Original

Biomechanical Analysis of Poly Lactic-co-glycolic Acid Catheter Combined with Bone Marrow Mesenchymal Stem Cells and Extracellular Matrix Transplantation for Long Sciatic Nerve Defect Repair

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Abstract: We aimed to study the biomechanical characteristics of sciatic nerve after transplantation with poly lactic-co-glycolic acid (PLGA) catheter combined with bone marrow mesenchymal stem cells (BMMSCs) and extracellular matrix (ECM) gel in rabbit model of sciatic nerve injury, so as to provide biomechanics and other basis for the clinical practice. The rabbit sciatic nerve injury model was used in this study. The rabbits with sciatic nerve injury received autologous nerve transplantation (ANT), PLGA catheter combined with BMMSCs transplantation and PLGA catheter combined with BMMSCs and ECM gel transplantation respectively and then correspondingly grouped into ANT group, PCBT group and PCBET group. Twenty-four weeks later, the sciatic nerves in each group were used for electrophysiological examination, histomorphological observation and tensile mechanical properties test. Amplitude (AMP) and motor nerve conduction velocity (MNCV) values of the sciatic nerves in PCBET group were remarkably higher than those in the PCBT group and ANT group with statistical significance ($P < 0.05$). The tensile elastic limit stress, elastic limit strain, maximum stress and strain in PCBET group were all larger than those in the PCBT group and ANT group with a significant difference ($P < 0.05$). PLGA catheter combined with BMMSCs or PLGA catheter combined with BMMSCs and ECM gel can restore the elasticity and toughness of the injured sciatic nerve at some extent, and has obvious recovery effect on the function of the injured sciatic nerves.

Key words: Sciatic nerve defect, Autologous nerve graft, Jointgraft, Mechanical properties

Introduction

Tissue engineering brings new hope for obtaining tissue and graft through surgical operations¹⁾. Polylactic acid (PLA), polyglycolic acid (PGA) and their copolymers (PLGA) are a class of materials most widely researched and applied in tissue engineering at present²⁾. The scholars have made a large number of researches on the peripheral nerve injury by PLGA catheter transplantation and so on³⁻⁵⁾. Huang et al⁶⁾ used lamin-modified PLGA film to repair the injured peripheral nerve and found that as a core of the extracellular matrix protein, lamin can significantly improve the adhesion and affinity of the Schwann cells, which is conducive to the peripheral nerve regeneration. Moore et al⁷⁾ processed PLGA into multipass nerve scaffold and implanted the multipass nerve scaffold combined with the Schwann cells into the rat transverse spinal cord. 30 days later, the spinal cord axons regenerated.

Bone marrow mesenchymal stem cells (BMSCs), a cluster of adult pluripotent stem cells, are important cell sources for cell therapy and tissue engineering repair at present⁸⁾. The scholars have made a lot of efforts on the treatment of nerve injury using BMSCs transplantation. Kurwal et al⁹⁾ implanted the BMMSCs isolated from the rat bone marrow into fibrin catheter and used them to repair the 12 mm defect in rat

sciatic nerve. The results showed that the curative effect of the fibrin catheter combined with BMMSCs is significantly better than that of simple fibrin catheter group. Zhou et al¹⁰⁾ treated 10 mm defect in rat sciatic nerve using the acellular nerve scaffold combined with BMSCs and stem cells (SCs), and found that the combination of BMMSCs and SCs had better effect 16 weeks later than single BMMSCs or SCs transplantation. However, the previous studies have never involved the biomechanical properties analysis on the sciatic nerve repaired by PLGA catheter combined with BMMSCs and extracellular matrix gel (ECM) transplantation^{9,10)}. The destruction of soft tissues and organs in animals will change their biomechanical properties^{11,12)}.

Therefore, we hypothesized that the biomechanical properties of the sciatic nerve group will change after its structure of sciatic nerve is destructed, and the joint transplantation of PLGA catheter, BMSCs, and ECM will have certain effects on the repair of the damaged tissue structure, and the biomechanical properties of the sciatic nerve will get certain recovery. In view of this, the authors tested the electrophysiology, tensile mechanics, and histomorphology of the sciatic nerves in the animal model with sciatic nerve defect after joint graft of PLGA catheters and BMSCs or joint graft of PLGA catheters, BMSCs, and ECM,

Using biomechanical index to judge the therapeutic effects of PLGA catheter combined with BMMSCs transplantation and PLGA catheter combined with BMMSCs and ECM transplantation on the repair of sci-

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Figure 1. Different groups with different surgeries. A: Rabbits in the ANT group with autologous nerve transplantation. B: Rabbits in the PCBT group were treated with PLGA catheter combined with BMMSCs transplantation. C: Rabbits in the PCBET group were treated with PLGA catheter combined with BMMSCs and ECM gel transplantation.

atic nerve injury could provide biomechanical basis for the clinical repair of sciatic nerve injury.

Materials and Methods

Animals

Sixty healthy female Japanese white rabbits, aged 6 month and weighing 2.2-2.4 kg, were provided by Changchun High-tech Animal Experimental Center (license number: SCXK (Ji) 2003-0004). Rabbits were fed in cages with full grains feed. All rabbits were housed in a circumstance of constant temperature 22-24 °C, relative humidity 54-66%, natural lighting and well ventilated and free to drinking and food. This study was carried out in strict accordance with the recommendations in the Guide for the Care and Use of Laboratory Animals of the National Institutes of Health. The animal use protocol has been reviewed and approved by the Institutional Animal Care and Use Committee (IACUC) of Jinlin University.

Preparation of PLGA catheter

PLGA (Changchun Sinobiomaterials Co. Ltd., Changchun, Jilin, China) was dissolved in dichloromethane at a volume ratio of 70:30. NaCl with particle size of 200-300 micron was added as porogen (the mass ratio of PLGA and NaCl was 1:9) and mixed. The mixture was poured into a preset mould with inner diameter 1.6 mm, outer diameter 1.8 mm and length 40 mm. The mixture in the mould was naturally volatilized at room temperature in a fume cupboard. 96 hours later, the mold was released to pick out the PLGA and NaCl cylindrical catheter. After dried in a vacuum drying oven at 37 °C for 48 h, the PLGA and NaCl cylindrical catheter was soaked into 800 ml deionized water for 96 hours. During this period, the deionized water was changed every 4 hours. Then the PLGA and NaCl cylindrical catheter was dried in a dry box at 37 °C for 48 hours, followed by disinfection with 36 °C ethylene oxide for 12 hours. Then PLGA catheters were prepared for use. Before the experiment, the PLGA and NaCl catheters were cut into length 30 mm for use by the S-5 aseptic plastic scalpel which was produced by Xuyi Union Huai'an Yikang Medical Products Co., Ltd. (Xuyi, Jiangsu, China). Seventy pieces of NaCl and PLGA catheters were prepared for use.

Preparation of sciatic nerve defect animal model and grouping

The experimental rabbit was fixed on the animal operating table and anesthetized with 6% chloral hydrate (6 ml/kg) by intraperitoneal injection. After successful anesthesia, a midline incision was made on the posterior part of the rabbit left thigh. The left sciatic nerve was exposed and isolated layer by layer. At the 3 mm away from the inferior margin

of the piriform muscle, a 30 mm sciatic nerve was excised to prepare the model of 30 mm sciatic nerve defect. Then, the prepared animals were randomly divided into 3 groups: rabbits with sciatic nerve defect treated with autologous nerve transplantation (ANT group, $N=20$), rabbits with sciatic nerve defect treated with PLGA catheter combined with BMMSCs transplantation (PCBT group, $N=20$), and rabbits with sciatic nerve defect treated with PLGA catheter combined with BMMSCs and ECM transplantation (PCBET group, $N=20$).

Treatments

Rabbits in the ANT group were treated with autologous nerve transplantation. Under XT-X-6A surgical microscope (Zhenjiang Xintian Medical Instrument Co. Ltd., China), the autologous sciatic nerve cut off from the rabbit was implanted back into the sciatic nerve by suturing the epineurium of the ends using 9-0 noninvasive suture line (Qingdao Nike Medical Material Co. Ltd., China). Each end was sutured by four punctures (Fig. 1A), and then the muscles and skin were closed.

Rabbits in the PCBT group were treated with PLGA catheter combined with BMMSCs transplantation. BMMSCs were produced by Shanghai Yanyi Biotech Co. Ltd (Shanghai, China). The BMMSCs were cultured and subcultured in strict accordance with the instructions provided by the manufacturer. When the cells grew to 90% confluence, they were passaged at a density of $2 \times 10^4/\text{cm}^2$ at a circumstance of 95% air and 5% CO_2 at 37 °C after digestion by 0.05% trypsin. Cells were passaged every 5 days at a ratio of 1:2. The medium was changed every 3 days. The shape of rabbit BMMSCs was fibroblast-like in the early stage. We also found that there were several cell components in bone marrow. In addition to the differentiated cells such as stroma cells, there were also two kinds of pluripotent stem cells, hematopoietic stem cells and mesenchymal stem cells. Those with the phenotype of bone marrow mesenchymal stem cells were used in this study. Under the surgical microscope, the broken nerve ends were inserted into the both ends of the 30 mm PLGA nerve catheter, respectively. Then the epineurium and the PLGA nerve catheter wall were fixed with 9-0 noninvasive suture line (Qingdao Nike Medical Material Co., Ltd.) and sutured by four punctures at both ends. Then 1×10^9 cells/l BMMSCs at the fifth generation grown in a 5% CO_2 saturated humidity incubator at 37 °C were injected into the PLGA nerve catheter using a micro injector (Fig. 1B). After that, the muscles and skin were closed.

Rabbits in the PCBET group were treated with PLGA catheter combined with BMMSCs and ECM gel transplantation. The extracellular Matrix Gel was produced by BD (California, USA). Under the surgical microscope, the broken ends of the sciatic nerve were inserted into the both ends of the 30 mm PLGA nerve catheter, respectively. Then the

Figure 2. The stress-strain curves of the sciatic nerve in all the four groups. The ordinate represents the stress and the abscissa represents the strain. The establishment of the formula of stress-strain functional relation. From the stress-strain curves, the formula of stress-strain functional relation were established as follows:

The control group: $\sigma(\varepsilon)=2.9299e^5-10.5160e^4+4.6152e^3-30.2386e^2-0.2936e+0.7472$;
 The ANT group: $\sigma(\varepsilon)=4.9598e^5-21.7445e^4+35.7006e^3-0.9259e^2+25.134$
 The PCBT group: $\sigma(\varepsilon)=-0.7992e^5+4.6109e^4-2.6227e^3+0.4126e^2+1.1828$
 The PCBTET group: $\sigma(\varepsilon)=0.9285e^5-6.5147e^4+17.3074e^3+602544e^2+1.9244$

epineurium and the PLGA nerve conduit wall were fixed and sutured with 9-0 noninvasive suture line (Qingdao Nike Medical Material Co., Ltd.) by four punctures at both ends. The fifth generation of rabbit BMSCs (1×10^9 cells/l) grown in a 5% CO₂ saturated humidity incubator at 37 °C and extracellular matrix gel (1×10^9 /l) were injected into the PLGA nerve catheter using a micro injector (Fig. 1C). Then the muscles and skin were closed.

After surgery, the incision on each rabbit was rinsed with gentamicin to avoid infection. The rabbit limb was not externally fixed. When the rabbits were awoken from anesthesia, they were separately fed in cages, and each rabbit received intraperitoneal injection of penicillin 10,000 μ/kg twice daily for 7 days. The skin incision was disinfected with 75% alcohol once daily for 7 days. The rabbit cage padding was kept dry all the time.

Electrophysiological test of sciatic nerve

At 24 weeks after operation, electrophysiological test was carried out on the sciatic nerve of the experimental side (left) of each rabbit using NIM-Neuro Type 2 electromyograph (Medtronic Company, Minneapolis, Minnesota, USA). Rabbits were anesthetized with 10% chloral hydrate (10 ml/kg) by intraperitoneal injection. After the surgical field was disinfected, the rabbit was on prone position to expose the left and right sciatic nerve stem. The co-core needle electrode was punctured into the soleus muscle (M) as a recording electrode, while the grounding wire was fixed on the edge of the wounded skin with an alligator clips. A super stimulation of 50 mA current was applied on the parallel stimulating electrodes which were put on the proximal anastomotic stoma of the ischial tuberosity level (P) and the distal anastomotic stoma of the sciatic nerve branches (D) respectively to induce two action potentials. The electromyograph automatically displayed the latency and amplitude of action potential (AMP). The distance between the two electrodes was measured with a vernier caliper and input the instrument. The electromyograph could also automatically display the value of motor nerve conduction velocity (MNCV). Twenty rabbits in the experimental group were randomly selected to detect the right sciatic nerves by the same method as the normal control group.

After the electrophysiological test, using the anastomotic stoma of the rabbit sciatic nerve as the midpoint, a length of about 20 mm sciatic

Table 1 The electrophysiological results of the rabbit sciatic nerve in each group (n=20).

Groups	AMP (Mv)	MNCV (m/s)
Control	13.4±1.0 ^a	54.3±1.2 ^a
ANT	10.5±0.8 ^b	51.0±1.08 ^b
PCBT	11.5±0.7 ^c	53.0±0.1.0 ^c
PCBTET	12.5±0.7 ^d	52.2±1.6 ^d

Note: Data are shown as mean±SD. ^a*P*<0.05, vs. PCBT group and PCBTET group; ^b*P*<0.05, vs. PCBT group and PCBTET group; ^c*P*<0.05, vs. PCBT group and PCBTET group; ^d*P*<0.05, vs. control group.

nerve from each experimental side (left) was cut off as test samples (*N*=20). Twenty right sciatic nerves were randomly selected from each group to serve as the normal control group. All nerve specimens were kept in physiological saline for use.

Tensile test

MODEL55100 type automatically controlled electronic universal test machine produced by Changchun Test Machine Institute Group (Changchun, Jilin, China) was used in this study for the tensile test. The universal test machine equipped with a temperature adjustable thermostat which could be adjusted from -30 °C to 250 °C. CGA-5 type microscope produced by Changchun the Third Optical Instrument Factory (Changchun, Jilin, China) was employed to measure the length and diameter of sciatic nerve. The initial length and diameter of the sciatic nerve specimens in the control group, the ANT group, the PCBT group and the PCBTET group were all 20 mm and 1.52-1.55 mm, respectively. According to the method described in the literature^{13,14}, each sciatic nerve specimen was pretreated for the following experiments. The experimental temperature was controlled within 36.5±1.0°C. Each sciatic nerve specimen was clamped in the soft tissue holder, and a tensile load was applied to the specimen at a speed of 5 mm/min. In order to maintain the humidity of the specimen during the test, the normal saline was sprayed continuously to the sciatic nerve specimen. After the test, the computer automatically output the elastic limit strain, the maximum strain, the elastic limit stress, the maximum stress, the elastic limit load, the maximum load and stress-strain curves.

Observation of tissue morphology

One sciatic nerve specimen from the same part was randomly selected from each group to make frozen sections. Prepared sections were treated by routine manners and stained with hematoxylin and eosin (H&E). After staining, sections were dehydrated through increasing concentrations of ethanol and xylene. The species were observed by light microscope (BX51, Olympus, Tokyo, Japan) to find the change of the transect of nerve, including axons, nerve cells, myelin sheath, and nerve base-membrane.

Statistical analysis

The measurement data were expressed as mean±standard deviation (SD) and analyzed using SPSS16.0 software package (SPSS, Chicago, IL, USA). The difference of data between groups was analyzed using one-way ANOVA and Scheffe method. *P*<0.05 was regarded as significant difference. The formula of stress-strain functional relation of each group was established by mathematical regression analysis.

Table 2 The tensile test results of the rabbit sciatic nerve in each group ($n=20$).

Groups	Maximum load (N)	Maximum stress (MPa)	Maximum strain (%)	Elastic limit strain (%)	Elastic limit load (N)	Elastic limit stress (MPa)
Control	5.99±0.21 ^d	2.88±0.12 ^d	76.2±1.26 ^d	40.6±1.16 ^d	2.74±0.13 ^d	1.31±0.06 ^d
ANT	5.13±0.06 ^a	2.44±0.03 ^a	67.8±0.66 ^a	32.7±0.71 ^a	2.38±0.12 ^a	1.18±0.06 ^a
PCBT	5.25±0.07 ^b	2.51±0.03 ^b	66.4±0.83 ^b	33.2±0.92 ^b	2.52±0.09 ^b	1.24±0.04 ^b
PCBET	5.32±0.11 ^c	2.59±0.04 ^c	67.4±0.69 ^c	34.9±1.24 ^c	2.62±0.09 ^c	1.29±0.04 ^c

Note: Data are shown as mean±SD. ^a $P<0.05$, vs. PCBT group and PCBET group; ^b $P<0.05$, vs. PCBT group and PCBET group; ^c $P<0.05$, vs. PCBT group and PCBET group; ^d $P<0.05$, vs. control group.

Figure 3. The cross-section of rabbit sciatic nerves observed under a light microscope (HE staining). Scale bar = 100. A: A representative of the rabbit sciatic nerves in the control group; B: A representative of the rabbit sciatic nerves in the ANT group; C: A representative of the rabbit sciatic nerves in the PCBT group; D: A representative of the rabbit sciatic nerves in the PCBET group.

Results

Electrophysiological results

The electrophysiological results of the sciatic nerve in each group were shown in Table 1. The electrophysiological test showed that the AMP and MNCV values of the sciatic nerve in the ANT, PCBT and PCBET groups were significantly lower than those in the control group ($P<0.05$). However, the AMP and MNCV values of the sciatic nerve in the PCBET group were both markedly higher than those in the ANT and PCBT groups with significant difference ($P<0.05$). In addition, the AMP and MNCV values of the sciatic nerve in the PCBT group were also notably higher than those in the ANT group ($P<0.05$).

Tensile results of the sciatic nerve specimens

The tensile results of the rabbit sciatic nerve specimens in each group were shown in Table 2. The maximum load, maximum stress, elastic limit strain, elastic limit load and elastic limit stress of group

PCBT and PCBET group were greater than those of group ANT ($P<0.05$), but the maximum strain of ANT group was not significantly different from that of group PCBT and PCBET group ($P>0.05$).

The stress-strain curve of the sciatic nerve specimens

The stress-strain curves of the sciatic nerves in all the four groups were shown in Fig. 2. According to Fig. 2, the stress-strain curve of the control group was almost exponential when the strain of the sciatic nerve rose from 0 to 16.2% and approximately linear when the strain rose from 16.3% to 40.6%. However, when the strain was increased from 40.7% to 76.2%, the deformation of the sciatic nerve in the control group increased greatly and the nearly no loading capacity of the specimen left which tended to be damaged. In the ANT group, the stress-strain curve was basically exponential when the sciatic nerve strain was increased from 0 to 9.2% and approximately linear when the strain was increased from 9.3% to 32.7%. But when the strain rose from 32.8% to

67.8%, the specimen had large deformation with extremely low bearing capacity and tended to be destroyed. When the strain of the sciatic nerve in the PCBT group was increased from 0 to 9.7%, the stress-strain curve basically had an exponential relationship, but it was similar to the linear functional relation when the strain increased from 9.8% to 33.1%. When the strain was increased from 33.4% to 66.4%, the specimens in the PCBT group had great deformation with very low bearing capacity which led to the specimens to be destroyed. The stress-strain curve of the PCBET group was almost exponential as the sciatic nerve strain was increased from 0 to 11.4% and approximately linear as the strain was increased from 11.5% to 34.9%. In the PCBET group, the sciatic nerve specimens had large deformation and extremely low bearing capacity when the strain was elevated from 35% to 67.4%, which led to the specimens almost destroyed.

Morphological observation of the sciatic nerve specimens

The sciatic nerve specimens of each group were also used for the histopathological examination. The histopathological examination revealed that the rabbit sciatic nerve fibers in normal control group arranged orderly and the contents of nerve fiber such as axon had clear form; in addition, the axons were surrounded by myelin sheath (Fig. 3A). In the ANT group, fiber axons were observed beside the Schwann cells in the rabbit sciatic nerve, and a large number of early myelination was visible at the distal end (Fig. 3B). The sciatic nerve had a good myelination in the PCBET group; good nerve regeneration and orderly arrangements of the nerve fibers were also observed (Fig. 3C). The sciatic nerve regeneration was fairly complete in the PCBT group, with a good myelination; the nerve fibers were arranged orderly (Fig. 3D).

Discussion

Electrophysiological index is one of the important methods to judge the recovery effect of peripheral nerve injury in human or animals. In this study, the electrophysiological test on the rabbit sciatic nerves in each group showed that the MNCV and AMP values in the rabbits with sciatic nerve injury receiving PLGA catheter combined with BMSCs and ECM transplantation (PCBET group) were notably higher than those in the rabbits receiving autograft nerve transplantation (ANT group) or receiving PLGA catheter combined with BMSCs transplantation (PCBT group) with significant difference ($P < 0.05$), suggesting that the injured sciatic nerve treated with PLGA catheter combined with BMSCs and ECM transplantation got functional recovery to some extent.

Optical microscope observation on the microstructure of the sciatic nerves after transplantation repair is an important way to compare the recovery effects of various transplanting anastomoses on repairing the sciatic nerve injury. In this study, we found the sciatic nerve regeneration in the PCBET group was complete and the myelination was well, the nerve fibers arranged orderly prompting that PLGA catheter combined with BMSCs and ECM transplantation is conducive to the recovery of the injured animal nerve fibers such as sciatic nerve fiber. Although Bodian and Kluver-barrera double staining was not conducted in this study, HE stain of the sciatic nerve was enough to show that receiving PLGA catheter combined with BMSCs and ECM transplantation were effective to repair the injury sciatic nerve.

From the stress-strain curves of the sciatic nerves, we found that the stress-strain curve of the sciatic nerve specimens was basically in an exponential functional relation at the beginning tensile stress, and then became similar to the linear relationship with the increase of the tensile stress, followed by an approximately exponential functional relation

again as the tensile stress was further increased. With the continuously increase of the stress, the stress-strain curves began to have a greater slope with nonlinear change, the sciatic nerve fiber was extended, stretched, until destruction. The elastic limit strain, maximum stress and strain of the rabbit sciatic nerve in the PCBT and PCBET groups were larger than those in the ANT group, indicating that PLGA catheter combined with BMSCs and ECM transplantation improved the elasticity and strength of animal sciatic nerve in the sciatic nerve injury model. The improved elasticity of the sciatic nerve is conducive to resist deformation and external force and conducive to the repair and regeneration of the injured sciatic nerve. It is believed that the nerve fiber arrangement is disrupted in the sciatic nerve defect rabbit model and the nerve fibers are also damaged, which decreases the tensile mechanical properties. The injured sciatic nerves in the sciatic nerve defect rabbit model were repaired after the treatment with PLGA catheter combined with BMSCs transplantation or PLGA catheter combined with BMSCs and ECM transplantation, so the mechanical properties of the sciatic nerves were also restored.

At present, PLGA is a widely used cell culture scaffold in the field of tissue engineering¹⁵. BMSCs are a group of stem cells derived from bone marrow, with multipotent property and the self-renewal ability. They can be induced *in vitro* and *in vivo* to differentiate into neurons cells with glial phenotype¹⁶. BMSCs can secrete large amounts of nutrients that are beneficial for the nerve regeneration, myelination and axonal regeneration¹⁷. Studies have shown that the regulation of Schwann cells proliferation by BMSCs can promote the nerve regeneration¹⁸. BMSCs have convenient source, which can be rapidly proliferated *in vitro*, and have no transplantation rejection nor the ethical problem, thus they have drawn more and more attentions. At low temperature, extracellular matrix gel is in liquid state, which facilitates the BMSCs to implant and distribute easily and evenly. Extracellular matrix gel includes fibronectin, laminin, type IV collagen and other extracellular matrix components, which can promote the regeneration of nerve¹⁹. ECM gel is the extracellular matrix component secreted by Engelbrath Holm Swarm tumor cell line²⁰, containing collagen, laminin, fibronectin and other ingredients, which is in a liquid state at low temperature, easy to distribute the BMSCs. When the temperature reaches 37 °C, ECM generally becomes the gel, facilitating BMSCs to move but not leading the BMSCs to flow outside. Donzelli et al²¹ confirmed that ECM can promote nerve regeneration and induce the growth of neurite. In this study, we used PLGA catheter combined with BMSCs, PLGA catheter combined with BMSCs and ECM transplantation to treat the sciatic nerve injury animal model. The tensile mechanics, morphology and physiological function of the animal sciatic nerves were restored to some extent, which was consistent with the desired results. PLGA catheter combined with BMSCs and ECM gel transplantation has good repair effect on the injured sciatic nerve in the animal model of sciatic nerve injury.

The characteristics of this study lied in the tensile mechanical properties analysis after the animal model of sciatic nerve injury was treated with autologous nerve transplantation, with PLGA catheters combined with BMSCs, or with PLGA catheter combined with BMSCs and ECM gel transplantation; lied in the establishment of the expression of the stress-strain functional relation of each group by the method of mathematical regression analysis. Using mathematical statistical model to analyze the experimental data of the stress and strain can better clarify the mechanical properties of the sciatic nerve in each group, so as to provide a theoretical basis for the pathogenesis of sciatic nerve injury.

Due to the limited sample size of sciatic nerves and the individual

difference of rabbit sciatic nerves, the experimental data might have some discreteness, but it still has certain reference value for the clinical repair of the injured sciatic nerves.

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Conflict of Interest

The authors declare no conflict of interest.

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