

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

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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 C_{3/4} (10.0%), C_{4/5} (22.5%), C_{5/6} (42.5%) and C_{6/7} (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

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tissue of the cervical vertebrae. Important patho-physiologic factors in the development of CSM are static-mechanical, dynamic-mechanical and spinal cord ischemia.⁴ 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.⁵ 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.⁶ Spinal cord ischemia occurs when degenerative elements compress blood vessels that supply the cervical spinal cord and proximal nerve roots.⁷

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.⁸

Anterior cervical discectomy and fusion (ACDF) procedure developed by Cloward⁹ and Smith and Robinson¹⁰ 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 discectomy.^{11,12}

Because of high fusion rates, autogenous tricortical iliac crest graft is considered as the 'gold standard' of anterior reconstruction.^{13,14} But, it causes around 25% of donor site morbidity including hematoma, persistent donor site pain and infection.^{15,16} 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.¹⁷ 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.^{18,19} 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 complains, 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 complains, 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.

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JBPKIHS 2019; 2(2): 12-18

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

Grade	Root Signs	Cord involvement	Gait	Employment
0	Yes	No	Normal	Possible
I	Yes	No	Normal	Possible
II	Yes	No	Mild abnormality	Possible
III	Yes	No	Severe abnormality	Impossible
IV	Yes	No	Only with assistance	Impossible

Table 2: Upper limb function grade

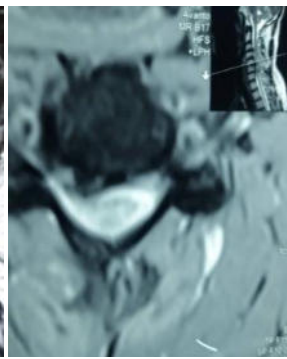
Grade	Description
0	Normal sensory and motor examination with no upper motor neuron signs
1	Sensory dysfunction with normal motor examination and no upper motor neuron signs
2	Upper motor neuron signs with no weakness
3	Motor weakness

Recovery = Nurick grading

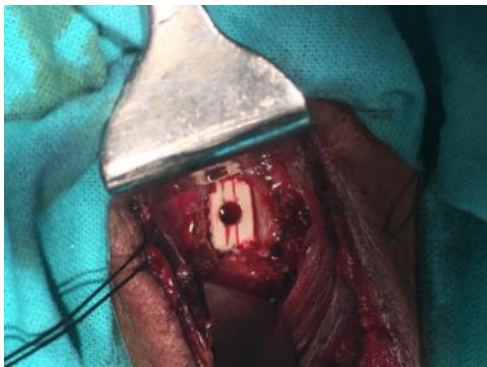
Excellent = 0 – I
 Good = II – III
 Fair = IV
 Poor = V



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.²⁰ and Yu et al.²¹ 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.²¹ and Li et al.²⁰.

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 Robinson¹⁰, C_{5/6} was the commonest level (50%) as well. In Gore and Sepic²² 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.²¹

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 Robinson¹⁰, outcomes were obtained as excellent in 64.2%, good in 14.2%, fair in 14.2% and poor in 7.1%. Rosenorn et al²⁵ 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%.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

1. Brain WR, Northfield D, Wilkinson M. The neurological manifestations of cervical spondylosis. *Brain*. 1952 Jun 1; 75(2): 187-225.
2. Irvine DH, Foster JB, Newell DJ, Klukvin BN. Prevalence of cervical spondylosis in a general practice. *The Lancet*. 1965 May 22; 285(7395): 1089-92.
3. Bohlman HH, Emery SE. The pathophysiology of cervical spondylosis and myelopathy. *Spine*. 1988 Jul 1; 13(7): 843-6.
4. Fehlings MG, Skaf G. A review of the pathophysiology of cervical spondylotic myelopathy with insights for potential novel mechanisms drawn from traumatic spinal cord injury. *Spine*. 1998 Dec 15; 23(24): 2730-6.
5. Wilkinson M. The morbid anatomy of cervical spondylosis and myelopathy. *Brain*. 1960 Dec 1; 83(4): 589-617.
6. Baron EM, Young WF. Cervical Spondylotic Myelopathy A Brief Review of Its Pathophysiology, Clinical Course, and Diagnosis. *Neurosurgery*. 2007 Jan 1; 60(suppl_1): S1-35.
7. Firooznia H, Ahn JH, Rafii M, Ragnarsson KT. Sudden quadriplegia after a minor trauma. The role of preexisting spinal stenosis. *Surgical neurology*. 1985 Feb 28; 23(2): 165-8.
8. Adams RD, Victor M. and Ropper AH. 1993. Diseases of the spinal cord, peripheral nerve and muscle. *Principles of neurology. 5th Ed. New York: McGraw-Hill, Health Professions Division*, pp.1100-1.
9. Cloward RB. The anterior approach for removal of ruptured cervical disks. *Journal of neurosurgery*. 1958 Nov; 15(6): 602-17.
10. Smith GW, Robinson RA. The treatment of certain cervical-spine disorders by anterior removal of the intervertebral disc and interbody fusion. *JBJS*. 1958 Jun 1; 40(3): 607-24.
11. Malloy KM, Hilibrand AS. Autograft versus allograft in degenerative cervical disease. *Clinical Orthopaedics and related research*. 2002 Jan 1; 394: 27-38.
12. Zdeblick TA, Phillips FM. Inter-body cage devices. *Spine*. 2003 Aug 1; 28(15S): S2-7.
13. Faldini C, Leonetti D, Nanni M, Di Martino A, Denaro L, Denaro V, Giannini S. Cervical disc herniation and cervical spondylosis surgically treated by Cloward procedure: a 10-year-minimum follow-up study. *Journal of Orthopaedics and Traumatology*. 2010 Jun 1; 11(2): 99-103.

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14. Kao FC, Niu CC, Chen LH, Lai PL, Chen WJ. Maintenance of inter-body space in one-and two-level anterior cervical inter-body fusion: comparison of the effectiveness of autograft, allograft, and cage. *Clinical Orthopaedics and related research*. 2005 Jan 1; 430: 108-16.
 15. Siddiqui AA, Jackowski A. Cage versus tricortical graft for cervical inter-body fusion. *Bone & Joint Journal*. 2003 Sep 1; 85(7): 1019-25.
 16. Silber JS, Anderson DG, Daffner SD, Brislin BT, Leland JM, Hilibrand AS, Vaccaro AR, Albert TJ. Donor site morbidity after anterior iliac crest bone harvest for single-level anterior cervical discectomy and fusion. *Spine*. 2003 Jan 15; 28(2): 134-9.
 17. Bagby GW. Arthrodesis by the distraction-compression method using a stainless steel implant. *Orthopedics*. 1988 Jun 1; 11(6): 931-4.
 18. Majd ME, Vadhva M, Holt RT. Anterior cervical reconstruction using titanium cages with anterior plating. *Spine*. 1999 Aug 1; 24(15): 1604.
 19. Eck KR, Bridwell KH, Ungacta FF, Lapp MA, Lenke LG, Riew KD. Analysis of titanium mesh cages in adults with minimum two-year follow-up. *Spine*. 2000 Sep 15; 25(18): 2407-15.
 20. Li F, Li Z, Huang X, Chen Z, Zhang F, Shen H, Kang Y, Zhang Y, Cai B, Hou T. Comparison of two reconstructive techniques in the surgical management of four-level cervical spondylotic myelopathy. *BioMed research international*. 2015 Jan 27; 2015.<http://doi.org/10.1155/2015/513906>.
 21. Yu S, Li F, Yan N, Yuan C, He S, Hou T. Anterior fusion technique for multilevel cervical spondylotic myelopathy: a retrospective analysis of surgical outcome of patients with different number of levels fused. *PloS one*. 2014 Mar 11; 9(3): e91329.
 22. Gore DR, Sepic SB. Anterior Cervical Fusion for Degenerated or Protruded Discs: A Review of One Hundred Forty-Six Patients. *Spine*. 1984 Oct 1; 9(7): 667-71.
 23. Cauthen JC, Kinard RE, Vogler JB, Jackson DE, DePaz OB, Hunter OL, Wasserburger LB, Williams VM. Outcome analysis of non-instrumented anterior cervical discectomy and inter-body fusion in 348 patients. *Spine*. 1998 Jan 15; 23(2): 188-92.
 24. Martin Jr GJ, Haid Jr RW, MacMillan M, Rodts Jr GE, Berkman R. Anterior cervical discectomy with freeze-dried fibula allograft: overview of 317 cases and literature review. *Spine*. 1999 May 1; 24(9): 852-9.
 25. Rosenørn J, Hansen EB, Rosenørn MA. Anterior cervical discectomy with and without fusion: A prospective study. *Journal of neurosurgery*. 1983 Aug; 59(2): 252-5.
 26. Islam MA, Habib MA, Sakeb N. Anterior Cervical Discectomy, Fusion and stabilization by plate and screw—early experience. *Bangladesh Medical Research Council Bulletin*. 2012 Dec 9; 38(2): 62-6.