Cervical Disc Replacement for Spondylotic Myeloradiculopathy

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Abstract

Background: Cervical disc replacement is a newer concept and rapidly developing surgical treatment. A prospective study was conducted to determine, if accurately implanted Bryan's cervical disc prostheses can provide relief from objective neurological symptoms and signs, stability and normal range of motion in cases of cervical disc prolapse with myeloradiculopathy.

Material and Method: Twenty patients underwent Bryan cervical disc replacement from Jan 2002 to Dec 2003. Young patients between age groups 21 to 50 years with degenerative cervical disc prolapse at C3-C7 with myeloradiculopathy were included in this study. Patients with significant facet joint arthropathy, unstable spine, trauma, tumour, osteoporosis and active infection were excluded from this study. Nurick's grading was used for quantifying the neurological deficit. Patients were operated by anterior cervical approach using a specially designed Bryan's cervical discectomy system. Neurological and radiological outcome was assessed post operatively and at 2,6,12 and 24 months follow up. Outcome analysis was carried out using modified Odom's criteria. The radiographic results were assessed by taking antero posterior (AP) and lateral radiographs of cervical spine to find range of motion and device position.

Results: The patients were in the age group of 31 to 50 years. There were 14 (70%) male and 6 (30%) female in this study. Neck pain and brachialgia were the presenting symptoms in all cases, 12 (60%) had radiculopathy and 8 (40%) had myelopathy. Single level disc prolapse was present as per Magnetic Resonance Imaging (MRI) in four (20%) at C4-C5, 12 (60%) at C5-C6 and 4 (20%) at C6-C7. Bryan's disc size 15 was used in 8 (40%) and size 17 was used in 12 (60%) patients. During post-operative, 02, 06, 12, and 24 months follow up, the clinical outcome was excellent in 16 (80%) and good in 4 (20%) as per modified Odom's criteria. There was demonstrated improvement in flexion, extension and rotation clinically and radiologically during follow up. There was no migration or displacement of device.

Conclusion: Cervical disc replacement for cervical disc prolapse with myeloradiculopathy represents an exciting new technology. Patients treated with the Bryan cervical disc prosthesis for single level cervical disc prolapse showed good to excellent improvement in neurological deficit. Clinically and radiologically maintenance of motion was found during follow up. More patients with longer follow up and post operative MRI to find out the protection to adjacent discs from abnormal stress will be required before this prosthesis is accepted as a treatment option.

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Key Words : Spondylotic myeloradiculopathy; Cervical disc replacement

Introduction

Anterior cervical microdiscectomy (ACD) and fusion (ACDF) has been successful operative method for cervical spondylotic myeloradiculopathy due to cervical disc prolapse [1]. The concept of accelerated degeneration of adjacent disc levels as a consequence of increased stress caused by interbody fusion of cervical spine is widely accepted [2]. These phenomenon supports the hypothesis that reconstruction of an intervertebral disc after discectomy with functional disc prosthesis would offer benefit.

To achieve this goal a functional disc prosthesis (cervical disc replacement) was devised by Vincent Bryan in 1993. Cervical disc replacement provides neural decompression and stabilization like ACDF. It also

provides full physiological neck motion and protects the adjacent disc degeneration [2].

Material and Method

A prospective study was carried out at our institution in twenty patients, who had presented with cervical spondylotic myeloradiculopathy and underwent implantation with Bryan's prosthetic cervical disc during Jan 2002 to Dec 2003.

Nurick's grading was used for quantification of neurological deficits. Radiological evaluation included Antero Posterior (AP) and lateral radiographs of cervical spine and Magnetic Resonance Imaging (MRI) in all cases to find out (a) the level of disc prolapse (b) thecal and nerve root compression and (c) cord changes. Computerised Tomography (CT) scan was carried out to find out the Bryan's cervical disc size preoperatively.

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Young patients between 21-50 years of age with degenerative cervical disc prolapse at C3-C7 levels with radiculopathy and/or myelopathy were included in this study. Patients with significant facet joint arthropathy, unstable spine, trauma, tumour, osteoporosis and active infection were excluded from this study.

All the cases were operated by anterior cervical approach from right side using a specially designed Bryan's cervical discectomy system. The Bryan cervical disc prosthesis (Fig. 1), manufactured by Spinal Dynamic Corporation, is a cervical intervertebral disc prosthesis, designed to permit motion similar to normal cervical functional spinal unit. The device consists of a Polyurethane nucleus, two titanium alloy surfaces (Shells) with porous coating to facilitate bony ingrowth and long-term stability, a polyurethane sheath forming a closed compartment and titanium alloy seal plugs for retention of lubricant. Anterior stops on each shell are designed to prevent posterior migration of the device. Prosthesis size are 14, 15, 16, 17 and 18mm.

The operative technique consists of

- i) Initial discectomy
- ii) Bryan's cervical discectomy instruments utilize a simple gravitational referencing system to establish a virtual axis in the intervertebral disc space that is used to position a milling fixture.
- iii) The fixture precisely controls the powered cutting instruments that prepare the vertebral end plates for placement of prosthesis.
- iv) The milled vertebral end plates exactly match the geometry of implants outer surface.
- v) The tight fit of prosthesis provides immediate AP and lateral stability.

The effectiveness of the device was assessed by evaluating each patient's pain, neurological function and range of cervical motion during follow up. The quality of life results were scored according to modified Odom's criteria in the post operative period and subsequently at 6, 12, and 24 months follow up

Fig. 1 : Bryan's cervical disc prosthesis

and categorized as follows:

- Excellent: Improvement of preoperative symptoms and signs.
- Good: Minimal persistence of preoperative symptoms; abnormal findings improved or unchanged.
- Fair: Definite relief of some preoperative symptom; other symptoms slightly improved or unchanged.
- Poor: Symptoms and signs unchanged or exacerbated.

The radiographic results were assessed by taking AP and lateral radiographs of cervical spine in the post op and after 06, 12 and 24 months follow up to find out the range of motion and device position. During postoperative period the patients were advised not to use any cervical collar and assume normal activities as soon as the postoperative pain subsided.

Results

Thirteen (65%) patients were in the age group of 31 to 40 years and 7(35%) were in the age group of 41 to 50 years. There were 14 (70%) male and 06(30%) female in this study. Neck pain and brachialgia were the presenting symptoms in all cases. Features of cervical spondylotic radiculopathy were present in 12 (60%) and myelopathy in 08(40%) cases.

Single level cervical disc prolapse was present in all the patients as per MRI with four (20%) at C4-C5, 12 (60%) at C5-C6 and 04 (20%) at C6-C7. Anterior cervical discectomy using specially designed Bryan's cervical discectomy apparatus (Fig 2) was carried out for four patients with C4-C5 disc prolapse (Fig 3), 12 with C5-C6 (Fig 4) and 04 with C6-C7 (Fig 5) disc prolapse. Bryan's cervical disc size 15 in 08 (40%) and size 17 in 12 (60%) was implanted. The operative time was 04 hours in first five cases and subsequently 2 ½ -3 hours. There was no intraoperative complication in the form of vascular/ oesophageal tear. No intraoperative or postoperative blood transfusion was required.

In the immediate postoperative period one patient with C6-C7 disc replacement developed temporary hoarseness of voice, which improved subsequently.

During immediate post-op, 02,06,12 and 24 month follow up, the quality of life results were excellent in 16(80%) patients with Nurick's Grade 0, 1 and 2 (Table 1). Four (20%) patients with Nurick's grade 3 and 4 showed improvement of preoperative weakness and spasticity and had good recovery as per Odom's criteria. None of the patients deteriorated post

Table 1

Nurick's classification of neurological disability

Grade	Features	No. of patients
Grade 0	Signs and symptoms of root involvement; no evidence of cord involvement	12
Grade 1	Signs of spinal cord involvement; normal gait	02
Grade 2	Slight difficulty in walking; full time employment not prevented	02
Grade 3	Difficulty in walking; prevent employment but ambulant without support	02
Grade 4	Able to walk only with help or frame	02
Grade 5	Chair bound; bed ridden	Nil

Fig. 2 : Specially designed Bryan's cervical discectomy apparatus

Fig. 3 : C4-C5 disc replacement

operatively or during follow up for 24 months.

There was demonstrated motion in flexion, extension and rotation clinically and radiologically during follow up (Fig 6). There was no migration or displacement of device in this series post operatively. No complications were noted in relation to the device itself in the form of breakage or subsidence.

Discussion

With established myeloradiculopathy, the management option for cervical disc prolapse is surgical decompression. Anterior cervical discectomy and ACDF is the standard surgical approach for cervical spondylotic myeloradiculopathy due to anterior thecal/nerve root compression [1].

Initial description of anterior approach for cervical discectomy always included bony fusion [3], which was popularized, by Smith and Robinson [4,5]. This was advocated to prevent the possibility of late kyphosis from disc space collapse or radiculopathy from foraminal

Fig. 4 : C5-C6 disc replacement

Fig. 5 : C6-C7 disc replacement

Fig. 6 : Follow-up C5-C6 cervical disc replacement

narrowing. Arguments in favour of fusion include the potential for the development of foraminal stenosis. Fusion stabilizes the spine and may prevent progressive deterioration due to instabilities [6]. The basic principle is that the bone graft between the involved interspaces gives inherent stability and allows fusion to occur even in degenerative situations. The anterior cervical decompression and fusion is now widely accepted as a safe and effective treatment modality for cervical disc

herniation. Studies for this procedure have found this to be reproducible, with a high level of patient satisfaction [7,8]. There are several factors affecting the fusion rate of anterior graft including the type of graft [4] and the surgical technique [9].

Interbody fusion of the cervical spine following cervical discectomy besides causing restriction of neck movements, also accelerates degeneration of adjacent disc levels due to increased stress from fusion [2,10,11, 12].

Proponents of disc prosthesis advance several reasons in favour of disc replacements ie. immediate pain relief, preservation of function, frequency of failed fusion, absence of drawbacks linked to autologous bone harvesting and possible absence of degeneration at adjacent levels. Therefore, cervical disc replacement offer the same benefit of decompression and fusion while simultaneously providing full neck motion and thereby protecting the adjacent disc levels from the abnormal stress associated with fusion by maintaining physiological motion and kinematics [13].

In 1998 Gill and co-workers patented the Bristol cervical disc [14]. This is a ball and socket type device made of stainless steel, which is screwed to the anterior sides of the adjacent vertebral bodies. Cummins reported on 20 patients implanted with the device and found good results. The device is being clinically evaluated [15].

Neurosurgeon Dr. Vincent Bryan and Alex Kunster, a Mechanical Engineer in 1993 designed the Bryan total cervical disc. The Bryan Total Cervical disc is designed as a low friction, wear-resistant elastic nucleus. This nucleus is set between and articulates with two titanium plates covered with a porous coating and screwed to the vertebral bodies. A flexible membrane surrounds the construct. It allows range of motion in all planes. Several authors have used the device. More than 4500 discs have been implanted all over the world by now. Our institution is the first in Asia to carry out single level Bryan's cervical disc replacement since Jan 2002.

Good to excellent clinical results are clearly demonstrated in this study of 20 patients receiving the Bryan's total cervical disc prosthesis. There was relief from neck pain, brachialgia, improved patient's quality of life and functionality. It also provided clinical and radiological stability and normal range of cervical motion. Similar results have also been reported by Goffin et al [13, 16, 17] in their study. However larger number of patients with longer periods of follow up and post operative MRI to find out the protection to adjacent discs from abnormal stress will be required before this prosthesis is accepted as a treatment option.

Conflicts of Interest

None identified

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