a problem, and cytotoxicity is a problem. Because the surface of carbon nanomaterials often lacks active and intelligent chemical functional groups, drug-loaded nanoparticles are difficult to disperse well in other materials [24]. Therefore, the performance improvement and connection group of drug-loaded nanoparticles and the diffusibility of carbon nanomaterials in other substances have a great effect.

2.2. Design model of nanotubes in bone joints

There are two main models for the design of nanotubes in knee arthroplasty, both of which are compressive stress-strain full curve constitutive models. The first is that the ascending section can be a quadratic or cubic equation, and the descending section is a rational formula. The constitutive model of is the most representative and generally accepted constitutive model of this form. The second typical constitutive model is that both the rising and falling sections are rational. The two constitutive models are as follows:

The first model:

$$\begin{cases} y = a_0 + a_1 x + a_2 x^2 + a_3 x^3 & x \leq 1 \\ y = \dfrac{x}{b_0 + b_1 + b_2 x^2} & x \geq 1 \end{cases} \tag{1}$$

In the formula, a_0, a_1, a_2, a_3 and b_0, b_1, b_2 all represent undetermined coefficients, its parameters are determined by specific application design.

The rising and falling sections of the second model are the same equation, but the parameter values in the equation are different. A_1, A_2, B_1, B_2 are undetermined coefficients:

$$y = \frac{A_1 + B_1 x^2}{1 + A_2 x + B_2 x^2} \tag{2}$$

2.3. Knee arthritis treatment

Total knee arthritis treatment surgery generally uses metal, polymer composite materials, etc., to imitate the appearance, structure and behavior of human joints to make artificial prostheses, which are put into the human body through surgery, so that people can use them like real tissues. TKA (Total Knee Arthroplasty) is often used to treat and improve serious bone and joint diseases, including two steps of osteotomy and soft tissue loosening, and finally achieve the goal of restoring the lower limbs, maintaining the balance of soft tissues, and achieving knee joint balance. This surgical method has been used as an effective method to reduce the patient's joint pain, correct joint abnormalities, and improve joint behavior. It has become more and more common in medicine. Correct care after surgery can promote the recovery of human bone and joint capabilities [25]. Artificial total knee arthritis treatment surgery is usually used clinically to treat end-stage knee disease. The main purpose of the operation is to improve the patient's pain and function to a certain extent, and at the same time it is defined as a deformity in the clinic. Perform correction processing. Whether the patient can receive active early painless rehabilitation training is very important to the outcome and prognosis of the operation. Since surgery often brings more trauma to the patient, if the patient's pain state cannot be effectively controlled, the possibility of the patient's active rehabilitation training in the later period can be significantly reduced. Preoperative preventive analgesia can effectively relieve pain during and after surgery [26]. Parry can inhibit the related enzymes synthesized by the surrounding prostate, thereby reducing the PGF2 (Prostaglandin F2), PGE2 (Prostaglandin E2) and PGI2 (Prostaglandin I2) in the patient's body, PGF2, PGE2 is prostaglandin. Prostaglandin is a large class of physiologically active unsaturated fatty acid organic compounds, and its basic structure is prostatic alkanoic acid. PGI2 represents prostacyclin in medicine. It has a significant blocking effect on the initial pain stimulating factors and reduces the activity of the inflammatory response in the body, thereby reducing the sensitivity of peripheral pain. Therefore, it not only has advanced analgesic effects, but also prolongs analgesic effects. During the postoperative tissue injury period, epidural anesthesia has not completely disappeared within 12 hours after surgery, but the multimodal analgesic effect has begun to take effect. Auxiliary preventive anesthesia can improve the analgesic effect and has a positive effect.

The treatment of knee arthritis can be roughly divided into two categories: total knee arthritis treatment and single joint replacement. Total knee arthritis treatment surgery is more helpful than other joint treatment surgery in improving the speed of rehabilitation and human function. Comprehensive treatment includes preoperative patient education and nutritional support, late pain relief, surgical recovery, rapid joint rehabilitation and so on. However, other knee treatment methods also have their own advantages, and the recovery rate of single joint replacement is fast.

2.4. Cell affinity of nanotubes

Nanomaterials have the ability to promote the replication, division, differentiation, maintenance, and penetration of soft tissue cells, and are a good performance of cell proximity. MSCs (Mesenchymal Stem Cells) bone marrow mesenchymal stem cells can form soft tissues in RGD (RGD usually refers to arginine glycine aspartic acid, which is a cell adhesion molecule and a ligand molecule widely present on the cell surface. It is often used as a recognition molecule for targeted carriers in pharmaceuticals.) gel. Nano-decalcified hydroxyapatite and recombinant proteins (including RGD) enhance the cartilage ability of mouse fat MSCs and human placental MSCs. When human placental MSCs have been implanted with alginate/nano-decalcified hydroxyapatite RGD gel and injected into the PLGA (Polylactic-co-glycolic acid) scaffold for culture, the content of extracellular matrix such as glycosaminoglycan and L1 collagen will be cultured for 21 days Accumulate to the maximum amount. This shows that the alginate/nano-decalcified hydroxyapatite/RGD hybrid gel can provide a three-dimensional environment for cartilage formation for human placental MSCs. The performance of nano- and micro-scale fibers was evaluated by the temporary expression of the MSCS cartilage marker genes on these scaffolds during the cartilage formation process of human bone marrow MSCs in vitro. The chondrogenic markers proteoglycan, chondroitin, Sox9 genetic genes and type 11 collagen are secreted more by cells on micron-sized fibers than on nano-sized fibers. It shows that micron-sized fibers can promote cartilage formation. Compared with a three-dimensional matrix composed of only microfibers, the bilayer nano/microfiber membrane containing chitosan is folded into a three-dimensional scaffold. The former provides the proliferation and synthesis of glycosaminoglycans for chondrocytes in vitro very important microenvironment. In the two-dimensional cell membrane, compared with chitosan microfibers, the surface of chitosan nanofibers can promote cell adhesion and proliferation, and can effectively prevent chondrocyte phenotype changes. These two differences are mainly due to the large pore size of micron-sized fibers that facilitates cell growth, while the unique size and high surface activity of nano-scale fibers facilitates the interaction between cells and materials. The construction of a double-layer collagen 1 large-pore PLA (Polylactic Acid) nanofiber scaffold not only retains the advantages of nanofibers, but also solves the problem that it is difficult for cells to grow into the nano scaffold. The three-dimensional porous PLLA (poly-L-lactic acid) nanofiber scaffold can simultaneously induce bone marrow MSCs to differentiate into cartilage and osteoblasts, which will lay the foundation for its use as a scaffold material for repairing osteochondral defects. The differentiated cells grow into chondrocytes to achieve the purpose of repair.

2.5. Sports rehabilitation training and sports balance methods

Balance is the ability of a person to maintain a certain form and shape under sports or quiet conditions, especially the ability to control the central stable point of the body on a small supporting surface. Shape adjustment and human body stability require the coordination of the head in the inner ear, human feeling and hearing. First, these three systems transmit information about changes in gravitational velocity and spatial displacement to the central nervous system. The central system classifies and analyzes the input information, and then transmits the information through the precursor nerves to act on the behavioral organs, and then transmits the information through the nerve lines on the human body to adjust the shape of the body, as shown in **Figure 1**. Human balance ability is divided into stable balance ability and sports balance ability. Stable balance ability refers to the ability to maintain the body’s center of gravity when the shape is relatively stable. Sports balance ability refers to the ability to adjust and maintain the person’s center of gravity and shape while walking. The balanced sensory organ is the vestibular nerve area, which belongs to the sensory system. When the speed of the human body becomes faster or slower, it will actively change the direction of the body’s tilt to maintain the balance of the center of gravity, thereby preventing the body from falling to the ground due to leaning or hitting others to protect the body from injury. Young people are in a critical period for the development of balance ability. The balance system will continue to mature with age, and posture balance methods similar to the elderly will appear in the future. The elderly can focus on posture control, and children can control posture automatically. Since the age of five, the ability of posture to improve postural stability has been significantly improved. At the age of 15, the human body’s information processing and analysis of the proprioceptive system, control system, and auditory system show similar ways to adults, but its posture retention is still far less than that of adults. At about 16, its balance ability is basically equal to that of an adult. Therefore, the development of human balance runs through the entire process of human growth and development.

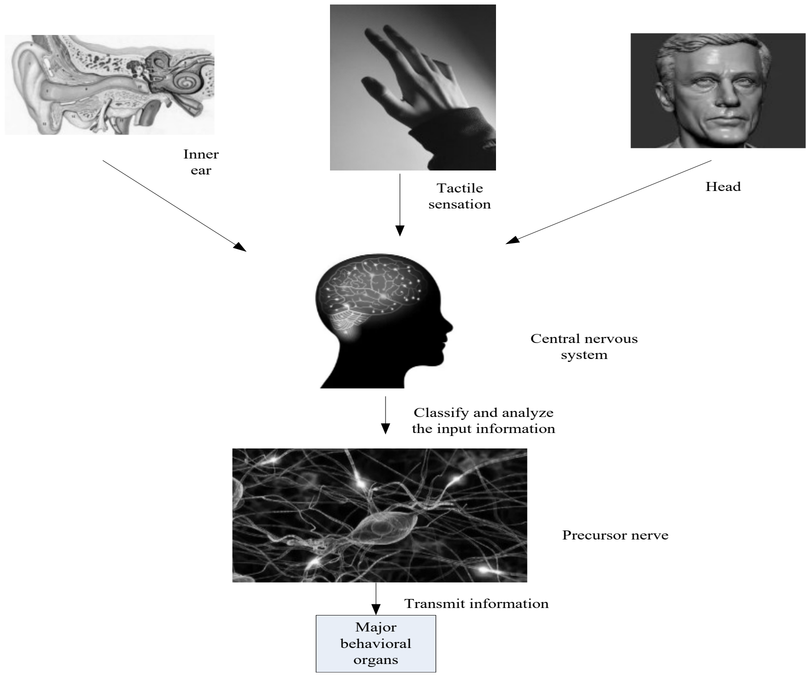

Figure 1. The process of adjusting the shape of the body and the stability of the human body.

3. Experimental design

3.1. Test setup

(1) Test subjects

Sixty patients who underwent knee arthroplasty from August 2019 to August 2020 were selected.

Inclusion criteria: The patient consciously joins and fills in the experimental informed form, the patient's relatives know and agree, and can exercise in life, and will use the Internet.

Exclusion criteria: Patients who do not cooperate, those who have exercise plans but do not implement them on time, and those whose relatives do not agree

Exclusion criteria: Those who do not have complete patient information and cannot participate in the assessment every month

(2) Test preparation

The patients who used nanotubes and those who did not use nanotubes were selected from the enrollees at a ratio of 1:1, and formed into 4 groups A, B, C, and D, each with 15 people. Among them, A were patients who used nanotubes during surgery and combined sports rehabilitation training federation; Group B was patients who used nanotubes during surgery but did not sports rehabilitation training federation; Group C was patients who did not use nanotubes during surgery but had exercise balance after surgery patients who exercised strength; Group D was patients who did not use nanotubes during the operation and did not perform balance exercises. There are 8 males and 7 females in the 4 groups, with an average age of

(52.37 ± 5.63) years old. There is no statistical difference in the residential address, environment, occupation, and nursing staff of the 4 groups (P > 0.1). Compare together. In addition, at the beginning of the trial, all patients were assessed at baseline, including knee function (KSS score), ability to self-care (Barthel Index, BI), and quality of life (SF-36 Health Questionnaire).

(3) Rehabilitation training process

Range of motion exercises: Do knee flexion and extension exercises for 30 minutes a day, 10–15 times each time, gradually increasing the range of motion.

Muscle strength training: Use low-load resistance bands to strengthen the front and back muscles of the thighs for 20 minutes, three times a week.

Walking training: 30 minutes of daily walking training, initially on a flat surface, gradually increasing the difficulty of walking, such as ramps and stairs.

(4) Protocol for the use of nanotubes

The nanotubes are administered at a dose of 10 mg twice a day, either orally or intravenously, depending on the patient's specific condition. The nanotube was administered once a day in the morning and once a day in the evening for oral patients and once a day in the evening for intravenous patients for 30 minutes each time. Monitor patient reactions and adverse reactions after each administration to ensure safety and efficacy.

3.2. Experimental process

Rehabilitation exercise related manuals were issued to the 4 groups, and the outpatient review was conducted every month within six months after discharge. And receive post-operative care in accordance with conventional methods, including joint exercises, muscle strength training and walking training.

Experimental group A and experimental group C performed sports rehabilitation training federation on the basis of conventional joint rehabilitation exercises. Experimental group B and experimental group D did not perform balance exercises during the rehabilitation phase after surgery. Each month, these 60 patients were tested by KSS and other tests to assess their recovery status, and after 6 months, the 6 groups of data were statistically analyzed.

(1) Balance exercise steps

The exercise method is generally to spread your hands shoulder-width apart, and lift your hands horizontally to both sides. The body first swings upwards and then downwards. Then you can gradually close your feet together to increase the difficulty of the exercise. Those who can successfully complete the above actions can be practiced with eyes closed. In addition, the toe of the right foot can be pressed against the heel of the left foot, and both arms can be raised horizontally for 5 seconds. If your balance is good, your legs should be naturally straight to your side where you stand for 5 seconds. If the above two actions can be successfully completed, you can practice the above two actions with your eyes closed. Many people can practice the above exercises together to increase the fun of the exercises.

(2) Data collection

The time is at the beginning of the experiment, 1–6 months after discharge, and a living ability assessment is conducted at the end of each month, it mainly collects the patient's initiative, pain and subjective feeling. After the patient is discharged from the hospital, the data during the patient's outpatient clinic should also be referred to. The data collector is a professional nurse.

(3) Statistical analysis

Use professional statistical analysis strategies to process and analyze the data, and express the evaluation data as (x ± s), use *t*-test and chi-square test to compare the overall data of the 4 groups, and use monthly measurement results for structural difference analysis and comparison. Next, the health status, body-related functions, and daily mobility of the four groups of patients are statistically feasible through the calculation of the *P* value.

4. Results

4.1. Nanotube's electrodynamic action on human body

The main constituent materials of nanotubes are carbonized titanium dioxide, zinc oxide, tungsten disulfide, chromium dioxide, arsenic dioxide, iron oxide, tungsten oxide, and molybdenum sulfide. As shown in **Figure 2**, VB (valence band) represents ZnO, and CB (conduction band) represents TiO, Eg (energy gap) stands for TiO_2, the band gap energy of ZnO is approximately 3.2–3.37 eV. It can remove heavy metal ions from the human body and is a potential catalyst substitute for the degradation of inorganic substances. Nanotubes can attenuate ultraviolet radiation to patients. Compared with titanium oxide, the biggest feature of zinc oxide is that it can absorb lighter chromatogram. The TiO_2 in the picture shows higher catalytic activity than other nanotubes, especially for patients after knee arthritis treatment. In addition, ZnO is a low-cost material with obvious advantages in applications. ZnO photocatalyst has high quantum efficiency and can be used as high-efficiency photocatalyst. The results show that nano-zinc oxide is very effective in degrading organic pollutants in food. However, ZnO as a catalyst also has some disadvantages, such as its use in the stomach and intestines of patients. It is prone to acid corrosion and dissolves on the surface to form acid zinc. In general, nanotubes are harmless to the human body and have great advantages in bone diseases, especially joints.

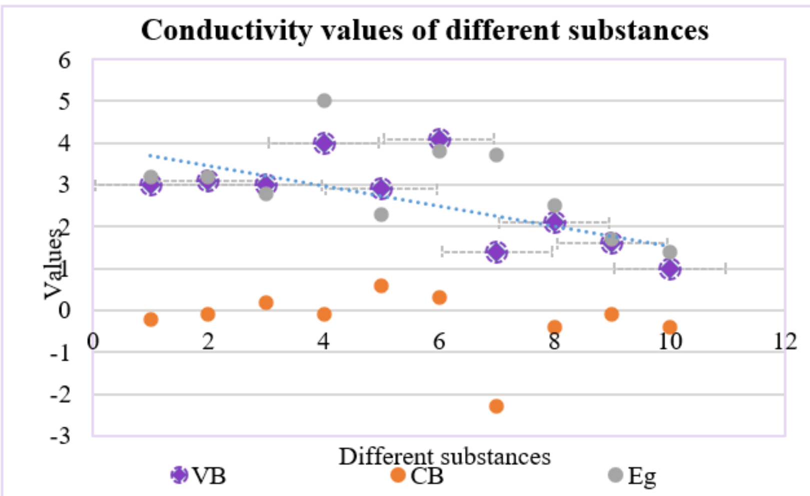

Figure 2. Conductivity values of different substances.

4.2. Differences in whether patients use nanotubes

In analyzing the difference between whether nanotubes are used or not, since both groups A and B use nanotubes, C/D is the control group relative to A/B. As shown in **Figure 3**, the KSS of the A/B group was at the same level as the C/D group at first, and it was gradually higher than the C/D group after 2 months. At the beginning of the experiment, the KSS of the C/D group was 2.66 higher than that of the experimental group, but it reached almost a level in the next month. From the second month, the self-care ability of the experimental group patients has been higher than that of the control group. At the end of the experiment. It is 5 units higher than the control group, indicating that the material of the nanotube is beneficial to the rehabilitation of patients after knee arthritis treatment.

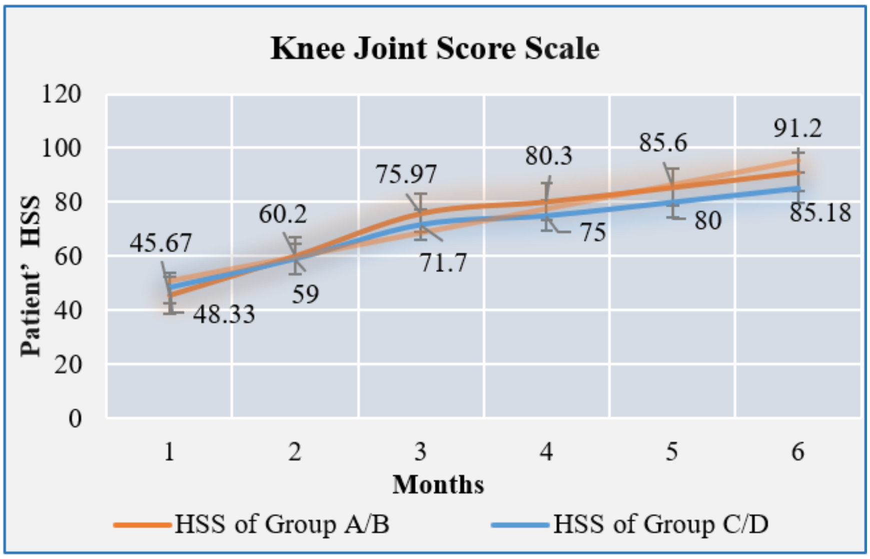

Figure 3. Knee joint score scale.

A comprehensive analysis of group A and group B shows that both groups use nanotubes. Compared with the comprehensive health status of group C and group D, the former is able to take care of themselves to a large extent, and it is obvious that the use of nanotubes has greatly increased the life and health status of patients after knee arthritis treatment. As shown in **Figure 4**, as the experiment progresses, the health status of patients who use nanotubes is reflected in their lives. In the first month, the health of patients who use nanotubes is more comprehensive than those who do not use nanotubes. It is 11% higher. The 4 groups of experimenters in the second and third months are relatively stable. The health status of the patients using nanotubes is more obvious in the fifth and sixth months. It was 21% higher in five months and 26% higher in the sixth month.

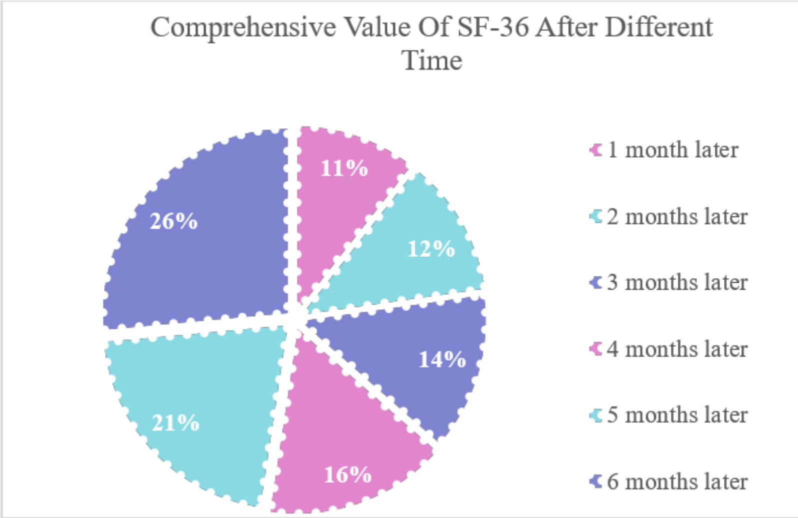

Figure 4. Comprehensive value of SF-36 after different time.

4.3. Effect of sports rehabilitation training federation

(1) Definition and evaluation of measured values

The KSS Score (Hospital for Special Surgery Knee Score) is used to assess knee function, including pain, function, range of motion, muscle strength, and stability. The rating ranges from 0 to 100, with higher scores indicating better functionality. The Barthel Index is used to assess the ability to perform activities of daily living (ADL), including eating, bathing, dressing, toiletting, bed and chair transfer, and walking. The total score is 100 points, with higher scores indicating better self-care skills. The SF-36 health questionnaire was used to assess health-related quality of life in eight categories: physical functioning, role functioning (physical), pain, general health, vitality, social functioning, role functioning (emotional), and mental health. Each area is scored on a scale of 0–100, with higher scores indicating better quality of life.

(2) Data analysis

The KSS, ADL, and SF-36 data analysis of the four groups of experimenters, as shown in **Table 1**, the use of nanotubes combined with exercise balance to exercise patients' living ability and behavioral ability are all higher than those without nanotubes. Nanotube linkage exercise balance force exercise is applied to patients after knee arthritis treatment. It can reduce the degree of inflammation and the incidence of other diseases, so it has a great impact on the health of knee patients.

Table 1. Comparison of KSS, SF-36, ADL before and after intervention (x ± s).

Group	Item	Start experiment	3 months later	6 months later
Group A and B (n = 30)	KSS	45.67 ± 9.93	75.97 ± 7.10	91.20 ± 3.66
	ADL	73.57 ± 11.14	88.47 ± 5.36	96.07 ± 4.58
	SF-36	79.27 ± 19.69	105.63 ± 13.99	127.10 ± 10.56
Group C and D (n = 30)	KSS	48.33 ± 7.16	71.70 ± 7.41	85.17 ± 5.01
	ADL	74.33 ± 15.91	82.10 ± 6.19	89.13 ± 6.14
	SF-36	81.60 ± 20.95	96 ± 90 ± 18.50	109.70 ± 11.42

Since groups A and C have performed balance exercises, and groups B and D have not performed balance exercises, groups A and C are experimental groups compared to groups B and D, respectively, and groups B and D are control groups. As shown in **Figure 5**, the indicators of group A are higher than those of group B. The KSS value is 2 higher than the control group, the ADL comprehensive value is 0.4 higher than the control group, and the SF-36 value is 0.8 higher than the control group. The group is 3.2 higher. The KSS value of C group was 1.9 higher than that of D group, ADL value was 0.5 higher than that of control group, SF-36 value was 0.8 higher than control group, and the comprehensive value of C group was higher than D group by 3.2. The KSS value in the comparison data between the two groups is the largest, indicating that balance exercises can improve the living ability of patients and accelerate the rehabilitation of patients undergoing knee arthroplasty. Based on the above data, it shows that the combination of nanotubes and balance exercises play a vital role in the rehabilitation of patients.

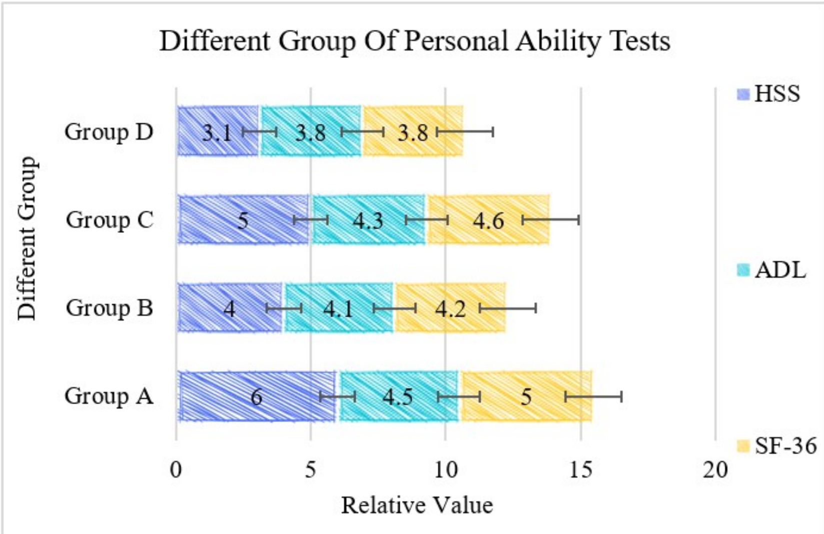

Figure 5. Different groups of personal ability tests.

5. Conclusion

With the development of rapid rehabilitation work, the combination of mobile edge computing and the sports rehabilitation training federation shortens the hospital stay of patients with knee arthritis, and few patients are transferred to professional areas for directional joint exercises. Hospitals and communities have not yet established a good patient management service combination, nor have they formed a continuous and effective system. At this time, the role of nanotechnology has emerged.

After knee arthroplasty, patients have low daily life rehabilitation ability and poor life behavior ability, and they cannot effectively perform various scientific physical exercises after leaving the hospital. Therefore, patients often lack the corresponding health awareness. Some patients believe that surgery can solve all problems. They will blindly follow exercise after they leave the hospital. If this happens, it will affect the lifespan of their artificial joints. Some patients have stopped rehabilitation exercises or failed to perform rehabilitation exercises in the correct way due to unhappy, poor willingness to heal, and weak family support system. They lost the chance of recovery and delayed the recovery process. If the intraoperative osteotomy is improper or the prosthesis is not accurately matched, it will cause the imbalance of the force line, which will further cause the patient's pain, prosthesis wear and loosening, and ultimately affect the patient's health and the retention time of the prosthesis in the patient. Nanotubes can be composed of carbon, and their hardness is in line with human physique. Currently, nanotubes are often used with reference to multiple human anatomical positions, such as the center of the ankle joint at the midpoint of the two ankles, the midpoint of the patellar groove, the intercondylar notch, and the femoral shaft, these human bones are located in a special and difficult position. The lower end and other positions are used as the reference position of the lower limb force line, and combined with the F angle formed by the patient's coccyx resolution axis through the femur and the T angle formed by the coccyx resolution axis through the femur to determine the balance of force in the body.

The results of the study preliminarily suggest that the use of mobile edge computing technology and nanotubes in combination with exercise rehabilitation may have the potential to improve knee function and quality of life. However, the data presented in this paper are not sufficient to draw firm conclusions, and more large-sample randomized controlled trials and mechanistic studies are needed in the future to verify this finding. Similarly, this study preliminarily explored the potential effects of combining nanotubes with exercise rehabilitation in the treatment of knee arthritis. However, due to the small sample size and limitations of the study design, further research is needed to validate these preliminary results and explore their specific mechanisms.

In addition, the use of nanotubes in medical treatment faces some potential side effects and ethical issues. Although nanotechnology has demonstrated great potential for drug delivery, the biocompatibility and long-term safety of nanoparticles have not been fully validated. Nanoparticles may cause immune responses, tissue damage, or other adverse effects, which need to be carefully evaluated in further studies. In terms of ethical issues, the use of nanotechnology also involves issues such as informed patient consent, privacy protection and fair access. Patients should be fully informed about the potential risks and benefits of nanotechnology and make informed treatment decisions. In addition, healthcare resources should be allocated to ensure that the benefits of new technologies are equitably accessible to all patients, rather than restricted to specific groups.

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