Recurrent tethered cord syndrome: a novel approach for a difficult surgical condition?

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Tethered cord syndrome (TCS) is a challenging disorder with a complex multifactorial etiology, which includes a thickened terminal filum, postrepair myelomeningocele, lipomyelomeningocele, and postoperative arachnoid adhesions. There are specific indications for surgery and clear surgical options including meticulous microscopic untethering of the cord, dividing the terminal filum, addressing the local pathology, and dividing adhesions. The use of adjuncts such as microsurgical techniques and intraoperative monitoring with microstimulation and recording has proved to be useful in reducing surgical morbidity. Unfortunately, as is common with such troublesome pathologies, the story often doesn’t end there. A number of patients who have undergone surgical treatment for TCS can present with clinical and radiological evidence of recurrent tethering. The treatment of recurrent cases, particularly those with multiple previous procedures or in whom the underlying pathology may not allow for complete microsurgical release, is particularly challenging. Considerable surgical acumen and skill are necessary to avoid neural injury and deal with postoperative complications such as wound breakdown, CSF leakage, and further recurrence of scar tissue, which naturally contracts, leading to further tethering.

There are a host of surgical techniques to avoid retethering and also several treatment options available. These include simple ideas like frequent patient turning while he or she is in the prone position postoperatively and early mobilization to avoid gravitational contact between the neural structures and the dura mater, and the use of synthetic dural substitutes to minimize adhesions. Other methods to minimize retethering include intradural retention sutures placed with subsequent duraplasty using autologous thoracolumbar fascia, and a technique of retaining the cord in the midline by fine stay sutures, between the pia mater and the conus and the anterior dura to posterior osseous elements. In keeping with its severity, there have even been drastic measures such as sectioning of the entire cord at a functionless level in cases of recurrent TCS. Other less desperate treatment options include conservative, symptom-driven care, and reexploratory microsurgical untethering operations. Repeated operations for TCS have the general complications that accompany additional surgery, namely lack of an adequate vascular infrastructure, wound breakdown, and danger to the underlying neural structures.

For the aforementioned reasons, alternative surgical options to manage recurrent or refractory tethered cord syndrome are welcome. In this issue of Journal of Neurosurgery: Spine, Hsieh et al. report on the use of vertebral subtraction osteotomy to treat 2 cases of recurrent TCS. As is common with novel operative techniques, the seeds for surgical innovation were planted in a cadaveric study. Using a fresh-frozen human cadaver model, those authors demonstrated that vertebral subtraction at T-11 and T-12 significantly reduced tension in the terminal filum and lumbosacral nerve roots. In a natural follow-up, Hsieh et al. have elegantly shown how lateral thinking in surgery can be used to treat a complex problem. Using 2 well-described cases of repeatedly surgically treated TCS, they described the application of vertebral subtraction osteotomy to manage this challenging condition. The 2 patients described had undergone 4–5 previous procedures, and in the patient in Case 2, a synthetic dural graft had previously been used in a futile attempt to prevent retethering. The initial conclusions from both cases would suggest that a posterior vertebral subtraction of 15–25 mm can lead to marked reduction in terminal filum tension, equivalent of releasing 90% of neural elements. Such an attempt in a field of recurrent dense fibrosis would certainly not be without a danger to neuronal function.

Although the authors should be commended for the application of lessons learned in one area of spine surgery to another challenging surgical field, the approach
described is not novel. The first report was in the Japanese literature in 1995 by Kokubun\textsuperscript{6} who reported a case of shortening spinal osteotomy, as a new surgical treatment for low-lying conus medullaris. This was followed by Güven et al.\textsuperscript{3} in 2001, who described a transpedicular decancellation osteotomy in 12 individuals who had undergone multiple operations with postlaminectomy kyphosis and fibrosis-related tethered cord. In this group of patients, the osteotomy was also carried out at a vertebral distinct from the site of pathology.

Although the approach of vertebral subtraction in recurrent TCS, as reported by Hsieh et al.,\textsuperscript{4} merits congratulation, 2 points are worth mentioning. First, vertebral subtraction deals with the tethered cord by reducing the vertebral column height, but it does not deal with any local disease. Thus, recurrence of tumor or lesions such as lipoma, pseudomeningocele, adhesions, and focal stenosis are not directly addressed by vertebral column shortening. Second, vertebral subtraction in itself is a major undertaking not without morbidity and complications including neural injury, pseudarthrosis, and scarring or adhesions that can also lead to TCS, as reported recently by 1 of the coauthors of this paper.\textsuperscript{6}

All this withstanding, this description of an elegant and laterally thought-out idea, is worthy of praise, and we look forward to future scrutiny of long-term results of this technique.

References

Response

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We thank Drs. Fehlings and Arvin for their comments. We fully agree with their eloquent editorial comments about our paper and the challenges surgeons face in the treatment of TCS.

First, we would like to acknowledge Dr. Kokubun for the first description of spinal column shortening for TCS.\textsuperscript{3} Given that that article was published in Japanese, we did not become aware of the reference until Dr. Kokubun and colleagues\textsuperscript{2} published their recent report of spinal column shortening osteotomy for vertebral fracture in a patient with TCS.

As Drs. Fehlings and Arvin discussed in their editorial, the impetus to search for an alternative treatment for TCS originates from the significant challenges surgeons continue to face in patients with multiple recurrences of TCS. Despite a multitude of advances in neurophysiologic monitoring and techniques to improve dura and soft-tissue closure, intraoperative neural injury and postsurgical CSF leakage or wound complications are not uncommon in surgery for recurrent TCS.

The concept of decreasing spinal cord and nerve root tension by spinal column shortening was first validated in a novel cadaveric model by the senior author prior to clinical application.\textsuperscript{1} Despite successful outcomes following 2 cases described in our current report and several others performed subsequently, we still do not advocate this treatment for patients with newly diagnosed TCS who are candidates for traditional surgery. In addition, we agree that this procedure is unlikely to be beneficial for patients who have symptoms from local disease processes, such as lipoma, regional intra- or extradural fibrosis, or stenosis. Nevertheless, we believe that in carefully selected patients, spinal subtraction osteotomy can reduce the rate of neural injury, CSF leakage, and wound complications by avoiding repetitive nerve dissection and dural opening with multiple repeated detethering procedures. Despite the relatively limited experience in spinal column subtraction osteotomy for TCS, there is already extensive experience in this procedure in spinal deformity.\textsuperscript{4,6} The safety and complication risks of the procedure have already been established in spinal deformity. On the other hand, long-term neurological function and outcome im-
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...improvement following spinal column subtraction osteotomy for TCS remain to be determined. Patients undergoing this procedure at our centers are actively enrolled in a prospective outcome study approved by our institutional review boards. We look forward to ongoing assessment and scrutiny of the efficacy of spinal column subtraction osteotomy to treat patients with recurrent TCS. (DOI: 10.3171/2008.12.SPINE08835)

References


