# Paradigm Shift of Interspinous Device Surgery for Degenerative Lumbar Diseases

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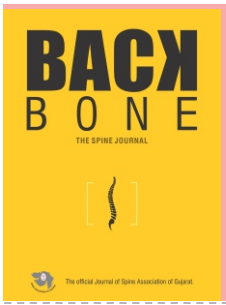
Instrumented fusion surgery is an effective surgery for severe degenerative lumbar diseases and can achieve satisfactory clinical outcomes with a high fusion rate. However, due to extensive nature and loss of segmental motion, instrumented fusion can cause complications and adjacent segment disease, and some patients require second surgery. On the contrary, decompression alone is an effective surgery for moderate degenerative lumbar diseases and can achieve satisfactory clinical outcomes. However, failed back surgery syndrome, such as recurrent lumbar disc herniation or spinal stenosis, can occur at the segment of prior surgery, and some patients also require second surgery. In clinical practice, there are indications for instrumented fusion surgery or decompression alone. However, for some cases, it is difficult to decide which surgery is appropriate for the patients; such a situation is called a grey zone (Fig. 1). Instrumented fusion surgery can be excessive, while decompression alone can involve segmental imbalance or problems postoperatively. Interspinous device surgery (ISD) can be considered for grey zone of degenerative lumbar diseases as new solution.

According to the traditional concepts, diseased lumbar segment with instability is a cause of low back pain and can require fusion. However, in clinical situations, fusion does not always correlate with successful outcomes. While about 10–20% of solid fusion patients complain of persistent low back pain, some non-union patients do not complain of low back pain. These results lead to questions and uncertainty regarding fusion surgery. First, it is unclear if lumbar instability is a cause of low back pain. Second, it must be determined if fusion surgery is necessary for lumbar instability. Recently, the biomechanical concept of the cause of low back pain has changed. Increased load transmission to facet joints and increased intradiscal pressure to the posterior part of a disc are considered important causes of low back pain. Therefore, spine surgeons view degenerative lumbar diseases differently, resulting in a paradigm shift in surgery of degenerative lumbar diseases.

ISD surgery is a dynamic stabilization surgery with an action mechanism of distraction of narrow interspinous space: ISD can widen the spinal canal and neural foramen to achieve indirect decompression of neural structures. In addition, ISD can restore normal lordosis and offset abnormal load shift of facet joints and increased intradiscal pressure to the posterior part of the disc to relieve low back pain. Based on the concept and action mechanism, good indications of ISD surgery are moderate lumbar spinal stenosis (Fig. 2), lumbar disc herniation (Fig. 3), and internal disc derangement (Fig. 4) associated with flexible extension instability or segmental imbalance, such as retrolisthesis or hyperlordosis, which can be reduced in flexion. In contrast, contraindications of ISD surgery are severe lumbar spinal stenosis, flexion instability, degenerative or isthmic spondylolisthesis, rigid extension instability of segmental imbalance that cannot be reduced in flexion, and multilevel degenerative lumbar scoliosis.

In our experiences of about 20 years with primary ISD surgery and revision surgery for failures of ISD surgery, the most common cause of failure of ISD surgery is inappropriate indication or patient selection. Another important cause of failure is incorrect surgical technique such as stand-alone use of ISD without decompression, excessive over-distraction (by over-sized ISD), and supraspinous ligament injury or spinous process fracture. These incorrect surgical techniques cause poor surgical outcomes and might require revision surgery. Based on these outcomes, the following advice is offered for successful ISD surgery for degenerative lumbar diseases. First, ISD surgery should be performed for patients with good indications. Second, ISD implantation should be performed after limited decompression including removal of a

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hypertrophied ligamentum flavum to preserve segmental stability (Fig. 5).

In our BMC Musculoskeletal Disorders Publication (Cho et al.) [1], we performed 15-year survivorship analysis of 94 patients with single-level lumbar disc herniation who underwent discectomy and DIAM implantation. We aimed to provide the longest follow-up evidence on the efficacy of DIAM implantation for single-level lumbar disc herniation. The results showed that 8.5% of the patients underwent reoperation at the DIAM implantation level during the 15-year follow-up. The mean time to reoperation was 6.5 years. Kaplan–Meier analysis showed a cumulative survival rate of the DIAM implant of 99% at 1 year, 97% at 5 years, 93% at 10 years, and 92% at 15 years after surgery. Our results showed that DIAM implantation significantly decreased reoperation rate for single-level lumbar disc herniation in 15-year survivorship analysis. This study provides the strongest evidence for the efficacy of DIAM implantation for the treatment of single-level lumbar disc herniation. In our view, this paper, coupled with our previous paper (Sur et al.) [2], settles the debate on the efficacy of DIAM implantation for the treatment of moderate lumbar spinal stenosis or lumbar herniation associated flexible extension instability or segmental imbalance.

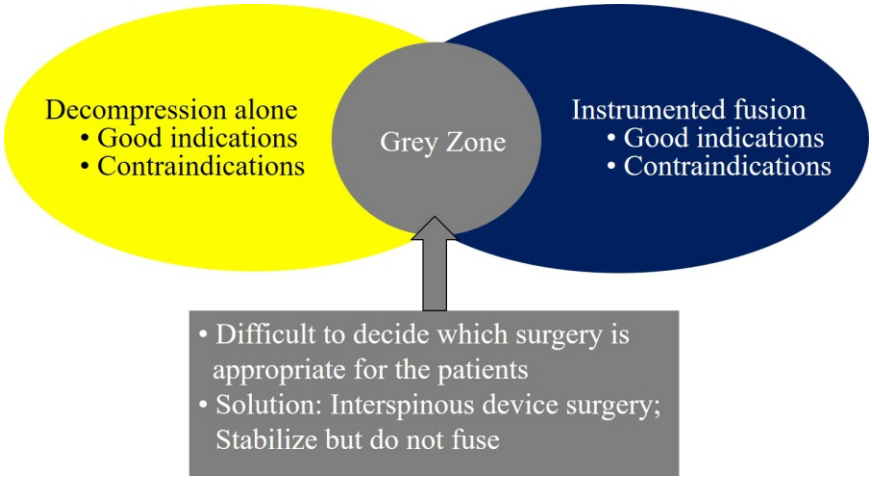


**Figure 1:** Schematic drawing shows that interspinous device surgery can be considered for grey zone of degenerative lumbar diseases as new solution.

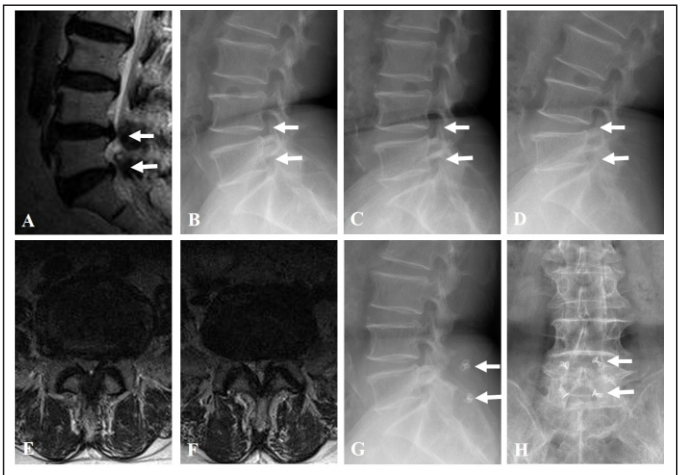


**Figure 2:** Magnetic resonance images (a, e, and f) show moderate lumbar spinal stenosis at L4-5-S1 segments. Neutral (b), flexion (c), and extension (d) lateral radiographs show that segmental imbalance, such as hyperlordosis and retrolisthesis, of L4-5-S1 segments is reduced in flexion but aggravated in extension. Post-operative radiographs (g and h) show limited laminectomy and DIAM implantation at L4-5-S1 segments with restoration of segmental lordosis.

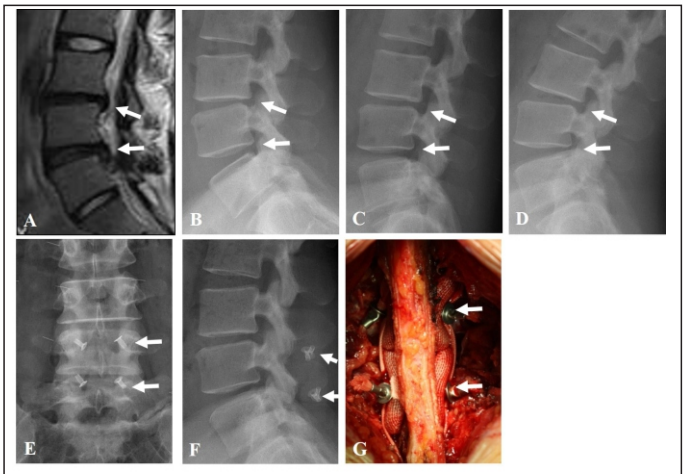


**Figure 3:** Magnetic resonance image (a) shows moderate lumbar disc herniation at L4-5-S1 segments. Neutral (b), flexion (c), and extension (d) lateral radiographs show that segmental imbalance, such as hyperlordosis and retrolisthesis, of L4-5-S1 segments is reduced in flexion but aggravated in extension. Post-operative radiographs (e and f) and clinical photo (g) show limited laminectomy and discectomy and DIAM implantation at L4-5-S1 segments with restoration of segmental lordosis.

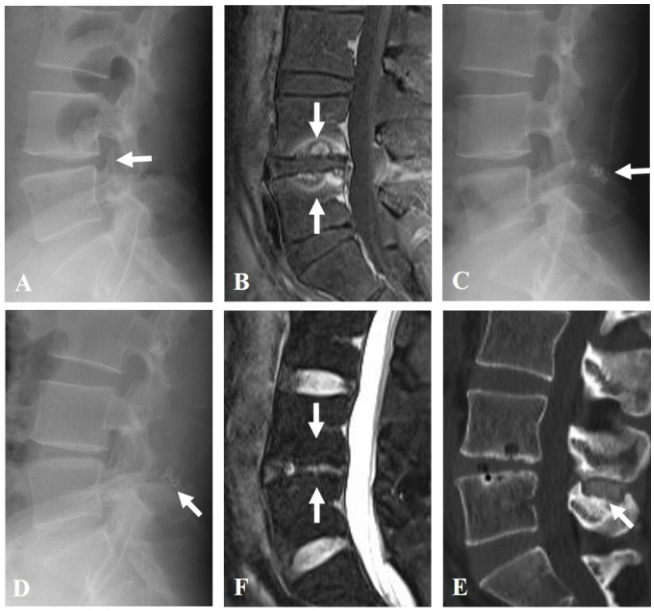


**Figure 4:** Neutral (a) lateral radiograph shows that segmental imbalance, such as hyperlordosis and retrolisthesis, at L4-5. Magnetic resonance image (b) shows internal disc derangement with severe modic change at L4-5 segment. Post-operative lateral radiograph (c) shows DIAM implantation with restoration of segmental lordosis at L4-5 segments. At 13 years after surgery, follow-up lateral radiograph (d), magnetic resonance image (e), and computed tomogram image (e) show well maintenance of segmental lordosis and DIAM implant at L4-5 with resolution of internal disc derangement with severe modic change.

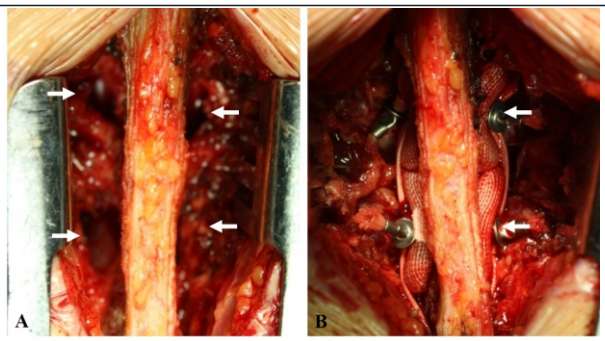


**Figure 5:** Intra-operative clinical photos (a and b) show limited laminectomy and DIAM implantation at L4-5-S1 segments.

## References

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2. Sur YJ, Kong JG, Park JB. Survivorship analysis of 150 consecutive patients with DIAM implantation for surgery of lumbar spinal stenosis and disc herniation. Eur Spine J. 2011;20:280-288.

**Declaration of patient consent:** The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the Journal. The patient understands that his name and initials will not be published, and due efforts will be made to conceal his identity, but anonymity cannot be guaranteed.

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