Uncosectomy Facilitated Cervical Foraminotomy using a new high-speed shielded curved device

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Abstract. Case series of 10 patients is presented documenting a new surgical technique for decompressing nerve roots in the cervical spine. The foramen is accessed from an anterior approach through the posterior uncus to facilitate a complete and clinically effective foraminal decompression.

Keywords: Decompression, ACDF, cervical foraminotomy, uncosectomy

1. Introduction

While radiological evidence of cervical nerve root compression due to foraminal stenosis is present in most elderly subjects and may be considered normal age-related spondylosis, it can be the cause of symptoms in a subset of individuals [1]. Radiculopathy can be disc related or from overgrown bone in the lateral recess or neural foramen. Cervical radiculopathy resulting from nerve root compression typically presents with pain in the shoulders and arms. Symptoms can also include numbness, tingling, muscle weakness and loss of reflexes [2]. While many of these symptoms can be treated conservatively, some patients will require surgery to relieve the nerve root compression. Surgical treatment is suggested when there is persisent pain over the course of weeks to months [3].

The common anterior approach for nerve root compression requires removal of the intervertebral disc which is often bulging posteriorly and contributing to myelopathy and/or radicular symptoms. Following cervical disc removal and nerve root decompression, the motion segment is typically stabilized by a fusion.

Robinson and Smith first described what has become the most widely used anterior surgical approach for cervical decompression and fusion in 1955 [4]. In 1966, Scoville and Whitcomb reported results of their posterior approach to surgically treat cervical radicular symptoms. [5] Variations of the anterior and posterior approaches have been described to decompress the cervical spine including a mini-open posterior approach through tubular retractors [6] and a microsurgical anterolateral approach which does not fuse the motion segment.

More recently, in a subset of indicated patients, total disc replacement (TDR) is being used as an alternative to the gold-standard anterior cervical discectomy and fusion (ACDF). Cervical decompression followed by total disc replacement may avoid

adjacent level degeneration associated with fusion [7]. Another option would be a combined anterior-posterior decompression and fusion, which would increase the operative time and the postoperative pain and morbidity. Complete anterior decompression of the cervical nerve root is limited by the risk of injury to the vertebral artery [8]. TDR promises to reduce common issues associated with fusion, including adverse events with plating and the risk of pseudarthrosis and adjacent level degeneration [9].

Figure 1 shows an axial view of a sub-axial cervical vertebra. The uncinate processes are upward bony projections on the lateral borders of the vertebral body. They extend more medial in the posterior regions of the vertebral body. It should be appreciated that a lateral recess or foraminal decompression will require removing some of the posterior portion of the uncinate process to access these areas of the cervical anatomy.

The removal has to be done cautiously with drilling at the base of the uncinate process because the nerve root lies just adjacent to it [10].

When considering the standard approach shared by an ACDF and total disc replacement, the unicnate processes can impede the reach of instruments used to decompress the foramen. This is especially true for the far lateral foramen where decompression of the exiting nerve root may be required.

The DReal™ Device (Carevature Medical Ltd. Rehovot, Israel) is a novel high-speed drill with a curved distal tip to access hard to reach anatomy and a shielded cutter to allow boney resection while protecting adjacent neural and vascular structures. The DReal™ Decompression Device is presented here as a safe and effective method for facilitating access of this hard to reach cervical anatomy. A picture of the DReal™ with inset of the rotating cutter and shield at the distal tip is shown in Figure 2.

This case series describes the surgical technique and outcome in ACDF and cervical disc arthroplasty patients that were decompressed following posterior uncosectomy using the DReal™.

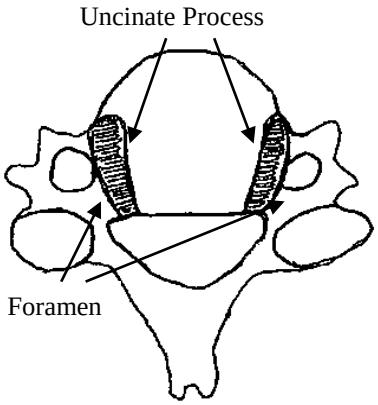

Figure 1: Axial view of a sub-axial cervical vertebra

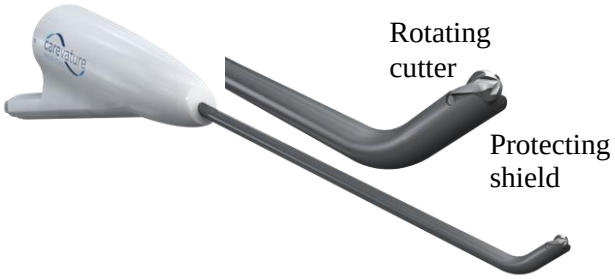

Figure 2: The DReal™ with inset of the rotating cutter and shield at the distal tip

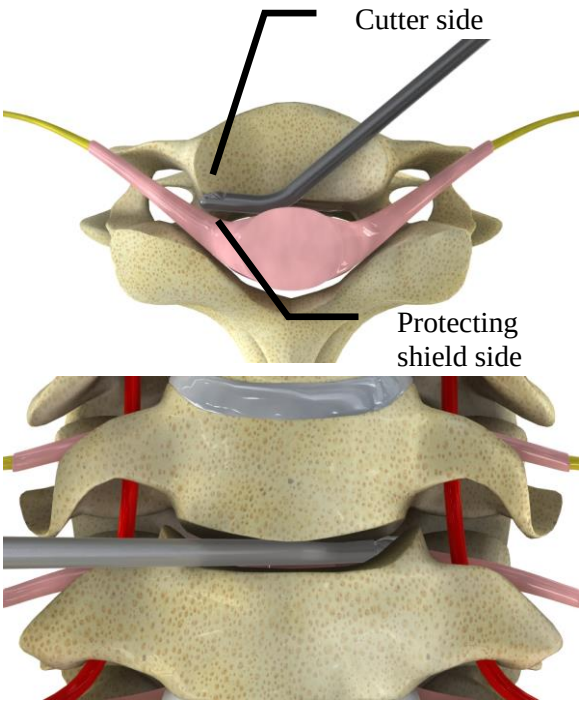

Figure 3: The DReal™ inserted through the disc space (up) and its tip shown below the uncinate process to be removed (bottom)

2. Methods

Ten patients were treated for cervical radiculopathy with either an ACDF or cervical disc replacement. The DReal™ was used to thin the uncus allowing the remaining uncus to be removed more easily with a Kerrison Rongeur, which in turn allowed unobstructed access to the foramen for decompression. Figure 3 shows the insertion of the DReal™ into the disc space.

The DReal™ was also used to remove the cartilage endplate in preparation for an interbody or arthroplasty implant. The DReal™ enabled meticulous end plate preparation to insure good incorporation of the implant with the superior and inferior vertebral bodies. Finally, the DReal™ is also helpful with removing osteophytes that are frequently present adjacent to the endplates on the posterior aspects of the vertebral bodies. These posterior osteophytes are typically difficult to reach safely with conventional instruments due to their proximity to the spinal cord and in some cases require a corpectomy of the vertebra.

Pain and disability outcomes were assessed using Visual Analog Scale (VAS) for pain in the neck and in the arm and Neck Disability Index (NDI) for each patient. Pre-op CT and MRI were obtained to identify location of the stenosis and post-op MRI was used to confirm boney resection in all patients.

3. Results

VAS and NDI scores were significantly improved. MRI confirmed complete boney resection in all patients. There were no adverse events related to DReal™ use.

Table 1 shows the patient demographics and levels operated. Table 2 shows pre-op and post-op clinical outcome measures. The VAS neck and arm columns indicates the pain into the neck and into the arm (left or right), respectively, in the morning before the surgery or during the prior day.

Figure 4A shows typical pre-op lateral and axial MRI for a patient with right sided nerve root compression (Patient no. 10) and Figure 4B shows the post op CT scan demonstrating resection of uncus and decompressed foramen.

Patient No.	Age	Smoker	Level	Procedure performed with DReal
1	49	No	ACDF C5C6C7	Resection of the postero-inferior angle of C5 and the postero-superior angle of C6
2	51	Yes	ACDF C5C6C7	Uncosectomy allowing a wide opening of the foramen and good root decompression (C6, right)
3	20	No	ACDF C4C5	Radicular release by uncosectomy (C5, left)
4	53	No	ACDF C6C7	Uncosectomy (C7, right)
5	48	Yes	P C5C6	Uncosectomy for good release of the C6 root in its foraminal portion (C6, left)
6	23	No	ACDF C6C7	Uncosectomy; excision of endplates (C7, left)
7	33	Yes	P C5C6	Uncosectomy; excision of endplates (C6, left)
8	43	No	ACDF C5C6C7	Uncosectomy; excision of endplates (C6 left and C7 left)
9	61	Yes	P C6C7	Uncosectomy; excision of endplates (C7, left)
10	27	No	ACDF C5C6	Uncosectomy (C6, right)

Table 1: patient demographics and levels operated

Patient No.	VAS PRE OP	VAS rad PRE OP	NDI PRE OP	VAS POST OP	VAS rad POST OP	NDI POST OP
1	80/100	80/100	31/50	29/100	16/100	13/50
2	65/100	80/100	37/50	45/100	0/100	15/50
3	50/100	50/100	15/50	0/100	0/100	0/50
4	90/100	40/100	33/50	20/100	0/100	.2/50
5	65/100	70/100	35/50	60/100	80/100	24/50
6	10/100	45/100	14/50	0/100	0/100	0/50
7	60/100	60/100	26/50	0/100	0/100	.5/50
8	80/100	80/100	14/50	30/100	0/100	.2/50
9	25/100	90/100	25/50	0/100	35/100	15/50
10	5/100	0/100	.8/50	0/100	0/100	0/50

Table 2: pre-op and post-op clinical outcome measures

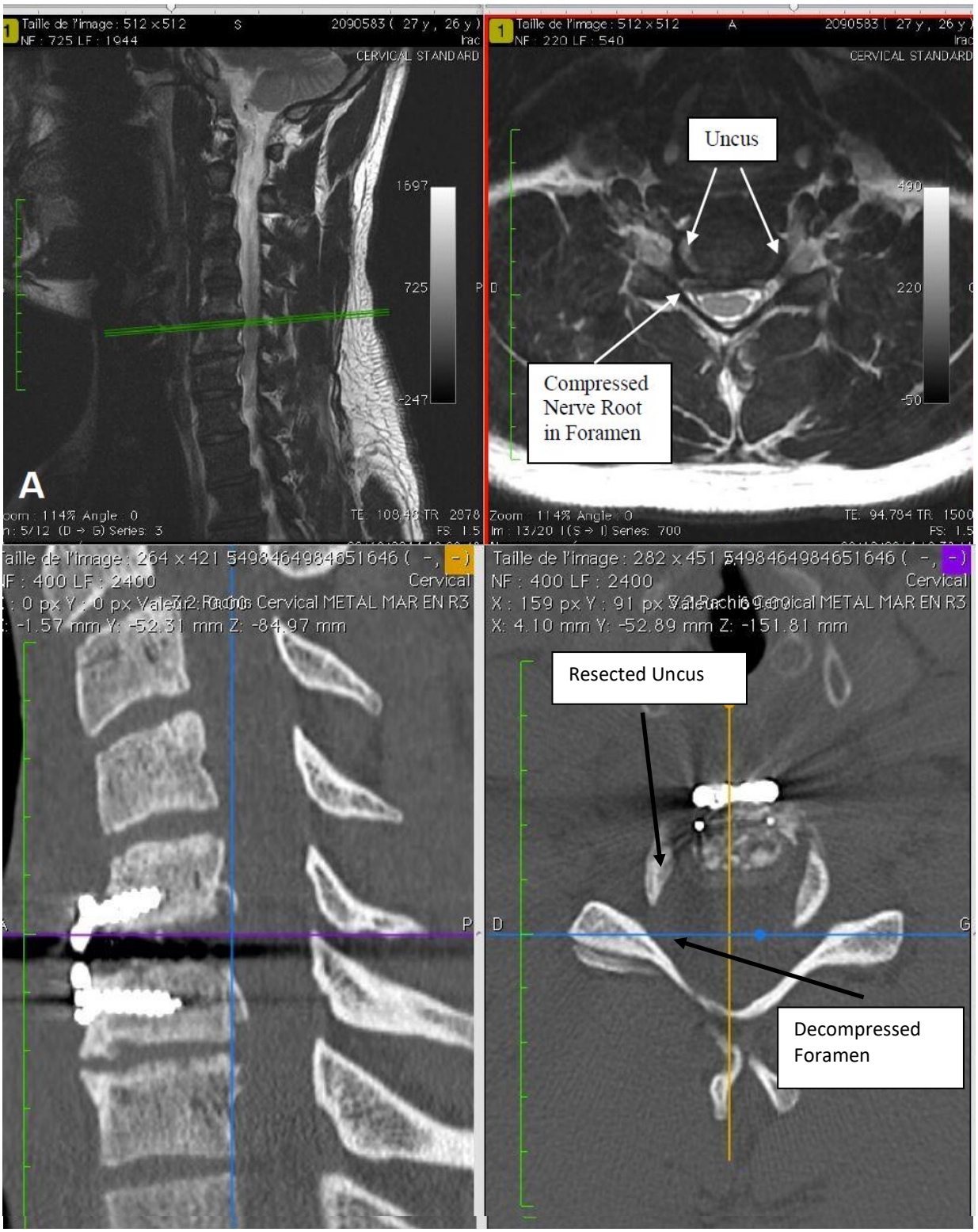

Figure 4: A) Pre-op lateral and axial MRI for a patient with right sided nerve root compression (Patient No 10). B) Post-op CT scan demonstrating resection of uncus and decompressed foramen

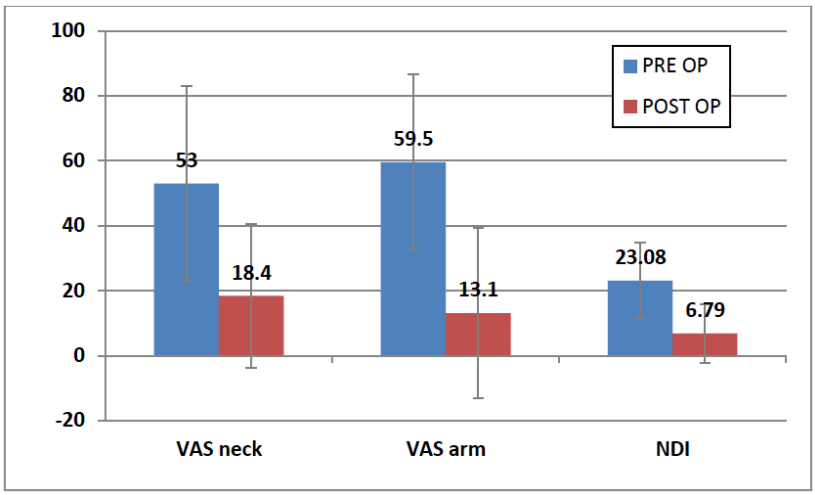

Figure 5: Averages of clinical outcome measures (columns) with standard deviation error bars

4. Discussion

As Table 2 shows, most of the patients reported pain and disability to some extent before the surgery. Patient no. 10 suffered from a herniated disc but did not suffer from significant neck and arm pain or neck disability. Nine of the ten patients suffered from mild to complete neck disability [11]. Except patient no. 10, all patients suffered from significant pain in the arm (VAS>40).

Figure 5 shows the averages of the clinical outcome measures before and after the operation. As the figure shows, all patients reported on reduced pain and disability after the surgery. Patient no. 4 suffered from significant pain after the surgery but his NDI measure improved. The difference between the pre-op and post-op measures group is statistically significant ($p<0.05$ for all three measures).

The authors did not encounter any obstacles using the DReal™ and it was found to be efficient when addressing the distal (or lateral) portion of the uncus, and made the procedure more efficient in terms of foraminal widening. Standing on the opposite side of the patient as the operative site provides direct vision and excellent control of the DReal™ during the uncosectomy.

5. Conclusion

The DReal™ Device, a new instrument designed for safe and efficient resection of bone in difficult to access anatomy, was used to perform posterior uncosectomy to facilitate complete and clinically effective cervical foraminal decompression. The DReal™ enabled uncosectomy, in combination with Kerrison Rongeurs, resulted in effective and efficient bony decompression in patients with cervical stenosis.

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