

Navigation-Assisted Minimally Invasive Surgery Deformity Correction



Taemin Oh, MD^{a,*}, Paul Park, MD^b,
Catherine A. Miller, MD^a, Andrew K. Chan, MD^a,
Praveen V. Mummaneni, MD^a

KEYWORDS

• Deformity • Spine surgery • Navigation • Minimally invasive • Scoliosis

KEY POINTS

- Use of intraoperative navigation can be an important tool for minimally invasive surgery (MIS) deformity correction.
- In the circumferential MIS approach, deformity correction is typically broken down to 2 stages: stage 1 often involves a prepsoas or transpsoas lateral approach or anterior lumbar interbody fusion, whereas stage 2 involves MIS transforaminal lateral interbody fusion (if appropriate) with percutaneous screw instrumentation.
- Outcomes using navigation in MIS deformity correction have both shown to be successful when appropriate indications are followed.

INTRODUCTION

Minimally invasive approaches to spinal surgery (minimally invasive surgery [MIS]) offer a promising alternative to open approaches, with emphasis placed on minimizing exposure-related morbidity (eg, blood loss, postoperative pain). However, this same minimal exposure can also limit direct visualization of the spinal anatomy. Although use of fluoroscopy can partially offset this disadvantage, use of fluoroscopy can also increase ionizing radiation exposure to the surgeon, staff, and patients. Intraoperative navigation can, thus, perform a critical role during MIS surgery, as it can facilitate

both safety and accuracy during highly complex surgical procedures while decreasing intraoperative radiation exposure.^{1–5}

One of the most common MIS methodologies for treating deformity involves a 2-stage approach: (1) stage 1 consists of a MIS transpsoas lateral extreme lateral interbody fusion [XLIF]/ direct lateral interbody fusion [DLIF] or oblique prepsoas approach for interbody fusion or an anterior lateral interbody fusion (ALIF); (2) stage 2 consists of a posterior approach, which can either incorporate open techniques (hybrid procedure) or exclusively use MIS techniques, such as the MIS transforaminal

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^a Department of Neurological Surgery, University of California San Francisco, 505 Parnassus Avenue, Room M779, San Francisco, CA 94143-0112, USA; ^b Department of Neurological Surgery, University of Michigan, 1500 East Medical Center Drive SPC 5338, Ann Arbor, MI 48109-5338, USA

* Corresponding author.

E-mail address: taemin.oh@ucsf.edu

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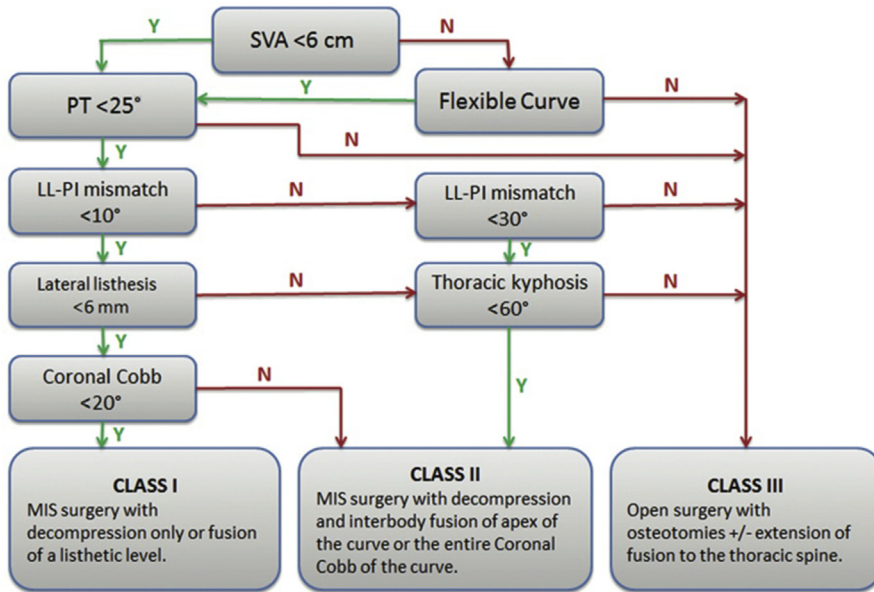


Fig. 1. Original MISDEF algorithm. LL-PI, lumbar lordosis-pelvic incidence; PT, pelvic tilt; SVA, sagittal vertical axis. (From Mummaneni PV, Shaffrey CI, Lenke LG, et al. The minimally invasive spinal deformity surgery algorithm: a reproducible rational framework for decision making in minimally invasive spinal deformity surgery. *Neurosurg Focus* 2014;36(5):E6; with permission.)

lateral interbody fusion (TLIF) with percutaneous instrumentation (circumferential MIS [cMIS]). The Minimally Invasive Spinal Deformity Surgery (MIS-DEF) algorithm can be used to assist in determining whether a cMIS approach is appropriate (Fig. 1).⁶ In this article, the authors detail the use of navigation within the framework of a 2-stage approach (Table 1).

TYPICAL INDICATIONS/CONTRAINDICATIONS FOR LUMBAR FUSION USING NAVIGATION

See Table 2.

SURGICAL TECHNIQUE/PROCEDURE

Preoperative Planning

- Assessment of 36-in-long cassette radiographs is essential to characterize the degree of spinal curvature and deformity. Bending radiographs or supine computed tomography (CT) scouts with reformatted images are helpful to assess for flexibility and spinal instability.
- Fixed deformities are technically challenging to treat via cMIS, and the likelihood of suboptimal deformity correction is high. In such cases, a traditional open or hybrid approach should be considered unless advanced MIS techniques, such as the MIS pedicle subtraction osteotomy, is planned.

Intraoperative Computed Tomography–Guided Navigation

- Several intraoperative CT-guided navigation systems are available, including the O-arm/STEALTH (Fig. 2; Medtronic Inc, Minneapolis,

Table 1 Surgical Approaches	
Approach	Basic Description
cMIS	Combination of a 2-stage approach emphasizing MIS techniques: <ul style="list-style-type: none"> • Stage 1: MIS transpsoas lateral or oblique prepsoas approach or ALIF for interbody fusion • Stage 2: Percutaneous pedicle screw instrumentation, with or without MIS TLIF
Hybrid	Combination of a 2-stage approach with mix of MIS and open techniques: <ul style="list-style-type: none"> • Stage 1: MIS transpsoas lateral or oblique prepsoas approach or ALIF for interbody fusion • Stage 2: open pedicle screw instrumentation
Open	Combination of a 2-stage approach with emphasis primarily on open techniques

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