CHAPTER 22

The Bryan Artificial Disc

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KEY POINTS

- In a prospective, randomized trial, the Bryan disc group demonstrated statistically significant better functional outcomes compared with the cervical fusion cohort.
- At 2 years’ follow-up, there are statistically significant improvements in the neck disability index, the neck pain and arm pain visual analog pain scores (VASs), and the SF-36 physical component score.
- In a prospective trial, there were no intraoperative complications, vascular or neurologic complications, spontaneous fusions, device failures, or explantations in the Bryan cohort.
- More motion was retained in the disc replacement group than the plated group at the index level ($P < .006$ at 3, 6, 12, and 24 months); the disc replacement group retained an average of 7.9 degrees at 24 months. In contrast, the average range of motion in the fusion group was 0.6 degrees at 24 months.

INTRODUCTION

The cervical spine is a linkage of specialized joints and, like other joints, may be the source of significant pain and functional incapacity with age, trauma, and subsequent degeneration. However unlike other major joints, the traditional perception is that motion in the cervical spine is not a necessity and has been routinely sacrificed for pain relief and functional recovery. For more than 50 years, anterior cervical discectomy and fusion (ACDF) has been the treatment of choice for cervical disc disease. Numerous studies have demonstrated the kinematic and biomechanical limitations inherent in this procedure in addition to the potential to accelerate adjacent segment degeneration. Thus, intervertebral disc replacement has been designed to remedy these shortcomings. Duggal et al confirmed preservation of motion in Bryan disc replacement–treated spinal segments with a mean range of motion of 7.8 degrees at 24 months. Sasso et al described normal flexion/extension motion (6.7 degrees) in comparison to ACDF of 0.6 degrees at 24 months postoperatively. In addition, abnormal motion at the adjacent segment of a fusion was demonstrated. An increase in anterior or posterior translation at the cephalad adjacent level in patients with arthrodesis occurred while the Bryan arthroplasty retained normal translation for the same amount of flexion/extension at the adjacent level.

INDICATIONS/CONTRAINDICATIONS

Indications for cervical arthroplasty include patients with radiculopathy or myelopathy at a single level owing to a focal herniated nucleus pulposus or uncovertebral osteophyte from C3 to C7 (Fig. 22–1). The intent is to use an arthroplasty as an alternative to arthrodesis after neural decompression. Contraindications include severe myelopathy secondary to retrovertebral osteophytes, multilevel disease, chronic infection, osteopenia, and posterior facet arthropathy.

DESCRIPTION OF THE DEVICE

The Bryan disc is a one-piece, biarticulating, metal on polymer, semiconstrained device with a variable instantaneous axis of rotation (Fig. 22–2). The component is composed of two titanium alloy shells that have a porus coating at the bone-implant interface, which promotes in-growth of bone providing long-term stability. Jensen reported adequate and reproducible bone ingrowth into the Bryan cervical disc end plates. Each shell has an anterior flange to articulate with the inserting device and also prevent posterior migration. The polyurethane nucleus between the shells is surrounded by a sheath creating a pseudocapsule over time. Saline is used as a lubricant inside the sheath. This also provides a hydraulic dampening effect under axial loads that allows shock-absorbing characteristics to the Bryan artificial disc (Fig. 22–4).

BACKGROUND OF SCIENTIFIC TESTING AND CLINICAL OUTCOMES

Goffin et al published results from a multicenter European study and found success rates in single-level Bryan cervical disc replacements at 6 months, 12 months, and 24 months of 90%, 86%, and 90%, respectively. In a bilevel study, success rates at 6 months and 1 year were 82% and 96%, respectively. At 1 year, flexion-extension range of motion per level averaged 7.9 degrees in the single-level arm and 7.4 degrees in the bilevel arm (Fig. 22–5). Complications included three hematomas, three subsequent decompressions, and one repair of pharyngeal and esophageal injury. One patient had migration of the
implant but was not greater than the 3.5-mm radiographic threshold. Sekhon et al. performed arthroplasty on 22 patients with myelopathy and 24 controls. Their study found both groups had significant arm and neck pain relief. The SF-36 and neck disability index scores reflected improvement, with numerically better results in the Bryan disc group but the results not statistically significant. The only complications were one hematoma and one required a fusion.

Anderson et al. reported on 73 patients with greater than 2-year follow-up. Forty-five patients rated excellent, seven rated good, 13 rated fair, and eight rated poor. SF-36 functional data demonstrated significant improvement from preoperative to 3-month postoperative time points and remained stable at 2 years after surgery. They reported no evidence of subsidence, and 89% of all patients had at least two degrees of motion. There was one early anterior device migration associated with a partially milled cavity.

Sasso et al. published data on 99 patients from a multicenter randomized trial. At 2-year follow-up, neck disability index for the Bryan group was statistically better than that for the
controls (Fig. 22–6). Arm pain VAS score was statistically better in the Bryan group compared with that of the control group. Neck pain VAS in the Bryan group was also statistically better than in the control group (Fig. 22–7). Flexion/extension motion in the Bryan disc group at 24 months was 6.7 degrees compared with 0.6 degrees in the control group.

**OPERATIVE TECHNIQUE**

Preoperative clinical and radiographic assessment is essential as in all operative procedures. Preoperative computed tomography (CT) scan allows determination of the exact dimensions of the disc space and use of a template to identify the appropriate size of the Bryan disc. Patient positioning is in a neutral orientation. Hyperextension should be avoided. This technique is a variation to the standard anterior fusion in which the neck is often intraoperatively in hyperextension by inserting a roll under the shoulders. Cervical artificial discs should be inserted in a neutral standing position. This is best facilitated by putting the rolled towel under the neck rather than the shoulders and raising the head by placing it on a folded towel. The position should approximate standing with the back against a wall and the head also against the same wall.

The cervical spine is accessed via a standard Smith-Robinson approach. Decompression is then performed at the affected level.
A milling technique using a jig creates concave surfaces on each vertebral endplate to match the convex porous-coated titanium endplates of the Bryan disc. The correct size of Bryan disc is determined using a combination of intraoperative techniques and preoperative radiographic studies. The center of the disc space is determined intraoperatively using a jig, which defines the uncovertebral joints and finds the center between these structures. A gravitational referencing system determines the sagittal angle of the disc space. With knowledge of the center of the disc space, a milling fixture is anchored to the vertebral bodies (Fig. 22–8). This fixture controls the cutting tools that mill the end plates to the exact geometry of the device end plate, providing immediate stability. Lateral fluoroscopy assists in determining the diameter of the implant. Final decompression of the foramen and spinal canal can be performed after preparation of the endplates. When motion-sparing devices are implemented, it is extremely important to completely decompress the neural structures, including the contralateral asymptomatic foramen. This is a significant variation to the standard fusion procedure in which the neural structures are protected by the lack of motion. The uncovertebral joints should not be sacrificed bilaterally in artificial disc replacement; however, aggressive decompression unilaterally is acceptable.

The Bryan disc is filled with sterile saline (Fig. 22–9) and positioned on an inserter that attaches to the flanges on the anterior titanium shells (Fig. 22–10). An intervertebral distracter allows atraumatic insertion of the prepared Bryan disc (Fig. 22–11). Appropriate placement is confirmed with anteroposterior (AP) and lateral fluoroscopy before skin closure (Fig. 22–12).
After implantation of the Bryan artificial disc, no cervical collar is needed. Patients are routinely discharged the same day of surgery. Patients are allowed to mobilize their neck immediately and return to work when comfortable. Traynelis et al. found in a prospective, randomized trial that patients undergoing Bryan cervical disc replacements returned to work statistically earlier than those having a fusion after cervical decompression.

CONCLUSIONS/DISCUSSION

Disc arthroplasty was developed to maintain motion to hypothetically reduce the risk of future adjacent segment degeneration. Other advantages are thought to be earlier return to activity and reduced surgical morbidity. Six devices are undergoing investigation by the U.S. Food and Drug Administration. The differences in materials, design, and implantation techniques on their performance are unknown. Preclinical testing for durability, stability, bony ingrowth, and inflammatory reactions show that current designs are meeting established criteria for success.

Early follow-up of human studies are encouraging, demonstrating at least as good outcomes with the advantage of motion preservation. Complications are few and manageable, and have not resulted in catastrophic neural injury. The rate of revision has been low. Longer follow-up is needed to determine if these devices can function over time and whether there will be an implant to host or host to implant reaction.

Although far from being an accepted standard, the concept of artificial disc replacement is gradually becoming a reality. The possibility of being able to minimize adjacent segment degeneration is exciting; however, much more intermediate and long-term outcome-based data are going to be necessary to prove that this technology supersedes the current gold standard of anterior fusion. Biomechanical studies demonstrate that disc replacement creates...
less adjacent level strain than fusion. With time, it is hoped that long-term studies will prove that this correlates to a lower incidence of adjacent level degeneration.

Wear studies suggest that there may be less potential for aseptic loosening than in large joint arthroplasty, although the reality of this will be borne out only with more follow-up time. Although early reports of success in the United States with the total disc replacement suggest that the intended effects are being achieved, the final results of arthroplasty with these devices and of cervical arthroplasty are pending the outcomes of long-term studies.

Prospective, randomized studies demonstrate the favorable outcomes of cervical disc arthroplasty using the Bryan disc in comparison to the gold-standard (ACDF) at 24 months for the treatment of patients with cervical myelopathy and radiculopathy. At 2 years’ follow-up, the Bryan artificial disc replacement demonstrated statistically significant improvements in the neck disability index, the neck pain and arm pain VASs, and the SF-36 physical component score compared with the control fusion population. The future looks bright for cervical arthroplasty, but further long-term studies are necessary.

REFERENCES

### Author Query Form

**Book:** Motion Preservation Surgery of the Spine: Advanced Techniques and Controversies  
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