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Clinical Study

Neurological complications using a novel retractor system for direct lateral minimally invasive lumbar interbody fusion

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ABSTRACT

We describe our experience using the RAVINE retractor (K2M, Leesburg, VA, USA) to gain access to the lateral aspect of the lumbar spine through a retroperitoneal approach. Postoperative neurological adverse events, utilising the mentioned retractor system, were recorded and analysed. We included 140 patients who underwent minimally invasive lateral lumbar interbody fusion (MI-LLIF) for degenerative spinal conditions between 2011 and 2015 at two major spinal centres. A total of 228 levels were treated, 35% one level, 40% two level, 20% three level and 5% 4 level surgeries. The L4/5 level was instrumented in 28% of cases. 12/140 patients had postoperative neurological complications. Immediately after surgery, 5% of patients (7/140) had transient symptoms in the thigh ranging from sensory loss, pain and paraesthesia, all of which recovered within 12 weeks following surgery. There were five cases of femoral nerve palsy (3.6% — two ipsilateral and three contralateral), all of which recovered completely with no residual sensory or motor deficit within 6 months. MI-LLIF done with help of the described retractor system has proved a safe and efficient way to achieve interbody fusion with minimal complications, mainly nerve related, that recovered quickly. Judicious use of the technique to access the L4/5 level is advised.

1. Introduction

Interbody fusion is advantageous over posterolateral fusion with theoretically higher fusion rates, better sagittal alignment and improved functional outcomes [1,2]. Anterior lumbar interbody fusion (ALIF) has long been used, mainly to spare posterior spinal elements. It carries the other advantages of better access for complete discectomy, and avoids perineural scarring. The anterior approach carries its own risk profile however, including vascular and visceral injuries, and sexual dysfunction [3].

The direct lateral approach utilises a lateral incision and retroperitoneal dissection to reach the lateral aspect of the lumbar discs. This was first described by McAfee et al. [4] and further developed by Ozgur et al. [5]. Injury of the lumbar nerve roots and the branches of the lumbar plexus, residing within the mass of the psoas major muscle, is the main concern. Several cadaveric studies have been published investigating the precise anatomy of the lumbosacral plexus in order to better define safe working zones through the muscle relative to the disc spaces [6,7]. Employing different modalities of electrophysiological monitoring potentially reduces the risk of neural compromise [8]. Nerve injuries during the lateral retroperitoneal approach to the spine have been reported with an incidence of 0.7% to 23% [9–11].

The lateral retroperitoneal approach offers a relatively safe corridor to the spine, minimising injuries to vascular and visceral structures encountered during the anterior approach, and avoiding the dural tears, multifidus muscular damage and nerve root injuries that can occur during the posterior approach. This burgeoning technique is increasingly employed to treat structural degenerative disorders of the lumbar spine. It can be used as a stand-alone procedure to manage isolated degenerative disc disease, or degenerative spondylolisthesis [12,13]. More commonly, it is used as a part of extensive reconstructive surgery in cases of degenerative scoliosis and sagittal deformity reconstruction [14,15].

The objective of this work is to present our experience with performing lateral lumbar interbody fusions using the RAVINE Retractor. We recorded and analysed the immediate neural complications.

2. Methods

The approval of our Research and Development Department was obtained. Inclusion criteria were patients treated consecu-

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Table 1
Demographics and treatment data for patients undergoing direct lateral minimally invasive lumbar interbody fusion

Number of patients	n = 140
Gender	
Females n (%)	99 (71%)
Males n (%)	41 (29%)
Age at surgery mean (range)	66 years (33–83)
Previous surgery	
Yes	39
No	101
Diagnosis	
Degenerative scoliosis	50
Spondylolisthesis	16
Adjacent segment disease	33
Degenerative disc disease	33
Pseudoarthrosis	8

tively with lateral interbody fusion of the lumbar spine between 2011 and 2015, by three surgeons at two spinal centres. Demographic and treatment data were collected retrospectively through chart review. However, the presence of neurological deficit or thigh symptoms was collected prospectively. All patients were symptomatic with back pain, and the majority had leg pain as well.

The procedures were performed utilising the RAVINE lateral access system (K2M, Leesburg, VA, USA). Polyetheretherketone (PEEK) intervertebral cages (Aleutian; K2M Inc, Leesburg, VA, USA), filled with synthetic bone graft, were used to achieve fusion. Neurophysiologic monitoring was used in all cases. All neurological perioperative complications were reported and followed up.

3. Results

A total of 140 patients underwent a minimally invasive lateral lumbar interbody fusion (MI-LLIF) between the year 2011 and 2015. There were 41 men, and 99 women. Diagnoses included degenerative scoliosis in 35% (50/140), adjacent segment disease in 23.5% (33/140), degenerative disc disease in 23.5% (33/140), degenerative spondylolisthesis in 11.4% (16/140), pseudoarthrosis in 5.7% (8/140). Total levels treated were 228, with an average of 1.6 levels per patient [35% one level, 40% 2 levels, 20% 3 levels, and 5% 4 levels]. The lumbar 4/5 (L4/5) level was instrumented in 28% of cases. Supplementary fixation was performed in 110, a lateral plate being used in 82 patients, and pedicle screw constructs in 28 patients. Direct posterior decompression was done for cases with residual leg pain due to lateral recess stenosis. The mean age at operation was 66 years (33–83 years). The mean follow-up was 13.4 months (3–40 months). Thirty-nine cases had undergone previous surgery at one of the operated levels (Table 1).

Immediately after surgery, 5% of patients (7/140) had transient sensory thigh abnormalities ranging from sensory loss to pain and paraesthesia, all of which recovered within 12 weeks following surgery. There were five cases of femoral nerve palsy (3.6% — two ipsilateral and three contralateral), all of which recovered completely with no residual sensory or motor deficit within 6 months. No postoperative wound infection or intraoperative visceral injuries were recorded (Table 2).

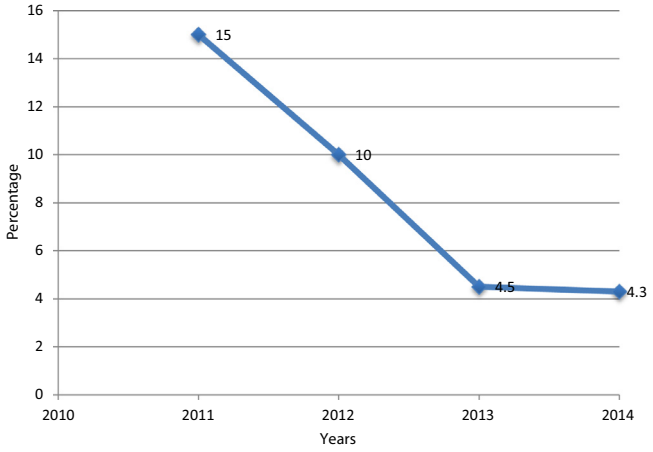

Fig. 1. Percentage of complications following minimally invasive lateral lumbar interbody fusion (MI-LLIF) in each year in which surgery was performed.

3.1. Postoperative neurological complications correlation with surgeons' experience

The rate of postoperative neurological complications following MI-LLIF steadily reduced with increased experience. Postoperative nerve related complications arose in five (15%) of the 33 lateral fusion cases in the first year, four (10%) of the 40 patients in the second year, two (4.5%) of the 44 patients in the third year, and one (4.3%) of the 23 patients in 2015 (Fig. 1).

3.2. Postoperative neurological complications correlation with each level

The rate of postoperative neurological complications differed according to instrumented level — L1/2 in two cases, L2/3 in four cases, L3/4 in seven cases, and L4/5 in 10 cases.

3.3. Postoperative thigh numbness correlation with construct length

Of 12 patients with neurological complications, four patients had one level fusion, two patients had a two level fusion, three

Table 2
Neural complications following lateral lumbar interbody fusion procedures

Complication	Diagnosis	Levels	Fixation	Outcome
Sensory abnormalities	DDD	L1/2,L2/3,L3/4	Bilateral pedicle screws	Full recovery within 12 weeks
	DDD	L3/4	Bilateral pedicle screws	
	DDD	L3/4	Lateral MIS plate	
	ALD	L1/2,L2/3,L3/4,L4/5	Bilateral pedicle screws	
	LCS	L2/3, L3/4	Bilateral pedicle screws	
	ALD	L1/2, L2/3, L3/4	Bilateral pedicle screws	
	ALD	L1/2, L2/3	Bilateral pedicle screws	
Ipsilateral femoral nerve palsy	DS	L4/5	Unilateral decompression and pedicle screws	Full recovery within 4 months
Contralateral femoral nerve palsy	Degenerative Scoliosis	L2/3, L3/4, L4/5	Bilateral pedicle screw	Residual lumbar pain
Femoral nerve palsy	DS	L4/5	Unilateral pedicle screws	Full recovery within 6 months
Femoral nerve palsy	Degenerative scoliosis	L2/3,L3/4,L4/5	Bilateral pedicle screws	
Femoral nerve palsy	ALD	L3/4	None	

ALD = adjacent level disease, DDD = degenerative disc disease, DS = degenerative spondylolithesis, LCS = lumbar canal stenosis, MIS = minimally invasive surgery.