Minimally Invasive Spine Surgery in Small Animals

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KEYWORDS

• Spine • Veterinary • Approach • Minimally invasive • Open

KEY POINTS

- Minimally invasive spine surgery (MISS) in humans leads to shorter surgery times, decreased intraoperative blood loss, shorter durations of hospital stay, and decreased complications.
- MISS uses intraoperative imaging, magnification, and special instrumentation, and applies minimally invasive access strategies.
- Few veterinary studies have evaluated MISS, most using standard approaches with video assistance for improved visualization; few apply MISS access strategies using special retractors.
- Although MISS in small animals is currently not commonplace, modifying one's approach from open to miniopen procedures is the first step toward applying minimally invasive principles.

The goal of minimally invasive surgery (MIS) is to perform a surgical procedure with the least iatrogenic trauma as possible. The minimally invasive approach must not compromise the goal of the procedure, and should be applicable regardless of the underlying disease. MIS has become popular in human spine surgery and has been used for cervical, thoracolumbar, and lumbosacral (LS) procedures. Such approaches require modifications in access strategies to the different anatomic locations of the spine. Using specialized retractors and either endoscopic or magnification assistance, decompressive and stabilization procedures are performed successfully in humans through MIS approaches, while still being able to adhere to orthopedic fixation principles. The application of MIS to the vertebral column of veterinary patients is still at its early stages, with only few experimental and rare clinical reports available. The increasing availability of instrumentation necessary for MIS will allow veterinary surgeons to further develop minimally invasive techniques for veterinary patients and their specific spinal diseases.

Disclosure Statement: The author has nothing to disclose.
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Vet Clin Small Anim ■ (2017) ■–■
http://dx.doi.org/10.1016/j.cvsm.2017.08.008 **vetsmall.theclinics.com**

The application of MIS to the spine (minimally invasive spinal surgery [MISS]) requires careful preoperative planning and intraoperative imaging, as well as the use of specialized instrumentation and surgical techniques.[1] After the anatomic location of the pathology has been identified, the type of procedure required and thereby type of MIS approach can be determined. Correct positioning of the patient is paramount for MIS to ensure adequate instrument placement and avoid movement of landmarks during surgery. Using positioning aids such as sandbags or beanbags, and tape, belts, or metal holding frames, the patient is maintained in a fixed position so that approach trajectories can be maintained. Entry areas for instruments are localized using intraoperative imaging such as fluoroscopy or computed tomography (CT). Then, MIS surgical techniques are used, often using specialized retractors, to approach the spine and perform the required procedure.

ACCESS STRATEGIES

Most open approaches use subperiosteal dissection of tissues, where muscles, tendons, and ligaments are elevated or cut away from their osseous attachments. In human spine surgery, specific concerns are associated with traditional open approaches. Experimental models and clinical studies have shown that such approaches to lead to direct effects on soft tissues such as denervation of elevated musculature with subsequent atrophy, increased intraoperative bleeding, reduction of segmental innervation to the area owing to damage to the local nerves, and compromised local blood supply owing to damage to local vessels.[2] Studies using MRI to evaluate changes in paraspinal musculature after lumbar decompressive surgery found significantly fewer negative changes in cases with MISS versus open approaches.[3,4] Postoperative sequelae from a larger approach are increased scar tissue formation, which may impair the function of local musculature. In humans, local pain syndrome is a well-recognized postoperative complication from spinal surgery. Traditional approaches to the vertebral column seem to be associated with longer postoperative need for analgesia and immobilization, leading to longer durations of recovery and disability. These undesirable effects have an economic effect on people and efforts are made to reduce them through minimally invasive approaches.

To decrease the undesirable effects of extensive tissue dissection, MISS approaches are aimed at being muscle sparing and maintaining soft tissue attachments as much as possible.[5] There are 2 types of muscle sparing approaches: intermuscular and intramuscular.

The intermuscular approach uses anatomically defined tissue planes to access parts of the spine. Although such tissue planes are separated, an effort is made to spare tissue attachments to bone. The intramuscular approach uses muscle-splitting techniques to gain access and achieve a direct path to the area of interest. Because the target area can be approached via the most direct route, tissue dissection can be kept to a minimum. The intramuscular approach is the standard approach for MIS techniques such as percutaneous procedures or procedures using tubular retractors. Both procedures use dilating trochars and intraoperative imaging to determine accurate positioning of instruments. The learning curve for the application of these procedures to the spine is high.

INTRAOPERATIVE IMAGING

To avoid the need for visualization of identifiable landmarks and use a targeted muscle-sparing approach to a specific location, some form of imaging must confirm