

# Minimally Invasive Versus Open Surgery for Degenerative Lumbar Spine Lesions: Review Article

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## **Abstract:**

Degenerative lumbar spine disorders are commonly treated using decompression, posterior fusion, or interbody fusion procedures. Although conventional open surgery provides wide exposure of the operative field, it may cause extensive paraspinal muscle injury, greater blood loss, postoperative pain, prolonged hospitalization, and delayed recovery. Minimally invasive surgery was developed to reduce approach-related tissue damage while maintaining comparable neural decompression, stabilization, fusion, and clinical outcomes. Current evidence suggests that minimally invasive lumbar procedures may reduce intraoperative blood loss, hospital stay, and some perioperative complications compared with open surgery. However, reported differences in operative duration, quality-of-life improvement, and long-term functional outcomes remain inconsistent across techniques and pathological conditions. Minimally invasive procedures also have limitations, including expensive equipment, a steep learning curve, restricted visualization, and potential technical difficulties. Their cost-effectiveness may depend on whether reduced hospitalization, transfusion requirements, and recovery time compensate for higher procedural and equipment costs. This review compares minimally invasive and open surgical approaches for degenerative lumbar lesions, focusing on complications, hospital stay, operative time, blood loss, quality of life, and economic outcomes.

**Keywords:** Minimally invasive surgery; Open spine surgery; Degenerative lumbar disease; Lumbar decompression; Lumbar fusion; Transforaminal lumbar interbody fusion; Clinical outcomes.

## **Introduction:**

Several treatment options are available to treat degenerative spinal diseases, such as laminectomies, posterior fusions, and interbody fusions, depending on their locations, correction necessities, and surgeon philosophy. Traditionally those techniques were made in an open fashion, which allowed a great visualization of the surgical field; however, it comes with a more morbid and tissue-damaging procedure (1).

. Therefore, with the advance in technology and surgical knowledge, minimally invasive techniques (MIS) arose as a solution to reduce surgical morbidity, while maintaining the same benefits of the traditionally/open surgeries, in this way allowing older and weakened patients could have access to the benefits of those surgeries with a reduced risk of complications (2).

Several studies investigated the possible advantages of MIS techniques against the traditional open procedures. Showing that the MIS procedures were usually associated with reduced blood loss, and length of hospital stay, were usually like open surgeries regarding the clinical benefits and surgical duration, and with incremental cost–benefit varying according to the techniques included in the studies. However, those articles are usually focused only on one technique or on one pathology, which might raise questions about whether the observed effects are exclusively related to a specific condition or technique or if they might be true in a more general aspect (3).

Minimally invasive techniques were and still are one of the greatest revolutions in spinal surgery, as those techniques allowed surgeons to treat patients that usually require but were too weakened to receive an open procedure and to face its complications. However, the MIS techniques are not without pitfalls such as pricy materials and steep learning curves **(4)**.

#### Complications and length of stay

One of the key points of minimally invasive surgery is its theoretical ability to reduce the intra and postoperative complications involving lumbar surgery. Goldstein et al., 2016 showed in a meta-analysis that using MIS PLIF or TLIF could lead to reduced medical complications compared to the open version of the same procedures. Similarly, Hu et al., 2016 showed that using MIS TLIF significantly reduced the complications rate when compared with the open TLIF procedure **(5)**.

Interestingly studies investigating specifically the use of MIS technology to treat spondylolisthesis showed a significant reduction in length of stay, but not in the complication rates **(6)**.

#### Surgical duration and blood loss

In a recent study comparing MIS versus open TLIFs Hockley et al., it showed that patients who underwent MIS procedures had significantly lower surgical time and blood loss. Further, Lu et al., showed that using MIS techniques to treat spondylolisthesis could lead to a significant reduction in surgical time and blood loss **(7)**.

Similar to when comparing open with MIS decompressions for extraforaminal discectomy, Akinduro et al., 2017 showed that MIS techniques showed lower blood loss and surgical time.

Also, when studying the effects of MIS decompression against open decompressions, Evaniew et al., 2021 showed that patients receiving MIS decompressions had lower blood loss and surgical time **(8)**.

Finally, Qin et al., 2018, also showed the advantages of MIS-TLIFs over open TLIFs in blood loss, however, differently than the previous study, the authors reported higher operative in the MIS-TLIF group, in consonance with the findings of the prospective subgroup of Lu et al., 2017 study that showed an increased operative time in MIS surgeries, also similar to the findings presented by Miller et al., 2020, who reported no differences in surgical time between patients receiving MIS-TLIF or open TLIF for single-level degenerative pathologies **(8)**.

#### Quality of life

Like the present study, there is heterogeneity between the effects of MIS surgeries compared to open surgeries regarding the improvement of the quality-of-life measures. Evaniew et al., 2019, in a registry study, reported that patients receiving MIS or open had similar leg pain improvement, with MIS patients having a slightly lower chance to achieve back pain MCIDs at 12 months. Further, Heemserk et al., 2021 showed that MIS and open surgeries have similar outcomes at two years of follow-up when treating degenerative lumbar diseases **(9)**.

Finally, Miller et al., 2020 showed that pain severity between MIS and open patients was similar, however, the ODI at the last follow-up slightly favored MIS techniques results consistent with the presented by Qin et al., 2019 that reported better ODI outcomes for patients receiving MIS TLIFs to treat spondylolisthesis **(6,10)**.

#### Surgical costs

One of the most controversial aspects of the MIS-open corundum is the cost-effectiveness of the minimally invasive techniques, on whether the reduction in blood loss and hospitalization times compensates for the costlier materials needed to perform MIS surgeries **(11)**.

In a study published in 2016, Goldstein and collaborators reported a cost-saving from MIS procedures ranging from 2.5 to 49%. Further Vertuani et al. 2018, in a simulation of costs and cost-effectiveness based on the United Kingdom and Italy surgical prices for both MIS and open surgeries, showed that in both countries the MIS techniques were presented with increased cost-effectiveness compared to open procedures. Finally, Droehaag et

al. 2021, showed in a recent meta-analysis that MIS-TLIF was more cost-effective than Open TLIF, with all the four included studies lying in the “Less Costly & More Effective” (12).

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