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ORIGINAL STUDY

Long-term follow-up of the anterior lumbar interbody fusion procedure

Dimitri VERBRUGGEN, Thomas TAMPERE, Dirk UYTTENDAELE, Gwen SYS, Bart POFFYN

Department of Orthopaedic Surgery and Traumatology, Ghent University Hospital, Belgium

Purpose : **To evaluate the long-term clinical results and the effectiveness of the anterior lumbar interbody fusion procedure.**

Methods : **Between 1999 and 2005, 60 ALIFs were performed in 59 patients. Mean age was 41.1 years. Clinically, patients were evaluated at a mean follow-up of 9.5 years using the Visual Analogue Scale grading scale, the Oswestry Disability score and the SF-36 questionnaire.**

Results : **Preoperative and postoperative clinical evaluation scores of 38 patients were available. Nineteen patients were lost to follow-up, and 2 patients died during the follow-up. The fusion rate was 84%. Mean preoperative VAS-score for back pain was 6.69 (± 2.15) ; in the long term, the mean VAS-score was 4.95 (± 2.95), which was a significant improvement. ($p < 0.01$). The postoperative ODI-score was 36.11 (± 22.32), while the preoperative ODI-score was 59.31 (± 17.16), which demonstrates a significant improvement. According to the SF-36, mild to good results were observed.**

Conclusions : **The ALIF procedure can offer significant pain relief and improved function if a strict indication policy is followed.**

Keywords : spine ; lumbar spine ; interbody fusion ; outcome ; low back pain .

INTRODUCTION

The anterior lumbar interbody fusion (ALIF) is an established treatment for patients with degenerative disc disease (DDD). In comparison with the posterior lumbar interbody fusion (PLIF), the anterior approach has many advantages. These advantages include ease of anatomical dissection, spare injury to the posterior spinal muscles, reduced operative time and blood loss, no scarring within the spinal canal and no perineural fibrosis (*3,7*). However, ALIF is a challenging procedure with regards to the preparation of the iliac and lumbar blood vessels and the ureter (*7*).

The results reported in the literature are variable Early clinical trials have reported excellent clinical results and fusion rates (84-98%) (*5,9*). In addition, later clinical trials have reported a wide range of clinical outcomes and fusion rates (44-81%) (*3,5,6,9*). Burkus *et al* stated that clinical outcomes do not correspond with radiographic evidence of fusion (*1*).

The goal of this study was to evaluate the clinical outcome of the ALIF procedures performed at Ghent University Hospital and to determine the patients' quality of life after surgery. Does the strict

■ Dimitri Verbruggen, MD.
■ Thomas Tampere, MD.
■ Dirk Uyttendaele, MD, PhD.
■ Gwen Sys, MD, Bart POFFYN, MD, PhD.
Department of Orthopaedic Surgery and Traumatology, Ghent University Hospital, Belgium.
Correspondence : Verbruggen Dimitri, Department of Orthopaedic Surgery and Traumatology 1P5, Ghent University Hospital, De pintelaan 185, 9000 Ghent, Belgium.
E-mail : Dimitri.verbruggen@ugent.be

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indication policy, maintained at this institute, result in acceptable outcomes ?

A possible difference between L4-L5 and L5-S1 surgical outcomes was also investigated.

The patients were asked whether they would again consent to this type of surgery.

MATERIALS AND METHODS

Study design

A prospective cohort study.

Population

Between January 1999 and October 2005, 59 patients underwent an open anterior lumbar interbody fusion. Of these patients, 27 were male and 32 were female. Nineteen patients were lost to follow-up ; five of these patients were foreign. Nine patients changed their address, and the researchers were unable to contact them. Two patients died due to vehicle accidents.

The study population consisted of 38 patients overall.

Level of fusion

ALIF was performed 20 times on vertebral level L4-L5, 38 times on level L5-S1 and 1 time on level L4-L5-S1.

Pre-operative evaluation

All patients underwent a physical examination, conventional X-Rays (Fig. 1 & 3), MRI (Fig. 2), infiltration of the facet-joints and discography prior to surgery. The patients were also evaluated using the Visual Analogue Scale (VAS) and the Oswestry disability index (ODI).

The VAS questionnaire serves as an index for pain. It is reclassified in back and leg scores and measures the maximum and minimal pain, as well as the actual pain suffered at that moment.

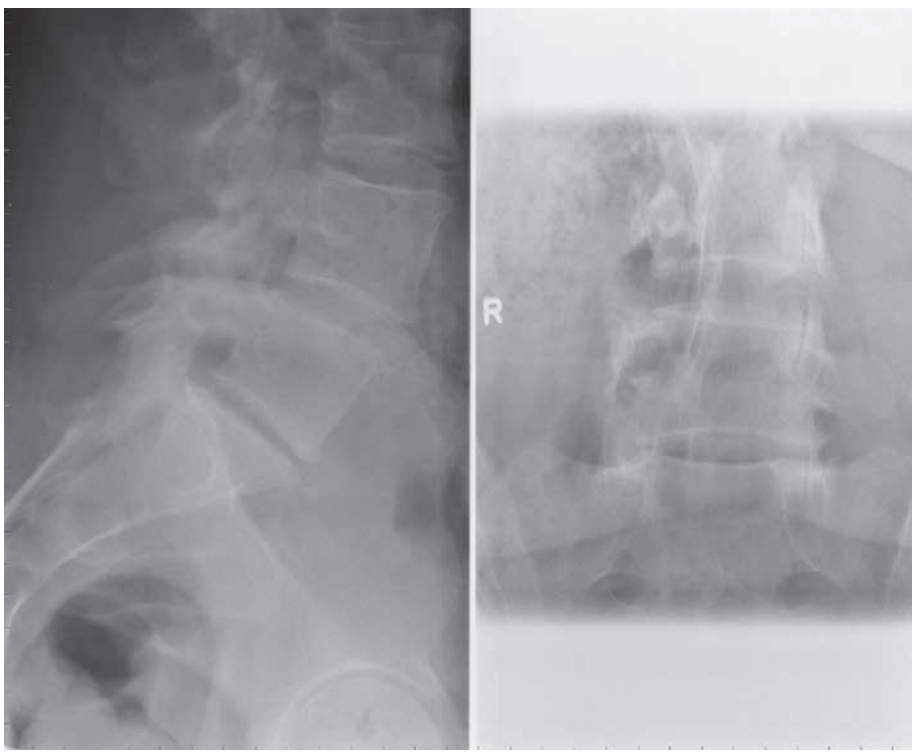

Fig. 1. — Conventional preoperative X-Ray.
The X-Ray shows disk space prolapse with osteophyte formation at level L5-S1.

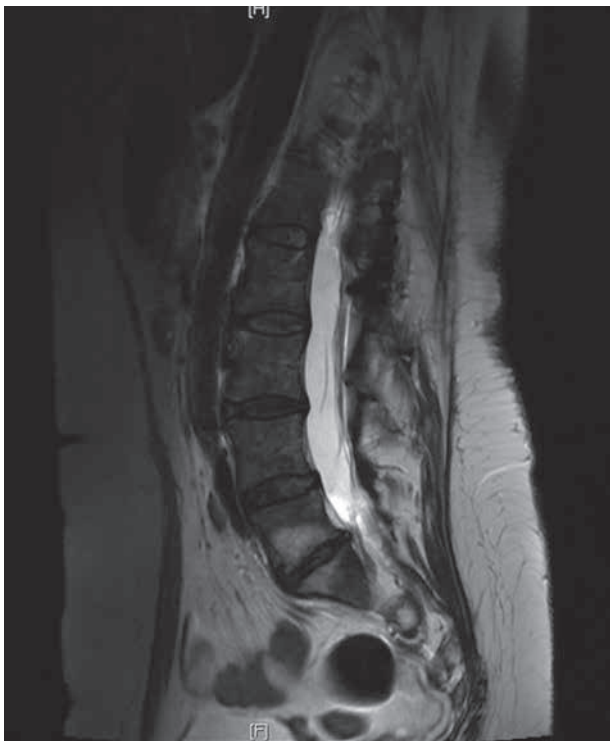

Fig. 2. — Preoperative MRI.
At level L5-S1 : bulging disc with discreet posteromedian disc herniation. No central spinal stenosis is observed. Bone edema is present on both vertebrae.

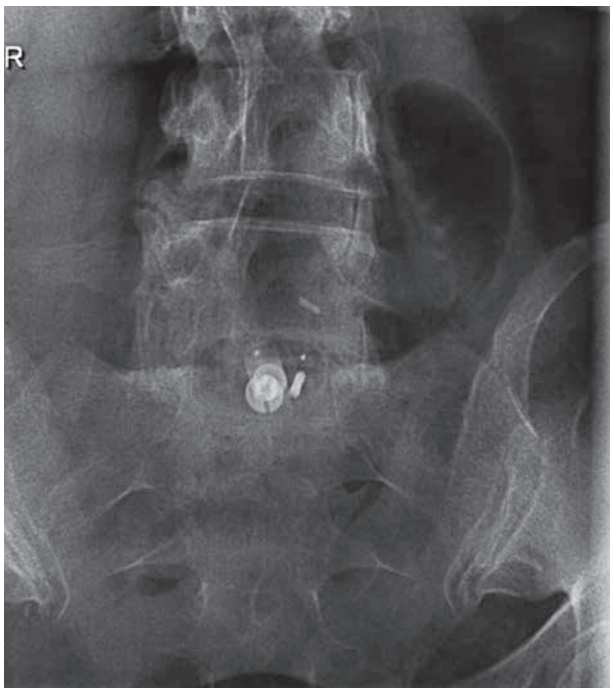

Fig. 3. — Conventional postoperative X-Ray.
Status after interbody fusion L5-S1.

The ODI questionnaire evaluates Activities of Daily Living (ADL).

Post-operative evaluation

The patients were again evaluated again in the postoperative period using the VAS and ODI questionnaires. In addition, there was an evaluation of the quality of daily life, for which the Short Form Health Survey (SF-36) questionnaire was used. The SF-36 questionnaire is subdivided into the following 9 categories : physical functioning, role limitations, bodily pain, social functioning, general mental health, role limitations due to emotional problems, vitality/energy/fatigue, general health perception and health compared to the previous year.

Indications for surgery

The indications for surgery were monosegmental symptomatic DDD with more or less than 5 mm height loss, bisegmental symptomatic DDD with more or less than 5 mm height loss, foraminal stenosis due to soft tissue herniation and failed disc surgery without laminectomy.

The exclusion criteria spondylodiscitis, spondylolysis, sponylolisthesis, spinal tumors and recurrent discal herniation with radicular symptoms.

The authors would like to emphasize that a very strict indication policy was maintained.

Procedure

All patients were operated on by the senior surgeon (BP). The patients were placed in the supine position on the operating table. The approach used to access vertebral levels L4-L5 was a left-sided median approach, while the approach used to access vertebral levels L5-S1 was a low transverse incision (Pfannenstiel-incision) (*2,4, 8*). The ureter and iliac vessels were mobilized to the opposite side depending on the localization of the iliac bifurcation to avoid excessive traction on the ureter and the vessels (*2,8*). The correct vertebral level was identified by radioscopy. A discectomy was performed and the endplates were prepared (*4*). After distraction of the intervertebral space, a cage filled with autograft bone, which was harvested from the iliac crest, was placed. The space around the cage was filled with Healos® bone substitute

(Johnson & Johnson, New Brunswick, New Jersey, US).. In all of the L4-L5 cases, an anterior plate was placed, and depending on the stability of the L5-S1 level, a stand-alone cage was used. In case of instability at the level L5-S1, the use of an extra supportive plate was mandatory.

Statistics

Statistical analysis was performed using SPSS statistics 19.0 (SPSS Inc., Chicago, IL). The tests included the Wilcoxon Signed Ranks test, Unpaired t-test and Chi-square test.

RESULTS

1. Demography

The study population consisted of 38 ALIF procedures in 38 patients. Twelve ALIF procedures were performed at the level of L4-L5 and 26 at the level of L5-S1. The mean age at surgery was 41.11 years (range 25-63 years), and the mean follow-up was 9.49 years (range 5.0-12.0 years). There were 16 males and 22 females. Six patients required post-operative red blood cell transfusion, due to low hemoglobin. No vascular complications occurred.

In all cases the cage was filled with autograft bone. No complications associated with the bone harvesting occurred.

2. Clinical outcome

There was an improvement in pain according to the VAS-questionnaire in the study population. The postoperative score was, on average, 2 points lower compared to preoperative scores (Table I) ; in other words, the patients reported less pain in the postoperative setting than in the preoperative setting. This improvement was statistically significant ($P < O.OO1$) in both the VAS-back (Fig. 4) and VAS-leg score (Fig. 5) for maximal, minimal and actual pain.

When subdivided according to vertebral levels (L4-L5 and L5-S1), there was a significant improvement ($P < 0.05$) in both levels in the VAS-back and VAS-leg scores.

There was also a statistically significant improvement ($P < 0.005$) for each aspect of the ODI-score and for the total score (Fig. 6). The post-operative

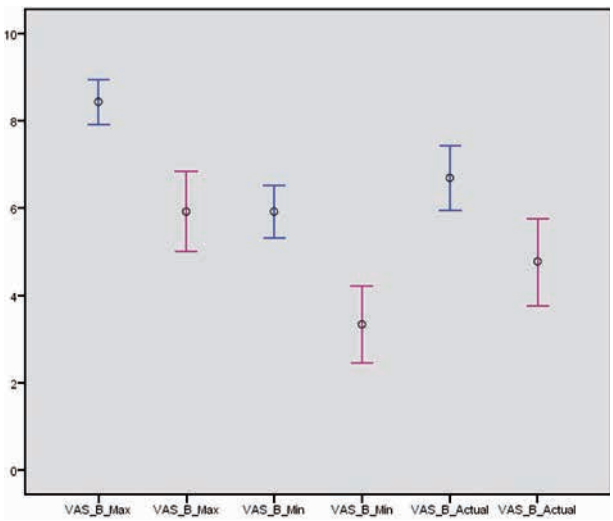

Fig. 4. — Preoperative vs. postoperative VAS-Back score. Preoperative scores are blue (left in figure), postoperative scores red (right in figure).

Table I. — Pre- and postoperative scores on the VAS questionnaire for all patients (L4-L5 & L5-S1)

	Mean (S.D.)		
	Preoperative	Postoperative	Difference pre versus postoperative score
VAS_B_Max	8.43 (1.481)	6.11 (2.679)	2.32
VAS_B_Min	5.91 (1.755)	3.50 (2.555)	2.41
VAS_B_Actual	6.69 (2.153)	4.95 (2.950)	1.74
VAS_L_Max	7.06 (2.287)	4.87 (3.206)	2.19
VAS_L_Min	5.03 (2.491)	3.08 (2.705)	1.95
VAS_L_Actual	5.83 (2.467)	3.97 (3.166)	1.86

A significant difference ($P < 0.05$) on all scores was noted in favor of surgery.

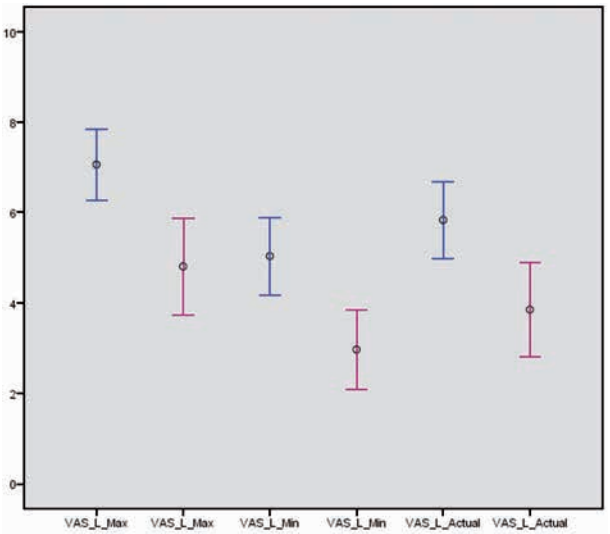

Fig. 5. — Preoperative vs. postoperative VAS-Leg score. Preoperative scores are blue (left in figure), postoperative scores red (right in figure).

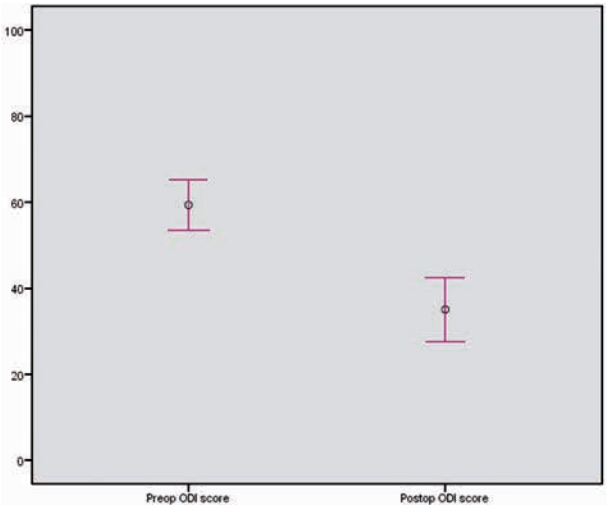

Fig. 6. — Preoperative vs. postoperative total ODI-score

Table II. — Pre- and postoperative scores on the ODI questionnaire

	Mean (S.D.)		
	Preoperative	Postoperative	Difference pre versus postoperative score
Pain	3.40 (1.914)	2.21 (1.277)	1.19
Selfcare	2.29 (1.341)	1.13 (1.339)	1.16
Lifting	3.63 (1.215)	2.58 (1.407)	1.05
Walking	2.46 (1.442)	1.47 (1.330)	0.99
Sitting	2.91 (.951)	1.74 (1.107)	1.17
Standing	3.49 (1.095)	2.21 (1.339)	1.28
Sleeping	2.69 (1.207)	1.42 (1.222)	1.27
Sex	2.57 (1.558)	1.50 (1.590)	1.07
Social	3.20 (1.023)	2.03 (1.533)	1.17
Travel	3.03 (1.124)	1.76 (1.422)	1.27
Total Score	29.657 (8.5816)	18.05 (11.162)	11.607
Odi Score (%)	59.3143 (17.16318)	36.11 (22.324)	23.2043

A significant difference ($P < 0.05$) on all subscores and total score was noted in favor of surgery.

ODI-score was, on average, 1.1 points lower than the preoperative score (Table II).

When reclassified according to vertebral levels, there was also a statistically significant improvement ($P < 0.05$) on both levels.

The SF-36 questionnaire was submitted in the post-operative setting only. The results from this questionnaire showed mild to good scores with large variations on every aspect of the SF-36 (Table III).

Table III. — Postoperative scores on the SF-36 questionnaire

	Mean	S.D
Physical Functioning	51.58	25.90
Role Limitations	32.14	39.56
Bodily pain	49.86	24.42
Social Functioning	65.71	32.13
General Mental Health	65.71	20.79
Role limitations due to emotional problems	64.76	44.97
Vitality, energy, fatigue	52.86	18.08
General Health perception	53.00	22.53
Health compared to last year	43.57	20.42

Mean score shows mild to good results, with a large standard deviation.

3. Is there a difference between L4-L5 and L5-S1 surgery ?

As confirmed earlier in the present study, surgery on vertebral level L4-L5 or L5-S1 resulted in a significant improvement.

No statistical difference was found when comparing the outcomes at level L4-L5 with the outcomes at level L5-S1.

Accordingly, surgery on level L4-L5 had the same results as surgery on level L5-S1.

4. Would the patient consent to the surgery if he had known what he knows now ?

All 38 patients were asked this question. Twenty-seven patients responded yes, 10 patients responded no, and 1 patient was indecisive. These responses gave a redo-ratio of 73%.

Twenty patients returned to work after a mean period of 7.5 months. Seventeen patients never returned to work ; 8 of these patients did not have a professional occupation prior to the surgery (3 were unemployed, and 5 were housewives).

5. Is there a correlation between nonunion and inferior clinical outcome ?

A nonunion was found in 6 cases : 2 at the L4-L5 level, and 4 at the L5-S1 level. The fusion rate was 84%. The reason for non-union could not be identified.

No significant correlation between postoperative VAS/ODI-score and nonunion could be found.

DISCUSSION

Many studies concerning the treatment of DDD with the ALIF procedure are available. There is, however, a great variation in the selection of patients, fusion rates and reported clinical outcomes (*1,3,5*). Burkus *et al* stated that clinical outcome do not correspond with radiological results (*1*).

Clinical outcome was evaluated using evolution in Oswestry and VAS leg and VAS back score. The patients' quality of life was evaluated using the SF-36 questionnaire.

In this present study, a significant improvement in pain and disability was observed. However, it should be noted that although the results were favorable, they were not excellent, as the surgery did not restore patients to having perfect functional status. This outcome begets the question of whether this gain in functional status is sufficient to justify surgery. However during the long time follow-up, the disc degeneration process could have progressed as well. Final follow-up only might be difficult to show the results of anterior surgery. In the literature, no comparable results were found because of variations in indications for surgery and evaluation

systems. Seventy-three percent of the patients in our study would choose to undergo the same surgery again. Considering these results, we conclude that the ALIF procedure is an acceptable option to treat these selected patients with DDD.

The authors again emphasize the importance of preoperative clinical and technical examination. Only a selected group of patients are deemed to be fit for the ALIF surgery.

Future research should focus on the remaining 27% of patients who stated they would not choose to undergo the surgery again. Of the 10 patients that would refuse to undergo the same surgery, 3 patients said that their backpain was worse after the surgery. The 7 other patients reported few improvement. The reasons for lack of improvement are unclear. Progression of DDD is a possible factor.

In all patients, an autograft of the iliac crest was used in the cages, and the space around the cage was filled with bone substitute Healos® (Johnson & Johnson). The literature remains unclear regarding whether autograft, allograft or a combination of these two is the best treatment option (*5,6*).

The fusion rate in this study was 84%, but no correlation with clinical outcomes was found.

This finding is confirmed by the literature (*1,3*). For instance, Tiusanen *et al* reported worse values in the Oswestry index (*9*).

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