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# Riding the Wave of Innovation: Endoscopic Spine Surgery Is Here to Stay

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Since the early days of surgical practice, surgeons have strived to achieve surgical goals while minimizing approach-related damage to adjacent tissues. The adaptation of endoscopy has played a critical role in miniaturizing access corridors in various surgical fields and contributed significantly to improved functional outcomes and decreased operative morbidity. In many procedures, such as cholecystectomies and joint surgeries, endoscopic approaches are now considered the standard of care.

Endoscopic techniques in spine surgery have encountered numerous obstacles and setbacks during their development. Despite the initial demonstration of feasibility by Kambin and Hijikata 50 years ago,<sup>1,2</sup> the widespread adoption of endoscopic spine surgery was initially impeded by inadequate visualization, illumination, and the absence of tissue ablation technologies. However, advancements over the past 5 decades have addressed these challenges. The introduction of high-definition digital cameras and efficient LED illumination has significantly improved the visualization of the surgical field. Additionally, modern high-speed burrs allow for efficient bone resection and decompression of neural elements. Furthermore, specialized radiofrequency tools provide efficient hemostasis and dissection of neural tissues. Also, the development of frameless stereotactic navigation has flattened the learning curve and expanded the range of indications for endoscopic spine surgery. These notable advancements have played a pivotal role in enabling full-endoscopic spine surgery to expose and visualize principal anatomic landmarks used in conventional procedures, marking a paradigm shift.<sup>3</sup>

The establishment of defined principal anatomical landmarks for each full-endoscopic procedure has concluded the ages of “believing” in the endoscopic technique. Furthermore, this standardization allows for more effective teaching and encourages rigorous scientific investigation of surgical outcomes.

Through a worldwide effort, endoscopic spine surgeons have standardized full-endoscopic procedures with respect to target areas, principal anatomical landmarks, and nomenclature.<sup>4</sup> Several prospective randomized controlled trials have shown the noninferiority of full-endoscopic spine surgery compared with traditional surgery.<sup>5–7</sup> Pooled data from 6 randomized controlled trials suggest that full-endoscopic spine surgery reduces the rate of perioperative complications by half compared with traditional surgery.<sup>8</sup> Impressively, the full-endoscopic technique decreases the rate of surgical wound infections 16-fold compared with the conventional technique.<sup>9</sup> Despite all of this, the rate of adoption spinal endoscopy in the United States is far behind the rest of the world.<sup>10</sup> Why? During a recent national meeting, I heard a prominent spine surgeon voice his concern that endoscopic spine surgery is too difficult to perform to gain wider traction. This was somewhat surprising to hear from a member of a medical field that typically does not shy away from risks or difficulties.

I suspect that the reasons behind the slow adoption of full-endoscopic spine surgery in the United States are primarily linked to the complexity of the health care system and its inability to support the implementation of novel, less morbid spinal procedures. First, teaching hospitals with high overhead costs often prioritize complex surgeries with substantial profit margins. At the same time, smaller noninstrumented procedures are moved to satellite hospitals with minimal teaching. This neglects the true mission of academic institutions to train the next generation of skilled surgeons in all aspects of spine surgery. Instead, our trainees gain the greatest exposure to the most aggressive and invasive spine procedures. Second, full-endoscopic surgery requires acquisition of capital equipment, which is often opposed by hospital administrators—although this opposition tends to dissolve quickly when the administrators themselves or their close ones require such care. Last, despite the additional training and increased surgical skills necessary, endoscopic spine surgery does

not provide any financial rewards for the surgeon—in fact, it is quite the opposite, with insurances commonly rejecting full-endoscopic spine surgeries as “experimental.”

Despite these obstacles, an increasing number of spine surgeons in the United States perform full-endoscopic surgeries. A growing body of excellent clinical research supports the benefits of this novel innovative surgical technique. We recently initiated a multicenter endoscopic spine research group (ESRG) to provide benchmark outcomes and allow for quality improvement initiatives. Considering the ambulatory nature of the procedures and their minimal complication rates, this technology is highly suitable for the development of innovative postoperative care through virtual smartphone applications.<sup>11</sup> Moreover, surgical ingenuity continues to drive the development of new applications for technology, ultimately enhancing patient care. Patients themselves are becoming more organized and actively requesting full-endoscopic spine procedures. Although the field is still in its infancy, further innovation in surgical tools, adjunct technology, and advanced perioperative care are expected to propel its advancement even further.

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