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Microscopy-Assisted Decompression Treatment of Multi-Segment Cervical Spondylotic Myelopathy

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Abstract: How to find the most effective and scientific way to prevent and treat spine diseases is a common concern of medical workers and sports work. Because Tai Chi has a certain role in the field of spine health care and spine medical treatment, the research content of this paper is the study of microscopically assisted decompression in the treatment of cervical spondylotic myelopathy. In this paper, 54 patients with cervical spondylotic myelopathy were treated with microscopically assisted fine decompression. The results showed that the physiological curvature of cervical vertebrae and the fusion height after operation were significantly recovered compared with that before operation. The fusion rate was 100% at the last follow-up. The stability of cervical vertebrae was good. There was no loss of the intervertebral height. There was no complications such as plate loosening or screw breaking, The curative effect was satisfactory. Microscopical technique has achieved good clinical effect in cervical operation.

1. Introduction

In recent years, the study of the natural history of cervical spondylotic myelopathy has become a hot topic, which is closely related to the choice of treatment. At present, the occurrence, development and outcome of cervical spondylotic myelopathy are generally recognized, but individual differences cannot be ignored. We need to have a relatively complete understanding of the natural history of cervical spondylotic myelopathy, so as to make clear the relationship between its natural course characteristics and personal characteristics, as well as the course characteristics without surgical intervention. This requires us to further explore the individual characteristics of cervical spondylotic myelopathy patients, find out their common characteristics, change rules and their correlation, In order to evaluate the clinical treatment work correctly.

The degenerative change of cervical intervertebral disc is the most important cause in the

pathological process of cervical spondylotic myelopathy [1-2]. To evaluate the clinical efficacy of anterior decompression in the treatment of cervical spondylotic myelopathy, Qiao analyzed the clinical data of 84 patients with cervical spondylotic myelopathy from August 2005 to March 2016. According to the operation method, 42 cases in each group were divided into control group and observation group. The control group received posterior laminoplasty, and the observation group received anterior segmental decompression. The operation time, intraoperative blood loss, hospitalization time, bone graft fusion time and complication rate were observed [3-4]. Murphy used diffusion-based spectroscopy to quantitatively assess axon / sheath injury, cell inflammation, and axon loss in the spinal cord of cervical spondylotic myelopathy (CSM). One of the main shortcomings of CSM management is the lack of effective diagnostic methods to stratified treatment and predict results [5-6]. Wang reviewed the clinical data of 32 patients with anterior cervical discectomy and fusion, and followed up for more than 5 years. Wang used the visual analogue scale, the neck disability index and the modified Japan Orthopaedic Association pain or myelopathy symptom score to evaluate the clinical results [7-8].

Among many sports, Tai Chi, as a wonderful flower in the traditional sports of the Chinese nation, has gradually revealed and studied the special exercise value of human body in detail, which has been highly valued at home and abroad, and has become an effective sports medical project [9-10]. Callahan randomly divided 343 people into intervention group and waiting control group to evaluate the effectiveness of Tai Chi program of Arthritis Foundation for community arthritis participants [11-12]. Sun study explored the effect of one-year regular Tai Chi on neuromuscular response in elderly women. 41 elderly women completed the study. The TC group (n = 21) used 24 TC, while the control group read newspapers or watched TV as required. Electromyogram was measured before and after the intervention. After one year's intervention, there were significant differences in the posttest results of neuromuscular response time among groups in rectus femoris, semitendinosus, tibialis anterior muscle and gastrocnemius muscle. The results showed that the neuromuscular response time of TC group in rectus femoris, semitendinosus, tibialis anterior and gastrocnemius muscles was significantly shorter than that of baseline[13-14]. Through combing the existing literature, it is found that there is no in-depth and systematic study on the theory and practice of the impact of Tai Chi on spine health, and no comprehensive discussion and disclosure of the special role of Tai Chi in promoting spine health, which provides opportunities and challenges for this paper [15]. With cervical spondylotic myelopathy treated by microscopically assisted anterior cervical fine decompression were analyzed retrospectively to evaluate the clinical effect. In order to establish the theoretical system of Tai Chi, and make Tai Chi, a traditional Chinese sport, better serve the health of spine and meet people's pursuit of health.

2. Microscope-Assisted Decompression Treatment of Multi-Segment Cervical Spondylotic Myelopathy and Tai Chi

2.1. Multi-Segment Cervical Spondylotic Myelopathy

The degenerative change of cervical intervertebral disc is the most important reason in the pathological process of cervical spondylotic myelopathy. The intervertebral disc tissue is a sealed body composed of cartilage plate, fibrous ring and nucleus pulposus. It begins to degenerate at about 30 years old, which is one of the earliest degenerated tissues in human body. The water content of the nucleus pulposus of the cervical intervertebral disc is as high as 90% at birth and about 80% in adulthood. The water content decreases with the increase of age, and the water content affects the elasticity and tension of the intervertebral disc. The cervical intervertebral disc can absorb concussion and transmit stress. The fiber bundles of the fiber ring overlap each other obliquely, making the fiber ring become a solid tissue, which can bear large bending and torsion

loads, and jointly maintain the stability of the spine. With the increase of age, the nucleus pulposus gradually dehydrated, its elasticity decreased, and it is easy to be compressed. In addition, the distribution of blood vessels in the intervertebral disc gradually decreased, even without blood vessels, and it is more prone to degeneration. Once the fiber ring cracks appear, it is difficult to heal. The decomposition of proteoglycan and the decrease of proteoglycan and water content are the earliest changes in the histomorphology of nucleus pulposus, which will lead to the reduction of the height of the intervertebral disc, the narrowing and relaxation of the intervertebral space, and the weakening of the stability of the intervertebral joint. The degeneration of simple intervertebral disc does not necessarily have clinical symptoms, but the degenerative intervertebral disc resistance is weakened, the stability of cervical vertebra is decreased, the fiber ring behind is easy to rupture, leading to the backward protrusion of nucleus pulposus, thus compressing the spinal cord or nerve root blood vessels, etc., and causing corresponding clinical symptoms. In the early stage of spinal cord dysfunction, it can be recovered. If the symptoms of spinal cord injury do not get treatment for a long time, and the pathological changes gradually develop, the degeneration, softening and cavity formation of spinal cord can be secondary, resulting in irrecoverable damage.

There are great individual differences in the dysfunction caused by cervical spondylotic myelopathy. The light one can show numbness of one or more fingers, while the heavy one can show total paralysis of limbs. The main clinical symptoms of CSM are: neuralgia of limbs, numbness and weakness of upper limbs, poor fine activity of hands, unsteadiness of gait, feeling of walking on cotton and spasm of lower limbs. Most of the patients were positive for pathological signs. In addition, some patients may have symptoms of rectal and bladder dysfunction. Any one of the above symptoms or a combination of these symptoms will eventually lead to dysfunction of the body and a decrease in the sense of movement, which will lead to a decline in the quality of life. Although the disability associated with this degenerative disorder is progressive and has a profound impact on people's lives, it may not be diagnosed for a long time. Therefore, early diagnosis and control of the disease are needed.

The recovery and maintenance of intraoperative correction and postoperative cervical curvature and intervertebral height in patients with cervical spondylotic myelopathy is helpful to enlarge the cervical canal and intervertebral foramen, which is closely related to the surgical effect. Anterior cervical surgery can effectively restore the curvature of the operation stage, and properly open to restore the intervertebral height. In order to avoid the long-term deterioration of neurological symptoms in patients with cervical spondylotic myelopathy, it is very important to maintain good cervical curvature and intervertebral height.

2.2. Anterior Operation

The commonly used methods of anterior cervical decompression and fusion include simple discectomy and fusion, subtotal corpectomy and fusion and internal fixation, internal fixation with fusion cage and plate, and artificial disc implantation and fusion. For the compression symptoms of a single segment, simple discectomy and subtotal corpectomy can relieve the compression and neurological symptoms. For compression cervical spondylotic myelopathy of multiple segments, subtotal vertebral resection and fusion plate internal fixation can be selected. For the treatment of cervical spondylotic myelopathy, different surgical methods have their own advantages and disadvantages. However, the operation time is long and the fusion interface is many. Long segment subtotal vertebrectomy reduces the operation time and the interface of bone graft fusion, at the same time, prolongs the arm of force of the graft, and increases the risk of fusion failure caused by the micro motion of the interface of bone graft after operation. The purpose of segmental method is to combine the advantages of anterior approach and avoid its disadvantages as much as possible.

Segmented method is a selective subtotal vertebrectomy + discectomy decompression and bone graft fusion. The idea is to perform subtotal vertebrectomy in the segments with large compression range and severe degree, which avoids the appearance of long arm of graft, reduces the interface of bone graft fusion, enhances the stability and improves the rate of bone graft fusion with the application of anterolateral steel plate, and the effect is satisfactory.

Anterior cervical decompression and fusion is one of the main methods for the treatment of cervical diseases, which can effectively relieve the compression and restore the normal physiological curvature of the cervical spine, and reconstruct the stability of the affected cervical segments. Although the fixation and fusion of the diseased cervical segments improve the local physiological abnormality and relieve some symptoms of nerve compression, with the long-term follow-up of the patients who received the operation, it was found that the adjacent segments of the fused segments would degenerate or lose stability in varying degrees after a period of time, and even some neurological dysfunction or axial symptoms would appear again. The long-term abnormal stress of spine will result in protective compensatory mechanism, such as hyperosteogeny, hypertrophy of ligamentum flavum and osteophyte of anterior and posterior edge of vertebral body. Complete decompression is the guarantee of good curative effect of cervical spondylotic myelopathy.

The traditional open-door surgery can damage the articular surface in different degrees, and the sensory nerve endings of the posterior branch of the cervical nerve can be damaged by suspending the lamina on the small articular capsule or paravertebral tissue on the hinge side. At the same time, the small joint capsule and paravertebral soft tissue can be damaged and aseptic inflammation can be caused by the traction of the suspension suture, and then scar tissue can be formed, which has a certain limit on the activity of the small joint. If the segment with imaging degeneration and slight compression of the spinal cord is not removed, it may accelerate the degeneration of the intervertebral disc due to the increase of stress bearing after the fusion of adjacent segments, further compression of the spinal cord will cause neurological symptoms. If all the segments are removed, it is suspected of over treatment, and it is not conducive to maintaining the good activity of the cervical spine after the operation. Not all osteophytes will be absorbed after fusion. Osteophyte absorption is a long process, so removal of osteophyte is conducive to complete decompression and improve short-term efficacy. For the simple ossification of the posterior longitudinal ligament, it is also necessary to resect as much as possible to obtain better dural expansion. The adhesion between the posterior longitudinal ligament and dural sac should be handled carefully to avoid complications such as cerebrospinal fluid leakage.

2.3. Tai Chi Promotes Spine Health

Functional exercise is a kind of therapy which can cure and defend the diseases of strain and promote the recovery of physiological function of injured tissues and joints by active or passive movement of trunk or limbs. Traditional Chinese medicine has a history of using functional sports to prevent and treat spinal diseases. Functional exercise can improve the muscle strength and endurance of spinal muscles, promote blood circulation and eliminate inflammation, effectively relax local spasm muscles and break the pain circulation. The specific movements in medical sports can also help the self-reduction of the small joints of the spine, correct the deformation of the spine, keep exercising for a long time, enhance the elasticity of the muscles and ligaments related to the spine, and promote the recovery of the stability of the spine.

Tai Chi pays most attention to the adjustment of the spine, mainly makes a series of requirements for the posture of the spine, through hanging the top, vertical items, round crotch, crotch retraction, chest pulling back, waist loosening and hip retraction, etc., try to consciously ease the physiological

curvature of the spine, the straightening of the spine will reduce the moment of inertia and non axial component of the whole trunk, and make the stress distribution of the intervertebral disc more uniform, It can increase the stability of the spine itself. Tai Chi's "empty neck and top strength" is conducive to straightening the cervical vertebra, relaxing, coordinating and balancing the neck muscles, restoring the spinal cord, blood vessels and trachea to their normal positions, and making the whole spine pull up; combined with "Qi sinking Dantian", it makes the whole spine pull down. Vertically, pull-up and pull-down is the performance of modern medicine "traction" in Tai Chi, and "traction" is one of the most effective means of modern medicine for spine deformation. Tai Chi can enhance the strength and coordination of spine related muscles and ligaments, improve the range of motion of joints, and improve the stability of spine. By practicing Tai Chi, we have strengthened the exercise of vertical muscle, multifidus muscle, lumbar transverse process muscle, interspinous muscle and other rear core strength muscle groups, so as to maintain and strengthen the stability of the joint spine, and provide guarantee for the consolidation treatment and prevention of recurrence.

As a traditional Chinese sports, Tai Chi has a good role in promoting the health of the human body. More importantly, Tai Chi has a special exercise value for the axis spine of the human body. Tai Chi is a kind of spiral movement in essence. During the movement, the waist is turned to the spine, the wrist is turned to the arm, and the ankle is turned to the knee, forming a series of full movement and integrated rotation movements. At the same time, Tai Chi has the requirements of virtual spiritual strength, Qi sinking into the red field, standing in the middle and the waist leading, internal and external consistency, hardness and softness, speed and slowness. Tai Chi, as a special exercise requirement, plays a positive role in promoting the health of the spine, so it has a very good role in prevention, auxiliary treatment, rehabilitation and consolidation of the treatment effect.

3. Experimental Objects and Methods

3.1. Test Subject

In this article, 54 cases of multi-segment cervical spondylotic myelopathy treated in a hospital from January 2019 to January 2020 were selected. The clinical symptoms, signs and cervical spine X-ray lateral position, hyperextension flexion film, and CT scan two-dimensional reconstruction MRI examination clearly confirmed that there are 30 males and 24 females with multi-segment cervical spondylotic myelopathy; ages 30 to 70 years old, with an average age of 52 years; 6 of them are in 4 segments, 16 in three segments, and 30 in two segments; Among them, 12 cases were C3/4 segment, 60 cases were C4/5 segment, 54 cases were C5/6 segment, and 6 cases were C6/7 segment. The study was approved by the ethics committee and all patients gave informed consent and signed informed consent.

The standard hospital was 30-70 years old; the clinical symptoms, signs and imaging examinations were clearly multi-segmental cervical spondylotic myelopathy; 2 to 4 segments of the discs in C2 to C7 were affected and the spinal cord was compressed; the patients were informed about the experiment Agree and sign an informed consent form. Exclusion criteria: cervical spine tumor or tuberculosis; congenital malformation of the cervical spine; those with severe cognitive impairment who cannot successfully complete follow-up; combined with other systemic diseases and inflammatory diseases such as stroke.

3.2. Surgical Methods

The trachea was trained from right to left for about 1 week before surgery, and antibiotics were intravenously infused half an hour before surgery. After anesthesia, the patient was supine and the

head and neck were fixed behind the neck, placed under perspective, and sterilized. Take a lateral incision on the right side of the neck, 5-8 cm in length. Cut the skin, subcutaneous and platysma muscle, draw the carotid sheath to the outside, and the tracheoesophageal sheath to the inside to expose the prevertebral fascia, and cut the prevertebral fascia longitudinally. C-arm fluoroscopy determines and exposes the diseased intervertebral space, completes the complete removal of the endplate of the nucleus pulposus with the aid of a microscope, fine grinding of hyperplastic osteophytes with micro-grinding, and posterior longitudinal ligament resection, etc., and then uses the ALLANTIS anterior cervical spine Lumbar plate system, titanium mesh and CornerStone-Sr fusion cage were used for interbody fusion and titanium plate internal fixation. See again to confirm that the internal fixation position is good. The physiological saline was flushed to place negative pressure drainage, and the incision was sutured layer by layer.

In this paper, SPSS16.0 statistical software was used for data analysis. The measurement data was expressed as mean ± and standard deviation. The t test was used for comparison between the two groups. P<0.05 was considered statistically significant. The mean and standard deviation $(\bar{x} \pm s)$ are shown in formulas (1) and (2):

$$\mu = A_n = \frac{a_1 + a_2 + a_3 + ... + a_n}{n} \tag{1}$$

$$\sigma = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i - \mu)^2} \tag{2}$$

In the formula, the values X_1, X_2, X_3, ..., XN (all real numbers) have an average value of μ and a standard deviation of σ.

4. Discussion

4.1. Nerve Function Analysis

The JOA score and postoperative improvement rate of each group before and after operation are shown in Table 1.

Table 1. JOA score and postoperative improvement rate of each group before and after operation

	Preoperative score(points)	Postoperative score(points)	Postoperative improvement rate(%)	P
C3/4	7.7±2.2	14.6±1.5	32.4+8.5%	0.016
C4/5	7.8±1.3	14.6±2.1	74.4+2.8%	0.043
C5/6	7.4±1.9	14.6±1.6	73.7+3.2%	0.030
C6/7	7.5±1.8	14.7±1.6	73.6±5.5%	0.037

From the point of view of the recovery of spinal cord function, the difference in nerve function between the four groups before and after operation was statistically significant (t=2.994, P<0.05). The average score before operation was (7.6±1.9) points, and the average score after operation was (14.9±1.8) points, which was an increase of (7.3±1.8) points before operation. The difference was statistically significant (t=2.993, P<0.05). The average improvement rate is (73.5+5.6)%. Among 54 cases, 19 cases were excellent (33.4%), 27 cases were good (48.5%), 9 cases were moderate (17.5%), 1 case was poor (1.8%), and the excellent and good rate was 81.7%. The analysis results of JOA score and postoperative improvement rate of each group before and after operation are shown in Figure 1.

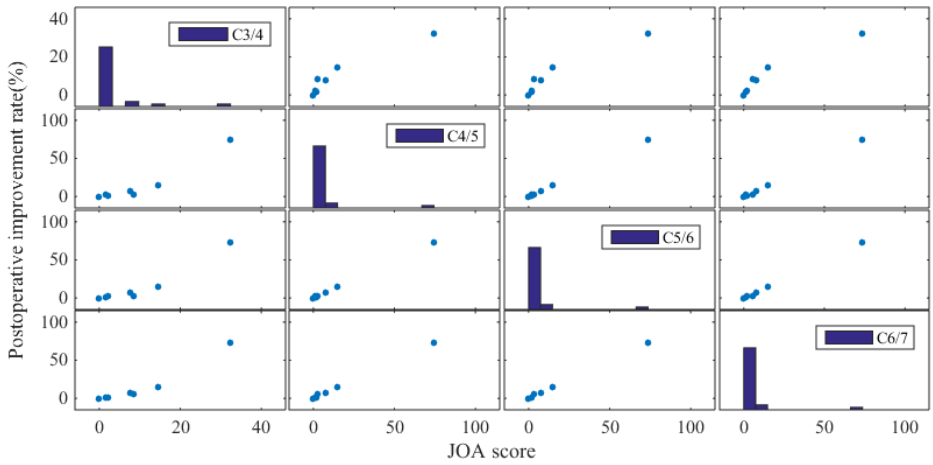

Figure 1. Analysis results of JOA score and postoperative improvement rate of each group before and after operation

Anterior cervical spine surgery can directly decompress the spinal cord compression factors from the front, such as degenerated intervertebral disc tissue, osteophyte at the posterior edge of the vertebral body, thickened or ossified posterior longitudinal ligament, and hyperplasia of the medial part of the hook joint. The physiological curvature of the cervical spine is restored, and bone can be directly implanted in the intervertebral space to restore the height of the intervertebral disc and reconstruct the stability of the diseased segment. The follow-up results of this group showed that anterior cervical decompression and interbody fusion with plate fixation can significantly improve spinal nerve function, postoperative JOA score was significantly increased, and the average improvement rate was higher. Cervical spine physiological curvature and postoperative intervertebral fusion height were significantly restored compared with those before surgery.The rate of intervertebral fusion at the last follow-up was 100%. Cervical spine stability was good. There was no loss of intervertebral height, and no complications such as plate loosening or screw breakage occurred, Satisfactory effect.

4.2. Comparison of the Changes of Cervical Spine Physiological Curvature by Segmented and Long Segment Decompression Fusion Fixation

A straight line drawn from the posterior upper edge of the odontoid process of the axis to the posterior lower edge of the C7 vertebra is the M line, a line drawn along the posterior edge of each vertebra of the cervical vertebra is the P line, the vertical transverse line at the widest place between the M line and the n line is the P line, and the length of the P line is the D value, that is, the physiological curvature of the cervical vertebra. The changes of physiological curvature of cervical spine in X-ray of segmental and long segment decompression fusion fixation are compared as shown in Figure 2.

There was no significant difference in physiological curvature of cervical spine between the two groups before and 1 week, 3 months and 6 months after operation ($P > 0.05$). There was significant difference between group A and group B at 1 week, 3 months and 6 months after operation and before operation ($P < 0.05$). Multisegmental decompression and fusion fixation has been used in clinic earlier. Its main advantages are wide decompression range, good operative field of vision, easy operation and complete decompression, especially for cases of multisegmental cervical spondylosis with extensive spinal stenosis and ossification of posterior longitudinal ligament. The operation is widely used and has achieved satisfactory clinical effect, but it also has its own

limitations and disadvantages: multiple vertebrae resection seriously destroys the stability of the anterior middle column of the spine, which is easy to cause instability of the cervical spine; because of the large decompression range, the amount of bleeding during the operation is more, which is not conducive to the safety of anesthesia and surgery; placing long titanium mesh in the decompression area, the stability of the internal fixation device is poor, The risk of graft displacement, subsidence and prolapse is easy to occur after operation, and the adjacent vertebrae are still prone to degenerate and aggravate after multiple vertebrae resection.

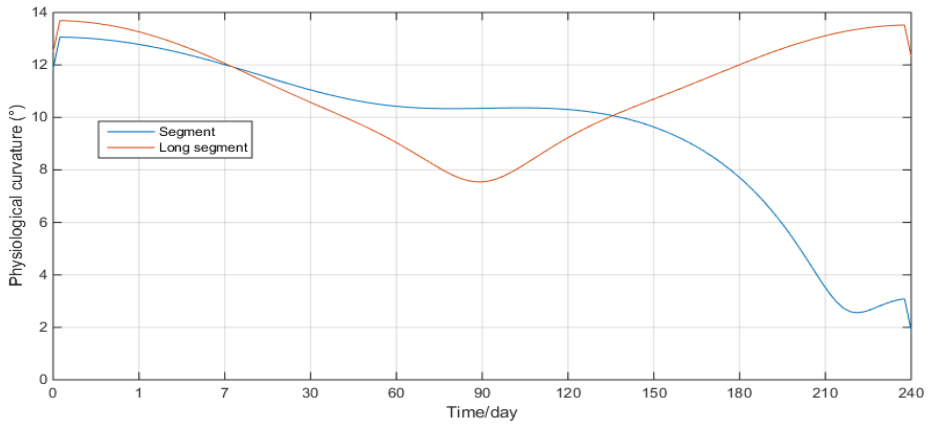

Figure 2. Comparison results of changes of cervical spine physiological curvature by segmented and long-segment decompression fusion fixation

Segmental decompression and fusion fixation has the following advantages: fewer vertebral bodies are removed, a vertebral body is retained relatively, which is beneficial to increase the area of bone grafting bed and increase the fusion rate of bone grafting to reduce the damage of vertebral body, which is in line with the principle of surgical operation to minimize tissue damage: the implant is divided into two parts, one is cage, the other is titanium mesh, and the stability of internal fixation device is relatively good, It is not easy to have the risk of internal plant displacement and anchor pulling, and the blood loss during the operation is less.

4.3. Analysis of Tai Chi Sports Intervention

After six months of Tai Chi exercise intervention, the lumbar status before and after exercise intervention was assessed, and the data were statistically analyzed. The results of comparison before and after exercise intervention are shown in Figure 3.

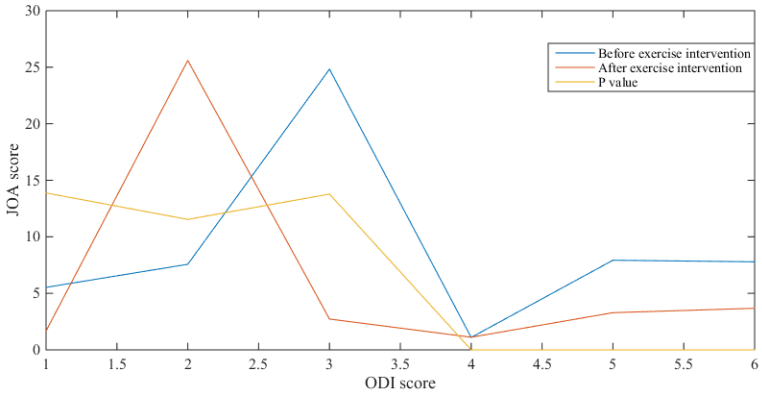

Figure 3. Results before and after exercise intervention

The results of t-test showed that there was significant difference between pain dimension (vast test, t = 13.87 (P = 0.00 < 0.01); symptom dimension (t test, t = -11.54 (P = 0.00 < 0.01); dysfunction dimension (t test, t = 13.78 (P = 0.00 < 0.01). The results showed that after six months of Tai Chi exercise intervention, the patients with chronic low back pain were significantly improved in pain index, symptom index and dysfunction index. Tai Chi exercise can better improve the waist and spinal function of the practitioners.

4.4. Analysis of Cervical Curvature and JOA Score before and after Operation

The cervical curvature and JOA scores before, 3 days after, 6 months after and 12 months after the operation as well as at the last follow-up are shown in Table 2.

Table 2. Cervical curvature and JOA score before operation, 3 days after operation, 6 months after operation, 12 months after operation and the last follow-up

Time	Cervical spine angle (°)	JOA score (points)
Preoperative	14.95±2.82	9.83±3.34
3d after operation	19.86±3.38	13.74±3.25
6 months after operation	19.59±2.67	13.65±3.16
12 months after operation	19.47±3.02	13.54±3.22

The operation was successfully completed without aggravation of neurological symptoms, incision infection, hoarseness, dysphagia and esophageal injury. At the last follow-up, there were no complications such as titanium plate fracture, screw loosening and fusion cage sinking or displacement. The physiological curvature of cervical vertebra recovered significantly after operation, JOA score was significantly higher than that before operation, and the difference was statistically significant (P < 0.05). The analysis results of cervical curvature and JOA score before and after operation are shown in Figure 4.

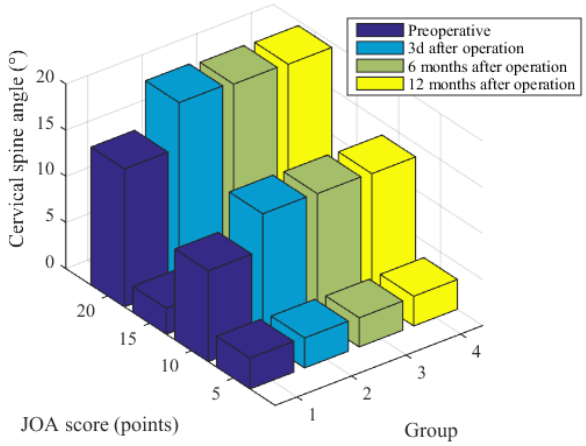

Figure 4. Cervical curvature and JOA score analysis results before and after follow-up

In this study, microscopically assisted anterior cervical refined intervertebral space decompression and internal fixation were used to achieve good initial results. The postoperative pain and neurological dysfunction were significantly improved, and Yuan JOA score was significantly improved. It can be seen that microscopical technique can be used in spine surgery to remove residual nucleus pulposus and reduce recurrence compared with direct vision surgery. Microscopical technique has achieved good clinical effect in cervical operation.

5. Conclusion

Through the investigation of Tai Chi group and non Tai Chi group, it is found that Tai Chi group is superior to non Tai Chi group in pain index, symptom index and dysfunction index in the age stage (40-65 years old) prone to lumbar disease. After six months of Tai Chi intervention, people with chronic low back pain have improved significantly in pain index, symptom index and dysfunction index.

In this paper, all patients have successfully completed the operation. The microscopically assisted anterior cervical surgery has the advantages of clear vision, tacit cooperation, thorough fine decompression, and immediate functional recovery after operation, significantly improving the excellent rate of anterior cervical surgery, which is a safe and effective surgical method for the treatment of multi-level cervical spondylotic myelopathy.

There are still some deficiencies in this paper. Because this study is a retrospective case analysis, the number of cases in Yuan is small, and the follow-up time is short, and the long-term effect needs further study. The choice of operation mode should not only be evaluated by the improvement rate of neurological function, but also comprehensively consider the postoperative complications, the improvement of patients' quality of life and the patients' economic tolerance. Individualized treatment scheme should be adopted for the patients, the indications should be strictly mastered, and scientific operation scheme should be formulated according to the characteristics of different cases, which is the key to obtain satisfactory curative effect.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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