Neurosurgical forum
Letters to the editor

Titanium Cervical Cage

TO THE EDITOR: In a recent issue of your journal, there was an article entitled “Subsidence of the Wing titanium cage after anterior cervical interbody fusion: 2-year follow-up study,” by Schmieder et al. (J Neurosurg Spine 4: 447–453, June, 2006).

Abstract

Object. Cage subsidence occurs after anterior cervical discectomy and fusion (ACDF). The aim of this prospective study was to evaluate subsidence and total segmental height after implantation of a newly designed Wing titanium cage. Furthermore, alignment of the entire cervical spine was analyzed 2 years after surgery.

Methods. Fifty-four patients (26 women and 28 men) whose mean age was 48.3 years underwent ACDF. Follow-up examinations were performed at discharge and 6, 12, and 24 months postoperatively by an independent investigator. The clinical course was evaluated using the visual analog pain scale and the Prolo scales. Measurements of subsidence and total segmental height were conducted, and the alignment of the entire cervical spine was classified using two methods.

In 54 patients 64 levels were fused. The patients noted a significant reduction of pain, and scores on both Prolo scales were significantly improved. At the 2-year follow-up examination, subsidence was present in 30 of the 67 fused segments. There was a statistically significant correlation between subsidence and the presence of posterior spondylosis at the initial surgery. Furthermore, there was a significant correlation between reduction of total segmental height and the presence of subsidence; however, subsidence did not prevent the development of a solid bone arthrodesis (fusion rate 98%) or have an adverse effect on the alignment of the cervical spine.

Conclusions. Titanium Wing cage–augmented ACDF was associated with comparatively good long-term results. Subsidence was present but did not cause clinical complications. Furthermore, radiological studies demonstrated that the physiological alignment of the cervical spine was preserved and a solid bone arthrodesis was present at 2 years after surgery.

The authors performed the procedure in 54 patients, proving that interbody decompression and fusion with titanium cages is a good alternative to plates and screws. Data in the 117 cases in our experience further confirm the practicability of this procedure. These cases were those in which the titanium cage was used without any major complications. Since then, we have switched to polyetheretherketone (PEEK) cages, which have several advantages over the titanium ones. During the past 2 years, we have been using PEEK cages for almost 2 years now. The clinical results are as good as those with titanium cages. Long-term follow-up evaluations will provide data regarding fusion and subsidence. Our impression so far is that there is a reduced number of cases with cage migration. Therefore, we agree that this procedure can be well recommended.

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Retroperitoneal Approach


Abstract

The retroperitoneal surgical approach has gained acceptance as a way to access the ventral aspect of the lumbar spine. Visualization is often limited, however, by the psoas muscle, which lies along the posterolateral aspect of the spine. Improved visualization is often attempted by retracting the muscle from the wound, which generally pulls the muscle laterally from the spine but not posteriorly, which is desirable for a better exposure of the spine, particularly the neural elements. In this paper, the authors describe a simple, atraumatic technique for retraction of the psoas muscle that allows excellent visualization of the spine.

The authors’ idea of using threads for dynamic retraction of the psoas major muscle to expose the lumbar spine in the retroperitoneal approach is enlightened. As the pictures showed, exposure with this method is good. Moreover, the author highlighted the strategy to avoid lumbar spine nerve injury. However, there is at least one problem, according to our experience, that the authors did not mention: genitofemoral nerve injury.

The genitofemoral nerve arises from L-1 and L-2. It runs through the substance of the psoas major muscle, emerging near its medial border opposite the third or fourth
They found that the level of the genitofemoral nerve (Fig. 1). At a variable distance above the inguinal ligament, the nerve divides into a genital branch and a femoral branch. The genital branch crosses the lower end of the external iliac artery, enters the inguinal canal through the deep inguinal ring, and runs with the spermatic cord to the scrotum. It supplies the cremaster muscle and skin of the scrotum in the male. In the female, it accompanies the round ligament of the uterus and supplies the skin of the labia. The femoral branch runs on the lateral side of the external iliac artery, passing behind the inguinal ligament, and enters the femoral sheath lateral to the femoral artery. It supplies the skin over the upper part of the femoral triangle.

The positions at which the genitofemoral nerve emerges on the abdominal surface of the psoas major muscle were studied by Moro and colleagues. They found that the level at which the genitofemoral nerve crosses the psoas major muscle ranges from the cranial third of the L-3 vertebral body to the caudal third of the L-4 vertebral body. Usually, the genitofemoral nerve is visualized on the surface of the psoas major muscle. In fact, we can see the nerve in Fig. 1a, b, and d of Dr. Rao and colleagues’ article (the somewhat white line enclosed by the psoas major muscle fascia). In Fig. 1a and b, we can see that the nerve is pressed by the threads.

Injury of the genitofemoral nerve can result in hyposthesia of the scrotum or labia major and/or skin over the femoral triangle and loss of the cremasteric reflex. In fact, a case of transitory genitofemoral nerve paralysis after anterior lumbar operations has been reported. Occasionally, genitofemoral neuralgia may occur, which is a more troublesome condition. The clinical features of genitofemoral neuralgia consist of intermittent or constant pain in the inguinal region with radiation of pain to the genitalia and upper thigh. Although no case of genitofemoral neuralgia have been reported after anterior lumbar operations, it does occur due to entrapment of the nerve in adhesions following appendectomy, herniotomy, or even blunt trauma to the inguinal region. Treatment includes nerve blocking, sometimes even nonsurgical blocking, or section of the nerve.

So, we think it is better to pass threads under the genitofemoral nerve to avoid entrapment of this nerve, even though bruising of the psoas major muscle may cause genitofemoral neuralgia. Although the incidence of this complication is rare, it is better to inform the patient before the surgery.

**References**


**RESPONSE:** We are grateful to Drs. Kong and Wang for their thorough and insightful comments on our technical note. Their comments regarding possible injury to the genitofemoral nerve are certainly germane. (Indeed, one of the reviewers of our original submission was concerned about potential injury to the nerve.) As mentioned in their letter, the course of the genitofemoral nerve is quite superficial at some points, particularly at the L3–4 levels of the psoas muscle. If visualized, entrapment of the nerve can be avoided with the use of sutures. One of the advantages of our technique is the use of multiple sutures placed along the length of the psoas muscle. This method allows for distribution of the retraction forces over a wide area. Moreover, the tension of each suture can be easily adjusted and periodically released. We believe that this “dynamic retraction” minimizes trauma to both the muscle and the nerve. In our experience, no patient has reported either hip flexor weakness or genitofemoral neuralgia. Certainly, as Drs. Kong and Wang indicate, the patient must be warned of any potential injury to the nerve before surgery.

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**Thoracic Myelopathy**

**TO THE EDITOR:** We read with interest the article by Aizawa and colleagues (Aizawa T, Sato T, Sasaki H, et al: Thoracic myelopathy caused by ossification of the ligamentum flavum: clinical features and surgical results in the Japanese population. *J Neurosurg Spine* 5:514–519, December, 2006). The authors reported on the biggest clinical trial of thoracic ossification of the ligamentum flavum (OLF), including clinical features, surgical method, and outcome.

**Abstract**

**Object.** Data obtained in patients with thoracic myelopathy

![Fig. 1. Drawing illustrating the genitofemoral nerve and its relation with the psoas major muscle.](image-url)
caused by ossification of the ligamentum flavum (OLF) were retrospectively reviewed to clarify clinical features and surgical outcomes in the Japanese population.

**Methods.** Seventy-two patients who underwent surgery for OLF-induced myelopathy in the Miyagi Prefecture, Japan, between 1988 and 2002 were observed for at least 2 years. Clinical data were collected from medical and operative records. The patients were evaluated pre- and postoperatively using the modified Japanese Orthopaedic Association (JOA) scale (maximum score 11). The relationships among various factors (age, sex, and preoperative duration of symptoms) affecting the preoperative severity of myelopathy and postoperative improvement were examined.

**Conclusions.** In this series the surgical outcome was relatively good and depended on the severity of myelopathy; thus early and correct diagnosis is required to avoid poorer results. The male/female ratio was 3.2 and the mean patient age at surgery was 61 years for men and 68 for women. The patients commonly noticed numbness or pain in their lower legs or gait disturbances. In a total of 104 decompressed intervertebral disc levels, more than 80% of the ossified ligaments were at the T9–10 level or lower. The mean preoperative JOA score of 5.1 improved to 7.9 after an average of 46 months. The postoperative results statistically depended on the preoperative severity of myelopathy. Among studies of patients with OLF-related myelopathy, the present study had the largest sample size, which should help clarify the clinical features of OLF myelopathy.

We here share some of our opinions.

First, the authors stated that “The choice of surgical procedure was based on the CT classification of OLF; the lesion was categorized as lateral, extended, enlarged, fused, or tuberous . . . .” In the first three types, the ossifications in the bilateral ligamentum flavum did not fuse at the middle of the spinal canal or exist unilaterally. Thus, the ossified ligament could be removed by either fenestration or French-door laminectomy. On the other hand, in the latter two types, the ossifications of both sides fused so that they were removed by en bloc laminectomy.” This is an enlightened approach; however, one thing should be emphasized. As we have reported previously,1 the shape of the ossified ligaments on computed tomography (CT) can change according to the different scanning planes. We found a variety of types on different planes in one patient. Therefore, a thin-slice CT scan should be obtained. It is important to take a correct axial image of the pathological lesions, and the images of all pathological lesions without exception should be included. If there are different types of images on serial scanning, the classification should be based on the aggravated lesion.1

Second, the authors mentioned a fenestration or French-door laminectomy method. We followed the procedure described by Smith and Godersky,2 who reported on seven cases of OLF, all treated using laminectomy/medial facetectomy. No detail of fenestration could be found. Two other articles were cited, which we cannot read because they are published in Japanese. We cannot find the method in the English literature either. According to our experience, the thoracic segment is different from the cervical and lumbar regions. The operation must be performed totally out of the spinal canal.4 A tiny invasion can result in severe spinal cord injury. Thus, it would be very helpful if the authors described the surgical method in detail.

Third, we carefully studied Fig. 2 in their article. In comparing the figure with its legend, we wondered whether there was a mistake in the description for panels A and B. We here share some of our opinions.

**References**

1. Kuh SU: Answer to the letter by W. Wang et al. concerning the article: Contributing factors affecting the prognosis surgical outcome for thoracic OLF (S. U. Kuh et al.). *Eur Spine J* 15: 1030, 2006


**RESPONSE:** We thank Drs. Kong and Wang for their valuable comments on our paper about OLF. As they mentioned, some of the references were written in Japanese because patients with OLF myelopathy are more frequently seen in Japan than in other countries. Thus, not all readers of the *Journal of Neurosurgery: Spine* can read those articles.

Their first comment was about the CT-demonstrated shape of OLF. As Drs. Kong and Wang pointed out, the shape of the ossification sometimes changes according to the different scanning planes.5 We also obtain several CT scans from pedicle to pedicle of each intervertebral segment in every patient. As our coauthors indicated, ossification at the just cranial plane of the facet joint center alone mostly affects the narrowing of the spinal canal, which should be represented by the CT-demonstrated shape of the OLF.1 Therefore, we use this plane for classification of the OLF shape. Basically, the surgical procedure is selected depending on this CT classification. However, we check all CT planes in detail preoperatively. When the ossifications of both sides fuse at the center of the spinal canal in any plane, which is not common in our experience, we actually choose en bloc laminectomy.

Their second comment was about the fenestration or French-door laminectomy method. Our paper in the textbook *Ossification of the Posterior Longitudinal Ligament*, which was recently published, should promote an understanding of those surgical procedures.6 We include an illustration of the two methods in the present letter (Figs. 1 and 2). Briefly, the technical points of these procedures are as follows. The outer cortex and cancellous layer of the laminae that contain the OLF are first removed between each chevronlike portion by using an air drill. The transverse incisions are made just at the cranial or caudal side of the chevronlike portion. The lateral longitudinal incisions are made at the medial margin of the pedicles and are curved slightly more laterally at the level of the facet joint to avoid the site where the OLF is located deeply anterior while preserving the most lateral portion of the joint. A central longitudinal incision is made at the midline portion of laminae.
traversing the interlaminous space. Then, the laminae are carefully opened at the midline.

The last comment was about the CT classification. Figure 2A–C are somewhat complicated, and we are very sorry that Fig. 2C (not 2B) should be identified as closer to the lateral type, and Fig. 2A as the enlarged type. The comments concerning our classification are correct in the figure legend. The OLFs of the lateral and extended types are located only in the capsular portion of the ligamentum flavum, and thus these ossifications are not large. They usually cause spinal canal narrowing with degenerative changes of the facet joints as spur formations and/or the developmental narrow canal.

References

Bone Morphogenetic Protein and Fusion

To the Editor: In their article (Villavicencio AT, Burneikiene S, Nelson EL, et al: Safety of transfornaminal lumbar interbody fusion and intervertebral recombinant human bone morphogenetic protein–2. J Neurosurg Spine 3: 436–443, December, 2005), Villavicencio and colleagues referred to the work by Haid et al., claiming that the fusion rates during posterior lumbar interbody fusion using recombinant human bone morphogenetic protein (rhBMP)–2 with cylindrical interbody cages were lower in patients treated with BMP-2 than in those treated using an autograft (77.8 and 92.3%, respectively).
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Abstract

Objective. Recombinant human bone morphogenetic protein–2 (rhBMP-2) is being increasingly used for spinal fusion. There are few data regarding its clinical safety, effectiveness, and clinical outcome when applied on an absorbable collagen sponge (ACS) in conjunction with allograft for transforminal lumbar interbody fusion (TLIF).

Methods. Seventy-four consecutive patients undergoing TLIF for degenerative disc disease were divided into five groups depending on whether the patient underwent a minimally invasive or open approach, as well as the number of spinal levels surgically treated. Surgery-related data, fusion results, complications, and clinical outcome were evaluated. The mean follow-up duration was 20.6 months (range 14–28 months). The radiographic fusion rate was 100% at 12 and 24 months after the surgery. No bone overgrowth or other complications related to BMP use were demonstrated.

Conclusions. Analysis of the results demonstrated that TLIF combined with a BMP-2–soaked ACS is a feasible, effective, and safe method to promote lumbar fusion. There were no significant intergroup differences in clinical outcome between patients who underwent open compared with minimally invasive procedures. Patient satisfaction rates, however, were higher in the minimally invasive procedure group. The efficacy of BMP-2 was not dependent on which approach was used or the number of spinal levels that were treated.

Note, however, that the success rates as expressed in percentages are exactly opposite, indicating that the use of recombinant BMP was superior, although not statistically so, compared with autograft treatment. This finding accords with our own, as well as with the experience of other investigators using recombinant BMPs in different bone microenvironments including long bone nonunions and acute fractures, scaphoid nonunions, and spinal fusions.

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References


RESPONSE: We thank Drs. Smoljanovic, Vukicevic, and Pecina for their letter and corrections. The inaccuracy was related to some difficulty in following the results that had been reported for the mentioned prospective, randomized clinical study. We apologize for failing to notice the change in the reported fusion rates at 24 months. We would like to point out some additional discrepancies in the various publications regarding this same study. The study was initially presented as a prospective, randomized clinical trial in which 71 patients had been enrolled at 14 investigational sites. Patients underwent posterior lumbar interbody fusion (PLIF) procedures with threaded cages and were randomized into two groups: cages were filled with either autogenous bone graft (36 patients) or BMP-2 (35 patients). The following results were reported: “the fusion rate was lower in the INFUSE Bone Graft group at the 12-month postoperative time point” (see Fig. 32). The final paper by Haid et al. included only 67 patients (34 investigational and 33 control) with fusion rates of 92.3% (investigational) compared with 77.8% (control) at the 24-month follow up.

We attempted to follow these results and determine whether patients lost to follow up were accounted for. Fusion rates were equal (93.1%) for both groups at 6 months post-treatment. The rates for the same study were 84% (investigational) compared with 90.5% (control) according to McKay and Sandhu, and 85.2% (investigational) compared with 92% (control) according to Haid et al. at the 12-month follow up.

The authors had stated that at least 90% of the patients in both groups were available for follow up at 12 months post-surgery. However, they stated that the “decrease in fusion rate in the investigational group at 12 months appears to be artificially low because seven patients who were evaluated at 24 months could not be evaluated at 12 months.” Thus, if seven patients were not available, then only 79.4% of the patients (27 of 34) for follow up and not at least 90% as stated in the paper. As Smoljanovic and colleagues correctly noted, the success rate was just the opposite at 24 months (92.3% for the investigational group compared with 77.8% for the control group). This difference was not statistically significant. Moreover, if one believes the fusion rate (97.3%) for the investigational group (Table 3 of their paper), the difference may have been statistically significant.

We would also like to point out that Haid et al. stated that “patients who had secondary surgeries because of persistent low-back symptoms and clinically suspected nonunions were considered as having failed fusions and were classified as failures in all fusion calculations, regardless of their independent radiologic assessment.” These same authors continued with the following statement: “three [patients in the investigational group] were classified as failures because they had undergone a second spinal surgery at the same level but were not considered radiographic fusion failures.”

Therefore, it remains unclear whether the investigators of this prospective study made some simple miscalculations or whether, as one of the authors stated in the response to the commentary, “the possibility of having a substance that precludes the use of harvested iliac crest autograft and that enhances the fusion process is desirable and unquestionably biases our interpretation of the data.”

For these reasons we are unable to agree with Smoljanovic and associates that the results of this particular study “indicate that the use of recombinant BMP-2 was superior.” We have cited quite a few studies with rhBMP-2 applications in spine fusion surgery in which superior results were demonstrated, including ours with a 100% radiographic fusion rate. Last and most important, we definitely cannot...
agree that the results of using rhBMP-7 in scaphoid and tibial nonunions could prove any efficacy or safety of rhBMP-2 in spine applications. Extensive reviews on this subject have been presented elsewhere; even a posterolateral spine fusion cannot be compared with interbody lumbar fusion.

**References**


