Evaluation of Results of Anterior Cervical Discectomy Fusion (ACDF) by Cervical Cage with Bone Graft for the Treatment of Single Level Cervical Spondylotic Myelopathy

D Mishra, R Chowdhury, S Batajoo, M Shrestha
Department of Orthopaedic Surgery, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh

Abstract

Background: Cervical spondylotic myelopathy (CSM) is a common spinal cord disorder that develops in elderly people. Anterior cervical decompression and fusion (ACDF) is an effective and reliable procedure for the treatment of CSM.

Objective: To find out the results of ACDF by cervical cage with bone graft for the treatment of single level cervical spondylotic myelopathy.

Methods: This prospective observational study was conducted in the Department of Orthopaedics, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, over a period of two years from March 2015 to August 2017. Forty patients with cervical spondylotic myelopathy were diagnosed on the basis of presenting complains, clinical examination and investigations and were enrolled in this study. The history of the patients was collected, clinical examination was done and relevant investigations were done for each patient. In this study, Nurick grading and VAS scale were used for evaluation of the result.

Result: Male gender was predominant in this study; male-female ratio was 2.63:1. Mean age of the patients was 45.9 ± 9.1 years within the range of 30-65 years. Both sides were affected in 14 (35.0%) cases, only right side was affected in 15 (37.5%) cases and only left side was affected in 11 (27.5%) cases. Involved disc spaces were C3/4 (10.0%), C4/5 (22.5%), C5/6 (42.5%) and C6/7 (25.0%). Transient dysphagia was observed in 2 (5.0%), transient paraparesis in 1 (2.5.0%), wound infection in 1 (2.5.0%) case and damage to the dura was observed in 1 (2.5.0%) case. Signs of fusion were observed in 10 (25.0%) cases after 3 months, 30 (75.0%) cases after 6 months and in all patients after 12 months. The result was found to be excellent in 35 (87.5%) and good in 5 (12.5%) cases.

Conclusion: Anterior cervical discectomy and fusion by cervical cage with bone graft is an effective procedure for management of CSM.

Keywords: ACDF, bone graft, cervical cage, cervical myelopathy

Introduction

Cervical spondylosis can be responsible for spinal cord compression and thus myelopathy.1 Cervical myelopathy is found more and earlier in men than in women. It is found in 13% of men in the third decade and after 70 years of age, almost all men suffered from it. But, it was found in 5% of women in the fourth decade going up to 96% over the age of 70.2 Cervical spondylotic myelopathy is dependent on a number of factors.3 Spondylosis means the degenerative changes that occur in the spine, including: degeneration of the joints, intervertebral discs, ligaments and connective
tissue of the cervical vertebrae. Important patho-
physiologic factors in the development of CSM
are static-mechanical, dynamic-mechanical and
spinal cord ischemia. The reduction of spinal
canal diameter and spinal cord compression is
static-mechanical. The intervertebral discs dry
out resulting in loss of disc height due to aging.
Dynamic stressors indicate the abnormal motion
of the cervical spine during flexion or extension
which may cause spinal cord injury
synergistically with static-mechanical factors.
Spinal cord ischemia occurs when degenerative
elements compress blood vessels that supply the
cervical spinal cord and proximal nerve roots.
Neck stiffness, unilateral or bilateral deep,
aching neck, arm and shoulder pain and possibly
stiffness or clumsiness while walking are the
signs and symptoms of CSM. Complaints of
neck stiffness are common in the early stages of
CSM. Weakness or stiffness in the legs is the
hallmark symptom of CSM.

Anterior cervical discectomy and fusion
(ACDF) procedure developed by Cloward and
Smith and Robinson is the surgical
management of CSM. This procedure allows
direct decompression of the spinal canal,
enlargement of stenotic neural foramen along
with restoration of intervertebral disk height.
Various interbody implanting devices are used
for reconstructing the stability of the segment
involved after anterior discetomy.

Because of high fusion rates, autogenous
tricortical iliac crest graft is considered as the
‘gold standard’ of anterior reconstruction.
But, it causes around 25% of donor site
morbidity including hematoma, persistent donor
site pain and infection. Bagby et al designed
the first hollow cylindrical cage device (Bagby
Bone Basket) made of stainless steel which
allowed bone ingrowth to prevent these
complications. Later on, the stainless steel
cages were replaced by titanium mesh cage
(TMC) and became the most widely used device
in anterior fusion due to its excellent mechanical
behavior and preferable clinical outcomes. In
this study, cage with bone graft was used.

Methods
This prospective observational study was
conducted in the Department of Orthopaedics,
Bangabandhu Sheikh Mujib Medical University
(BSMMU), Dhaka, Bangladesh, from March
2015 to August 2017. Forty single level cervical
spondylotic myelopathy patients diagnosed on
the basis of presenting complaints, clinical
examination and investigations, of age 30- 65
years were included in this study. Patients with
cervical spine injury (fracture or dislocation),
nerve injury, cervical tumors, inflammatory and
autoimmune disorder were excluded from this
study.

A questionnaire was prepared by the researcher
considering key variables like: age, sex,
presenting complaints, clinical findings,
associated medical conditions, investigations,
preoperative findings and outcome of the surgery
by Nurick grading. The aims, objectives,
procedures, risks and benefits of the operation
were explained to the selected patients. Then,
written informed consent was taken from each
patient. History of the patients was collected,
clinical examination was done and relevant
investigations were done for each patient. Results
of the study were evaluated using Nurick
grading and VAS Scale. Radiological evaluation
of fusion was done by X-ray and CT scan.
Surgical procedure: A transverse skin incision
was performed over the targeted vertebral level.
The platysmal muscle was identified and incised. The oesophagus was identified and retracted medially, while the sternocleidomastoid and underlying carotid sheath was retracted laterally. The prevertebral fascia was divided, and the longus colli musculature was further retracted. The offending disc was removed with a rongeur. As the posterior aspect of the vertebral body was reached, osteophytes were removed. The posterior longitudinal ligament was visualized. The entire disc, vertebral body endplates was decorticated. Bone graft was taken from the iliac crest. The graft was, then, applied in the cervical cage and applied in the disc space. Its position was checked by fluoroscopy. Then after proper haemostasis; longus colli muscle along with cut edge of anterior longitudinal ligament was approximated, omohyoid muscle was repaired, platysmal layer, subcutaneous tissue and skin were closed in layers. Sterile dressing was done and cervical orthosis was applied before extubation. The cervical brace was worn for 6 weeks.

Statistical significance was set at p < 0.05 and confidence interval set at 95%. Categorical data were assessed using Chi-square test and numerical data were assessed using paired t-test.

**Grade Description:**

**Table 1: The Nurick myelopathy scale**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Root Signs</th>
<th>Cord involvement</th>
<th>Gait</th>
<th>Employment</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Yes</td>
<td>No</td>
<td>Normal</td>
<td>Possible</td>
</tr>
<tr>
<td>I</td>
<td>Yes</td>
<td>No</td>
<td>Normal</td>
<td>Possible</td>
</tr>
<tr>
<td>II</td>
<td>Yes</td>
<td>No</td>
<td>Mild abnormality</td>
<td>Possible</td>
</tr>
<tr>
<td>III</td>
<td>Yes</td>
<td>No</td>
<td>Severe abnormality</td>
<td>Impossible</td>
</tr>
<tr>
<td>IV</td>
<td>Yes</td>
<td>No</td>
<td>Only with assistance</td>
<td>Impossible</td>
</tr>
</tbody>
</table>

**Table 2: Upper limb function grade**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Normal sensory and motor examination with no upper motor neuron signs</td>
</tr>
<tr>
<td>1</td>
<td>Sensory dysfunction with normal motor examination and no upper motor neuron signs</td>
</tr>
<tr>
<td>2</td>
<td>Upper motor neuron signs with no weakness</td>
</tr>
<tr>
<td>3</td>
<td>Motor weakness</td>
</tr>
</tbody>
</table>

Recovery = Nurick grading

Excellent = 0 – I
Good = II – III
Fair = IV
Poor = V
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Pre-operative X-ray

Pre-operative MRI of cervical spine, sagittal and axial view

Intra-operative photograph

Cage with bone graft

Per-operative C-arm picture

Post operative X-ray
Results
Mean age of the patients was 45.9 ± 9.1 years, within the range of 30-65 years. Male gender was predominant; male-female ratio was 2.63:1. Both sides were affected in 14 (35.0%) cases, only right side was affected in 15 (37.5%) cases and only left side was affected in 11 (27.5%) cases. Involved disc spaces were C_{3/4} (10.0%), C_{4/5} (22.5%), C_{5/6} (42.5%) and C_{6/7} (25.0%). Transient dysphagia was seen in 2 (5.0%) patients which recovered within very short period, transient paraparesis in 1 (2.5%), wound infection 1 (2.5%) and damage to the dura was observed in 1 (2.5%) patient.

After 1 month, 10 (25.0%) patients had neck pain; neck stiffness was observed in 4 (10.0%) patients and gait disturbance in 2 (5.0%) patients. After 3 months, neck stiffness was observed in 1 (2.5%) patient. After 6 months, no complication was observed. All patients had weakness of both lower limb before operation and after operation, it was present in 4 (10.0%), 1 (2.5%) and 0 (0.0%) patients after 1 month, 3 months and 6 months respectively. Signs of fusion were observed in 10 (25.0%) patients after 3 months and in 30 (75%) patients after 6 months and 40 (100%) after 12 months. After treatment, all patients were followed up at 1, 6 and 12 months. The outcome was assessed using Nurick grading. The result was found excellent in 35 (87.5%) and good in 5 (12.5%) cases.

Discussion
In this study, most of the patients were in age group 41-50 years followed by 9 (22.5%) in 51-60 years, 9 (20.0%) >60 years and 3 (7.5%) patients in ≤40 years. Mean age of the patients was 45.9 ± 9.1 years within the range of 30-65 years. Li et al. and Yu et al. found the mean age of their study subjects to be more than 55 years. Males were predominant in this study and male female-ratio was 2.63:1. Males were predominant also in the study of Yu et al. and Li et al.

Both sides were affected in 14 (35.0%) cases, only right side was affected in 15 (37.5%) cases and only left side was affected in 11 (27.5%) cases. Involved disc spaces were C_{3/4} (10.0%), C_{4/5} (22.5%), C_{5/6} (42.5%) and C_{6/7} (25.0%). In our study, the highest percentage of inter space involvement was seen in C_{5/6} (42.5%). In the study of Smith and Robinson, C_{5/6} was the commonest level (50%) as well. In Gore and Sepic series, commonest level of involvement was also C_{5/6} (51%). C_{5/6} is the commonest level of involvement because it is the most mobile area of cervical spine.

Regarding peri-operative complications, transient dysphagia was seen in 2 (5.0%) patients which recovered within very short period, transient paraparesis in 1 (2.5%), wound infection 1 (2.5%) and damage to the dura was observed in 1 (2.5%) patient. Dysphagia was observed in 2.8% cases in the study of Yu et al.

All patients had weakness of both lower limbs before operation and after operation; weakness of both lower limbs was present in 4 (10.0%), 1 (2.5%) and 0 (0.0%) patients after 1 month, 3 months and 6 months respectively. Signs of fusion were observed in 10 (25.0%) patients after 3 months, in 30 (75%) patients after 6 months and in 40 (100%) patients after 12 months. ACDF of 1 to 3 levels has been reported to be effective and safe in decompressing ventral pathology. The rate of fusion in single-level ACDF ranges from 80% to 95%.23,24
After treatment, all patients were followed up from 1 to 12 months. The outcome was assessed using Nurick grading. Results were found to be excellent in 35 (87.5%) and good in 5 (12.5%) cases. In the study of Smith and Robinson\textsuperscript{10}, outcomes were obtained as excellent in 64.2%, good in 14.2%, fair in 14.2% and poor in 7.1%. Rosenorn et al\textsuperscript{25} showed the outcome was excellent in 41.3%, good in 27.5%, fair in 6.2% and poor in 24.1% cases. Islam MA et al showed the outcomes to be excellent in 50.00%, good in 37.50% and fair in 12.5%\textsuperscript{26}.

**Conclusion**

From the results of this study, it can be concluded that anterior cervical discectomy and fusion by cervical cage with bone graft is an effective procedure for the management of cervical spondylotic myelopathy.

**References**


