

## Minimally Invasive Techniques for Lumbar Interbody Fusions

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Spinal fusions have been performed for nearly a century for a variety of conditions, such as for infections, trauma, deformity, degenerative conditions, and after resection for spinal tumors [1–11]. Typically, spinal fusions are performed as posterior/posterolateral or anterior for lumbar interbody arthrodesis. Traditionally, the ability to achieve adequate exposure to perform these procedures required an open surgical approach; however, with the advent of newer techniques and technology, combined with an improved understanding of surgical anatomy, newer minimally invasive techniques have been developed.

Some of the more common minimally invasive spine surgery (MISS) techniques being used for achieving lumbar interbody fusions are addressed. As such, the main posterior approach includes the transforaminal lumbar interbody fusion (TLIF), whereas anterior techniques include retroperitoneal and transperitoneal anterior lumbar interbody fusion (ALIF) approaches. In addition, other recent techniques are addressed, such as the extreme lateral interbody fusion (XLIF) and axial lumbar interbody fusion (AxialLIF). The subsequent discussion includes

a general review of the history, indications, brief overview, and description of each surgical technique.

### History

The first description of lumbar interbody fusion was published in the 1930s by Capener and colleagues [12]. The original technique was described as an anterior approach for treatment of spondylolisthesis of the lumbar spine. A complete discectomy was performed, and the listhetic segment was reduced using a structural cadaveric bone graft with supplemental autograft as an ALIF. Subsequently, in the 1950s, Cloward [5] described a technique for performing a lumbar interbody fusion through a posterior laminectomy, which became known as a posterior lumbar interbody fusion (PLIF). In the original description, the PLIF procedure was designed to preserve the facet joints and required nerve root retraction to allow for adequate disc excision and placement of the interbody graft or cage. In the attempt to reduce the risk for nerve root injury and irritation and provide enhanced visualization of the intervertebral disc, the TLIF approach was described [13,14]. In the ensuing years, an extreme lateral/transposoas approach to the spine has been reported for XLIF procedures [15]. In this

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technique, access to the lumbar spine is achieved by a lateral approach that passes through the retroperitoneal fat and psoas major muscle. Theoretically, this approach avoids the potential complications associated with an anterior retroperitoneal and transperitoneal approach to the lumbar spine, thereby avoiding the major vessels that typically are encountered with the traditional ALIF approaches. More recently, a percutaneous approach to the anterior lumbosacral spine that uses the presacral space has been described [16–18].