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Clinical Study

Anterior lumbar interbody surgery for spondylosis results from a classically-trained neurosurgeon

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ABSTRACT

Anterior lumbar surgery for degenerative disc disease (DDD) is a relatively novel technique that can prevent damage to posterior osseous, muscular and ligamentous spinal elements. This study reports the outcomes and complications in 286 patients who underwent fusion – with artificial disc implants or combined fusion and artificial disc implants – by a single-operator neurosurgeon, with up to 24 months of follow-up. The visual analogue scale (VAS), Oswestry Disability Index (ODI), Short Form 36 (SF36) and prospective log of adverse events were used to assess the clinical outcome. Radiographic assessments of implant position and bony fusion were analysed. Intraoperative and postoperative complications were also recorded. Irrespective of pre-surgical symptoms (back pain alone or back and leg pain combined), workers' compensation status and type of surgical implant, clinically significant improvements in VAS, ODI and SF36 were primarily observed at 3 and/or 6 month follow-up, and improvements were maintained at 24 months after surgery. A 94% fusion rate was obtained; the overall complication was 9.8% which included 3.5% with vascular complications. The anterior lumbar approach can be used for treating DDD for both back pain and back and leg pain with low complication rates. With appropriate training, single-operator neurosurgeons can safely perform these surgeries.

1. Introduction

Anterior lumbar interbody surgery has been available for some time in orthopaedic spinal surgery but is a relatively new tool in the neurosurgical approach to lumbar degenerative disc disease (DDD). The anterior approach allows access to the whole disc, leading to a larger interbody graft, fusion cage, or artificial disc implant (ADI) in the intervertebral space where 80% of axial spinal loading occurs [1–3]. This method does not damage the posterior bony elements including the posterior osseous-ligamentous tension band, pars interarticulares, facet joints and paraspinal muscles; injuries to these structures can lead to increased perioperative pain, flat back syndrome and axial back pain [4–6]. This technique avoids complications from prone positioning, retraction of nerve roots or thecal sac, and it also reduces the risk of misdirected screws. Despite the possible advantages, few neurosurgeons are comfortable with this trans-abdominal approach.

In this prospective study we describe the operative technique, and clinical and radiological outcomes and complications from a single-operator neurosurgeon performing ADI, anterior lumbar interbody fusion (ALIF) and adjacently combined fusion and artificial disc implant (hybrid) procedures.

2. Methods

2.1. Patient demographics

Patients were selected for surgery due to DDD with or without radiculopathy and were treated either with ADI, ALIF or the hybrid procedures based on surgeon and patient preference. A total of 286 lumbar or lumbosacral spondylosis operations were performed over a 5 year period. The demographics of all patients are presented in Table 1.

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Table 1
Demographics of patients undergoing anterior lumbar surgery for degenerative disc disease

Demographic	n			
Sex				
Male	133			
Female	153			
Age group, years				
<35	46			
35–50	168			
>50	72			
Type of pain before surgery				
Back only	118			
Back and leg	168			
Workers' compensation				
With	80			
Without	206			
Admission days[a]				
1–3	39			
4–6	179			
7–9	55			
>10	8			
Operative levels				
Single-level	229			
Multi-level	57			
Types of operation	Specific level of operation			
	L2–3	L3–4	L4–5	L5–S1
Artificial disc insertion	0	3	31	47
Anterior lumbar interbody fusion	0	4	47	145
Hybrid (ADI and ALIF)	1	8	33	27

ADI = artificial disc insertion, ALIF = anterior lumbar interbody fusion.
[a] Missing data for five patients.

2.2. Surgical techniques

2.2.1. Patient positioning

After endotracheal intubation, the patient was placed in the supine lithotomy position. This allows the surgeon to move from the right side of the patient during the retroperitoneal exposure to between the patient's legs during the discectomy and instrumentation phases of the surgery. The latter operating position also assists the surgeon's judgement of the midline prior to radiological or navigational confirmation during disc implantation.

2.2.2. Abdominal incision and ascending lumbar vein ligation

The horizontal incision was marked and favoured for its cosmetic superiority over vertical scars in the hypogastrium. A percutaneous stereotactic reference screw was placed in the anterior aspect of the iliac crest. Preoperative stereotactic lumbosacral CT images were registered to the reference screw and intraoperative fluoroscopy. The skin was opened and the anterior rectus sheath was divided vertically to the left of the midline, to enable dissection posterior to the rectus abdominis muscle fibres. The inferior epigastric artery and vein were tied and divided to prevent any potential bleeding. Hand and swab sticks were used to dissect external to the peritoneum. The dissection proceeded anteriorly to the retroperitoneal quadratus lumborum, psoas with ureter, inferior vena cava and tributaries, the aorta and common iliac arteries. The peritoneal cavity and its contents were retracted manually by an assistant.

At the level of L5/S1, the presacral fascia and periosteum containing the superior hypogastric plexus were dissected away from the bone, from the left to the right side. This may help reduce the risk of retrograde ejaculation in male patients. The disc space was approached between the common iliac arteries and veins and these vessels were mobilised as needed by gradual stretching of their surrounding fascia using swab sticks.

At levels L3/4 and L4/5, the left ascending lumbar vein was identified where it enters the left common iliac vein. It was clipped and divided to prevent avulsion from the left common iliac vein. Segmental veins and arteries were diathermied, clipped and divided to allow gradual mobilisation of the inferior vena cava and aorta to the right of the midline. Gradual stretching of fascial attachments using swab sticks was effective in achieving mobilisation without tearing any vessels.

2.2.3. Discectomy

To keep the aorta, inferior vena cava, common iliac vessels and the peritoneum retracted, a self-retaining retractor system was used (EndoRing, Medtronic Sofamor Danek, Memphis, TN, USA) along with pins temporarily inserted into the vertebral bodies adjacent to the discectomy levels. The removal of disc material proceeded in a similar fashion to an anterior cervical discectomy. Central, posterolateral and foraminal disc prolapses were readily removed after the disc space was largely cleared. Decompression of the thecal sac and, when required, exiting nerve roots, was visually confirmed.

2.2.4. Interbody fusion

A polyethylethylketone (PEEK) interbody spacer filled with bone morphogenic protein-soaked collagen matrix (Infuse Bone Graft, Medtronic Sofamer Danek) was placed into the disc space. A titanium anterior locking plate (anterior tension band plate, Synthes Inc., West Chester, PA, USA) was applied to achieve fixation.

2.2.5. Artificial disc implant

Maverick lumbar prostheses (A-Mav or O-Mav, Medtronic Sofamer Danek) were used for all ADI procedures in this series. The A-Mav device is larger than the O-Mav; it is inserted in a direct antero-posterior direction while the O-Mav has a smaller, triangular footprint in the axial plane and is inserted obliquely. The StealthStation (Medtronic Sofamer Danek) has software specific to the O-Mav implant to guide accurate midline placement despite its oblique insertion angle, which in our experience obviates any difficulty in positioning the ADI accurately. The selection of A-Mav or O-Mav prostheses was at the surgeon's discretion and was influenced by perceived difficulty of achieving adequate midline exposure for the larger A-Mav in each individual patient.

2.2.6. Wound closure

After successful cage/plate or ADI placement, the vertebral retractor pins were removed and the peritoneal sac resumed its normal position. The posterior and anterior rectus sheaths were closed with resorbable polydioxanone 2-0 sutures and the deep fascia with resorbable 2-0 polyglyconate sutures. The skin was finally closed with running subcuticular 3-0 monofilament resorbable suture and reinforced with Steri-Strips (3M Corporation, St. Paul, MN, USA).

2.3. Clinical outcome

The Visual Analogue Scale (VAS) and Oswestry Disability Index (ODI) were used to assess pre and postoperative pain status while the Short Form 36 (SF36) physical component summary (PCS) and mental component summary (MCS) were employed for evaluating pre and postoperative disability and mental health status, respectively. All postoperative assessments were conducted at 3, 6, 12 and 24 months.

CT scans and sagittal flexion/extension radiographs were qualitatively assessed by clinical radiologists postoperatively to assess either the progress of spinal fusions or the amount of movement across the operated disc spaces.

2.4. Statistical analysis

The means and 95% confidence intervals of the respective clinical outcome measures at each time point were calculated using