Motion preserving anterior cervical disc arthroplasty in patients with cervical radiculopathy was introduced to prevent symptomatic adjacent disc degeneration compared with anterior cervical discectomy and fusion. However, spine surgeons remain hesitant to fully endorse one surgical technique over the other without well-designed randomized clinical trials (RCTs) reporting long-term outcomes. A survey distributed to members of AOSpine International found that members believed that fusion had the highest effectiveness on arm pain but also had a higher risk of adjacent segment disease compared with arthroplasty. In contrast, an evolving body of evidence suggests that arthroplasty is superior to fusion based on arm pain, neck pain, functional improvement, neurological success, and rates of serious adverse events outcomes. Although RCTs have shown that arthroplasty has advantages over fusion, consensus on clinical effectiveness among spine surgeons has not been reached yet, and clinical practice adoption efforts are varied.

The study by Johansen et al represents the latest contribution to investigate the long-term outcomes in patients undergoing surgery with arthroplasty or fusion for cervical radiculopathy. Surgery was exclusively performed at the subaxial cervical segment (C5-C6) for C6-C7 radiculopathy using the Discover prosthesis (Depuy-Synthes) for arthroplasty and Cervios cage for fusion. The same arthroplasty device had been investigated in an RCT conducted in 3 other European countries and China. After a 2-year follow-up period, those studies concluded that fusion had a higher incidence of radiographic adjacent segment changes and suboptimal improvement of symptoms compared with arthroplasty. Interestingly, those results did not hold at 5 years after surgery. The study by Johansen et al found no differences in outcomes measures, such as reoperation rates, symptom relief, and health-related quality of life measures. These findings suggest that the earlier reported advantages of arthroplasty compared with fusion may not carry on to a longer follow-up time, and the effects of treatments may change if patients were followed beyond the study period.

Early criticism of the literature reporting short-term results of Investigational Device Exemption studies in the United States has concentrated on the lack of long-term follow-up. Moreover, studies conducted outside the US have achieved longer follow-up but did not include a comparative group. To date, few well-designed RCTs of arthroplasty vs fusion for cervical radiculopathy have provided enough evidence to support long-term outcomes, albeit concerns that the results of those RCTs could only be applicable for highly selective groups of patients (for example, those with 1-segment disc disease, 2-segment disc disease, absence of deformity, or instability) and specific surgical interventions (eg, multisegment treatment, including >2 segments or noncontiguous segments, or hybrid treatment). Those shortcomings of RCTs could be addressed by real-world evidence research studies, which primarily offer a better representation of routine clinical practice scenarios and longer follow-up time at a lower cost.

In parallel, efforts are being undertaken to understand the biomechanics of motion-sparing or motion-preserving spinal technologies. Computational analysis using anatomical Finite element model of the spine could provide information that is otherwise unobtainable or impractical to obtain from cadaveric experiments or human clinical studies, such as the influence of implant size and positioning (eg, anterior or lateral), loading patterns, and design and material composition, on the biomechanics of the cervical spine after arthroplasty. Nonetheless, changes at the adjacent spine segments should be appreciated when investigating arthroplasty or motion preservation devices. A better understanding of the biomechanical alterations at the index and adjacent segment of the cervical spine after cervical arthroplasty is crucial to resolve some of the skepticism that prevents...
some spine surgeons from considering arthroplasty in the armamentarium of cervical spine surgery for radiculopathy.

Lastly, cost-effectiveness analysis studies have identified arthroplasty as cost-effective compared with fusion, primarily owing to the reduced rate of secondary surgery in patients who undergo arthroplasty. However, Johansen et al found that fusion and arthroplasty had the same reoperation rates, prompting reconsideration of the financial benefit of arthroplasty with long-term follow-up. Considering both treatment modalities could be good options for treating cervical radiculopathy in select patients, factors such as cost and operative time may weigh in when choosing a treatment modality. The good results with arthroplasty for cervical radiculopathy may increase their use in the future, but the limited indications for arthroplasty should be adhered to. A careful assessment of disc height, bone density, instability, facet joint degeneration, and other factors should be conducted before opting for arthroplasty. Fusion remains the procedure of choice for patients with severe disc collapse, instability, and severe spondylosis.

ARTICLE INFORMATION
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REFERENCES