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Short communication

Novel instrumentation and technique for tissue sparing posterior cervical fusion

Bruce M. McCormack [a,*], Raman Dhawan [b,c]

[a] Department of Neurosurgery, University of California San Francisco, San Francisco, CA, USA
[b] Department of Orthopedic Surgery, FLH Hospitals, Geneva, NY, USA
[c] Department of Orthopedic Surgery, Crouse Hospital, Syracuse, NY, USA

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ABSTRACT

Authors have developed a simple, disposable instrument set for posterior cervical fusion (PCF). The instruments and technique minimize soft tissue disruption and facilitate access for cervical facet joint cartilage decortication. Technique is proposed for select patients not requiring laminectomy.

1. Introduction

Posterior cervical fusion (PCF) is a well established treatment for cervical degenerative disease. Standard exposure has been traditionally achieved with a midline incision immediately dorsal to the intended spinal segment and subperiosteal dissection of the target level and several adjacent spine segments. This procedure while associated with good results and the test of time, is also associated with a significant perioperative morbidity. Detachment and displacement of paraspinal muscles may lead to chronic soft tissue pain. Here, we report a simple instrument set for small incision access to the lateral mass, lateral lamina and facet joint decortication that minimizes soft tissue disruption.

2. Instrumentation

Introduction of all instruments to the lateral mass and facet joint should be aided by use of fluoroscopy to confirm proper placement. The instrumentation system (Figs. 1 and 2) is made of medical grade titanium alloy and consists of the following components:

1. Access chisel: a 285 mm post with a 6 mm spatula shaped tip designed to enter the posterior cervical facet capsule and abut the proximal pedicle (Fig. 3A and B). Spatula shoulder is 13 mm caudal from the tip, a secondary design feature that acts as a stop to the lateral mass bone. The shoulder has a radiolucent marker/hole that, when properly positioned in the facet, approximates the posterior facet line on lateral fluoroscopy (Fig. 3B).
2. Decortication trephine: a 188 mm hollow tubular structure that slides over the facet access chisel. The distal end is a beveled, rat toothed rasp/file. The proximal end is a handle for rotatory decortication movements by the surgeon.
3. Fork mallet: a 120 mm structure used for light malleting of access chisel as well as controlled separation of the guide tube and rasps (see below, components 4 and 5).
4. Guide tube: a 222 mm hollow tubular instrument with a tapered, bifurcated teeth that serves to keep the joint distracted. The guide tube is inserted over the facet access chisel and malleted into the facet joint. The guide tube also has a shoulder 13 mm from the tip to prevent unwanted advancement. Similar to the access chisel, the guide tube shoulder has a radiolucent marker that approximates the posterior facet line on lateral fluoroscopy.
5. Decortication rasps: a 274 mm rasp (file configuration) custom fit to the guide tube for removing facet cartilage and decorticating bone.
6. Decortication burr: a 275 mm rotatory configuration rasp custom fit to the guide tube for removing facet cartilage and decorticating bone.
7. Bone graft tamp: a 262 mm plunger within the guide tube to deliver bone graft material over the decortication bed.

* Corresponding author at: University of California San Francisco, 2320 Sutter Street, Suite 202, San Francisco, CA 94115, USA. Fax: +1 415 923 9255.
E-mail address: bmccormack@neurospine.org (B.M. McCormack).

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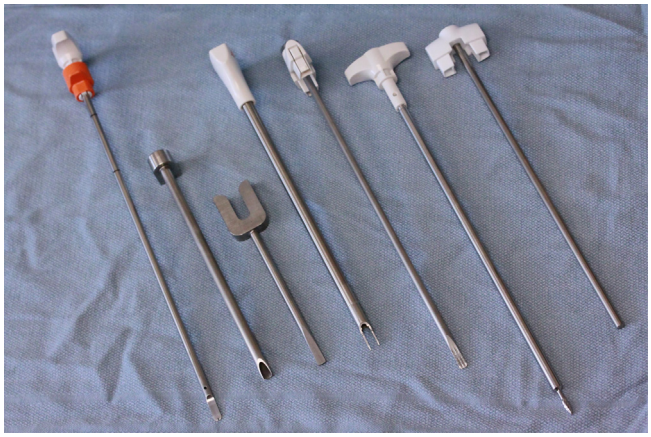

Fig. 1. Instrumentation (from left to right): access chisel, decortication trephine, fork mallet, guide tube, decortication rasp, decortication burr, and bone graft tamp.

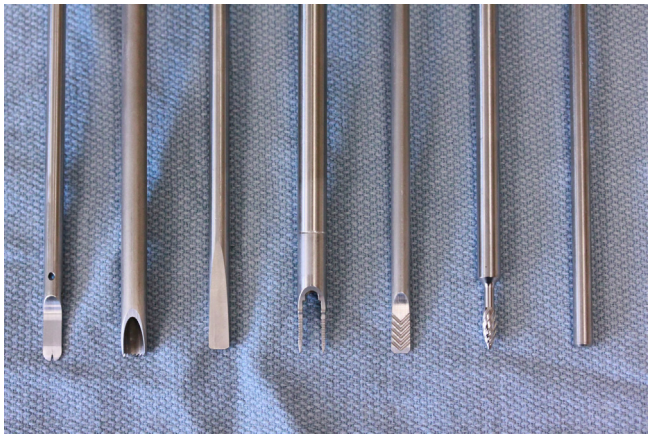

Fig. 2. Instrumentation (from left to right): access chisel, decortication trephine, fork mallet, guide tube, decortication rasp, decortication burr, and bone graft tamp.

2.1. Procedure

Incision is just off mid-line and typically made two to three levels below the target level depending on facet anatomy (Fig. 6). An externally placed Steinman pin aligned with the intended facet under fluoroscopy can guide the rostral caudal placement of the skin incision. Incision is carried through the subcutaneous tissue and ligamentum nuchae. Paraspinal muscles and fascia are dissected from the spinous process and displaced laterally. The access chisel is inserted through the incision into the facet at the target level and advanced until it abuts the pedicle of the rostral vertebra (Fig. 3). The decortication trephine is then advanced over the access chisel to dissect fascia and muscle attachments off of the lateral lamina and lateral mass under visual guidance (Fig. 5). Lateral mass and lamina above and below the facet are decorticated. The guide tube is then placed over the access chisel and advanced into the facet joint (Fig. 6). The guide tube maintains facet distraction, provides visualization, and serves as a working channel. The access chisel is then removed and the facet articular surfaces are decorticated with the rasps and burrs. Bone graft material is then inserted through the guide tube and placed into the decortication bed. All instruments are withdrawn. Multiple levels can be treated using one small incision (Figs. 4 and 6). Paraspinal muscles are re-approximated to the midline and the wound is closed in sequential layers. The procedure is then repeated on the contralateral side.

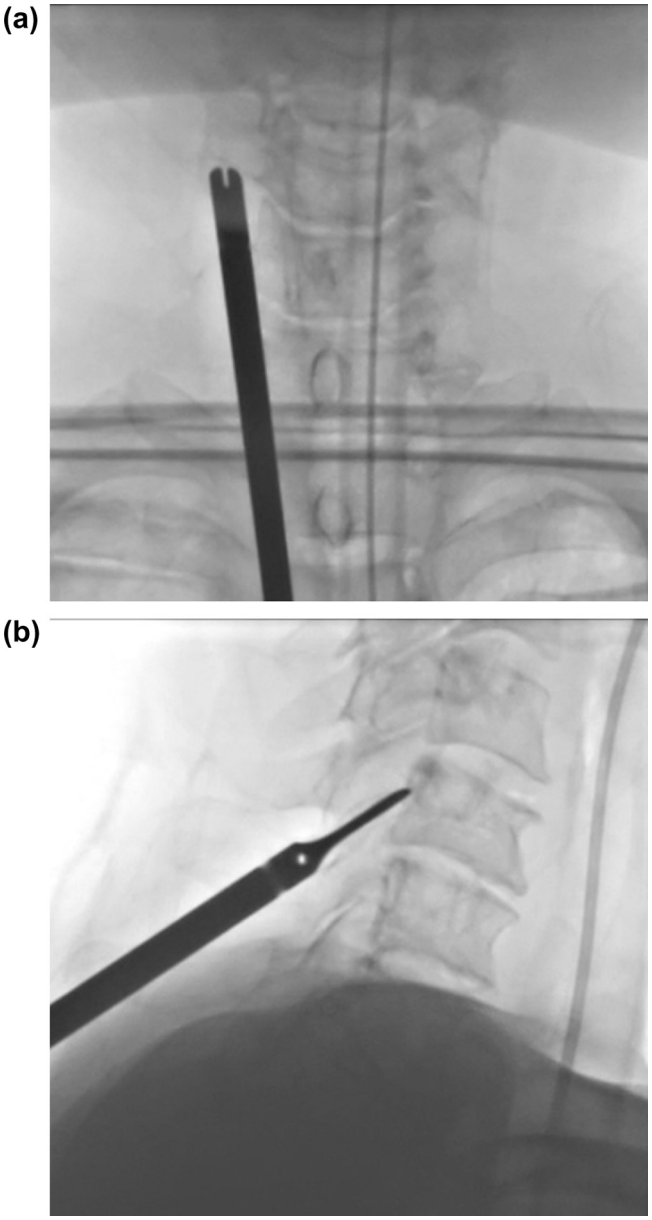

Fig. 3. Intraoperative flouroscopy image showing facet chisel properly positioned in the C5–6 facet on AP (A) and lateral (B) view. On lateral view, the radiolucent hole is at the posterior facet border.

3. Results

Between June 2012 and June 2013, this instrument set and technique have been used in 40 patients who underwent a total of 68 levels of posterior cervical fusion. There were no nerve root or vertebral artery injuries, no procedure related complications, and no revision surgeries following this procedure.

4. Discussion

PCF is a reliable and time tested procedure. However, there are drawbacks. Decortication of facet cartilage can be difficult with some posterior approaches because facet orientation is not in the same plane as the surgical approach. Muscular and ligamentous attachments to the spinous process and medial lamina are detached to facilitate exposure of the lateral mass bone as this is

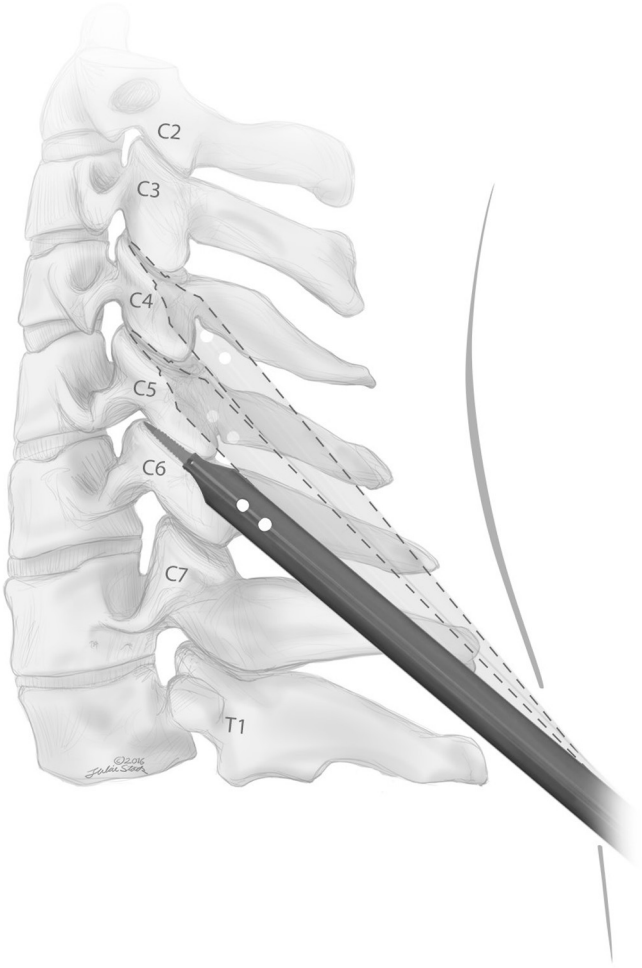

Fig. 4. Lateral cervical view of the guide tube at lower level C5–6 with access to several superior levels through one minimally invasive incision.

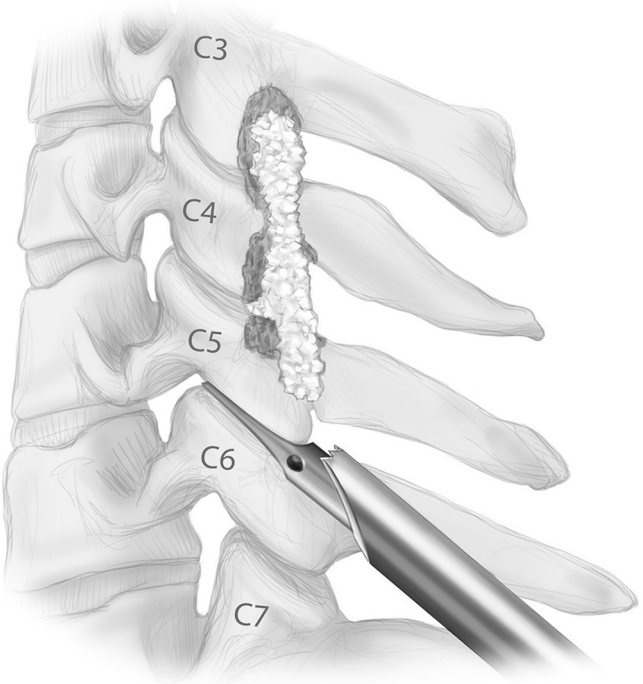

Fig. 5. Lateral cervical view with decortication trephine over access chisel to decorticate superior and inferior lateral masses at C5–6.

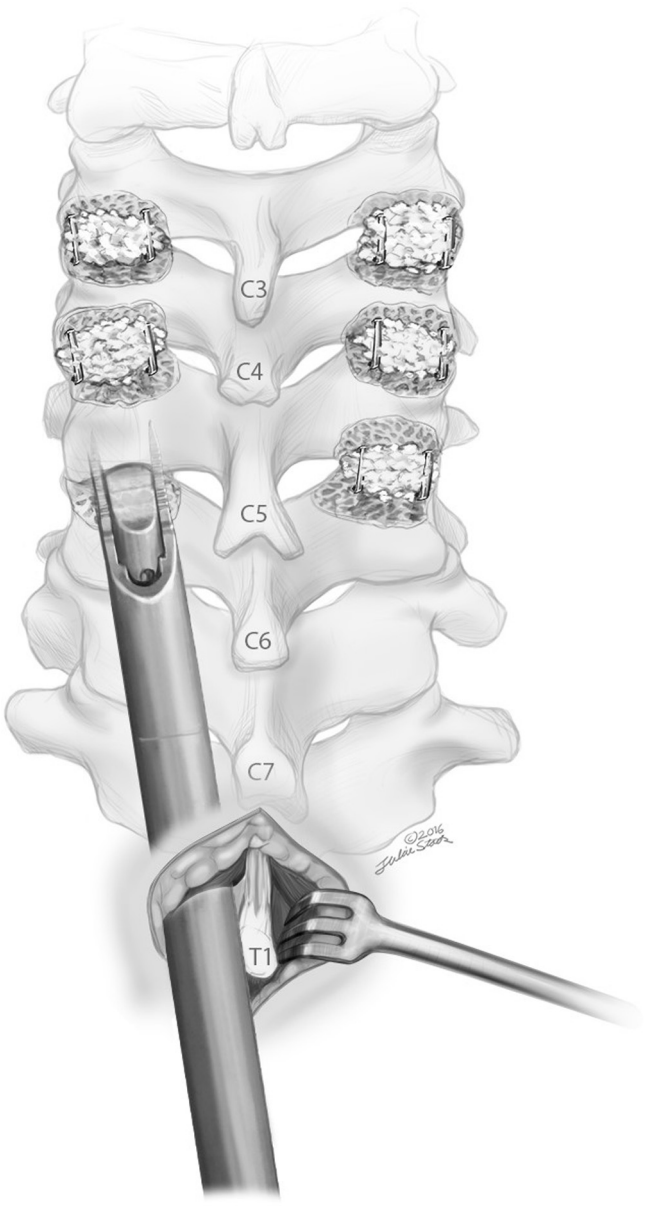

Fig. 6. PA cervical view with guide tube over decortication rasp. Facets are decorticated with medial to lateral anglulation, avoiding medial nerve. Midline minimally invasive incision at C7–T1 with superior two-level access.

the most common site of arthrodesis. Much of this bony exposure is not used for arthrodesis. Adequate exposure for lateral mass arthrodesis requires soft tissue dissection typically a level above and below the intended segment. Muscle displacement with retractors can damage soft tissue.

PCF is associated with significant perioperative morbidity. A retrospective cohort study by Choy et al. of 3401 patients following PCF for a wide spectrum of disorders found a 30-day readmission rate of 6.2%, of which postoperative infection accounted for 17.06% of readmissions [1]. Return to operation rate was 4.97%. A uniform cohort to look at the morbidity of PCF are those patients with symptomatic pseudarthrosis after anterior fusion for degenerative disc disease. This is because these patients can be satisfactorily treated with a salvage anterior or posterior fusion, and successful arthrodesis and not neural decompression is the major determinate in outcome [2]. Carreon et al. reported greater blood

loss, infection and overall complication rate with posterior approaches compared to ACDF [3]. Four to five day hospital stay is typical for PCF because paraspinal muscle dissection makes for a more painful recovery than ACDF [3,4]. Moreover, chronic moderate to severe neck pain has been reported in 28% of patients treated with salvage PCF despite achieving solid arthrodesis [5]. Soft tissue damage has been implicated as one source of this chronic residual pain [5]. Currently only 14% of all cervical fusions in the United States are performed posteriorly [6]. There are many reasons for this, but two are increased perioperative morbidity and long-term myofascial pain problems associated with PCF muscle dissection [7].

Reducing soft tissue damage with PCF is one strategy to reduce perioperative morbidity and improve ultimate outcomes. Approaching the dorsal cervical spine in the same trajectory as the facet surface plane offers advantages even though the approach creates a more distant approach compared to a direct dorsal approach. It allows optimal decortication of the facet cartilaginous surface. A small incision is used to insert an elongated access chisel into the appropriate facet which, confined by facet anatomy, serves as a post extending out through a minimal skin incision. The surgeon uses the post to apply rotatory decorticators to the medial lamina and rostral and caudal lateral mass. A guide tube inserted after the chisel facilitates rasping of the facet cartilaginous endplates, a task which is difficult to perform with open posterior fusion techniques previously described in the literature. Most soft tissue dissection of the lamina and spinous process required with lateral mass fixation or interspinous wiring is avoided. The facet access and decortication instruments described herein can also be used with other PCF approaches to improve facet cartilage decortication.

5. Conclusion

Instruments and technique allow direct visualization for decortication and fusion of the cervical lateral mass and facet joints and minimizes collateral damage to paraspinal muscles.

Disclosure statement

B.M. McCormack has a financial interest in the company that manufactures the instrumentation. No financial support was received for the development or preparation of this manuscript. The other author declares no financial interest or other conflicts of interest related to this work.

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