

Lateral Access Minimally Invasive Spine Surgery

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Andrew A. Sama
Juan S. Uribe
Editors

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Editors

Michael Y. Wang
Neurological Surgery
University of Miami
Miami
Florida
USA

Juan S. Uribe
Department of Neurosurgery
Tampa General Hospital
University of South Florida
Tampa
Florida
USA

Andrew A. Sama
Weill Cornell Medical Center
Hospital for Special Surgery
New York
New York
USA

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Foreword

It is both an honor and a pleasure to introduce and highlight this excellent contribution in the field of spine surgery. Drs. Wang, Sama, and Uribe have assembled a world-class field of experts to describe the current understanding of the minimally invasive lateral approach to the spine. This truly novel technique has gained traction over the past decade and now clearly is part of the spine surgeons' armamentarium in the treatment of multiple spinal pathologies. The lateral technique has endured and stood the "test of time," with reproducible results improving patient outcomes in the properly selected patients. This technique has gained widespread credibility in degenerative, deformity, traumatic, and neoplastic conditions. With experience, surgeons are learning how to weave this technique into their skill set, how and when to apply it, and combine this technique with posterior open, minimally invasive, or hybrid posterior procedures.

The authors have chosen a cogent and thorough format to present these concepts. Foundational concepts are presented initially, with subsequent sections devoted to approach, navigation, and monitoring. Soft tissue pearls are addressed in great detail, as this technique is "all about the details." Individual pathologies are discussed, with a following section on technical nuances, complications, and their management. The authors clearly make the point that this technique requires strict adherence to detail, planning, and access to facilitate a reliable, reproducible outcome. The lateral technique has proven critical in obtaining spinal alignment, so critical of durable clinical outcomes.

My colleagues have approached this topic with honesty, highlighting current controversies and points of discussion. The lateral technique is here to stay. It is not experimental and can be safely performed by any surgeon willing to address the learning curve. However, there are "advanced" techniques, such as anterior longitudinal ligament sectioning, that carry potential significant complications, and thus should be done in the hands of experts. Like any surgical experience, as we gain more familiarity with the nuances of the technique, a greater facility will emerge; what was once unusual, will become commonplace.

In the past few decades, we have seen significant evolutionary transformations in spinal surgery: pedicle screws, cervical lateral mass screws, anterior spinal plating, navigation, etc., and it is clear that the lateral technique is transformational. This procedure, with both its simplicity and complexity, has clearly advanced the field of spinal surgery. "Knowledge is Power."

This text provides a great breadth and depth of knowledge about the current state of the lateral technique. With this knowledge, surgeons have gained greater control and power in taking care of our patients. That is why we practice medicine. This book is an excellent contribution to our field.

Atlanta, GA, USA

Regis W. Haid Jr., MD

Preface

Traditional posterior spinal surgery has been criticized because of the extent of disruption of normal tissues in order to provide access to the spine. With the development of enabling technologies, less-invasive approaches to the spine have been established allowing for the ability to minimize damage to uninvolved collateral structures without compromising the ultimate surgical goals. Numerous studies have shown the value of less-invasive approaches not only in terms of reducing patient morbidity and expediting recovery but also in providing cost-effectiveness.

Over the past decade, lateral lumbar interbody fusion (LLIF) has been popularized as a less-invasive, tissue-sparing approach in the treatment of a variety of spinal disorders. Initially applied primarily for degenerative lumbar pathologies, the technique has evolved to be valuable in the management of spinal trauma, tumors, and complex spinal deformity. The technique has been shown to be versatile, reliable, and reproducible with an acceptable safety profile. Dr. Wang has assembled many of the experts and taught leaders in the field and has developed a long overdue text dedicated to the field of LLIF. *Minimally Invasive Lateral Spine Surgery* provides a detailed discussion of patient selection, surgical indications and techniques, and complication avoidance from many of the foremost “lateral” spinal surgeons. In addition, a frank assessment of the risks and complications of the procedure are presented. Wherever possible the authors have relied on the evidence base to discuss outcomes and shortcomings.

Lateral lumbar fusion is clearly “here to stay,” and it is beholden on the proponents and experts in this field to provide teaching and instruction to those willing to learn. This book succeeds in that goal as well as in providing a valuable resource to surgeons experienced with LLIF. Central to discussion of any surgical technique is the patient who trusts the surgeon to make an evidence-based decision regarding the optimal solution for their particular condition. This is not lost on Dr. Wang who has done a terrific job of keeping the patient front and center in this book.

I believe that *Minimally Invasive Lateral Spine Surgery* should be read and studied not only by spine surgeons with a focus on less-invasive techniques but by all spine surgeons. LLIF has become an essential spine surgical option that should be a part of our armamentarium as we strive to optimize our patient care.

Chicago, IL, USA
May 3, 2016

Frank M. Phillips, MD

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Part I

Introduction

History and Rationale for the Minimally Invasive Lateral Approach

1

Luiz Pimenta, Luis Marchi, Leonardo Oliveira,
Fernanda Fortti, Etevaldo Coutinho,
Rubens Jensen, and Rodrigo Amaral

1.1 Introduction

The minimally invasive lateral approach, since its first technical report [1], has been shown to be a less invasive alternative to access the anterior column of the thoracolumbar spine, providing direct visualization of the spinal structures while reducing adjacent vascular, sympathetic, and visceral trauma associated with open anterior approaches. In addition, less blood loss, less postoperative pain, shorter hospital stay, and faster return to daily activities are associated with this technique [2–5]. The lateral approach has been utilized in an increasingly number of surgical indications. It was first described to treat low back pain associated with degenerative disc disease above L5 level, avoiding patients with severe central canal stenosis [6]. Over the years, indications were extrapolated, showing that indirect decompression of the neural structures can be achieved by disc height restoration [7], and ligamentotaxis can derotate the vertebral body,

providing coronal alignment [8–12]. Other published indications, with or without posterior supplementation, are adjacent level disease, pseudoarthrosis, trauma, infection, sagittal alignment, spondylolisthesis revision surgeries, and total disc replacement [13–25]. The scientific evidence has been growing and being highlighted in high-impact publications in the literature, showing its advantages, efficacy, and safety related to this technique. These advances make surgeons responsible for learning and using these new techniques and technologies in order to provide their patients better clinical and radiological results with less complications.

1.2 Historical Approaches to the Lumbar Spine

The first description of a lumbar laminectomy dates from 1829, by Smith, to treat progressive paresis following a lumbar fracture [26]. Thenceforth, new approaches and surgical indications emerged in the literature, being the early reports of fusion published in 1930s [27] for the treatment of spondylolisthesis, what would later be called anterior lumbar interbody fusion (ALIF) [28]. This technique allows the surgeon to prepare a greater surface area, with better blood supply and better load distribution in comparison to the posterior column, essential in the process of fusion [29]. Obviously, the anterior approach has inherent

L. Pimenta (✉)
Instituto de Patologia da Coluna (IPC),
São Paulo, Brazil

University of California, San Diego, Brazil
e-mail: LuizPimenta@luizpimenta.com.br

L. Marchi • L. Oliveira • F. Fortti • E. Coutinho
R. Jensen • R. Amaral
Instituto de Patologia da Coluna (IPC),
São Paulo, Brazil



Fig. 1.1 Comparison of cage contact area for PLIF, LLIF, and TLIF (*Left to right*)

disadvantages, as abdominal muscle dissection, mobilization of the great vessels and abdominal content, dissection of the presacral plexus, retrograde ejaculation, and urinary retention. An access surgeon is often in collaboration with the spine surgeon. Nowadays, the anterior approach progressed and the utilization of laparoscopic techniques allowed the surgeon to perform the surgery with smaller incisions, what is now considered a mini-open technique [30]. The procedure consists of blunt dissection of the abdominal musculature, manual dissection of the retroperitoneal space, while self-retaining retractors allows direct visualization of the anterior spinal column, enabling a large cage insertion for interbody fusion.

On the other hand, the minimalization of the posterior approach to herniated discs and spondylolisthesis have led to less disruptive techniques, in attempt to decrease tissue trauma and enhance clinical outcomes. Jaslow [31] and Cloward [32] initially described the posterior lumbar interbody fusion approach (PLIF) separately in the 1940s. This approach has the advantage to directly decompress the neural structures during interbody cage placement. However, it requires cauda equina retraction and higher risk of nerve roots injury [33]. A modification of this technique was proposed by Harms in 1982 [34], with a unilateral approach that theoretically require less tissue trauma, less bone resection and dural retraction, called transforaminal lumbar interbody fusion (TLIF). Both PLIF and TLIF do not allow inserting large implants, generating less contact between the endplates and the graft, which may impair fusion (Fig. 1.1).

In an attempt to minimize tissue trauma and improve biomechanical support, an anterolateral retroperitoneal approach was described, with posterior dissection and retraction of the psoas muscle [35–37]. However, iatrogenic neural deficits and muscle hypotonia subsequent to lumbar plexus compression due to psoas retraction may occur [38]. The psoas traverse minimizes nerves compression, but carries an inherent risk of direct nerve injury. Early attempts to surpass this issue include evoked EMG monitoring, but with a 60-degree approach and patient in prone position [39]. This orientation routinely incarcerates nerves of the lumbar plexus, hindering safe access to the intervertebral disc and placement of intervertebral devices (Fig. 1.2). Nevertheless, this experience provided advances in the use of EMG monitoring in spine surgery, despite the little usefulness, safety, and effectiveness of this surgical approach.

1.3 Development of Lateral Access Surgery

The complications and technical challenges associated with anterior endoscopic surgery led to the development of a new trajectory to the intervertebral discs (Fig. 1.3). It was described as lateral endoscopic transpsoas retroperitoneal approach (LETRA) and was first presented in 2001 [40]. This technique utilized a blunt finger dissection of the retroperitoneal space, insertion of tubular portals with endoscopic visualization, but without EMG monitoring. The first clinical report on

Fig. 1.2 60-degree approach with the patient in prone position, with routinely incarcerated nerves of the lumbar plexus during access

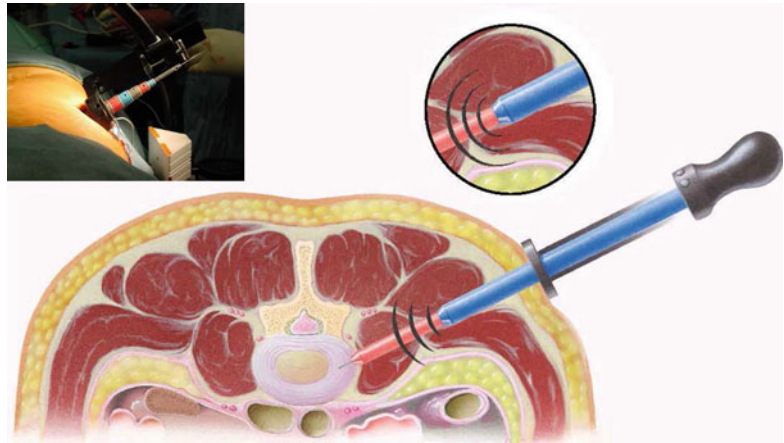
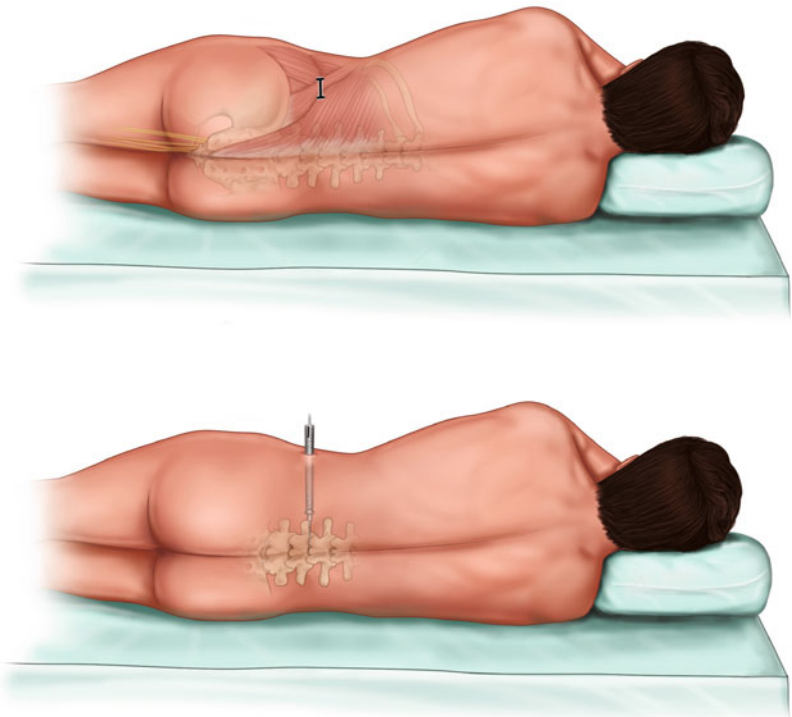


Fig. 1.3 Very first drawing of the initial idea of a 90-degree approach to the lumbar spine, what would become in the future the LLIF



85 consecutive patients has shown 14% incidence of postoperative psoas weakness and 3.5% incidence of slight thigh atrophy [1].

Thus, there was a need to develop tools that allow secure lateral access to the lumbar spine, overcoming the disadvantages and preventing iatrogenic neurological injuries. An expandable retractor was developed (NuVasive®, Inc., San

Diego, CA) to provide direct visualization of the surrounding structures, improving visibility achieved by endoscopic viewing. To guide the passage through the psoas muscle, an EMG neuromonitoring prevented the blind traverse of the psoas muscle, protecting the integrity of the neural structures. Thereby, the lateral lumbar interbody fusion (LLIF) is defined as a 90-degree

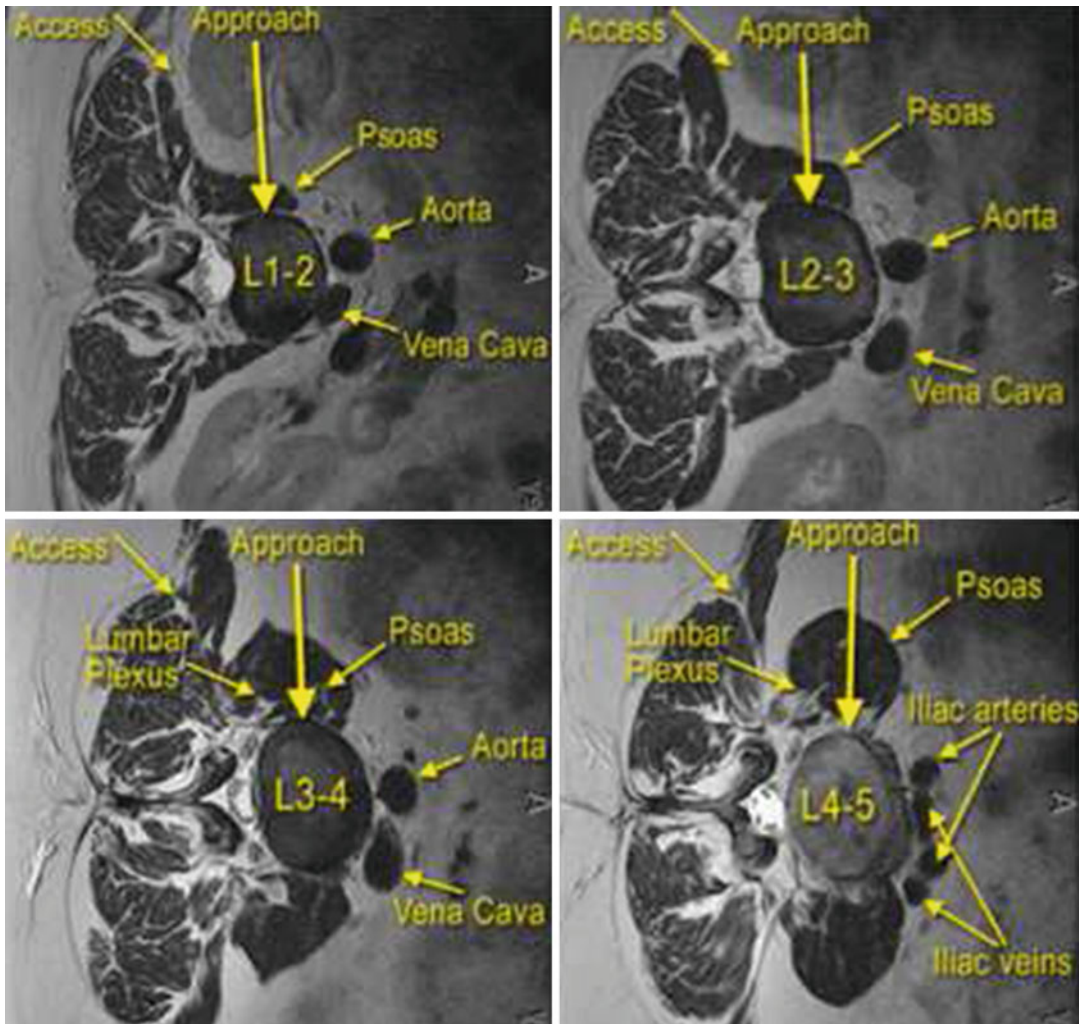


Fig. 1.4 Relevant anatomy for lateral access surgery of the lumbar spine

lateral, retroperitoneal transpsoas approach to the anterior spinal column, with minimum tissue trauma by use of blunt finger dissection of the retroperitoneal space and tactile guidance of the first dilator to the psoas surface. Figure 1.4 shows the relevant anatomy for lateral access surgery in lumbar spine. The utilization of a split-blade retractor generates a customizable working portal that allows direct visualization, with the opportunity to insert a wider cage implant in comparison to other anterior interbody devices. The bilateral annular release allows the device to reach both sides of apophyseal ring, generating a more stable construction and greatest biomechanical advantage. The technique also permits

the restoration of the normal disc and foraminal heights, allowing indirect decompression of the neural structures through an anterior intervertebral fusion, correcting sagittal and coronal alignment, stabilizing the targeted level and facilitating bone ingrowth without the morbidity of open surgeries.

1.4 Validation of the Technique

The initial experience in lateral access surgery included less complex surgical indications, like 1- or 2- level interbody fusion for degenerative conditions [5, 41]. As the procedure maintains