



American  
Association of  
Neurological  
Surgeons



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Kerry N. Weems, Acting Administrator  
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Department of Health and Human Services  
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Dear Mr. Weems:

On behalf of the American Association of Neurological Surgeons (AANS), Congress of Neurological Surgeons (CNS), North American Spine Society (NASS), Scoliosis Research Society (SRS), and Spine Arthroplasty Society (SAS), we appreciate the opportunity to comment on the recently released CMS posting of potential National Coverage Determination (NCD) topics. In particular, our comments refer to the following four proposed NCD topics: 1) Bone Morphogenetic Proteins (BMP), 2) lumbar fusion for degenerative disc disease, 3) artificial cervical discs, and 4) vertebroplasty (VP) and percutaneous vertebral augmentation (kyphoplasty) (KP).

The Medicare national coverage determination process is potentially a very powerful tool to define and regulate quality health care. At its best, it can encourage critical analysis of the medical literature and the practice of evidenced based medicine. It can support best treatment options, limit unsubstantiated care and direct and stimulate needed research. At its worst, however, it can restrict individual patient treatment options and decisions based upon physician experience and be applied inappropriately and in unintended ways, especially by non-Medicare insurance carriers.

Three areas of concern need to be highlighted. First, the study population for an NCD must be clearly defined. For example, spinal fusion is a procedure performed for a wide variety of diagnoses ranging from fracture to spinal deformity to disc degeneration. Each sub-group has

different treatment indications and different levels of evidence. An NCD should clearly identify to whom it does and does not apply. The specific recommendation should not be expanded without careful consideration to dissimilar groups of patients with different diagnoses.

Second, an NCD focuses on the Medicare population (over age 65 or patients with permanent disabilities). Modern medicine realizes that individual patient physiology is a better metric than a patient's age for determining care. When NCDs are based on age, (for example, non coverage over the age of 65) there should be a mechanism for individual consideration for atypical cases (For example, the 68 year old marathon runner, or the 22 year old paraplegic).

Finally, when evaluating the literature, many studies do not specifically include or target the Medicare population. Such research should not be summarily dismissed in the NCD process. It does require, however, careful analysis to determine if and when the study conclusions can be extrapolated to the Medicare population. Similarly, studies done primarily in the Medicare population may be applicable to younger, non-Medicare patients.

A task force composed of members of the above societies was convened to review the proposed NCD topics. A list of the task force members, as well as their disclosures, is attached. The medical evidence, as well as some pending publications and some research in progress, was reviewed and summarized for each topic. Each topic was then evaluated using three criteria:

1. Strength of the evidence
2. Relevance to the Medicare population
3. Likelihood that an NCD will improve the quality of spine care

Using these criteria, we have attempted to rank the topics in order of importance to patients. CMS NCD proposed topics in order of importance to Medicare patients:

1. BMP
2. VP/KP
3. Multilevel fusions
4. Cervical TDA

We have also taken the liberty of suggesting additional topics for NCD consideration in the future, which may be beneficial for CMS to consider. Those topics are as follows:

1. pulsed radiofrequency facet rhizotomy
2. moderate sedation
3. spinal orthosis
4. dynamic spinal fixation
5. interspinous distraction
6. intraoperative spinal monitoring

## **Bone Morphogenetic Protein (BMP)**

### *CMS Proposed Topic-*

“Members of the BMP family are potentially useful as therapeutics in areas such as spinal fusion. BMP-2 and BMP-7 have been shown in clinical studies to be beneficial in the treatment of a variety of bone-related conditions including delayed union and non-union. BMP-2 and BMP-7 have received Food and Drug Administration (FDA) approval for human clinical uses. Certain off-label uses in cervical spine fusion may be associated with life-threatening complications. Is the evidence adequate to demonstrate health improvements in the Medicare population?”

### **Task Force Comments**

Since FDA approval of rhBMP-2 (Medtronic) in 2002, BMPs have been widely used during spine fusion. The initial indication for BMP (rhBMP-2), based upon a premarket study by Medtronic Sofamor Danek (Memphis, TN) was as a bone graft substitute for use during anterior lumbar interbody fusion at a single level, L4-S1 performed in conjunction with an interbody titanium cage (LT cage-Medtronic). Its use in anterior lumbar spine surgery has expanded to treat multiple levels of pathology and to include interbody devices from different manufacturers and devices of varying compositions (metal, bone and synthetic substances). Its “off-label” use has also been extended to posterior lumbar spine applications such as posterolateral fusion (PSF) or transforaminal interbody fusion (TLIF), and, to a much lesser extent, cervical spine applications have been reported. We will briefly review the evidence and comment on each of these uses

### **Anterior Lumbar Spine**

Multiple studies, both basic science (1-3) and clinical (4-12), have substantiated the use of rhBMP-2 as a substitute for iliac crest bone graft (ICBG) in anterior lumbar interbody fusion. Equivalent fusion rates for have been demonstrated in a randomized prospective trial comparing anterior interbody fusion with either BMP or ICBG at a single level, L2-S1 in conjunction with titanium interbody cages. Multiple case series have also demonstrated its effectiveness (13-19). BMP has been shown to be safe (20) and eliminates the need for a separate incision to obtain bone graft and its associated morbidity. Despite its high product cost, BMP has also been shown to be cost effective (8-9) through more rapid mobilization, decreased hospital stay and more rapid return to work. The majority of these studies were done in younger patients and do not specifically address the Medicare population. Younger patients with strong, non-osteoporotic bone are required for fixation of the interbody titanium cage. There is no evidence to suggest that the BMP would be less safe or less effective in an older patient. Indeed, bone quality and not age may be a more important factor to consider when pathology permits a choice between anterior or posterior approach to achieve spinal fusion.

### **REFERENCE LIST- Anterior Lumbar Spine**

1. Sandhu HS, Toth JM, Diwan AD, Seim HB III, Kanim LEA, Kabo JM, Turner AS, “Histological evaluation of the efficacy of rhBMP-2 compared with autograft bone in sheep spinal anterior interbody fusion” *Spine* 27 (6): 567 – 575, 2002.

2. Hecht BP, Fischgrund JS, Herkowitz HN, Penman L, Toth JM, Shirkhoda A “The use of recombinant human bone morphogenetic protein 2 (rhBMP-2) to promote spinal fusion in a nonhuman primate anterior interbody fusion model” *Spine* 24 (7): 629 – 636, 1999.
3. Boden SD, Martin GJ Jr, Horton WC, Truss TL, Sandhu HS, “Laprosopic anterior spinal arthrodesis with rh BMP-2 in a titanium interbody threaded cage.” *J Spinal Disord* 11: 95-101, 1998.
4. Burkus JK, Sandhu HS, Gornet MF. “Influence of rhBMP-2 on the healing patterns associated with allograft interbody constructs in comparison with autograft.” *Spine*, 31(7):775-81, 2006.
5. Burkus JK, Sandhu HS, Gornet MF, Longley MC “Use of rhBMP-2 in combination with structural cortical allografts: clinical and radiographic outcomes in anterior lumbar spinal surgery” *J Bone Jt Surg*, 87 (6): 1205-1212, 2005.
6. Burkus JK, Heim SE, Gornet MF, Zdeblick TA “Is INFUSE Bone Graft superior to autograft bone? An integrated analysis of clinical trials using the LT-CAGE lumbar tapered fusion device” *J Spinal Disord Tech*, 16 (2): 113 – 122, 2003.
7. Burkus JK, Dorchak JD, Sanders DL “Radiographic assessment of interbody fusion using rhBMP-2” *Spine*, 28 (4): 372 – 377, 2003.
8. Polly DW, Ogilvie JW, Mafilios MS, Ackerman SJ, Wang JC, Heim SE, Shaffrey CI, Stralka SW, Sandhu HS “A cost analysis of bone morphogenetic protein versus autogenous iliac crest bone graft in single-level anterior lumbar fusion” *Orthopedics*, 26(10): 1027 – 1037, 2003.
9. Ackerman SJ, Mafilios MS, and Polly DW “Economic Evaluation of Bone Morphogenetic Protein Versus Autogenous Iliac Crest Bone Graft in Single-Level Anterior Lumbar Fusion” *Spine*, 27 (16s): 594-599, 2002.
10. Burkus JK, Transfeldt E, Kitchel SH, Watkins R, Balderston R “Clinical and radiographic outcomes of anterior lumbar interbody fusion using recombinant human bone morphogenetic protein-2” *Spine*, 27 (21): 2396 – 2408, 2002.
11. Burkus JK, Gornet MF, Dickman C, Zdeblick TA “Anterior interbody fusion using rhBMP-2 with tapered interbody cages” *J Spinal Disorders*, 15 (5): 337 – 349, 2002.
12. Boden SD, Zdeblick TA, Sandhu HS, Heim SE “The use of rhBMP-2 in interbody fusion cages. Definitive evidence of osteoinduction in humans: A preliminary report” *Spine*, 25 (3): 376 – 381, 2000.
13. Slosar PJ, Josey R, Reynolds J. “Accelerating lumbar fusions by combining rhBMP-2 with allograft bone: a prospective analysis of interbody fusion rates and clinical outcomes.” *Spine J*; 7: 301-307, 2007.

14. Hansen SM, Sasso RC. “Resorptive response of rhBMP2 simulating infection in an anterior lumbar interbody fusion with a femoral ring” J Spinal Disord Tech., Apr; 19 (2):130-4, 2006.
15. Pradhan BB, Bae HW, Dawson EG, Patel VV, Delamarter RB. “Graft resorption with the use of bone morphogenetic protein: lessons from anterior lumbar interbody fusion using femoral ring allografts and recombinant human bone morphogenetic protein-2” Spine, 31:277-84, 2006.
16. Lee JY, Zeiller S, Voltaggio L, Lim MR, Hilibrand AS, Vaccaro AR, Anderson G, Albert T “Histological analysis of a displaced femoral ring allograft spacer filled with a recombinant human bone morphogenetic protein-2 soaked collagen sponge. A case report” J Bone Jt Surg, 87:2318-2322, 2005.
17. Resnick DK, Choudhri TF, Dailey AT, Groff MW, Khoo L, Matz PG, Mummaneni P, Watters WC, Wang J, Walters BC, Hadley MN “Guidelines for the performance of fusion procedures for degenerative disease of the lumbar spine. Part 16: bone graft extenders and substitutes” J Neurosurg Spine, 2: 733-736, 2005.
18. Schuler TC, Burkus JK, Gornet MF, Subach BR, Zdeblick TA “The correlation between preoperative disc space height and clinical outcomes after anterior lumbar interbody fusion” J Spinal Disord Tech, 18(5): 396-401, 2005.
19. Kleeman TJ, Ahn UM, Talbot-Kleeman A “Laparoscopic anterior lumbar interbody fusion with rhBMP-2: A prospective study of clinical and radiographic outcomes” Spine, 26 (24): 2751 – 2756, 2001.
20. <http://www.fda.gov/cdrh/pdf/P000058.html>

### **Posterior Lumbar Spine**

While the body of literature evaluating BMPs in posterior spine fusion is somewhat limited by its relatively recent clinical availability, the literature is growing rapidly and includes a number of high quality studies. We have included some discussion of studies still in the editorial review process in order to demonstrate an appropriate response to CMS staff’s expressed concern that ongoing critical evidence development should be undertaken once new technologies reach clinical practice. Several general issues are important in the evaluation of this literature. Firstly, variations in the specific BMP used, as well as dose, concentration, and carrier for each BMP may significantly affect risks or benefits. The studies evaluating high dose rhBMP-2 (40 mg, 2.0 mg/ml), lower dose rhBMP-2 (12 mg, 1.5 mg/ml), and rhBMP-7 all contribute to our overall understanding of biologics in lumbar fusion, but cannot necessarily be considered interchangeably. Secondly, the initial experience suggests that risks and benefits may differ based upon site (lumbar versus cervical) and application technique (PSF versus TLIF).

### **Posterolateral Spine Fusion (PSF)**

The most significant available body of evidence examines the use of rhBMP-2 in posterolateral lumbar fusion. In 2002, Boden reported on a pilot study comparing rhBMP-2 (40mg, 2.0 mg/ml)

and iliac crest bone graft (ICBG) which suggested better fusion rates in the rhBMP-2 patients (Boden, S., Spine 2002; 27(21):2396-408). This led to an FDA approved randomized controlled IDE trial for rhBMP-2 and a compression resistant matrix (CRM) versus ICBG in single level posterolateral fusion. Two-year results from two centers participating in the IDE trial for rhBMP-2 (40 mg, 2.0 mg/ml) in single level posterolateral fusion have been reported (Dimar, J., Spine: Vol. 31, Number 22, pp 2534-2539). This subset of the RCT indicates better fusion rates, equivalent clinical outcomes and no increase in complications with rhBMP-2 versus ICBG. It is important to note that the dose/concentration of rhBMP-2 used in this study (40 mg, 2.0 mg/ml) was significantly greater than the dose/concentration (12 mg, 1.5 mg/ml) in the clinically available Infuse Bone Graft™ product (rhBMP-2/ACS). This raises the question of whether similar fusion rates will be achieved with the product in clinical use, but also affords a test of safety for posterolateral fusion, as complications were not seen with the much higher dose IDE protocol. A second published study from the same IDE trial data reports that the use of rhBMP-2 offsets, at least in part, the adverse effect of cigarette smoking on lumbar fusion rate (Glassman, S., Spine: Vol. 32, Number 15, pp 1693-1698). The complete IDE trial data set has been presented at national meetings, but is not yet published.

Several case series reports have been published on the use of clinically available Infuse Bone Graft™ (rhBMP-2 12 mg, 1.5 mg/ml) in an off-label posterolateral fusion application. One study examines the combination of rhBMP-2/ACS and ICBG, reporting better fusion rates at 2 years postoperatively as compared to ICBG alone (Singh, K., J Spinal Disord Tech 2006;19(6):416-423.). Another study reports on rhBMP-2/ACS in combination with several non-ICBG bone graft extenders, including local bone, demineralized bone matrix and bone bank bone (Glassman, S., Spine J 2007; 7:44-9). This study reports fusion rates equal to or better than ICBG in single and multilevel posterolateral fusion cases. Neither study identifies complications related to the use of rhBMP-2/ACS. An additional study examines repeated exposures to rhBMP-2 without evident adverse consequences (Carreon, L., Spine. 2008 Feb 15;33(4):391-3.). An IDE pilot study comparing rhBMP-2 (12 mg, 1.5 mg/ml) combined with a ceramic bulking agent versus iliac crest bone graft in posterolateral lumbar fusion has been undertaken. It has been presented and is in editorial review (Bae H, Spine J 2007;7;IS-163S).

Most recently, a non-industry sponsored RCT comparing Infuse Bone Graft™ (rhBMP-2/ACS) versus ICBG in patients over 60 years of age has been completed. The study examines clinical outcomes, fusion success, and directly measured economic parameters. Initial perioperative cost data from this RCT demonstrated an increased initial cost for the hospital, but a net savings for the payer over a 3-month period with the use of rhBMP-2/ACS (Glassman, S., Spine J., 2008 (8), pp 443-448). The two-year data revealed similar HRQOL outcomes, but better fusion on CT scan, fewer complications, lower revision rate and lower overall cost in the rhBMP-2/ACS group. This two-year RCT data has been presented, and received the Outstanding Paper Award, at the International Meeting for Advanced Spine Techniques (IMAST) in 2008. The study has been accepted for publication in SPINE, but has not yet reached its publication date. Despite this, the CMS staff may want to consider these data because they so directly address the issues raised in the proposed NCD topic question.

The literature assessing rhBMP-7 (OP-1) in posterolateral spine fusion, also suggests safety, and probable efficacy, based on an RCT comparing rhBMP-7 and ICBG in single level fusion for

degenerative spondylolisthesis (Vaccaro, A., Spine 2005; 30:2709-16.). This study resulted in FDA approval of OP-1 putty, through the HDE process, as an alternative to ICBG in compromised patients. An additional small RCT comparing rhBMP-7 and ICBG in instrumented posterolateral fusion revealed equivalent radiographic success, however nonunion was detected at exploration in 4 of 7 patients (Kanayama, M., Spine 2006; 31:1067-74.).

### **Transforaminal Lumbar Interbody Fusion (TLIF)**

A second common off-label application for rhBMP is in Transforaminal Lumbar Interbody Fusion (TLIF). No Level 1 data exist regarding the role of BMP in TLIF surgery. Several case series have been reported with variable findings. Two initial studies reported high fusion rates and minimal complications using rhBMP-2 for open and minimally invasive TLIFs (Schwender, J., J Spinal Disord Tech 2005 Feb;18 Suppl:S1-6., Villavicencio A., J Neurosurg Spine 2005;3(6):436-443.). Subsequently, concerns have been raised regarding the risk of heterotopic bone formation associated with the use of rhBMP-2 in TLIF. Conflicting evidence includes a prospective CT analysis which documented asymptomatic heterotopic bone in 20% of cases (Joeseph, V., Spine 2007 Dec 1;32(25):2885-90.), and a report of 5 patients seen at a referral center with heterotopic bone and radiculopathy (Wong DA, Spine J. 2007 Nov 21. [E-pub ahead of print]). Whether the risk for symptomatic heterotopic bone formation is dependent upon surgical technique, rhBMP-2 dose or any other surgical variable remains undetermined. No data regarding the use of rhBMP-7 in TLIF are available.

### **Cervical Spine**

Notwithstanding its off-label status, the use of bone morphogenic protein in the anterior cervical spine is considered controversial. This status derives primarily from two clinical observations. First, high fusion (bone healing) rates, in the absence of BMP, with stand-alone allograft have been consistently reported in the literature for both anterior discectomy and corpectomy constructs. Thus, the need for an iliac crest autograft substitute or replacement may have a limited role in comparison to the lumbar spine. Second, the use of BMP in the anterior cervical spine has been reported to be associated with higher than usual rates of soft-tissue swelling, dysphagia, and respiratory complications.

There is conflicting evidence regarding the safety and incidence of soft-tissue complications with BMP use in the anterior cervical spine. In a retrospective study of 200 patients who underwent anterior cervical discectomy with a PEEK spacer and low dose BMP, an incidence of dysphagia of 7 percent was reported (1). In contrast, Shields et al (2) reported a 23 percent complication rate among 151 patients who underwent anterior cervical surgery with high-dose BMP. Complications included postoperative hematomas or readmission for swallowing difficulty or airway distress.

In a retrospective comparative study, another group found a significantly higher incidence and severity of dysphagia in twenty-two patients in whom BMP was used compared to twenty-four in whom allograft alone was used to effect an anterior cervical discectomy and fusion (3). Similarly, Smucker et al (4) found a statistically significantly higher rate of so-called "swelling events" with use of BMP in sixty-nine patients compared to 165 non-BMP controls who underwent anterior cervical spine surgery.

Indeed, higher level evidence exists. In a prospective randomized controlled comparison of thirty-three patients who underwent anterior cervical discectomy and fusion with BMP or allograft, Baskin et al (5) reported no device-related complications. In contrast, Butterman (6) performed a non-randomized, prospective comparison of patients undergoing anterior cervical discectomy and fusion with iliac crest autograft or low-dose BMP. He reported a 50 percent rate of dysphagia in the BMP group versus a 14 percent rate in the iliac crest group.

Provided that close observation of a patient's airway is maintained, perhaps with a planned postoperative intubation interval, off-label BMP use in the anterior cervical spine may have some role as a salvage maneuver in complex cases in which the fusion environment is substantially challenged, such as in the treatment of established nonunions, unusually long multi-level defects, or osteomyelitis (7-8). As peri-esophageal and tracheal inflammation is less likely with posterior application, BMP also may have some role in the posterior cervical spinal fusions in highly select cases (9).

In summary, the current limited data suggest that there is persistent controversy regarding the use of BMP in the anterior cervical spine. The data suggest that its routine use for elective anterior cervical spine surgery does not seem to be warranted. While appropriate dosage has been proposed as a primary factor to ensure safety, the current literature is conflicted regarding this issue.

There is an overwhelming paucity of data evaluating the use of BMP in the posterior cervical spine, making any recommendation regarding its routine use difficult.

### **Summary - BMP**

While the indications for the use of BMPs in spinal surgery in the Medicare population are not fully defined, substantial evidence exists supporting the efficacy and cost effectiveness of BMP in the anterior lumbar interbody fusion. Moderate and increasing evidence is being developed for its use in posterolateral fusions compared to ICBG. Posterolateral fusion, in conjunction with decompression for stenosis or deformity correction, in spondylolisthesis, or degenerative scoliosis, is the most common spinal fusion technique performed in the Medicare population. The Professional Society Coalition Task Force believes that BMP is a reasonable and safe alternative to ICBG in anterior interbody lumbar fusion. For posterior spinal fusion, there is moderate and increasing evidence that BMP is also beneficial. We also believe that ongoing additional investigation will contribute to refinements in dose, carriers and site specific applications for these valuable biologic technologies. In the anterior cervical spine, the evidence is limited and there remain unanswered safety concerns and we do not support its broad use except in ongoing research trials.

### **Recommendations- BMP**

- 1. Anterior Lumbar Fusions- Recommend coverage in Medicare and non-Medicare patients without severe osteoporosis.**
- 2. Posterior/Lateral Lumbar Fusion- Delay decision pending publication of pending literature.**

3. **Posterior Interbody Fusion- Literature is insufficient to make recommendation. Further study should be encouraged.**
4. **Anterior Cervical Spine- The use of BMP should not be covered/approved for routine use in the cervical spine. The use of BMP for complex, revision, or salvage situations may be appropriate in certain cases. Such cases should be considered on an individual basis. Further study should be encouraged.**
5. **Posterior Cervical/Thoracic Spine- Literature is insufficient to make recommendation. Further study should be encouraged.**

### **Cervical BMP References**

1. Tumialan, L.M., et al., *The safety and efficacy of anterior cervical discectomy and fusion with polyetheretherketone spacer and recombinant human bone morphogenetic protein-2: a review of 200 patients.* J Neurosurg Spine, 2008. **8**(6): p. 529-35.
2. Shields, L.B., et al., *Adverse effects associated with high-dose recombinant human bone morphogenetic protein-2 use in anterior cervical spine fusion.* Spine, 2006. **31**(5): p. 542-7.
3. Vaidya, R., et al., *Complications of anterior cervical discectomy and fusion using recombinant human bone morphogenetic protein-2.* Eur Spine J, 2007. **16**(8): p. 1257-65.
4. Smucker, J.D., et al., *Increased swelling complications associated with off-label usage of rhBMP-2 in the anterior cervical spine.* Spine, 2006. **31**(24): p. 2813-9.
5. Baskin, D.S., et al., *A prospective, randomized, controlled cervical fusion study using recombinant human bone morphogenetic protein-2 with the CORNERSTONE-SR allograft ring and the ATLANTIS anterior cervical plate.* Spine, 2003. **28**(12): p. 1219-24; discussion 1225.
6. Buttermann, G.R., *Prospective nonrandomized comparison of an allograft with bone morphogenic protein versus an iliac-crest autograft in anterior cervical discectomy and fusion.* Spine J, 2008. **8**(3): p. 426-35.
7. Aryan, H.E., et al., *Corpectomy followed by the placement of instrumentation with titanium cages and recombinant human bone morphogenetic protein-2 for vertebral osteomyelitis.* J Neurosurg Spine, 2007. **6**(1): p. 23-30.
8. Allen, R.T., et al., *Bone morphogenetic protein-2 (BMP-2) in the treatment of pyogenic vertebral osteomyelitis.* Spine, 2007. **32**(26): p. 2996-3006.
9. Oluigbo, C.O. and G.A. Solanki, *Use of recombinant human bone morphogenetic protein-2 to enhance posterior cervical spine fusion at 2 years of age: technical note.* Pediatr Neurosurg, 2008. **44**(5): p. 393-6.

### **Vertebroplasty and Kyphoplasty**

#### *CMS Proposed Topic-*

“Vertebroplasty and kyphoplasty are radiologic procedures for the treatment of the intense pain caused by vertebral compression fracture in patients whose pain has been refractory to medical management or other therapy. Vertebroplasty and kyphoplasty involve the intraosseous injection

of acrylic cement under local anesthesia and fluoroscopic guidance to control the pain of vertebral fractures associated with osteoporosis, tumors, and trauma. Typically, vertebroplasties are performed in an outpatient setting, while kyphoplasty typically requires hospital admission. Is the evidence adequate to demonstrate health benefits from pain reduction in selected patients?”

### **Task Force Comments**

Vertebroplasty (VP) and kyphoplasty (KP) are procedures performed for conditions that are common in the Medicare population, specifically patients over the age of 65. Approximately 35% of women in the US 65 years or older have osteoporosis. Vertebral compression fracture (VCF) is the most common complication of this condition and more than 700,000 new vertebral compression fractures occur every year in the United States alone. These fractures account for more than 100,000 hospital admissions and close to \$1.5 billion in annual costs.

Although most patients with VCF are asymptomatic or minimally symptomatic, a significant number of patients have sufficient pain to limit activity, resulting in decreased quality of life and disability. VCF may also lead to progressive spinal deformity, and the incidence of additional fractures is increased in patients with an incident VCF. They may be associated with other systemic conditions, including metastatic disease and chronic steroid use.

Conventional treatment for VCF is designed to alleviate symptoms, and includes analgesic medications, a variety of bracing alternatives, and modification of activity. Some patients do experience improvement in their symptoms over time, with medical treatment. Failure of medical management often results in the option of a percutaneous surgical procedure being offered. However, the severity of a patient’s pain and the associated disability are the determining factors for whether a trial of medical management is warranted.

Percutaneous vertebral augmentation (PVA) is a minimal access procedure which restores strength to the fractured vertebra by the injection of polymethylmethacrylate (PMMA). Vertebroplasty (PV) and kyphoplasty (KP), a variation of vertebroplasty, have become increasingly popular as a treatment alternative for VCF. Leading experts from many major insurance carriers have reviewed the body of scientific literature available and concluded that coverage for these procedures is warranted.

The following conditions are considered indications for this procedure, provided the affected vertebra has not been extensively destroyed and the patient’s medical condition permits treatment:

- 1) osteoporotic vertebral compression fractures that have not responded to medical treatment including bracing, rest, analgesics, with incapacitating pain that may preclude mobilization in a previously mobile patient;
- 2) osteolytic vertebral metastasis or myeloma with severe back pain related to vertebral body destruction without cortical involvement; and
- 3) painful vertebral hemangioma

Percutaneous vertebroplasty is contraindicated in patients with local infection, spinal cord compression, destruction of the posterior wall of the vertebral body and severe degrees of vertebral body collapse; certain other medical conditions, such as coagulopathies, may preclude the procedure.

Results from the current studies evaluating vertebroplasty and kyphoplasty for treatment of both VCF related to osteoporosis and metastatic disease point to consistent and dramatic reduction in pain, typically within one day of the procedure. Other significant outcomes include decreased analgesic use and improvement in physical function or disability scale scores (Bouza et al 2006).

The most consistently raised issue in recent TEC assessments relates to the nature of studies, specifically the lack of comparative, blinded randomized clinical trials, and the use of subjective measures of pain and activity as outcome measures. The literature has consistently described pain relief, measured by VAS score, in a large percentage of patients treated with PVA (Bouza et al 2006; Eck et al 2008; Hulme et al 2006). Furthermore, pain relief is durable. Similar clinical benefits are noted in both VP and KP (Eck et al 2008).

The majority of the studies published on PVA are in the form of prospective consecutive case series or retrospective studies (Eck et al 2008). The retrospective studies include large numbers of patients whose quality of life is reportedly substantially improved with PVA intervention (Bouza et al 2006; Eck et al 2008; Hulme et al 2006).

The most commonly reported complications following PVA were cement leaks perioperatively or subsequent fractures in the first year post procedure. Cement (PMMA) leaks are commonly quoted at around 9% of treated osteoporotic vertebrae and slightly higher for metastatic fractures. Most leaks involve the disc or perivertebral soft tissues and are most commonly clinically asymptomatic (Hulme et al 2006). New fractures of remote and adjacent vertebrae in most studies occurred in frequency equivalent to the general osteoporotic population that had one previous vertebral fracture (Hulme et al 2006).

Recognizing the limitations of the current literature, and balancing that with the clinical benefits described in large numbers of patients according to the retrospective studies, the following summary comments are provided:

1. PVA is a reasonable treatment option for managing vertebral compression fractures related to osteoporosis or metastatic disease.
2. Multiple studies indicate that both procedures are safe and efficacious in the treatment of osteoporotic and pathological vertebral compression fractures. The most common complication is extravasation of cement, which is of no consequence in most patients.
3. Many prospective consecutive case series indicate that PVA improves pain and function. There are no large long term randomized clinical trials comparing PVA with the natural history of VCF. In fact there exist no quality studies of the natural history of vertebral compression fractures.

4. Both VP and KP have similar clinical results and can be performed on an outpatient basis.
5. Kyphoplasty is significantly more expensive than vertebroplasty without a proven value added benefit.

Despite the lack of randomized clinical trials, the consistency of the findings regarding a large improvement in pain and function indicates that both vertebroplasty and kyphoplasty are effective in the treatment of pain due to vertebral fractures. VP is reasonable and necessary by producing immediate improvement in a patient's quality of life, primarily through the alleviation of pain and rapid return to ambulation. KP is equally as effective, but at a substantially greater cost. NASS encourages CMS to focus on best patient care by continuing coverage for patients with these minimally-invasive treatments that have been safely and successfully performed on thousands of patients across the United States, typically providing patients with immediate relief from pain and an independence from reliance on narcotics.

In summary, the benefits of vertebroplasty and kyphoplasty far outweigh any risks and the risks of conservative therapy, and the success rates are consistently high. These procedures are effective by producing immediate improvement in a patient's quality of life, primarily through the alleviation of pain and rapid return to ambulation. The value added benefit of KP over VP has not been demonstrated.

#### **Recommendations- Vertebroplasty/Kyphoplasty**

- 1. VP- Recommend coverage in Medicare and non-Medicare patients for osteoporotic VCF**
- 2. KP- Recommend coverage in Medicare and non-Medicare patients for osteoporotic VCF**
- 3. VP and KP- Recommend coverage in Medicare and non-Medicare patients for osteolytic vertebral metastasis, myeloma and vertebral hemangioma**
- 4. There is no added value of KP over VP and CMS hospital and outpatient payment policy should be equivalent for the two procedures.**

#### **Vertebroplasty / Kyphoplasty References**

Bouza C, Lopez T, Magro A, Navalpotro L, Amate J. Efficacy and safety of balloon kyphoplasty in the treatment of vertebral compression fractures: a systematic review. *Eur Spine J* 2006; 15:1050–1067.

Eck J, Nachtigall D, Humphreys S, Hodges S. Comparison of vertebroplasty and balloon kyphoplasty for treatment of vertebral compression fractures: a meta-analysis of the literature. *Spine J*. 2008; 8(3):488-497.

Hulme P, Krebs J, Ferguson S, Berlemann U. Vertebroplasty and Kyphoplasty: A Systematic Review of 69 Clinical Studies. *Spine* 2006; 31(17):1983–2001.

## **Multi-level Lumbar Fusion for Degenerative Disc Disease**

### *CMS Proposed Topic-*

“For certain patients, a two level spinal fusion may be an effective treatment for debilitating back pain from two degenerated lumbar discs. Multilevel fusion as a primary treatment for low back pain from degenerated discs is a controversial topic in spine medicine. However, lumbar fusion of three or more levels of the low back as a primary treatment for back pain is rarely recommended, and many surgeons recommend against it in all cases of multilevel degenerative disc disease. Is the evidence adequate to specify groups that do and do not benefit from the lumbar fusion procedure?”

### **Task Force Comments**

Our primary concern with regard to the proposed NCD topic on multilevel lumbar fusion revolves around the difficulty in clearly defining the population in question. We agree that there is no high quality or even consistent lower quality evidence indicating that multilevel (3 or more level) fusion is effective as a treatment for isolated back pain without neurological deficit, deformity, or stenosis. Evidence to definitively support or refute the efficacy of such procedures is not likely to be available in a reasonable timeframe because these procedures are uncommonly performed in any patient population. According to MedPar data, a grand total of 688 such multilevel procedures with a primary diagnosis of degenerative disc disease were performed in the United States during 2007 (out of approximately 57,000 fusions performed for degenerative disease). Given difficulties with the fidelity of administrative databases, it is likely that the true incidence is even lower due to failure to code for associated diagnoses. Furthermore, when such procedures are performed, they are more likely performed in an elective fashion on younger patients. These are “boutique” procedures that are not typically performed in the over age 65 Medicare or Medicaid population.

Answerable questions must be used as the basis for reasoned debate when policy decisions are proposed. For example, at the 2006 MCAC meeting on lumbar fusion, the published MCAC question, similarly described as fusion for isolated low back pain in the Medicare population, was not able to be addressed. The majority of data reviewed by the speakers, and much of the panel discussion, addressed the utilization of lumbar fusion in completely different patient populations. Nonetheless, the panel was required by procedure to vote on the atypical use of fusion for low back pain in the Medicare population, as this was the specific MCAC question. As there was no evidence relevant to the Medicare or Medicaid population, the panel was forced to conclude that such procedures were not supported by high quality evidence. This conclusion, supported by a draft Tech Report, has been published and used to inappropriately limit access to lumbar fusion in other populations.

It is also imperative that multi-level fusion procedures for isolated axial LBP or axial LBP without neural compression are not confused with multilevel fusion procedures that are

performed for the purposes of deformity correction, correction of instability, or following destabilizing decompressive procedures in the elderly. There is substantial evidence indicating that the use of fusion in such situations improves functional outcome. In particular, data from the SPORT study, which has been presented and published since the 2006 MCAC meeting, provide high quality evidence supporting the benefit of lumbar fusion in appropriately selected patients (Weinstein JN, N Engl J Med 2007;356;22:2257-2270). Also, consistent with the CMS call for evidence development surrounding lumbar fusion in the Medicare population (Schafer J, Spine 2007;32(22):2403-2404.), several studies examining the role of single and multilevel fusion in older patients have now been published, or are awaiting publication (Glassman SD, Spine J 2007;7(5):547-551, Okuda S, J Bone Joint Surg Am. 2006 Dec;88-A(12):2714-2720, Glassman SD, Spine J. E-pub 2008, Bridwell K, SRS 2008, Ghogowala, Benzel, etc).

We welcome any and all opportunities to discuss the appropriate use of multilevel fusion in the Medicare population. We agree that demonstration of benefit for lumbar fusion, or any surgical intervention, limited to simple cases and idealized populations is not ultimately sufficient to predict value in standard clinical practice. We believe that additional and ongoing evidence development is critical to guide appropriate resource utilization in the Medicare population. It is our assertion that identification of the most specific and relevant question for analysis is critical in order to maximize the utility of the subsequent analysis.

### **Recommendations- Multi-level (3 or more levels) Lumbar Fusion for Degenerative Disc Disease**

- 1. For DDD without deformity or instability, or iatrogenic instability caused by decompression of nervous elements, (isolated axial LBP or axial LBP without neural compression)- Do not recommend coverage in Medicare and non-Medicare patients**
- 2. For DDD with deformity, extensive decompression or instability- Recommend coverage in Medicare and non-Medicare patients**

### **Artificial Cervical Discs**

*CMS Proposed Topic-*

“Artificial cervical discs are being developed in an effort to treat symptomatic degenerative disc disease more effectively. The goal of this type of technology is to maintain spinal motion following anterior discectomy, to reduce the incidence of degeneration of adjacent disc levels of the spine (adjacent-segment disease), and to permit more rapid return to normal activity. Is the evidence adequate that this procedure results in improved health for the Medicare population?”

### **Task Force Comments-**

Spinal spondylosis and cervical degenerative disease are a common problem in the United States and associated with aging (Emery 2001). This is due to the avascular nature of the spinal disc and as it loses proteoglycans, such as chondroitin sulfate, and moisture it is unable to repair itself

and becomes inelastic with microfissures and associated disc herniations resulting in settling and collapse of the disc space. This change in the disc space results in abnormal spinal motion patterns and further leads to anatomical changes in the formation of osteophytic spurs and can be associated with impingement of nerve roots or the spinal cord. This is a common radiographic finding, with 60% of people over the age of 40 showing evidence of cervical degenerative disc disease and spondylosis, and by age 65, almost 95% of men and 70% of women have such changes. While most radiographic changes are asymptomatic, a significant number (over 5 million) of US adults are disabled by spine-related disorders and a portion of these patients are good candidates for surgery.

The initial treatment for cervical spondylosis and degenerative disease is not surgery. Rather, patients undergo initial management with pharmacological agents such as NSAIDs, analgesics, or muscle relaxants, and supplemented with physical therapies such as traction, strength training, stretching, massage, or manipulation therapies. If symptoms persist or worsen, then additional treatment including biofeedback or cognitive therapies may be added along with interventional procedures such as epidural steroid injections, facet joint radiofrequency denervation, or trigger point injections.

These treatments are not panaceas for this disease process, with over \$80 billion dollars a year spent on the pain and symptoms related to the non-surgical management of spinal disorders (Brook 2008). This can be contrasted to the \$570 million that CMS paid in professional fees in 2007 for the entire field of neurosurgery (cranial and spinal), which represents less than 1% of what has been spent on non-surgical treatment. Non-surgical treatments have resulted in an increase in expenditures of 65% (adjusted for inflation) from 1997 to 2005 (Brook 2008). Unfortunately despite these treatments, patients continue to experience physical function limitation and decrease in the activities of daily living with persistent issues related to their mental health, physical functioning, work, school and social limitations.

This debilitating degeneration disease was first noted by Bailey and Casamajor in 1911 when they first described osteo-arthritis of the cervical spine. Clarke and Robinson in 1956 noted that this was not a static problem, but rather that disease and symptom progression was common, albeit gradual. However, improvement was rare and prognosis was generally poor. Cervical spondylosis and associated myelopathy remains the most common cause of nontraumatic spastic paraparesis and quadriparesis, and represents 23.6% of these severely disabled and medically needy patients (Moore 1997).

This unacceptable natural history of this disease has led to the development of surgical treatments and techniques. Typically, surgical patients have failed 2-6 months of conservative therapy and are unable to perform their activities of daily living due to pain or neurological symptoms. In these patients, surgery, most commonly anterior cervical discectomy and fusion (ACDF) with or without plate fixation has resulted in the resolution of symptoms in over 80% of those treated (Xie 2007, Yue 2005). The excellent results have resulted in increased use of surgery for cervical spondylosis, especially as more surgeons are trained in this technique. The frequency of cervical surgeries performed has grown from 26,000 per year in 1988-90 to 124,000 procedures in 1999 (Lee 2004).

Although surgery has improved on the patient's health as compared to their natural history of their disease, it is not without its own drawbacks. Chief amongst these are concerns regarding adjacent segment spondylosis, which has been reported to occur at a rate of 2.9% per year with an overall incidence of 25.6% based on survivorship analysis. This has been felt to be related to variables related to the patient's underlying clinical disease along with iatrogenic and lifestyle choices, but also related to the fusion construct itself as related to the biomechanical alterations of a functioning joint.

This plus a desire to speed recovery and maintain normal neck motion has led to the advent of artificial intervertebral disc arthroplasty as an alternative to anterior cervical fusions in patients with cervical spondylosis and degenerative disc disease (Acosta 2005, Anderson 2007, Smucker 2006, Phillips 2005, Anderson 2004, Pracyk 2005, Bertagnoli 2005). Additional studies have shown that cervical arthroplasty is safe and at least as effective as cervical fusions in those patients who had similar surgical indications to ACDF such as radiculopathy and myelopathy (Brown 2006; McAfee 2004). There are reports that the patients with cervical arthroplasty have an improved post-operative course possibly due to the absence of an anterior plate or the need for an orthoses, and also have a shorter recovery period due to not using bone grafts (Traynelis 2007, Goffin 2006). As well, cervical disc arthroplasty has been associated with maintaining cervical disc height, along with lordosis and motion at the index and at the adjacent cervical spine levels (Sears 2006). This has been postulated to reduce the risk of adjacent level degeneration (Traynelis 2007) and improve the force/load transfer to the adjacent cervical levels (Phillips & Garfin 2005).

Biomechanical models show that there is altered adjacent segment kinematics in patients or spines with a fusion, but as these are biomechanical studies, they do not portend to establish clinical relevance (Anderson 2007, Phillips 2005, Wigfield 2002). It is only in the recent past that further development of available tools to study cervical spine kinematics in a clinical setting has been developed and this shows that there is preserved adjacent segment kinetics in patients with an arthroplasty (Cheng 2007).

Cervical disc arthroplasty is a technology that has final approval from the appropriate governmental regulatory bodies, with the Prestige ST Cervical Disc receiving FDA marketing approval on July 16, 2007 and the ProDisc™-C Total Disc receiving a premarketing application (PMA) approval on December 17, 2007 and further FDA marketing approval on December 22, 2007. In addition, the Bryan Cervical Disc received an approvable decision by an FDA advisory panel on July 17, 2007 but has not received a final marketing approval.

These devices have similar indications for use in skeletally mature patients with cervical spine disease at C3-C7 necessitating a single-level decompression. The devices are implanted via an open anterior approach, similar to that of an ACDF, and used for symptoms similar to an ACDF for patients with intractable pain, radiculopathy, and/or myelopathy associated with radiographic studies showing a herniated cervical disc or cervical spondylosis and osteophytes.

Three large multicenter prospective randomized IDE studies have been completed comparing cervical disc arthroplasty with anterior cervical discectomy and fusion (Aetna Policy No. 0591).

They have concluded that disc arthroplasty is a safe and reasonable alternative to anterior cervical fusion.

Mummaneni<sup>14</sup> in 2007 reported statistical noninferiority for disc arthroplasty versus ACDF in all three primary outcome variables (Neck Disability Index (NDI), neurological status, and functional spinal unit height (FSU)) and for the overall success composite outcome. The neurological status was the only primary outcome variable for which statistical superiority was achieved. The arthroplasty patients showed preservation of motion with retention of sagittal angular motion of over 7 degrees and also a 2-point greater improvement in the Neck Disability Index (NDI).

They were unable to show that variables such as functional spinal unit (FSU) height reached predetermined levels, but it should be noted that they had difficulty due to anatomical interference and that alternate determinations were made without the FSU height included. Although it was not statistically significant, there was an overall success with better SF-36 at 12 and 24 months associated with a greater relief of neck pain and earlier return to work in the arthroplasty group. There were no serious associated adverse events and no cases of implant failure or migration, along with a lower rate of revision surgeries ( $p = 0.0277$ ) including a lower rate of supplemental fixation ( $p = 0.0031$ ) and of re-operations at the adjacent segment ( $p = 0.0492$ ).

Murrey<sup>16</sup> reported a prospective, randomized, controlled trial of 209 patients with 1-level DDD with concordant radiculopathy and/or myelopathy randomized 1:1 to receive PRODISC-C® or ACDF with plate and allograft with follow-up of 3 and 6 weeks, 3, 6, 12, 24 months. The results showed that Prodisc-C® is “not inferior” to ACDF 2 years after surgery in Overall Success, the study’s primary endpoint.

Heller<sup>15</sup> reported a prospective, randomized, controlled trial of 463 patients with 1-level DDD with concordant radiculopathy and/or myelopathy randomized 1:1 to receive BRYAN® Cervical Disc or Atlantis® Cervical Plate with allograft (ACDF) with follow-up of 3 and 6 weeks, 3, 6, 12, 24 months. The results showed that the BRYAN® Cervical Disc maintained segmental motion at 24 months after implantation and was associated with improved NDI Success (superiority), improved clinical outcomes, and 13 days faster return to work compared to ACDF patients. Statistical superiority in Overall Success (study’s primary endpoint) was demonstrated at 24 months.

Criticism has been raised regarding the non-inferiority design of these trials, and how such a study design does not provide sufficient evidence insufficient to justify coverage. While the studies do not prove superiority, they consistently demonstrate improvement in pain and function that is equivalent to fusion. Additionally the studies have been criticized (BC/BS TEC Assessment (<http://www.bcbs.com/blueresources/tec/tec-assessments.html>)) due to their non-blinded nature. However, this is confusing the science behind device studies with those from other non-surgical disciplines. It would be physically impossible to double blind a surgeon regarding an implant that is to be surgically placed.

Cervical disc arthroplasty is not frequently used in Medicare age patients, with the average study population being young with patients in their mid-40s. Prior IDE studies included patients only between the ages of 18-60, and along with their exclusion criteria which excluded patients with severe disabilities and comorbidities, do not capture patients within the Medicare population. The study by Mummaneni did include patients with cervical arthroplasty up to age 72, and had fusion control patients up to age 73, this was a very small number of patients and data on this subgroup will not be able to show any statistical significance.

It remains unknown if cervical disc arthroplasty will decrease the incidence of adjacent level disc degeneration. There is some evidence that the early re-operation rate is less for disc arthroplasty than the fusion group, but this is due to pseudoarthrosis at the index level in the fusion group and not adjacent level degeneration. Reasonable long term wear characteristics are suggested by biomechanical studies, but clinical data are not available at this time.

### **Recommendations- Cervical disc arthroplasty**

**1. For cervical spondylosis and disc herniation in non-Medicare population- Recommend coverage**

**2. For cervical spondylosis and disc herniation in the Medicare population- Literature is insufficient to make recommendation. Further study should be encouraged.**

### **References – Cervical disc arthroplasty**

1. Aetna Clinical Policy Bulletin: Intervertebral Disc Prostheses. Policy Number: 0591 (Last Review: 05/23/2008) ([http://www.aetna.com/cpb/medical/data/500\\_599/0591.html](http://www.aetna.com/cpb/medical/data/500_599/0591.html))
2. Lee CK, Langrana NA. A review of spinal fusion for degenerative disc disease: need for alternative treatment approach of disc arthroplasty? *Spine J.* 2004 Nov-Dec;4(6 Suppl):173S-176S.
3. Moore AP, Blumhardt LD. A prospective survey of the causes of nontraumatic spastic paraparesis and a tetraparesis in 585 patients. *Spinal Cord* 1997; 35:361-7.
4. Brook, Deyo, Mirza, et al, "Expenditures and Health Status among Adults with Back and Neck Problems". *JAMA.* 2008;299(6):656-664.
5. Lees F, Turner JW. Natural history and prognosis of cervical spondylosis. *BMJ* 1963;2:1607-1610.
6. Clarke E, Robinson PK. Cervical myelopathy: a complication of cervical spondylosis. *Brain* 1956;79:483-510.
7. Radhakrishnan K, Litchy WH, O'Fallon M, Kurland LT. Epidemiology of cervical radiculopathy—..., 1976 through 1990. *Brain* 1994;117:325-335.
8. Kadanka Z, Bednarik J, Vohanka S, et al. Conservative treatment versus surgery in spondylotic cervical myelopathy.... *Eur Spine J* 2000;9:538-544.
9. Sampath P, Bendebba M, Davis JD, Ducker TB. Outcome of patients treated for cervical myelopathy.... *Spine* 2000;25:670-676.
10. Hilibrand AS, Carlson GD, Palumbo MA, et al.: Radiculopathy and myelopathy at segments adjacent to the site of a previous anterior cervical arthrodesis. *J Bone Joint Surg* 81-A:519-528, 1999.

11. Bucy PC, Heimbarger RF, Oberhill HR: Compression of the cervical spinal cord by herniated intervertebral discs. *J Neurosurg* 5:471-492, 1948.
12. Frykholm R: Lower cervical vertebrae and intervertebral discs: surgical anatomy and pathology. *Acta Chir Scand* 101:345-359, 1951.
13. Hilibrand A, et. Al. Radiculopathy and myelopathy at segments adjacent to the site of a previous anterior cervical arthrodesis. *Journal of Bone & Joint Surgery* 1999; 81 (4): 519-528.
14. Wang JC. McDonough PW. Endow KK. Delamarter RB. Increased fusion rates with cervical plating for two-level anterior cervical discectomy and fusion [Journal Article] *Spine*. 25(1):41-5, 2000 Jan.
15. Ghiselli G. Wang JC. Bhatia NN. Hsu WK. Dawson EG. Adjacent segment degeneration in the lumbar spine. [Journal Article] *Journal of Bone & Joint Surgery - American Volume*. 86-A(7):1497-503, 2004 Jul.4.
16. Okawa, Shinomiya, Takakuda, et. Al. A cadaveric study on the stability of lumbar segment after partial laminotomy and facetectomy with intact posterior ligaments. *J of Spinal Disorders*. 9(6):518-26, 1996 Dec.
17. Mummaneni, et al. *Journal of Neurosurgery Spine*. 2007 Mar; 6(3):198-209. Clinical and Radiographic Analysis of Cervical Disc Arthroplasty Compared with Allograft Fusion: A Randomized Controlled Clinical Trial. [Medtronic Funded, PRESTIGE® Cervical Disc\* (Medtronic)]

This was a prospective, randomized, controlled trial of 541 patients with 1-level DDD with concordant radiculopathy and/or myelopathy randomized 1:1 to receive PRESTIGE® Cervical Disc or ATLANTIS® Cervical Plate with allograft (ACDF) and followed up at 3 and 6 weeks, 3, 6, 12 and 24 months. The results noted that the PRESTIGE® Cervical Disc maintained segmental motion at 24 months after implantation and was associated with improved neurological status (superiority), improved clinical outcomes, and a reduced rate of secondary surgeries compared to ACDF. Superiority in overall success (study endpoint) was demonstrated at 24 months in the PRESTIGE® Cervical Disc cohort.

18. Heller, et. Al. Abstract, 2007 North American Spine Society Annual Meeting. Comparison of BRYAN® Cervical Disc Arthroplasty with Anterior Cervical Decompression and Fusion: Clinical and Radiographic Results of a Randomized Controlled Clinical Trial. [Medtronic Funded, BRYAN® Cervical Disc (Medtronic)]

This was a prospective, randomized, controlled trial of 463 patients with 1-level DDD with concordant radiculopathy and/or myelopathy randomized 1:1 to receive BRYAN® Cervical Disc or Atlantis ® Cervical Plate with allograft (ACDF) with follow-up of 3 and 6 weeks, 3, 6, 12, 24 months. The results showed that the BRYAN® Cervical Disc maintained segmental motion at 24 months after implantation and was associated with improved NDI Success (superiority), improved clinical outcomes, and 13 days faster return to work compared to ACDF patients. Statistical superiority in Overall Success (study's primary endpoint) was demonstrated at 24 months in the BRYAN® Cervical Disc cohort.

19. Murrey, et. Al. Abstract, 2007 Cervical Spine Research Society Annual Meeting. Twenty-four month results from the prospective, randomized, multi-center IDE Trial of PRODISC-C® vs. ACDF. [PRODISC-C®, Synthes Spine]

This was a prospective, randomized, controlled trial of 209 patients with 1-level DDD with concordant radiculopathy and/or myelopathy randomized 1:1 to receive PRODISC-C® or ACDF with plate and allograft with follow-up of 3 and 6 weeks, 3, 6, 12, 24 months. The results showed that Prodisc-C® is “not inferior” to ACDF 2 years after surgery in Overall Success, the study’s primary endpoint.

20. Sasso, et. Al. J Spinal Disord Tech. Vol. 20, Number 7, Oct. 2007. Clinical Outcomes of BRYAN® Cervical Disc Arthroplasty: a Prospective, Randomized, Controlled, Multi-Center Trial With 24-month Follow-up. [BRYAN® Cervical Disc, Medtronic]

This was a prospective, randomized, controlled trial of 115 patients from 3 U.S. IDE study sites for the BRYAN® Cervical Disc IDE Study Subset of 463 patients with 1-level DDD with concordant radiculopathy and/or myelopathy randomized 1:1 to receive BRYAN® Cervical Disc or ATLANTIS® Cervical Plate with allograft (ACDF) with follow-up of 3 and 6 weeks, 3, 6, 12, 24 months. The results noted that the BRYAN® Cervical Disc maintained segmental motion at 24 months after implantation and was associated with statistically superior scores in Neck Disability Index, Neck Pain, and SF-36 PCS 24 months after surgery.

21. Porchet, etl al. Neurosurg Focus 2004 Sept; 17:36-43. Clinical Outcomes with the PRESTIGE® II Cervical Disc: Preliminary Results from a Prospective Randomized Clinical Trial. [Medtronic Funded, PRESTIGE® Cervical Disc\*, Medtronic]

This was a prospective, randomized, controlled trial of 55 patients consisting of 27 PRESTIGE® II Cervical Disc with 28 iliac crest autograft fusion and with 2-year follow up with most of the outcome measures tending to favor the PRESTIGE® II Cervical Disc, and with the PRESTIGE® II Cervical Disc maintaining motion at treated level without adjacent segment compromise.

22. Hacker, et al. Journal of Neurosurgery Spine 2005 Dec; 3:424-28. Cervical Disc Arthroplasty: A Controlled Randomized Prospective Study With Intermediate Follow Up Results. [Medtronic Funded, BRYAN® Cervical Disc, Medtronic]

This was a prospective, randomized, controlled trial of 46 patients with 1-level DDD with concordant radiculopathy and/or myelopathy randomized 1:1 to receive BRYAN® Cervical Disc or ATLANTIS® Cervical Plate with allograft with follow up of 3 and 6 weeks, 3,6,12 and 24 months. The results show that all patients reported in this study had reached a minimum of 1-year follow up with no device related complications and with equivalent results in relief of arm and neck pain seen in both study groups. The treatment parameters other than OR time were similar with no serious neurological or systemic complications observed and preserved motion was revealed in all BRYAN® Cervical Disc-treated patients.

23. Coric, et al. Journal of Neurosurgery Spine, 2006 Jan, Vol 4:31-35. Prospective Rrandomized Controlled Study of the BRYAN® Cervical Disc: Early Clinical Results from a Single Investigational Site. [Medtronic Funded, BRYAN® Cervical Disc, Medtronic]

This was a prospective, randomized, controlled trial of 33 patients with 1-level DDD with concordant radiculopathy and/or myelopathy randomized 1:1 to receive BRYAN® Cervical Disc or ATLANTIS® Cervical Plate with allograft and follow up of 3 and 6 weeks, 3, 6, 12, 24 months. The results noted that at mean follow up at time of report of 19 months, there was no device related complications and had similar improvements seen in both study groups. The BRYAN® Cervical Disc patients demonstrated maintenance of motion at treated level.

24. Nabhan, et al. Eur Spine J, 2007 Mar; 16(3):423-30. Disc Replacement Using PRODISC-C® versus Fusion: A Prospective Randomized and Controlled Radiographic and Clinical Study. [PRODISC-C®, Synthes Spine]

This was a prospective, randomized, controlled trial of 25 patients with cervical disc herniation who were randomized to receive either a PRODISC-C® or ACDF. Radiostereometric analysis was used to quantify intervertebral motion immediately and at 3, 6, 12 and 24 weeks. Clinical results were judged using VAS and neuro examination. Motion decreased in both groups over time; however, the loss of segmental motion was significantly higher in the ACDF group. Significant pain reduction was observed in both groups ( $p>0.05$ ). The cervical spine disc prosthesis preserves cervical spine segmental motion within the first 6 months after surgery. Clinical results were the same as early results of ACDF.

25. Anderson, et al. Journal of Neurosurgery, 2004. Comparison of Simulator-Tested and Retrieved Cervical Disc Prostheses. [BRYAN® Cervical Disc, Medtronic].

This study compared wear/debris of human explanted BRYAN® Cervical Discs and PRESTIGE® Cervical Discs to wear/debris from discs tested on a spine simulator. Simulator predicted adequate wear for prostheses out to 40 years and human explants exhibited less wear than predicted by simulators (5 to 10 fold).

26. Anderson, et al. The Spine Journal, 2004. The BRYAN® Cervical Disc: Wear Properties and Early Clinical Results. [BRYAN® Cervical Disc, Medtronic]

This was an in vitro study to assess the BRYAN® Cervical Disc's wear properties and clinical results with an in vitro mechanical testing in a caprine animal model and in a prospective European human trial. In vitro wear averaged approximately 1.76% by weight at 10M cycles and 18% by weight at 40 million cycles. Wear debris were present in periprosthetic tissues without inflammatory response in animals. 90% of European trial patients had satisfactory results.

27. Bertagnoli, et al. Journal of Neurosurgery, 2005. Early Results After PRODISC-C® Cervical Disc Replacement [PRODISC-C®, Synthes Spine]

This was a case series with follow up at 3, 6, and 12 months and looking at radiographic examination (ROM), ODI, and VAS. At 12 months 63.6% patients completely satisfied, 36.4% satisfied, and 0% unsatisfied.

28. Bertagnoli, et al. Ortho. Clin N. Am., 2005. Cervical Disc Replacement:Part II Clinical Results. [PRODISC-C®, Synthes]

This was a case series of 27 patients with follow up at 3 and 6 wks, 3, 6, 12 months looking at NDI, VAS, ROM, and other clinical parameters. At 12 months it was noted that 52% completely satisfied, 36% satisfied, 12% unsatisfied.

29. Cummins, et al. Journal of Neurosurgery, 1998. Surgical Experience with an Implanted Artificial Cervical Joint. [BRISTOL-CUMMINS DISC]

This is a retrospective cohort study looking at the surgical experience with the implantation of movable stainless-steel joints in 20 patients. Joint motion was determined by measuring the distance between cervical spine segments during flexion/extension. Follow up 3-65 months. No patients required additional motion segment surgery. Radiography did not demonstrate fusion at the treated level in any patient. Adjacent segment joint degeneration was absent. 16 of 20 patients reported improvement in pain relief. Three patients were considered failures because pain persisted or worsened. Complications were attributed to poor screw placement, incompatible screws, one-size-fits-all implants, and manufacturing errors. Stainless steel appears too suitable for this joint replacement design. With appropriate modification of sizes, this joint is shown to be capable of stability and motion and deserves further clinical evaluation.

30. Datta, et al. J Spinal Disord Tech, Vol. 20, Number 1, Feb. 2007. Sagittal Split Fractures in Multilevel Cervical Arthroplasty Using a Keeled Prosthesis [PRODISC-C®, Synthes Spine]

This is a case report of a 34-year old male with a 2-level cervical spondylosis unresponsive to nonoperative care for 24 months. FDA compassionate use granted for treatment with Prodisc -C® at C5-6 and C6-7 levels The PRODISC-C® was inserted successfully at the C6-7 level. Following that, during use of a keeled osteotome at the C5-6 level, a loss of resistance was felt and radiographic imaging revealed a sagittal split fracture of the C6 vertebral body with no instability or loose fragments observed. Insertion of the PRODISC-C® at C5-6 was performed as planned. Postoperative radiographic evaluation revealed a fracture of the C5 vertebral body that was not detected during surgery. The patient had immediate relief of his preoperative symptoms and eventual relief of neck pain related to the fracture. The author concludes that this adverse event may be attributed to the keeled design of the prosthesis, as well as the need for chisel cutting before and during insertion of the prosthesis.

31. Dmitriev, et al. SPINE, 2005. Adjacent Level Intradiscal Pressure and Segmental Kinematics Following Cervical Arthroplasty. [PCM®, Cervitech, Inc.]

This is a laboratory study looking at intradiscal pressure at levels adjacent to an arthroplasty. In 10 cadavers, similar adjacent level IDP's were recorded between TDR

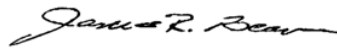
and intact spine in all loading conditions ( $p < .05$ ). Segment above both arthrodesis groups had higher intradiscal pressure at adjacent level above ( $p < .05$ ).

The American Association of Neurological Surgeons, Congress of Neurological Surgeons, North American Spine Society, Scoliosis Research Society, and Spine Arthroplasty Society appreciate the opportunity to offer these comments to CMS regarding potential NCD topics. We look forward to our continued relationship to further improve patient access to quality spine care.

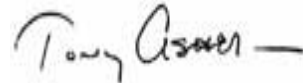
Sincerely,



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