Letters to the Editor

NEUROSURGICAL FORUM

Differences between Dynamic Cervical Implant and artificial discs

TO THE EDITOR: We read with great interest the article by Dr. Matgé and colleagues⁹ (Matgé G, Berthold C, Gunness VRN, et al: Stabilization with the Dynamic Cervical Implant: a novel treatment approach following cervical discectomy and decompression. *J Neurosurg Spine* 22:237–245, March 2015). The authors reported on 53 patients with cervical disc disease who were treated with anterior discectomy and Dynamic Cervical Implant (DCI) stabilization. The results were promising and comparable with those of the currently available cervical artificial discs (CADs) on the market. However, there are distinct differences between these devices that need to be clarified.

The basic structure of the DCI is far less sophisticated than CADs. Most CADs are composed of two pieces that form a ball-and-trough mobile joint. The DCI is a piece of metal bent into a U shape that, after insertion into the disc space, provides elasticity during flexion and extension of the neck. The spring-like design of the DCI naturally facilitates extension (like a spring) and limits flexion (like a bumper). In contrast to the DCI, the common CAD is a joint free of any internal force and totally depends on surrounding musculatures during motion. This inherent discrepancy is likely to cause less range of motion (ROM) during flexion and more ROM during extension (Fig. 1). Therefore, the statement, “Another unique feature is the ability of the device to function as a shock absorber, which allows axial compression in flexion, and limited extension from the neutral position, thereby protecting the adjacent levels from excessive stresses,” may not be accurate. In our opinion, the true merit of the DCI is that it is a pro-lordotic device that provides modest anterior column support (certainly less than cages but more than most artificial discs). Whether this unloads the facet joints remains uncertain.

Furthermore, the authors state in their conclusion that the potential advantages of the DCI over anterior cervical discectomy and fusion (ACDF) and cervical total disc replacement include minimizing “the development of ASD [adjacent-segment disease].” We concur with the authors that the presence of only 1 case of symptomatic ASD at 24 months after implantation of a DCI is encouraging, compared to many other series.^{1–15} The clinical evidence provided in the article, however, is not sufficient to support this conclusion. To date, several prospective, randomized, controlled trials comparing 1- or 2-level CADs to ACDF

FIG. 1. Cobb angle measured after implantation of a DCI (A and B [same images provided in Fig. 1 left and right of the Matgé et al.⁹ article]) and after implantation of a Prestige CAD (C and D, our patient) during neck flexion and extension. The DCI (A and B) provided more ROM in extension (A vs C) and allowed less ROM in flexion (B vs D) than the CAD (C and D). Although the radiopaque portions of both devices look similar on lateral radiographs, the CAD provides no spring force at the most-anterior (ventral) aspect of the device.

have yielded no conclusion on the issue of decreasing rates of ASD.^{5,8,10,12}

The development and application of the DCI in the treatment of cervical spondylosis is cutting edge, and the authors should be commended for sharing their experi-

ence with worldwide readers of the *Journal of Neurosurgery: Spine*. The DCI has a unique feature of allowing only flexion and extension while completely eliminating translation, axial rotation, and lateral bending, which all other CADs do. Whether this in-between characteristic has a role in the treatment paradigm of cervical degenerative disc disease and spondylosis remains uncertain and requires more clinical data for evaluation.

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DISCLOSURE

The authors report no conflict of interest.

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Response

We thank Wang and colleagues for their comments on differences between the DCI and CADs. The spring-like design of the DCI with axial stiffness facilitates extension (like a spring with a defined rigidity) and limits flexion (like a bumper with an incorporated stop when both anterior ends are touching), permitting a shock-absorber effect inside the device rather than a shock transmission only to the endplates. The posterior rounded and uncompressible portion of the device maintains disc and foraminal height together with facet unloading. The device also allows some facet joint translation during flexion and extension, as seen on dynamic radiographs.

Biomechanical studies by Auerbach and Rundell¹ and Welke et al.³ did not show excessive stresses on adjacent vertebral levels, as seen also in FXA (functional x-rays analyses) studies by Herdmann et al.²: The MCR (mean center of rotation) of the operated segment moved slightly upwards to the top endplate in contact with the DCI, whereas the MCR of both adjacent segments showed no shift at all during the follow-up period. Thus, we did not observe any radiological signs of segmental degeneration in either adjacent segment after DCI surgery (with regard to MCR, ROM, and disc height at both adjacent segments). Some of the key points of the preliminary biomechanical

studies comparing DCIs to fusion and CADs, which need further confirmation, were as follows: In general, CADs resulted in increased mobility at the index level during both loading and displacement-controlled scenarios. The increased rotational ROM after CAD surgery observed for extension, axial rotation, and lateral bending was associated with increased facet-contact loading. Conversely, DCIs maintained limited ROM at the index level compared with CADs but prevented facet contact in all loading modes. The results demonstrate that by providing limited subaxial motion in the sagittal plane (flexion and extension) but limiting axial rotation and lateral bending, the DCI facilitates protection of the index-level facet joints, while at the same time protecting the adjacent levels from excessive loading. The DCI serves as a compromise between rigid fixation with the CAD and the potential index-level hypermobility demonstrated with the CAD. By protecting the facet joints, the DCI may serve as an alternative to CADs and, furthermore, may provide a motion-preserving alternative to patients with preexisting facet arthrosis and in whom the CAD is currently contraindicated. The reset power of the DCI is a distinct feature compared with the CAD, explaining the pro-lordotic effect mentioned by Wang and colleagues.

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Screw fixation technique

TO THE EDITOR: With great interest we read Mendes et al.'s¹ description of a technique for anterior, endonasal atlantoaxial fixation (Mendes GAC, Dickman CA, Rodriguez-Martinez NG, et al: Endoscopic endonasal atlanto-

axial transarticular screw fixation technique: an anatomical feasibility and biomechanical study. *J Neurosurg Spine* 22:470–477, May 2015). We have placed a single lag screw into the occipital condyle through an anomalous C-2 lateral mass in the setting of basilar invagination but never across a normal C1–2 facet. The technique is intriguing and indeed may be useful for some patients in providing increased biomechanical stability in association with posterior fixation or even acting alone to provide arthrodesis.

However, a few significant issues will need to be overcome. The authors appropriately noted the significant limitation of current instruments and required a custom-made 45° angled screwdriver. They described their exposure as allowing them to access the C1–2 articular surface for decortication and autograft placement. In our experience with approximately 35 patients, the upper C-1 anterior arch was easily accessed, but C1–2 was not, except in the setting of basilar invagination. In these patients, the additional problem of anterolisthesis of C-1 on C-2 significantly complicated the technique described. In a cadaver, surgical access tends to be slightly greater than in living patients, perhaps because of craniocervical settling and shrinkage of the nasopharyngeal mucosa.

Intraoperatively, limited caudal access usually makes it difficult to visualize the C1–2 joint and nearly impossible to perform debridement of the joint and bony fusion. That said, many patients with chronic C1–2 instability already have some degree of pseudarthrosis, and elderly patients may not be amenable to 2 procedures. Therefore, a single approach, even if it only provides decompression and instrumentation without fusion, may be all that can be tolerated and will at least provide some option for these patients.

In describing their approach, they mention the performance of a sphenoidotomy. This step is unnecessary for a typical transodontoid approach (though originally described) and is only needed if there is severe platybasia with the dens invaginated behind the flattened clivus. If this additional room is needed for instrumentation, it would be useful to hear the authors comment on this.

Finally, the potential for injury to the vertebral artery is discussed, but aberrant internal carotid artery anatomy (dolichoectasia) is more common in the elderly and needs to be evaluated (CT angiography) prior to any anterior approach to the craniovertebral junction.

This technique does hold great promise. It is unlikely that the “clean contaminated” concerns with endonasal access will be an issue any more than in intradural surgery, but the risk of infection with retained hardware needs to be addressed. We look forward to further reports on the technique and the development of appropriate instrumentation. We applaud the authors for their anatomical knowledge, ability, and creativity in creating this technique.

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DISCLOSURE

The authors report no conflict of interest.

Reference

1. Mendes GAC, Dickman CA, Rodriguez-Martinez NG, Kalb S, Crawford NR, Sonntag VKH, et al: Endoscopic endonasal atlantoaxial transarticular screw fixation technique: an anatomical feasibility and biomechanical study. **J Neurosurg Spine** 22:470–477, 2015

Response

We appreciate the comments of Drs. Gardner, Fernandez-Miranda, Snyderman, and Wang regarding our recent paper. Their significant practical experience will further the development of the anterior transarticular technique.

A limitation of our study is the normal craniovertebral junction anatomy of the cadaveric specimens. We learned that the placement of anterior transarticular screws was feasible in this setting; however, we have not yet attempted our technique in live surgery. We hypothesize that this technique could be applied in select cases when preoperative planning studies suggest that the C1–2 lateral masses line up in the appropriate anterior-to-posterior and cranial-to-caudal trajectory.

We would like to address several comments made by the Pittsburgh team. First, performing a sphenoidotomy was helpful in increasing surgical freedom and improving manipulation of the angled instruments and screws. Second, regarding access to the C1–2 joint for arthrodesis, one might consider supplementing the endonasal exposure with a transoral corridor to achieve more caudal access and facilitate decortication of the joint. Third, their comment about the potentially problematic anatomy of the ca-

rotid artery is particularly apt, and we agree that its course should be evaluated prior to considering the application of this surgical technique.

As we stated in our report, the proposed anterior transarticular technique is not meant to replace the posterior approach, which has demonstrated value. Our group, under the leadership of Drs. Volker Sonntag, Curtis Dickman, and Neil Crawford, has played an important role in advancing posterior fixation of the craniovertebral junction. We hope that our new technique will not only give clinicians another option for select patients but also ultimately improve the safety and morbidity of patients with disease treated in this challenging region.

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