Evolution of the lateral extracavitary approach to the spine

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The development of alternative approaches to spine disorders marked an evolutionary change in the methods by which surgeons address diseases that affect the ventral portion of the spine. From the advent of spinal surgery until quite recently, physicians used posterior approaches almost exclusively for the treatment of all pathological processes. Surgeons subsequently became frustrated and disenchanted with outcomes of patients with anterior vertebral body disease when these procedures were applied. This sentiment is best reflected in the surgical thought related to Pott disease. In this paper, the authors chart the development of an influential approach to the spine that is designed to address these issues: the lateral extracavitary approach. They trace its origins to early precursor procedures and follow its use in current practice for the treatment of a variety of spinal disorders. They also examine its applications, role, and continued importance in the age of minimally invasive surgery.

KEY WORDS • extracavitary approach • history of medicine

The evolution of spinal surgical practice has been driven by three primary goals: decompression, stabilization, and correction of deformity.¹ During the late 19th and early 20th centuries, surgical options for the treatment of lateral and paraspinal disease were limited. Ménard and Capener pioneered approaches for the treatment of Pott disease (tuberculosis of the spine); however, each of these procedures had its limitations and neither became popular. In 1976, Larson and his team at the Medical College of Wisconsin expanded on the work of the former two innovators. Larson's group defined a method in which the surgeon could safely approach lateral and anterior spine disease and perform posterior stabilization during the same procedure through the same incision. This procedure, called the "lateral extracavitary approach" was initially devised for the treatment of Pott disease and vertebral osteomyelitis (SJ Larson, personal communication, 2003).¹² During the past 30 years, this approach, along with modifications, has been used in the management of spinal disorders of the thoracic and lumbar spine due to trauma, neoplasm, degenerative disease, and infection.^{2,3,5,7-9,12,13,15,17,19,20,21} In this article, we will review the evolution of this procedure from its inception to its current applications with minimally invasive technology.

HISTORY OF THE APPROACH

The modern development of spinal surgery has its origins in the advancement of posterior approaches for the decompression of neural elements in cases of trauma and

infection.^{1,16} By the late 19th and early 20th centuries, laminectomy had become the standard surgical approach for spinal disorders of all types; this procedure had become safer with the application Lister's principles of antisepsis and the anesthetic techniques used by Morton in 1848.^{1,10,11} Despite the wide-spread application of laminectomy in the late 19th century, the results of these procedures and patient outcomes had discouraged many physicians.^{1,16} This provided the impetus for the development of new therapeutic approaches and methods to combat these problems, particularly in the treatment of Pott disease of the spine.

In 1894, Ménard described a novel approach to the treatment of the thoracolumbar spine, which in the modern literature is commonly refer to as the costotransversectomy.^{1,16} Recognizing the failure and limitations of posterior approaches for the management of diseases of the vertebral body as well as the associated poor clinical outcomes, Ménard developed and devised a procedure that provided a greater exposure to the lateral aspect of the spine. He described an incision over the apex of the kyphotic deformity (the suspected location of the abscess); after creating this incision Ménard dissected the rib and subsequently disarticulated and removed the proximal 4 to 5 cm of the rib and rib head. This provided direct exposure to the abscess, which allowed both its drainage and decompression of the affected regions.¹ Ménard, like Pott in his surgical procedure, attempted only to drain the infected region, and not to debride the entire abscess. Ménard's initial outcomes were encouraging, but long-term complications, such as secondary infections and the formation of drainage sinus tracts, quelled the initial optimism.¹ Ménard's description of this approach is similar, in many respects, to that of the costotransversectomy performed in modern surgical practice for exposure for thoracic discs.

Abbreviation used in this paper: LECA = lateral extracavitary approach.

Pott disease continued to be a significant cause of paraplegia in the early 20th century. It was in this setting that surgeons attempted to refine and build on the advances proposed by Ménard. In England, Norman Capener tackled this clinical problem, arguing that clinical outcomes could be improved and complications avoided by resecting the abscess in its entirety.¹ Because the bone involvement was typically found ventrally, available approaches had to be altered. Capener modified the costotransversectomy of Ménard, changing the plane of dissection. Whereas the dissection proposed by Ménard was medial to the dorsal paraspinal musculature, Capener split this muscle and retracted the ends both rostrally and caudally.^{1,6} This procedure, which he termed the “lateral rhachotomy,”^{1,6} gave the surgeon a more ventral exposure from a more lateral trajectory. The procedure was first used by Capener in 1933; it was reported by Seldon in 1935 and by Capener⁶ himself in 1954.¹ Although this procedure was developed as a means of treatment for Pott disease, its application was advocated for other diseases of the spine, such as tumors, trauma, and osteomyelitis.

THE LATERAL EXTRACAVITARY APPROACH

Sanford Larson altered and popularized Capener’s lateral approach to the spine in the 1970s and 1980s. Larson and his team at the Medical College of Wisconsin developed the LECA to the thoracic and lumbar spine.^{1,12} Larson’s approach to the surgical exposure differed from Capener’s approach, predominately in the mobilization of the paraspinal musculature. Following a subperiosteal dissection, the thoracolumbar fascia, subcutaneous tissue, and skin are elevated as a flap, as they are incised together along the angled portion of the incision. At the lateral aspect of the erector spinae group, a plane of dissection is defined and developed. This group of muscles, rather than being divided as Capener described, are then elevated and retracted medially along the length of the incision. Subsequently, self-retaining retractors can be inserted into the operative field.¹³ Once completed, the ventral and lateral aspects of the vertebral body come into view. In the thoracic spine, it is necessary to remove the rib head and the most proximal portions of the rib to access this exposure. In the treatment of lesions below L-3, the iliac crest may need to be resected to provide a similar exposure.¹²⁻¹⁴

The LECA is quite flexible in that it is easily combined with other procedures to allow for maximum neural decompression. The advantage of this procedure is that it provides the surgeon with access to both the posterior and lateral aspects of the spinal canal through the same incision. Because of this, the surgeon can now decompress both the ventral and dorsal aspects of the spinal canal, while having the ability to perform posterior spinal fusion and instrumentation.^{13,14} In addition, the exposure provided by this procedure allows the surgeon to identify the dura mater and the floor of the spinal canal simultaneously. This allows for the removal of the lesion with instruments that move away from the dura rather than toward it.⁷

The LECA, which was first devised for the management of Pott disease in the 1950s (SJ Larson, personal communication, 2003), and was subsequently reported in

the treatment of traumatic injuries to the thoracic and lumbar spine,¹² has been applied to a variety of diseases that are encountered in the thoracic and lumbar spine.⁴ The advantages of the procedure, as stated earlier, are the simultaneous exposure of both the ventrolateral and dorsal aspects of the spine, which would obviate the need for a separate incision and, potentially, a second operative procedure. In addition, it allows the surgeon to provide maximal protection of the neural structures by mobilizing abnormal tissue away from neural elements, rather than toward them. It permits the surgeon to work and progress in a logical sequence, by allowing initial anterior decompression, which is followed by posterior reduction of the deformity; instrumentation can be put in place before implantation of an anterior graft to ensure a proper fit. Afterward, posterior fusion can be accomplished if necessary. The flexibility granted by this procedure allows it to be used for the treatment of several spinal disorders including abnormalities of thoracic discs, tumors (primary and metastatic), infection, trauma, and deformity.^{2,3,5,7-9,13,15,17-22}

Despite these advantages, there are several drawbacks to this procedure.^{5,9,13,19} The degree of difficulty posed by the operation requires experience, expertise, and a working knowledge of thoracic and retroperitoneal anatomical structures. The most common complications are similar to those of most major spinal operations. Blood loss, at times, may be excessive, and may lead to coagulopathy and anemia.^{13,19} Postoperative ileus may occur for 1 or 2 days. Pulmonary structures may be compromised or injured, requiring the need of chest tube drainage for 1 or 2 days and aggressive respiratory treatments.^{13,19} Infection rates have been reported to range between 2 and 3%.¹³ Nevertheless, the LECA still has an important role in the treatment of patients with ventral disease of the thoracic and lumbar spine.

Minimally invasive approaches to the spine are becoming more widely practiced by the neurosurgical community. These approaches are now being applied in all areas of the spine for decompression, fusion, and placement of instrumentation. The expected benefits of these new procedures include less tissue dissection (muscle splitting), a decrease in perioperative pain, and a decrease in the length of the hospital stay. Clearly, there appear to be tangible benefits in the use of these approaches. Current studies, based on the work of Larson and Capener, are being conducted to apply these new methods to the exposure afforded by the LECA. New techniques in the treatment of thoracic disc herniation and thoracic instability are being developed by combining the latest technological innovations, with the anterior approaches popularized by Larson and his predecessors (unpublished data and ongoing studies).

CONCLUSIONS

The development of the LECA can trace its origins to the pioneering work of physicians who practiced more than a century ago. Through the innovative efforts of Ménard, Capener, and Larson, our community has been granted a safe means to decompress and fuse multiple areas within the thoracic and lumbar spinal canal. The LECA has been applied to most disorders that affect the

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spine. It is a useful operative technique and, with the application of new technological innovations, the LECA will remain a vital component of the neurosurgical armamentarium in the 21st century.

Acknowledgment

We thank Dr. Sanford Larson for his review of the manuscript.

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Manuscript received November 18, 2003.

Accepted in final form December 11, 2003.

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