Comparative study on the effect of anterior and posterior decompression in the treatment of multi-segmental cervical spondylotic myelopathy

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Abstract

Objective: To analyze and compare the clinical efficacy of anterior and posterior decompression in the treatment of multi-segmental cervical spondylotic myelopathy (MCSM), providing certain guidance for the clinical treatment. Methods: A total of 72 patients with MCSM who were admitted in our hospital from September, 2012 to October, 2014 were included in the study and divided into the anterior group (n=37) and the posterior group (n=35) according to different surgical methods. The patients in the anterior group were given anterior cervical discectomy fusion (ACDF) and anterior cervical corpectomy fusion (ACCF), while the patients in the posterior group were given laminoplasty (LP). The general materials, surgical materials, and postoperative functional recovery in the two groups were compared. Results: The comparison of gender, age, course, preoperative JOA score, follow-up time, and affected segment between the two groups was not statistically significant. The operation time in the anterior group was significantly longer than that in the posterior group, but the intraoperative amount of bleeding was significantly less than that in the posterior group. The postoperative spinal cord function in the two groups was significantly improved when compared with before operation; moreover, the improved degree in the anterior group was more obvious. The postoperative cervical physiological curvature in the anterior group was significantly increased, but in the posterior group was significantly reduced. The comparison of the occurrence rate of postoperative complications between the two groups was not statistically significant. Conclusions: The anterior and posterior surgeries in the treatment of MCSM can significantly improve the postoperative spinal cord function, among which the anterior surgery can effectively recover the cervical physiological curvature. It is recommended that an appropriate surgical method should be reasonably selected by comprehensively considering the clinical characteristics of MCSM patients and the characteristics of different surgical methods in order to obtain better curative effect and reduced complications.

1. Introduction

Multi-segmental cervical spondylotic myelopathy (MCSM) refers to the cervical spondylosis of spinal cord dysfunction due to spinal cord compression or blood supply limitation with image manifestations of continuous or discontinuous intervertebral disc degeneration of 3 or more segments, and is one of the most serious and complex types. The morbidity of cervical spondylotic myelopathy at home and abroad is gradually increasing, and currently approximately accounts for 10%-15% of cervical spondylosis[1]. The majority of cervical spondylotic myelopathy is progressively developed, finally leading to physical disability, which can severely affect the patients’ living qualities and even endanger the life; therefore, once it is found, an operation should be performed as soon as possible. Operation decompression is the most direct and effective method to treat cervical spondylotic myelopathy and has achieved a certain consensus[2]. The surgical methods for MCSM are mainly including the anterior decompression...
internal fixation: anterior cervical discectomy fusion (ACDF) and anterior cervical corpectomy fusion (ACCF), and the posterior decompression internal fixation: laminectomy and laminoplasty (LP). However, currently there is still a certain controversy over the choice of surgery methods, the efficacy, and the safety[3]. The study is aimed to compare the clinical efficacy of the anterior and posterior decompression in the treatment of MCSM and the related complications in order to provide a clinical basis for selecting the best treatment protocol.

2. Materials and methods

2.1. General materials

A total of 72 patients with MCSM who were admitted in our hospital from September, 2012 to October, 2014 were included in the study and divided into the anterior group (n=37) and the posterior group (n=35) according to different surgical methods. The patients in the anterior group were given anterior cervical discectomy fusion (ACDF) and anterior cervical corpectomy fusion (ACCF), while the patients in the posterior group were given laminoplasty (LP). Multiple related materials before and after operation were collected. The postoperative follow-up visit was carried out by telephone and outpatient reexamination. In the anterior group, 21 were male, and 16 were female; aged from 41 to 74 years old, with an average of (57.3±8.7) years old; course from 9 to 36 months, with an average course of (13.4±7.5) months; follow-up time from 11 to 38 months, with an average time of (15.1±6.9) months; preoperative JOA score from 7 to 13 years old, with average score of (9.1±1.4); preoperative cervical curvature from 6° to 12°, with an average of (10.1±2.7)°; 17 had C3-6 involvement, 12 had C4-7 involvement, and 8 had C3-7 involvement. In the posterior group, 22 were male, and 13 were female; aged from 42 to 71 years old, with an average of (56.5±7.8) years old; course from 7 to 38 months, with an average course of (14.1±6.3) months; follow-up time from 10 to 39 months, with an average time of (16.2±7.4) months; preoperative JOA score from 6 to 14 years old, with average score of (9.4±1.2); preoperative cervical curvature from 6° to 13°, with an average of (10.6±2.9)°; 15 had C3-6 involvement, 13 had C4-7 involvement, and 7 had C3-7 involvement. All the operations were performed by the physicians with the same levels. The comparison of gender, age, course, follow-up time, preoperative JOA score, cervical curvature, and affected segment distribution between the two groups was not statistically significant (P>0.05), and it was comparable. The study was approved by the Hospital Ethics Committee. Informed consents were obtained from all patients.

2.2. Inclusion and exclusion criteria

Inclusion criteria: (1) those who were confirmed with 3 or more segments of MCSM by the clinical manifestations, X-ray, CT, or MRI; (2) those whose surgical methods were ACCF, ACDF, or LP; (3) those whose general and imaging materials before operation and after operation were complete. Exclusion criteria: (1) those who had spinal injury, tuberculosis, tumor, and non-degenerative disease; (2) those who were merged with ossification of posterior longitudinal ligament and kyphosis; (3) those who had previous cervical surgery; (4) those whose preoperative and postoperative materials were not complete; (5) those who could not endure the operation due to heart, liver, kidney, and other serious diseases were excluded from the study.

2.3. Surgical methods

The conventional X-ray, CT, and MRI before operation were performed. The concurrent diseases were processed. The perioperative preparations were made. The surgical contraindications were excluded. The bed defecation training was performed before operation. Antibiotics were given half an hour before operation. In the anterior group, 21 cases were performed with ACCF, and 16 with ACDF. In the posterior group, 20 cases were performed with single-door LP, and 15 with double-door LP.

2.4. Postoperative processing

The postoperative processing in the two groups was basically identical. The drainage tube was placed for 48-72 h. The antibiotics were applied for infection prevention. The hormone and nerve nutrition were given. The cervical X-ray or CT scanning was reexamined. All the patients wore the cervical collar for fixation for 3 months.

2.5. Observation indicators

The observation indicators including the general indicators, the neurological function evaluation and imaging indicators were used to evaluate the surgical efficacy. The operation time, intraoperative amount of bleeding, and hospitalization time in the two groups were observed. X-ray was rechecked after operation. The postoperative JOA score, the improvement of spinal cord function, the vertebral physiological curvature, ROM recovery, and the postoperative complications in the two groups were recorded. JOA scoring was used to record JOA scores before and after operation, and the improvement rate of spinal cord function was calculated. Improvement rate=(Postoperative score-preoperative score)/17-
preoperative score) 100%. The efficacy was divided into: Excellent: RR 75%; good: RR 50%-74%; moderate: RR 25%-49%; poor: RR 0%-24%. Cobb angle was usually used to measure the vertebral physiological curvature in the clinic. Cobb refers to the included angle of the two extending lines on the inferior margins of C₂ and C₇.

2.6. Statistical analysis

SPSS 21.0 software was used for statistical analysis. T test or chi-square test was used for the comparison of operation time, intraoperative amount of bleeding, hospitalization time, JOA score, the improvement rate of spinal cord function, the cervical physiological curvature, and the postoperative complications between the two groups. P<0.05 was regarded as statistically significant.

3. Results

3.1. Comparison of the general materials between the two groups

The comparison of gender, age, course, follow-up time, preoperative JOA score, cervical curvature, and affected segment between the two groups was not statistically significant (P>0.05), and it was comparable (Table 1).

3.2. Comparison of the operation time, intraoperative amount of bleeding, and hospitalization time between the two groups

In the anterior group, the average operation time was (162.4±23.5) min, the average intraoperative amount of bleeding was (235.2±60.5) mL, and the average hospitalization time was (13.4±2.4) d. In the posterior group, the average operation time was (135.8±21.9) min, the average intraoperative amount of bleeding was (346.1±92.7) mL, and the average hospitalization time was (14.5±2.7) d. The operation time in the anterior group was significantly longer than that in the posterior group, but the intraoperative amount of bleeding was significantly less than that in the posterior group (P<0.05). The comparison of hospitalization time was not statistically significant (P>0.05).

3.3. Comparison of preoperative and postoperative JOA score and the excellent rate of spinal cord function improvement

In the anterior group, the preoperative JOA score was (9.1±1.4), and the postoperative JOA score was (14.7±1.2). In the posterior group, the preoperative JOA score was (9.4±1.2), and the postoperative JOA score was (13.8±1.3). The spinal cord function after operation in the two groups was significantly improved when compared with before operation (P<0.05), and the function improvement in the anterior group was more obvious (Table 2). In the anterior group, the excellent rate was 72.9% (12 excellent, 15 good, 7 moderate, and 3 poor). In the posterior group, the excellent rate was 71.5% (11 excellent, 14 good, 6 moderate, and 4 poor). The comparison of the excellent rate between the two groups was not statistically significant.

Table 1. Comparison of the general materials between the two groups.

<table>
<thead>
<tr>
<th>Clinical characteristics</th>
<th>Anterior group (n=37)</th>
<th>Posterior group (n=35)</th>
<th>χ²/df</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male/female (n)</td>
<td>21/16</td>
<td>22/13</td>
<td>0.278</td>
<td>0.598</td>
</tr>
<tr>
<td>Age (years)</td>
<td>57.3±8.7</td>
<td>56.5±7.8</td>
<td>0.410</td>
<td>0.683</td>
</tr>
<tr>
<td>Course (month)</td>
<td>13.4±7.5</td>
<td>14.1±6.3</td>
<td>0.427</td>
<td>0.670</td>
</tr>
<tr>
<td>Preoperative JOA score</td>
<td>9.1±1.4</td>
<td>9.4±1.2</td>
<td>0.973</td>
<td>0.334</td>
</tr>
<tr>
<td>Follow-up time (month)</td>
<td>15.1±6.9</td>
<td>16.2±7.4</td>
<td>0.652</td>
<td>0.516</td>
</tr>
<tr>
<td>Affected segment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C₃₋₄</td>
<td>17(12.8)</td>
<td>15(17.2)</td>
<td>0.176</td>
<td>0.916</td>
</tr>
<tr>
<td>C₄₋₅</td>
<td>12(15.3)</td>
<td>13(12.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C₅₋₆</td>
<td>8(23.2)</td>
<td>7(14.6)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Comparison of preoperative and postoperative JOA score and the excellent rate of spinal cord function improvement.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Before operation (score)</th>
<th>After operation (score)</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior (n=37)</td>
<td>9.1±1.4</td>
<td>14.7±1.2</td>
<td>18.473</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Posterior (n=35)</td>
<td>9.4±1.2</td>
<td>13.8±1.3</td>
<td>14.713</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>

Table 3. Comparison of the vertebral physiological curvature before and after operation between the two groups.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Before operation (°)</th>
<th>After operation (°)</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior (n=37)</td>
<td>10.1±2.7</td>
<td>14.9±3.6</td>
<td>6.488</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Posterior (n=35)</td>
<td>10.6±2.9</td>
<td>9.1±2.7</td>
<td>2.239</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>t</td>
<td>0.757</td>
<td>8.309</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>P</td>
<td>&gt;0.05</td>
<td>&lt;0.05</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
3.4. Comparison of the vertebral physiological curvature before and after operation between the two groups

In the anterior group, the cervical physiological curvature before operation was (10.1±2.7°), and after operation was (14.9±3.6°), showing that the cervical physiological curvature after operation was significantly increased (P<0.05). In the posterior group, the cervical physiological curvature before operation was (10.6±2.9°), and after operation was (9.1±2.7°), showing that the cervical physiological curvature after operation was significantly reduced (P<0.05). The comparison of cervical physiological curvature before operation between the two groups was not statistically significant (P>0.05). The cervical physiological curvature after operation in the anterior group was significantly greater than that in the posterior group (P<0.05) (Table 3).

3.5. Comparison of the postoperative complications between the two groups

In the anterior group, complications occurred in 6 cases, among which 1 had cerebrospinal fluid leakage, 3 had hoarseness, and 2 had water drinking bucking. In the posterior group, complications occurred in 5 cases, among which 1 had cervical instability, 3 had axial pain, and 1 had C3 nerve root palsy. The comparison of the occurrence rate of complications between the two groups was not statistically significant (P>0.05) (Table 4).

Table 4.
Comparison of the postoperative complications between the two groups.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Complications (n)</th>
<th>No complications (n)</th>
<th>( \chi^2 )</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior (n=37)</td>
<td>6</td>
<td>31</td>
<td>0.052</td>
<td>0.820</td>
</tr>
<tr>
<td>Posterior (n=35)</td>
<td>5</td>
<td>30</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. Discussion

The cervical spondylotic myelopathy is a kind of cervical degeneration disease commonly seen in the middle-aged and elderly people, which can cause a progressively spinal cord dysfunction. With the gradual aggravation of symptoms, the patients will lose their normal living and working abilities. MCSM with 3 or more segments involved can pose a greater hazard, and the treatment is more difficulty. However, currently, no effective drugs or other non-operation treatment methods are yet available. The majority of the patients are required for early operations after being confirmed in order to remove the spinal cord and nerve root compression, which can maintain the cervical stability and improve the dysfunction[4]. The common surgery methods for cervical spondylotic myelopathy include the cervical anterior approach and the cervical posterior approach, but it is not yet clear which is more appropriate for MCSM. The anterior surgery is by directly removing the compressive things, belonging to the direct decompression, in which the bone graft infusion was performed to stabilize the cervical vertebra, with a fine visual operative field and a thorough decompression, and can recover the cervical physiological curvature to reduce the axial pain[5]. However, meanwhile, some complications such as non-fusion of bone graft, collapse, displacement, and the degeneration of adjacent joints[6]. The posterior surgery is by expanding the vertebral canal to avoid the compressive things, belonging to the indirect decompression, in order to remove the spinal cord compression, with a safe surgical operation due to its indirect resection of compressive things, but the complications such as axial pain and nerve root palsy after operation will be induced due to its incomplete decompression. Theoretically, the combination of anterior and posterior decompression is more effective, but some researches demonstrate that[7,8] this surgical method is characterized by large trauma, higher technological requirement, long operation time, severe postoperative complications, and heavy economic burden; therefore, how to select the appropriate surgical method to obtain the better efficacy, to maximally recover the neurological function, and to reduce the complications, how to avoid the poor efficacy, second operation, and delaying the illness condition due to the inappropriate surgical method in order to prevent the aggravation of the physical and mental and economic burden are still the issues required to be urgently resolved.

In the study, a regular follow-up visit was paid to all the patients. No infection, neurological and vertebral injury, death, and severe complications occurred in the two groups, and the incision belongs to stage I curing. The operation time in the anterior group was longer than that in the posterior group due to its complex surgical method. The intraoperative amount of bleeding in the posterior group was significantly greater that that in the anterior group (P<0.05) due to its deep tissue incision and internal vertebral venous plexus engorgement; therefore, it is recommended that an appropriate blood preparation should be made before operation during the posterior surgery. Currently, the neurological function improvement is mainly applied to evaluate the postoperative clinical efficacy. JOA score criteria are more commonly used to evaluate the neurological function in MCSM patients. The higher the score is, the better the neurological function is. In the study, the comparison of preoperative JOA score between the two groups was not statistically significant, and it was comparable, thus guaranteeing the accuracy of the comparison of the postoperative JOA score. The results in the
study showed that the postoperative JOA scores in the two groups were significantly increased when compared with before operation, and the postoperative score in the anterior group was significantly higher than that in the posterior group ($P<0.05$), indicating that the spinal cord neurological functions in the two groups were significantly improved, and the function improvement in the anterior group was more obvious. The improvement excellent rate in the anterior group was 72.9%, that in the posterior group was 71.5%, and the comparison was not statistically significant, showing that the two methods have achieved satisfactory results. In the study, the cervical physiological curvature after operation in the anterior group was significantly increased, but that in the posterior group was significantly reduced ($P<0.05$). The anterior surgery can recover the height of intervertebral space and the cervical physiological curvature by distracting the decompressed segments and bone graft fixation, but the posterior surgery mainly destroys the continuity of vertebral plate and breaks the cervical mechanical equilibrium to straighten the physiological curvature to a certain degree. The change of cervical physiological lordosis can affect the stability of adjacent vertebrae in the cervical fusion segments, which can accelerate the degeneration of adjacent joints and affect the long-term operation efficacy. Therefore, in the study, it is argued that the anterior surgery can effectively recover the cervical physiological curvature when compared with the posterior surgery. Those who have poor physiological curvature before operation should better choose the anterior surgery. The comparison of the occurrence rate of the postoperative complications between the two groups was not statistically significant ($P>0.05$). In order to reduce the occurrence of complications as much as possible, except for the accurate evaluation and complete related examinations before operation, an earnest operation should be performed to avoid other unnecessary injuries, meanwhile, the postoperative nursing and infection prevention should be strengthened.

In conclusion, the treatment for MCSM is complex with various methods. The anterior and posterior approaches in the treatment of MCSM have their own disadvantages and advantages. The accurate and reasonable surgical methods should be selected to improve the clinical efficacy and living qualities by comprehensively considering the patients' conditions, clinical manifestations, image characteristics, postoperative complications, and economic costs.

References


