Comparison of Three Different Surgical Methods in the Treatment of Cervical Spondylotic Myelopathy

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Deng *et al.*: Comparison of efficacy of the three surgical methods in cervical spondylotic myelopathy treatment

The course of cervical spondylotic myelopathy is slow, the surgical treatment is difficult and the effect is general, and it is easy to cause the decline of patient's quality of life, even death. The aim of this study was to compare the efficacy of anterior, posterior and combined approaches in the treatment of cervical spondylotic myelopathy. A total of 105 cervical spondylotic myelopathy patients were selected from orthopedics department of our hospital from January 2016 to March 2019 according to the diagnosis and exclusion criteria. All patients were divided into the former group (n=36 cases), the latter group (n=34 cases) and the combined group (n=35 cases). After 3-12 mo of follow-up, Japanese Orthopaedic Association score was observed and the expression of interleukin 6, interleukin 8 and Tumor Necrosis Factor-alpha were detected. There was no significant difference in age, gender, course of disease, number of intervertebral space involvement and level of inflammatory factors among the three groups. The effective rate of the combined group was 91.4 %, which was significantly higher than that of the anterior group (66.7 %) and of the posterior group (67.6 %). After 3-12 mo of follow-up, we found that the Japanese Orthopaedic Association scores of the three groups were improved at 3, 6 and 12 mo after operation, and the improvement degree was positively correlated with the follow-up time, but the efficacy of the combined group was significantly better than that of the former group and the latter group. In addition, we found that the expression of Tumor Necrosis Factor-alpha, interleukin 6 and interleukin 8 in the three groups were significantly reduced at 3 mo after operation, and the level of Tumor Necrosis Factor-alpha, interleukin 6 and interleukin 8 in the combined treatment group was more significantly lower than that in the former and the latter two groups. The combination of anterior and posterior cervical surgery for cervical spondylotic myelopathy could achieve better therapeutic effect, recover and maintain the physiological radian of cervical spine, and effectively reduce the level of serum inflammatory cytokines in patients with cervical spondylotic myelopathy.

Key words: Cervical spondylotic myelopathy, combination of anterior and posterior cervical surge, operative effect, inflammatory cytokines

Cervical spondylosis (CS) is a common clinical disease, which has serious harm to human health[1,2]. In all CS, the incidence of radicular type is the highest, while that of spinal type is the most serious[3,4].Among them, the onset of cervical spondylotic myelopathy (CSM) is slow, most of them are 40-60 y old people and most of them have no history of trauma. When combined with developmental cervical stenosis, the age of onset will be further advanced[5-7].

In the course of CSM, the final result of its pathological development is the injury of spinal cord nerve[8]. Its symptoms are motor dysfunction and sensory disturbance, and some patients are gait instability. Most patients can have pathological reflection in physical examination, but some cases only have dynamic Hoffman sign when the neck is flexed and extended, which is also a unique manifestation of early CSM[9].

In view of the degree of spinal cord injury, the treatment of CSM could be divided into conservative treatment and surgical treatment. The main purpose of surgery for patients who need surgery is to expand the effective volume of spinal canal, increase the effective space of spinal cord, so as to reduce the compression and restore the function of spinal cord[10]. Combined anterior-posterior surgery for cervical spondylotic myelopathy is a relatively new technique that has previously been used for disorders of the thoracolumbar spine. CSM can either be performed in a single day or in a staged manner.

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The choice of pathological segments for access is now the focus of academic debate. The aim of present study was to study the effect of different surgical methods on CSM and inflammation.

A total of 105 patients with CSM underwent surgery in our hospital from January 2016 to March 2019 were selected and randomly divided into the anterior group (n=36), the posterior group (n=34) and the combined group (n=35).

Inclusion criteria: meet the diagnostic criteria of CSM; without acute infection and immune system disease.

Exclusion criteria: combined with severe spinal deformity; combined with thoracic, lumbar spinal cord or nerve root lesions that affect the function of lower limbs; combined with old fracture or traumatic cervical instability; combined with liver dysfunction.

All the patients participated in the study and informed the consent form voluntarily.

Patients in the anterior group were received anterior cervical vertebral subtotal decompression and fusion with internal fixation. Briefly, supine position was taken after intensive anesthesia of cervical plexus. Make a longitudinal incision of right sternocleidomastoid muscle followed by the subtotal incision of vertebral body. Open the intervertebral space, scrape out the cartilage plates of the upper and lower vertebral bodies, place titanium mesh of appropriate size and fix with self-locking plate.

Patients in the posterior group underwent posterior cervical single-door laminoplasty. In brief, the patient underwent general anesthesia, took the lateral position and bent the neck forward 20°~30°. Then made a posterior median incision of the neck, removed the C3~C7 spinous process bifurcated part, ground through the outer plate on the lateral spinous process root about 0.5 cm outward, kept the inner plate and made a groove, then made the full-thickness grinding through the lamina without damaging the spinal cord on the lateral side with the heavier symptoms, expanded the spinal canal, and suspended in the neck muscle.

Patients in the combined group received anterior and posterior cervical decompression. In brief, patients underwent posterior cervical single-door laminoplasty, and received anterior cervical vertebral subtotal decompression and fusion with internal fixation 1 w later.

The spinal nerve function of patients was evaluated using Japanese Orthopaedic Association (JOA) score. The spinal nerve function improvement rate= (post-surgery JOA score-pre-surgery JOA score)/(pre-surgery JOA score)×100%. Excellent: the spinal nerve function improvement rate ≥75 %; Good: 50 %≤ the spinal nerve function improvement rate <75 %; Fair: 25 % ≤ the spinal nerve function improvement rate <50 %; Poor: the spinal nerve function improvement rate <25 %. The Effective rate = (Excellent+Good)/Total×100 %.

The levels of serum inflammatory factors, including Tumor Necrosis Factor-alpha (TNF-α), interleukin 6 (IL-6) and interleukin 8 (IL-8), were detected in three groups before and 3 mo after operation. 3 ml fasting venous blood was drawn and centrifuged at 3000 r/min for 5 min, and stored at -80º. After then, the serum levels of TNF-α, IL-6 and IL-8 were measured through Enzyme-linked immunosorbent assay (ELISA). The team of treating doctor's ensured there is no other infection related inflammation interference in the combined group patient results during the evaluation post operativeIy.

Statistical Package for the Social Sciences (SPSS) 22.0 software was used for statistical analysis. The measurement data were expressed as mean±standard

TABLE 1: COMPARISON OF CHARACTERISTICS OF THE PATIENTS IN THE THREE GROUPS

Characteristics	Anterior group	Posterior group	Combined group	F/χ^2	p
N	36	34	35		
Age	55.83±7.58	56.02±8.03	55.99±7.88	1.043	0.274
Gender				0.054	0.973
Male	19	17	18		
Female	17	17	17		
Course of disease	19.77±7.94	20.33±6.95	20.09±7.02	0.993	0.346
Intervertebral involvement				2.291	0.682
2	13	14	12		
3	22	20	23		
4	1	0	0		

deviation. One way Analysis of variance (ANOVA) was used for comparison among three groups while t test was used for comparison between two groups. The counting data was analyzed with χ^2 test. $p<0.05$ suggested the difference was statistically significant.

There were no significant differences in age, gender, course of disease or the number of involved intervertebral space among the three groups, as shown in Table 1.

The effective rate of the combined group was 91.4 %, which was significantly higher than that of the anterior group (66.7 %) and of the posterior group (67.6 %), as shown in Table 2.

In the 12 mo of follow-up, the JOA scores of the three groups were all improved at 3, 6 and 12 mo post-surgery and the improvement was positively correlated with the follow-up time. Besides, the improvement of the combined group was more obvious than that of the anterior group and the posterior group, as shown in Table 3.

Before surgery, there was no significant difference in the expression levels of TNF-α, IL-6 or IL-8 among the three groups. At 3 mo after operation, the expression levels of TNF-α, IL-6 and IL-8 in the three groups were all decreased significantly, respectively. What's more, the decrease of TNF-α, IL-6 and IL-8 levels in the combined group was more evident than that in the anterior group and the posterior group, as shown in Table 4.

At present, it is generally believed that CSM is the result of many factors, including developmental factors, age factors, dynamic factors and vascular factors[11,12]. When the spinal cord is compressed for a long time or severely, the spinal cord tissue may necrosis and liquefy due to ischemia, resulting in the formation of cavities[13]. For patients with wider spinal canal and lighter symptoms or some patients who are unwilling to do surgery, some non-surgical treatment can be taken appropriately, and regular follow-up is also given. If conservative treatment is not effective or symptoms increase significantly, surgery is needed as soon as possible[11]. The ultimate goal of the operation is to eliminate the compression symptoms of spinal cord and nerve root, recover or reconstruct the height of intervertebral space, obtain normal physiological

TABLE 2: COMPARISON OF EFFECTIVE RATE OF THE PATIENTS IN THE THREE GROUPS

Groups	Excellent	Good	Fair	Poor	Effective rate (%)
Anterior group (n=36)	13	11	7	5	66.7
Posterior group (n=34)	13	10	5	6	67.6
Combined group (n=35)	18	14	2	1	91.4
χ^2					7.396
p					0.025

TABLE 3: COMPARISON OF JOA SCORES OF THE PATIENTS PRE AND POST-SURGERY IN THE THREE GROUPS

Groups	JOA scores			
	Before surgery	3 mo	6 mo	12 mo
Anterior group (n=36)	7.44±1.24	13.79±1.47	14.77±1.04	15.13±1.12
Posterior group (n=34)	7.35±1.27	13.66±1.20	14.45±1.12	15.01±1.01
Combined group (n=35)	7.74±1.43	15.78±1.28	16.62±1.44	16.99±1.32
F	0.948	33.565	43.143	39.232
p	0.724	0.000	0.000	0.000

TABLE 4: COMPARISON OF INFLAMMATORY FACTORS EXPRESSION PRE AND POST-SURGERY AMONG THE THREE GROUPS

Groups	TNF-α (pmol/L)		IL-6 (ng/L)		IL-8 (ng/L)	
	Before surgery	3 mo	Before surgery	3 mo	Before surgery	3 mo
Anterior group (n=36)	8.22±1.64	3.58±0.44	35.23±3.43	18.72±2.25	1.35±0.39	0.77±0.21
Posterior group (n=34)	8.14±1.24	3.73±0.67	36.34±4.18	18.03±3.19	1.34±0.37	0.72±0.25
Combined group (n=35)	8.23±1.33	2.32±0.36	35.77±3.62	15.41±2.14	1.37±0.29	0.55±0.426
F	0.435	14.344	0.342	11.034	0.854	16.134
p	0.522	0.023	0.643	0.027	0.254	0.018

curvature and the shape and volume of spinal canal corresponding to the spinal cord, recover the residual function of spinal cord as soon as possible and prevent the further development of the disease[14,15].

The choice of operation mode is an important factor that affects the postoperative effect, and also an important decision in the process of CSM operation[16]. For patients with CSM, the appropriate surgical approach should be selected according to the compression site, range and degree of spinal stenosis[10]. Anterior cervical surgery can reconstruct the anterior column of the vertebral body, stabilize the structure of the vertebral body, and restore the height of the cervical spine. Therefore, it can correct the reverse arch deformity of the cervical spine and restore the normal physiological curvature of the cervical lordosis. But it may also cause the injury of superior laryngeal nerve and recurrent laryngeal nerve, dysphagia and other complications[17]. Posterior cervical surgery can avoid these complications of anterior surgery and the operation is simple. In addition, the posterior approach did not destroy the anterior column, thus ensuring the stability of the cervical vertebra and further reducing the degeneration rate of adjacent segments. However, complications such as cerebrospinal fluid leakage and cervical kyphosis also exist in the posterior approach[18,19]. In order to verify the effect of different surgical methods, we added the combined approach based on the first two surgical methods. In the combined approach, single open door laminoplasty was performed after cervical vertebra first, then subtotal decompression was performed before cervical vertebra and bone graft fusion and internal fixation were performed.

Among all the selected patients, we found that the effective rate of the combined treatment group was significantly higher than that of the other two groups by comparing the effects of three different surgical procedures. After 3-12 mo follow-up, we found that JOA scores of the three groups were improved, but the combined group was better than the other two groups. In addition, we found that the expression of TNF-α, IL-6 and IL-8 in the three groups were significantly reduced at 3 mo after operation and the average water content of TNF-α, IL-6 and IL-8 in the combined treatment group was significantly lower than that in the anterior and the posterior cervical surgery groups.

In conclusion, the postoperative effect of CSM needs long-term observation and summary. Different surgical approaches should be selected according to the compression position, range and degree of spinal stenosis. CSM can be treated by anterior, posterior and combined operation. In some patients, the combined approach may achieve better therapeutic effect. Therefore, it is of great significance to select the right operation method to improve the clinical effect and reduce the complications.

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Conflict of Interests:

The authors declared no conflict of interest.

REFERENCES

1. Latka D, Miekisiak G, Jarmuzek P, Lachowski M, Kaczmarczyk J. Treatment of degenerative cervical spondylosis with radiculopathy. Clinical practice guidelines endorsed by the polish society of spinal surgery. Neurol Neurochir Pol 2016;50:109-13.
2. Chen XY, Wu J. Complications of cervical artificial disc replacement. Zhongguo Gu Shang 2015;28:975-8.
3. Desai A, Pendharkar AV, Swienckowski JG, Ball PA, Lollis S, Simmons NE. Utility of routine outpatient cervical spine imaging following anterior cervical corpectomy and fusion. Cureus 2015;7:e387.
4. Ma X, Xu G, Li M, Xie J, Chen L, Pei W. Measuring cervical vertebra movements using kinect sensor. In 2015 37th Annu Int Conf IEEE Eng Med Biol Soc 2015:2771-4.
5. Zhang L, Cheng Z, Cui Z, Ren Z, Peng B, Zhang X. Analysis of cervical sagittal parameters on MRI in patients with cervical spondylotic myelopathy. Zhongguo Xiu Fu Chong Jian Wai Ke Za Zhi 2017;31:451-4.
6. Lai BH, Wu JB, Ye H, Luo S. Application of guide combined with probing the internal wall of pedicle screw trajectory for subaxial cervical pedicle screw placement. Zhongguo Gu Shang 2017;30:805-9.
7. You JY, Zheng Y, Chen M, Fan JR. Anterior versus posterior approach for multilevel cervical spondylotic myelopathy: a meta-analysis. Zhongguo Gu Shang 2017;30:71-8.
8. Blume C, Wiederhold H, Geiger M, Clusmann H, Muller CA. Lacking benefit of intraoperative high-dose dexamethasone in instrumented surgery for cervical Spondylotic myelopathy. J Neurol Surg A Cent Eur Neurosurg 2018;79:116-22.
9. Quillo-Olvera J, Lin GX, Suen TK, Jo HJ, Kim JS. Anterior transcorporeal tunnel approach for cervical myelopathy guided by CT-based intraoperative spinal navigation. J Clin Neurosci 2018;48:218-23.
10. Virk SS, Phillips FM, Khan SN. Bundled payment reimbursement for anterior and posterior approaches for cervical spondylotic myelopathy: an analysis of private payer and Medicare databases. J Neurosurg Spine 2017;28:244-51.
11. Zhu XL, Xu WX, Ding WG, Sheng HF, Liu J, Hu Y, *et al*. Analysis of correlative factors of spinal cord posterior displacement after single door laminoplasty. Zhongguo Gu

Shang 2018;31:1114-8.
12. Kok CY, Chandrashekar H, Turner C, Manji H, Rossor AM. Can compressive thoracic cord lesions cause a pure lower motor neurone syndrome? Pract Neurol 2019;19:72-4.
13. Tetreault LA, Karadimas S, Wilson JR, Arnold PM, Kurpad S, Dettori JR, *et al*. The natural history of degenerative cervical myelopathy and the rate of hospitalization following spinal cord injury: an updated systematic review. Global Spine J 2017;7:28S-34S.
14. Kim J, Kim JY, Lee JM, Kang DH, Lee CH, Park IS, *et al*. Progressive cervical spondylotic myelopathy caused by tic disorders in a young adult with Tourette syndrome. Korean J Neurotrauma 2019;15:199-203.
15. Quinn JC, Kiely PD, Lebl DR, Hughes AP. Anterior surgical treatment of cervical spondylotic myelopathy. HSS J 2015;11:15-25.
16. Liu J, Chen X, Liu Z, Long X, Huang S, Shu Y. Anterior cervical discectomy and fusion versus corpectomy and fusion in treating two-level adjacent cervical spondylotic myelopathy: a minimum 5 y follow-up study. Arch Orthop Trauma Surg 2015;135:149-53.
17. Hrabalek L, Hlustik P, Hok P, Wanek T, Otruba P, Cechakova E, *et al*. Effects of spinal cord decompression in patients with cervical spondylotic myelopathy oncortical brain activations. Rozhl Chir 2014;93:530-5.
18. Li D, Hai Y, Meng X, Yang J, Yin P. Posterior open-door laminoplasty secured with titanium miniplates vs anchors: a comparative study of clinical efficacy and cervical sagittal balance. J Orthop Surg Res 2019;14:1-8.
19. Nori S, Aoyama R, Ninomiya K, Suzuki S, Anazawa U, Shiraishi T. Ossified posterior longitudinal ligament existing at an intervertebral level limits compensatory mechanism of cervical lordosis after muscle-preserving selective laminectomy. Spine Surg Relat Res 2019;3:312-8.

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