



Anterior cervical decompression using the “Hybrid Decompression Fixation” technique, a combination of corpectomies and or discectomies, in the management of multilevel cervical myelopathy

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Summary

In multilevel cervical myelopathy (MCM) the cord is compressed by soft and hard components, both at the discal level and behind the vertebral bodies. This may necessitate to perform multiple corpectomies in order to achieve adequate decompression. It is well known that multiple corpectomies are fraught with a high incidence of fixation failure. This may dictate the use of postoperative halo immobilization or the use of posterior laminoplasty for decompression.

We opted the use of a “hybrid” technique for anterior decompression of 3-4 levels. This is combination of corpectomies and discectomies preserving a vertebral bridge in the area of the decompression for further anchorage of the cervical plate.

We present our long term results using this technique. Reviewed 47 patients with MCM operated on with the hybrid method between 1999-2008. 24 had a 3 level surgery, 23 a 4 level decompression. Age ranged 46 to 83(mean 64). The 3L patients underwent 1 level corpectomy and single level discectomy. The 4L had either 1 level corpectomy and 2 level discectomy or 2 level corpectomy leaving a vertebral bridge the middle. All patients were instrumented using discal and vertebral body cages filled with autogenous local bone supplemented with an anterior dynamic plate to allow for postoperative subsidence. The plate was always attached with 2 screws to the vertebral bridge within the area of decompression. Operative time ranged between 2-4h. Only one patient deteriorated neurologically following surgery. All patients were placed only in a Philadelphia collar up to 6 weeks. Hospital stay ranged between 3-7 days (3.4). At follow up (15-84 months) neither hardware problems nor radiological pseudoarthroses were detected using flexion extension films. Satisfaction rate using the visual pain scale, showed marked reduction of cervical pain (from 51.12 to 1.81) only one patient reported increase of neck pain..

We have found the hybrid technique as a safe, well tolerated and efficient method for long anterior decompression of MCM.

Key words: Hybrid corpectomies discectomies, Multilevel spondylotic cervical myelopathy, Mechanical stability

INTRODUCTION

Anterior cervical corpectomy, a procedure designed to decompress the spinal cord, is usually an effective surgical technique in the management of cervical myelopathy. It has the advantage of allowing a thorough decompression including the resection of osteophytes and also improves fusion rates in cases where multilevel decompression is needed. Reconstruction of the spine is traditionally performed with strut bone graft. The structural stability of the cervical spine may be then supplemented with various anterior plates or external immobilization. To avoid low fusion rates with allograft use and donor site morbidity with autograft harvesting vertical titanium mesh fusion cages (Harms) have been used to replace the resected vertebral body.

The clinical outcome and attainment of fusion of a single level cervical corpectomy are usually excellent. The efficacy of this surgical modality when dealing with multilevel corpectomies is more problematic and less predictable..

If 4 disc levels have to be decompressed this can be accomplished with a three level corpectomy. The same number of discal space decompressions can be also realized with a 2 level corpectomy (and adjacent discectomies), one vertebra at each side of the decompression area, leaving an intact body in the middle of the decompressed area. Leaving the middle vertebral body intact increases the inherent mechanical stability of the decompressed cervical spine and also enables a stronger more stable mechanical reconstruction. It also shortens the mesh cage height, thus reducing rotational moments imposed on the implant-vertebra interface. This will certainly result in increased mechanical stability. We have employed this technique since 1999, which we nicknamed the “hybrid decompression fixation”. We would like to report our clinical experience with this surgical technique.

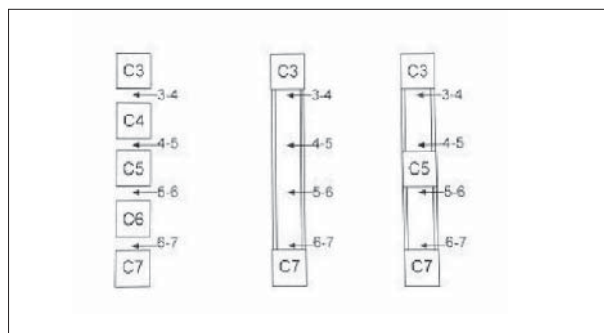


Fig. 1. If 4 disc levels have to be decompressed (left column) this can be accomplished with a three level corpectomy (middle column). The same number of discal space decompressions can be also realized with a 2 level corpectomy (and adjacent discectomies), one vertebra at each side of the decompression area, leaving an intact body in the middle of the decompressed area (right column). Leaving the middle vertebral body intact increases the inherent mechanical stability of the decompressed cervical spine and also enables a stronger more stable mechanical reconstruction

We retrospectively reviewed 47 patients with multilevel cervical myelopathy secondary to degenerative disc disease, on which the hybrid decompression fixation technique was applied between 1999-2008. All patients presented with a typical clinical presentation of myeloradiculopathy secondary to degenerative disc disease. 29 patients were males and 18 females. The mean age at surgery was 64 years (range 46 to 83). Neuroimaging showed evidence of multilevel cord compression due to a combination of “soft” and “hard” components. 34 of the patients had evidence of myelomalacia on the MR scans. Patients were graded according to the Nurick myelopathy scale. The mean grade was 3 (range 1-4).

All patients underwent anterior cord decompression, instrumented fixation and spondylodesis. The majority of the procedures were performed under continuous SSEP and MEP monitoring. These were recorded before and after patient positioning on the operating table. The head and neck were positioned in moderate extension for better surgical exposure and restoration of cervical lordosis. If the surgical positioning resulted in significant deterioration of the spinal cord monitoring signals repositioning was carried out. Spinal cord monitoring was continued during the surgical decompression and finally after instrumentation. All procedures were performed with the aid of fluoroscopy. 24 patients had 3 level surgery (3L) and 23 patients 4 level surgery (4L). A total of 164 discal levels were decompressed. The 3L patients underwent a single level corpectomy with adjacent discectomies and additional single level discectomy (Fig. 2A). The 4L patients had a 2 level corpectomy and adjacent four level discectomies leaving a vertebral bridge the middle (Fig. 2B). For adequate decompression during the corpectomy resection of the central portion of the body was performed, leaving small lateral edges of the vertebra intact (avoiding the vertebral artery). While the width of the corpectomy/discectomy was anteriorly about 14mm posteriorly adjacent to the spinal cord it was widened out to about 18-20 mm (Fig. 3). All patients were instrumented using titanium mesh cages with additional discal cages. Titanium 12 mm vertical mesh cages and horizontal PEEK or carbon discal fusion cages were packed with autogenous local bone derived from the corpectomy and supplemented with an anterior dynamic plate to allow for postoperative subsidence (Fig. 4). The plate was always attached with 2 screws to the intact vertebra within the area of decompression. Operative time ranged between 2.0-4 hours (average 2.2 h). Hospital stay ranged between 3-7 days (average 3.4). Patients were immobilized in a Philadelphia collar at the completion of surgery before extubation. After post-operative x-rays were obtained with confirmation of proper cage, plate and screw anchorage the patient wore the collar only at nighttime and during car travel for additional 6 weeks. At final follow up patients were evaluated by an independent observer with flexion/extension x-rays looking for any motion in the instrumented area as well as for the presence of bony fusion between the instrumented vertebrae. Attention was

also paid to any evidence of instrumentation failure. Pre and post-operative Nurick myelopathy scores were obtained in all patients.

RESULTS

At a mean follow up of 38 months after surgery (range 15-84 months) 28 patients reported subjective neurological improvement, 18 were unchanged and one patient deteriorated neurologically (Nurick C to D). 11 patients

experienced transient deltoid weakness (10 unilateral, 1 bilateral) that appeared several days after surgery and resolved completely within several weeks. At final follow-up neck pain resolved completely in 39 patients and arm or radicular pain in 32 patients. 18 patients had neither neck or extremity pain. Thirteen patients complained of residual neck pain the average visual analog score being 4.6. Likewise 15 patients complained of residual arm or radicular type pain, the average visual

Fig. 2. (2A): A construct of 3 levels (1 level corpectomy, 1 level discectomy, using special implants: vertebral body cage, disc cage, cervical plate DERO). (2B): A double level corpectomy, skipping a vertebral body in the middle, allows decompression of four discal levels (C3-7). The "skipped" body allows for firm plate anchorage along the decompression area

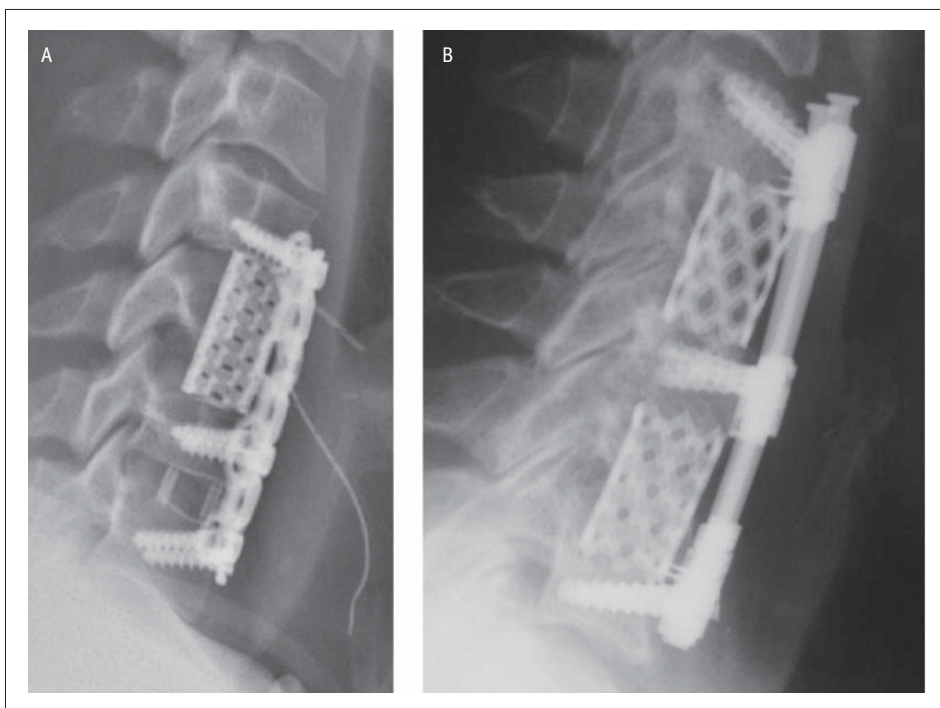
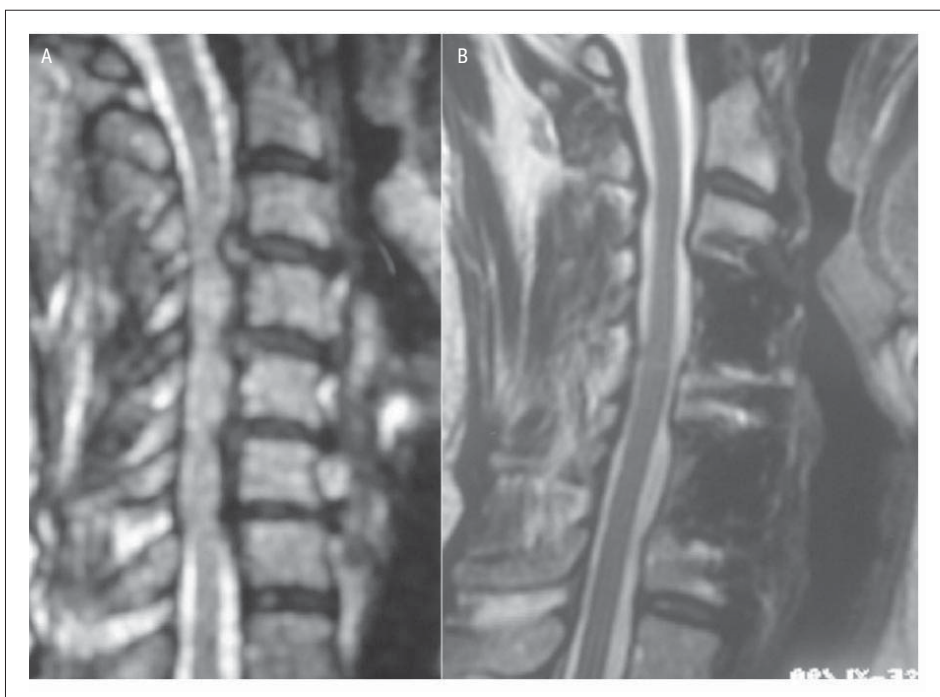


Fig. 3. (3A): Preoperative T2 sagittal MRI (same patient as in Fig. 2B). Note the compression at C3-4, C4-5, C5-6, C6-7. No CSF is noted at these levels. (3B): Postoperative T2 sagittal MRI. A complete cord decompression is noted. Note that CSF is now seen in front and behind the cord



analog score being 5.1. The average preoperative Nurick score was 3 and dropped postoperatively to 2.6. 13 patients exhibited a pronounced improvement in their Nurick scale, 9 showed a one-grade improvement and 6 patients a two grade improvement.

In one patient early mechanical failure of the construct occurred. This was successfully repaired by additional anterior surgery. At the end of the follow-up period X rays revealed evidence of bony fusion in 24

patients. Bone trabeculae were seen connecting the instrumented vertebrae (especially behind the vertical mesh cages) (Fig. 5). The fusion status could not be determined in one patient. No evidence of instrumentation failure was observed in any of the 47 patients. In 42 patients a normal lordotic posture of the spine was found (22-30°), a reduced lordosis was observed in 4 patients (10-15°) and a true kyphotic posture was found in only one patient (4).

Fig. 4. (4A): Intra-operative X ray. Note the distance between the proximal rod platform and the transverse connector. (4B): Note the postoperative settling. The proximal rod platform slid along the rod until it was stopped by the transverse connector

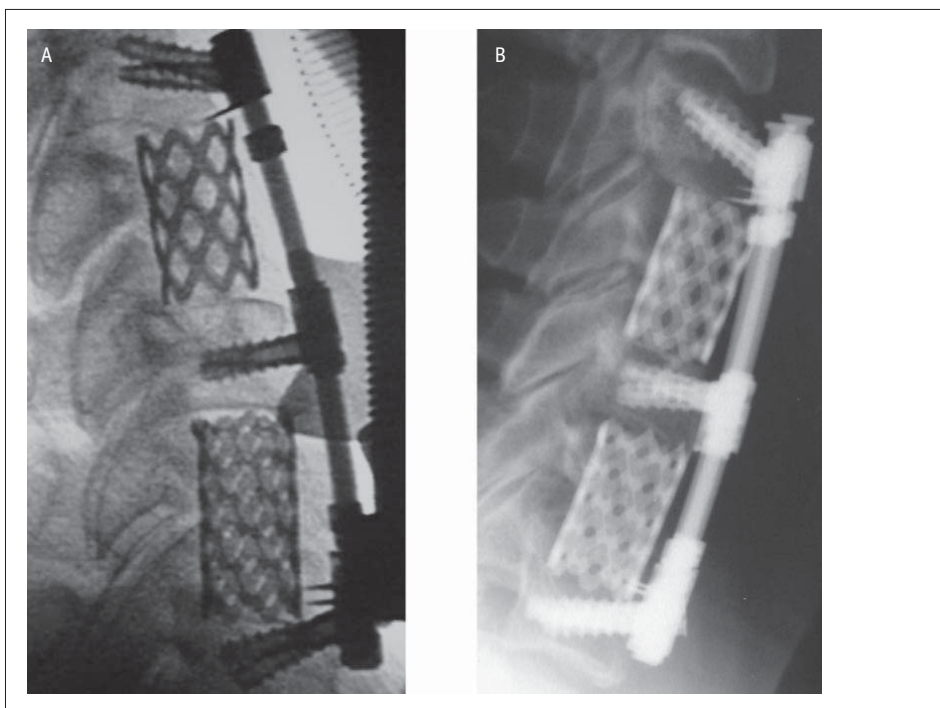
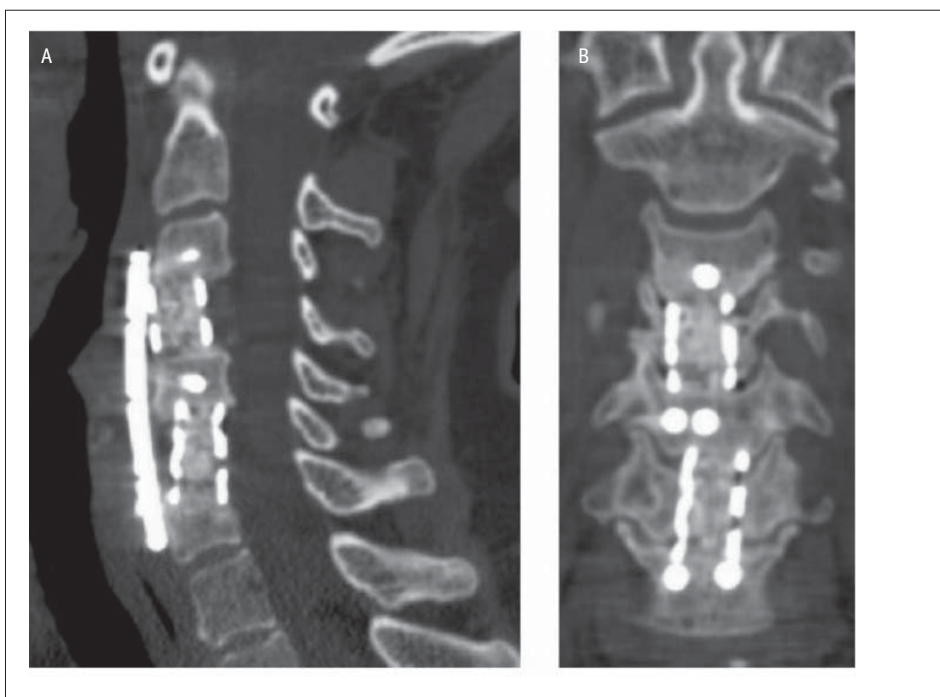


Fig. 5. Sagittal (A) and coronal (B) 1 year postoperative CT scan. Note the solid bony fusion inside the mesh cages



DISCUSSION

The optimal surgical procedure for multi-level cervical myelopathy remains controversial. Anterior decompression and fusion is today the most common surgical option. However bone graft donor site morbidity and mechanical failure are common complications. Posterior procedures are associated with significant post-operative axial pain and are contraindicated in the presence of a kyphotic cervical spine. Hee et al reported on a 19% incidence of plate problems in multilevel corpectomies (4 out of 21 patients) (5). These authors also noted increased frequency of graft migration with spondylodesis extending to C7 (5). Saunders et al reported on a 9.7% incidence of graft problems in patients undergoing 4 level corpectomies (10). Post-operative halo immobilization or posterior plate fixation (circumferential anterior decompression and fusion and posterior instrumentation) have been proposed to avoid construct failure following multiple anterior corpectomies.

Instead of using long autografts or allografts we prefer to reconstruct the spine with the aid of titanium mesh cage (Harms) packed with local bone derived from the cervical corpectomy and supplemented with an anterior plate. This obviates the need to harvest a rather large bone graft. The Harms cage provides immediate axial stiffness and stability. Despite the use of an anterior buttress plate, rotational instability is still possible and may result with construct failure. The "hybrid decompression fixation" technique allows multi-level anterior decompression, avoids bone graft donor site morbidity and provides a basis for stable mechanical reconstruction. In our experience construct failure with the hybrid technique is uncommon (4%). Even in the single case where mechanical failure occurred the reconstruction was performed in the same fashion and construct stability was achieved without the need of supplemental posterior fixation or halo immobilization. Recently Sing et al. (11) corroborated our hypothesis by in vitro mechanical testing and found that hybrid decompression fixation is more stable than the routine multilevel adjacent corpectomies. In addition the hybrid technique enables reliable reconstruction of the sagittal alignment.

One could argue that reconstruction of a 2 level corpectomy (performed in 23/47 of our patients) is almost

always mechanically stable. In reality all these 23 patients had a four level decompression and in other hands would have undergone a 3 level corpectomy.

The routine use of a "dynamic" anterior plate is important since with the "hybrid fixation" technique there are more than 2 interfaces of cage to vertebral end plate, hence more post-operative settling is possible (9). Settling was usually observed in the first or second post-operative days (Fig. 4). The greater number of graft end-plate interfaces has not resulted in an increased incidence of pseudoarthroses and fusion rates remained high. Others have also experienced high fusion rates with the use of titanium mesh cages (2,7).

Thalgot et al. (12) as well as Hee et al. (5) recommended additional posterior stabilization in elderly osteoporotic patients undergoing multiple corpectomies. Thirteen of our patients were 65 years or older (average age 71), yet we did not observe any mechanical failure in these 13 patients.

11 patients experienced transient deltoid weakness that appeared several days after surgery and resolved completely within several weeks. Similar cases have been previously reported (8). Presumably the shift of the cord following decompression leads to temporary dysfunction of the C5 root. Sakaura et al. (8) concluded that the incidence of this complication after anterior surgery is 4.3% and its etiology is unclear. In our experience C5 root palsy, alarming as it may be, has an excellent prognosis and a complete resolution of the motor weakness can be expected.

13 patients had significantly improved Nurick scores, 9 improved a whole grade and 6 patients improved two Nurick grades. If we consider that in many patients with long standing multilevel cervical spondylotic myelopathy surgery is indicated mainly to arrest the deterioration of cord function rather than attain neurologic improvement, than the goals of surgery were successfully achieved in the majority of our cases.

We therefore conclude that the "hybrid decompression fixation" technique is a safe and efficient method that allows multiple level anterior decompressions when managing multilevel spondylotic myelopathy. This technique obviates the need for staged circumferential procedures even in the elderly osteoporotic individual.