Minimally Invasive Lateral Lumbar Interbody Fusion and Posterior Instrumentation for Clinical Adjacent Segment Pathology

- A Retrospective Matched Cohort Study with Only Posterior Instrumentation -

Hyung-Ki Min, Kee-Yong Ha, Young-Hoon Kim, Sang-Il Kim,

Hyung-Youl Park[1], In-Soo Oh[2], Jun-Yeong Seo[3], Dong-Gune Chang[4]

[1]Department of Orthopedic Surgery, Seoul St. Mary's Hospital, College of Medicine, The Catholic University of Korea

[2]Department of Orthopedic Surgery, Incheon St. Mary's Hospital, College of Medicine, The Catholic University of Korea

[3]Department of Orthopedic Surgery, Jeju National University Hospital, Jeju National University

[4]Department of Orthopedic Surgery, Sanggye Paik Hospital, Inje University

Introduction

- Minimally invasive techniques have been increasingly applied for spinal surgery.

- No report has compared lateral lumbar interbody fusion (LLIF) with posterior instrumentation (PI) and conventional posterior lumbar interbody fusion (PLIF) with PI for **clinical adjacent segment pathology (ASP).**

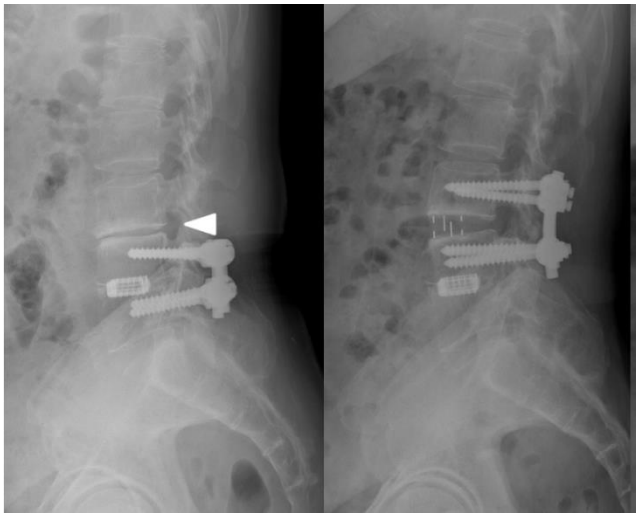
To evaluate the clinical and radiological efficacies of **minimally invasive LLIF for clinical ASP.**

Methods

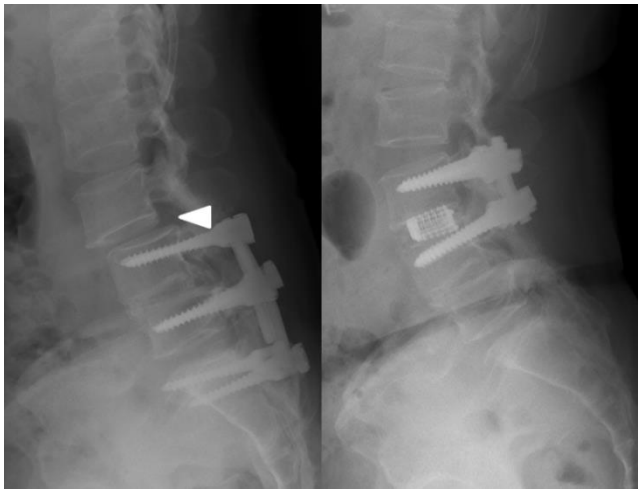
- **Patients population**
  - **Retrospective matched cohort study**
  - **<u>Inclusion criteria</u>**
    - Radiological evidence of ASP with intractable radiculopathy and low back pain
    - Minimal 24 months of follow-ups
  - **<u>Exclusion criteria</u>**
    - Indication for pedicle subtraction osteotomy (PSO) to restore lumbar lordosis (LL) and optimal global alignment
      - Inadequate LL or flat back posture after previous spinal fusion
      - Sagittal vertical axis (SVA) ≥ 5 cm or pelvic tilt more than 25°

Methods

- **Group 1 (Hybrid group)**
  - Minimally invasive LLIF together with open PI
  - 40 patients
- **Group 2 (Posterior group)**
  - Conventional PLIF with PI
  - 40 patients
  - 1-to-1 matching according to age, sex, body mass index (BMI), bone mineral density (BMD), and number of fusion levels of 128 patients



Hybrid group



Posterior group

Methods

- **Outcome parameters**
  - **Radiological outcomes**
    - Coronal Cobb's angle, pelvic incidence (PI), pelvic tilt (PT), sacral slope (SS), LL, thoracic kyphosis (TK), SVA
    - Segmental Cobb's angle and segmental lordosis
    - Indirect decompression effect: changes in thecal sac and foraminal height on MRI
    - Intra-operative endplate fractures during LLIF
    - Cage subsidence at 3-months and at the last follow-up
  - **Clinical outcomes**
    - Oswestry Disability Index (ODI), Visual analog scale (VAS) of back and leg pain
    - Operation time, estimated blood loss (EBL), blood transfusion
    - Post-operative major complications and re-operations

Methods

- **Statistical analysis**
  - **Perioperative continuous variables**
    - Unpaired Student's t-test between each group
    - Paired t-test within each group
  - **Categorical variables**
    - Pearson's chi-square test or Fisher's exact test

Results

- **Radiological outcomes between two groups**

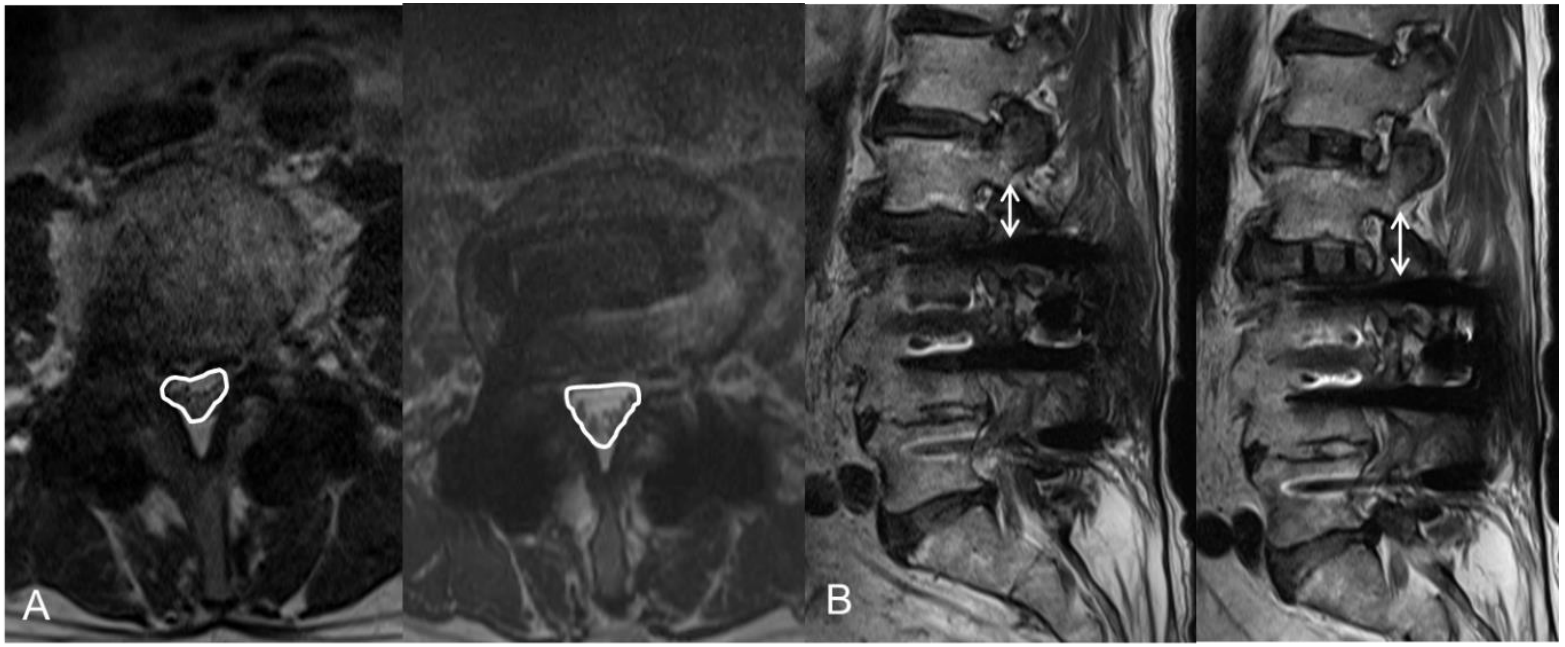
	LLIF + PI (hybrid)	PLIF + PI (posterior)	*p*
Coronal Cobb angle (°)			
Pre-operative	5.3 ± 3.9	5.9 ± 4.4	0.615
Δ Post-operative	-2.0 ± 3.8	-1.3 ± 3.9	0.451
Δ Last follow-up	-1.5 ± 3.5	-1.2 ± 4.7	0.747
Segmental Cobb angle (°)			
Pre-operative	5.7 ± 3.8	4.3 ± 4.0	0.100
Δ Post-operative	**-2.8 ± 3.4**	**-0.9 ± 3.1**	**0.012**
Δ Last follow-up	**-2.4 ± 3.9**	**-0.5 ± 3.2**	**0.026**
Pelvic incidence (°)	53.2 ± 10.2	52.4 ± 9.6	0.718
Pelvic tilt (°)			
Pre-operative	23.9 ± 9.7	22.9 ± 7.3	0.614
Δ Post-operative	-1.3 ± 4.1	-1.3 ± 5.0	0.973
Δ Last follow-up	-0.3 ± 5.5	0.1 ± 5.0	0.763
Sacral slope (°)			
Pre-operative	29.3 ± 9.1	29.5 ± 9.3	0.949
Δ Post-operative	0.4 ± 5.1	1.1 ± 4.7	0.510
Δ Last follow-up	0.5 ± 5.8	0.2 ± 4.7	0.828

Results (continued)

	LLIF + PI (hybrid)	PLIF + PI (posterior)	*p*
Segmental lordosis (°)			
Pre-operative	5.3 ± 13.4	9.0 ± 14.7	0.261
Δ Post-operative	**7.4 ± 8.7**	**2.5 ± 7.3**	**0.009**
Δ Last follow-up	**4.8 ± 7.5**	**0.8 ± 6.9**	**0.016**
Lumbar lordosis (°)			
Pre-operative	30.4 ± 16.7	31.4 ± 15.0	0.799
Post-operative	36.9 ± 13.4	33.5 ± 14.6	0.299
Δ Post-operative	**6.4 ± 9.2**	**2.1 ± 7.9**	**0.032**
Last follow-up	34.2 ± 15.5	31.8 ± 15.9	0.500
Δ Last follow-up	3.7 ± 7.5	0.4 ± 10.4	0.109
Thoracic kyphosis (°)			
Pre-operative	23.3 ± 14.7	21.3 ± 11.0	0.535
Δ Post-operative	0.3 ± 7.0	2.2 ± 5.9	0.251
Δ Last follow-up	-0.5 ± 6.8	1.8 ± 7.6	0.206
Sagittal vertical axis (mm)			
Pre-operative	64.0 ± 43.3	58.1 ± 39.3	0.565
Post-operative	40.7 ± 31.4	49.8 ± 39.0	0.291
Δ Post-operative	-23.3 ± 38.5	-8.2 ± 39.4	0.119
Last follow-up	51.8 ± 46.1	58.0 ± 44.4	0.580
Δ Last follow-up	-12.2 ± 42.7	-0.1 ± 49.1	0.286

Results

- **Indirect decompression effect of LLIF (only hybrid group)**
  - **Canal area**
    - Pre-operative: 83.4 mm^2 → Post-operative: 113.8 mm^2 **36.4%↑ (*p*<0.0001)**
  - **Foraminal height**
    - Pre-operative: 17.8 mm → Post-operative: 20.9 mm **17.4%↑ (*p*<0.0001)**



Results

- **Clinical outcomes including VAS and ODI**

	LLIF + PI (hybrid)	PLIF + PI (posterior)	p
VAS (back)			
Preoperative	8.1 ± 2.0	8.0 ± 2.2	0.790
Postoperative 3-month	**4.1 ± 2.0**	**5.6 ± 2.2**	**0.011**
Last follow-up	5.2 ± 2.4	5.2 ± 2.1	0.881
VAS (leg)			
Preoperative	6.9 ± 3.1	7.7 ± 2.9	0.270
Postoperative 3-month	4.0 ± 3.1	4.3 ± 3.3	0.603
Last follow-up	4.2 ± 3.3	4.6 ± 3.0	0.620
ODI			
Preoperative ODI	61.8 ± 14.4	65.1 ± 13.1	0.283
Postoperative 3-month	**48.9 ± 17.3**	**59.6 ± 17.2**	**0.007**
Last follow-up	**48.3 ± 17.2**	**56.3 ± 16.1**	**0.034**

Conclusions

- Hybrid surgery results in **indirect decompression** and **greater improvement in segmental coronal and sagittal correction** compared to posterior surgery.

- Clinical outcomes were also significantly better in the hybrid group.

LLIF combined with supplemental instrumentation

is recommended for clinical ASP.

Disclosure

We have no financial relationships to disclose.