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Comparison between Combined Lateral and Posterior versus All-Posterior Surgery for Adult Degenerative Scoliosis: A Propensity-Matched Analysis

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OBJECTIVES

- To examine differences in:
    - perioperative data
    - costs
    - outcomes

between lateral lumbar interbody combined with open posterior fusion (LLIF+OP) and all-open-posterior fusion (OP) in adult degenerative scoliosis (ADS).

BACKGROUND

- Adult degenerative scoliosis (ADS) is common in the aging population and often leads to pain, decreased quality of life and disability.[1–3]
- Various surgical techniques, including open and minimally invasive approaches, can correct coronal and sagittal malalignments.[2,4]
- There is no consensus on which approach offers optimal outcomes in ADS surgery.
- Surgical plans vary depending on surgeon preference, and the heterogeneity of patients makes robust comparison difficult.

METHODS

- Review of 2 databases (2008-2016) at a single institution
- Propensity score matching for parameters different at baseline.
- Perioperative data, implant and biologic costs, and radiographic outcomes were compared.

Inclusion criteria:

- ≥ 18 years
- Cobb ≥ 20°
- SVA ≤ 20 cm
- ≥ 5 levels with UIV ≤ T8 and extending to the sacrum and/or ileum
- > 12-months follow-up

Exclusion criteria:

- 3-column-osteotomy procedures
- prior fusion of > 2 levels
- patients with neuromuscular disease
- patients with incomplete data.

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RESULTS

- A propensity-match performed for BMI, Cobb, previous fusion and pelvic incidence resulted in a 40-patient study group (LLIF+OP = 20; OP = 20).

LLIF+OP:

- Longer OR time
  (405 vs. 286 min) $p < 0.01$
- Longer length of stay
  (9.3 vs. 5.8 d) $p < 0.01$
- Shorter total fusion length
  (6.2 vs. 7.5 levels) $p < 0.01$
- Higher inpatient transfusion volume
  (991 vs. 342 ml) $p=0.001$
- Higher total implant and biologic cost
  (42.2k vs. 33.6k USD) $p<0.001$

Both groups:

- Satisfactory coronal balance
  (Cobb < 20°)
- Satisfactory sagittal balance
  (PI-LL< ±5°)
- No difference in EBL
  (1645 vs. 1261 ml, p=0.478)
- No difference in complication
- No difference in reoperation rates

RESULTS

Table 1: Hospitalization, Surgery and Estimated Costs

Variable	LLIF+OP	OP	p-Value
No. of patients	20	20	
Length of stay ± SD (days)	9.3 ± 4.8	5.80 ± 1.4	**<0.001**
Discharge to inpatient rehabilitation (%)	40	25	0.501
Surgical variables			
Total levels fused	6.2 ± 1.1	7.5 ± 0.9	**0.001**
Surgery time ± SD (min)	405 ± 122	286 ± 52	**0.001**
EBL ± SD (ml)	1645 ± 1032	1261 ± 531	0.478
Intraop transfusion volume ± SD (ml)	319 ± 462	113 ± 151	0.231
Inpatient transfusion volume ± SD (ml)	991 ± 796	342 ± 272	**0.001**
Implants			
No. of pedicle screws ± SD	13.8 ± 2.1	16.0 ± 1.8	**0.003**
No. of pelvic bolts ± SD	1.2 ± 1.0	2.0 ± 0.0	**0.014**
Iliac fixation (%)	65	100	**0.008**
No. of LLIF cages ± SD	3.1 ± 0.7	0	N/A
No. of ALIF cages ± SD	0.4 ± 0.6	0	N/A
ALIF at L5/S1 (%)	30	0	N/A
No. of PLIF / TLIF cages ± SD	0.5 ± 0.5	0.8 ± 0.8	0.314
Biologics			
No. of BMP kits (large) ± SD	1.0 ± 0.3	2.1 ± 0.7	**<0.001**
DBM ± SD (ml)	73.5 ± 20.2	27.1 ± 14.2	**<0.001**
Allograft ± SD (ml)	43.2 ± 41.3	174.7 ± 139.4	**<0.001**
Bone substitutes ± SD (ml)	8.8 ± 10.2	0	**0.007**
Cell based matrix ± SD (ml)	2.0 ± 8.9	0	0.792
Resource cost estimation (USD)			
Implants ± SD	29‘651 ± 4‘040	18‘012 ± 2‘082	**<0.001**
Biologics ± SD	12‘568 ± ‘2‘999	15‘574 ± 5‘225	**0.001**
Total (Imlants+Biologics) ± SD	42‘253 ± 5‘235	33‘586 ± 5‘566	**<0.001**

Boldface type indicates statistical significance; EBL= estimated blood loss; LLIF = lateral lumbar interbody fusion; ALIF = anterior lumbar interbody fusion; PLIF= posterior lumbar interbody fusion; TLIF = transforaminal interbody fusion; BMP = bone morphogenetic protein (only large kits were utilized); DBM = demineralized bone matrix

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LIMITATIONS

- Small sample size
- Despite propensity-matching, selection bias concerns remain in a retrospective, non-randomized cohort.
- Pain and quality of life scores between groups were not compared (incomplete data)
- LLIF group: treated by 4 surgeons - OP group: treated by 1 single surgeon
- Some patients in the LLIF+OP group were additionally instrumented with ALIF
    - confounder for increased OR time
- Future prospective studies with high case numbers are necessary to achieve robust conclusions and longer, multi-year follow up is needed to truly assess the durability and cost-effectiveness of the two techniques.

CONCLUSIONS

- LLIF+OP and OP procedures both yield satisfactory deformity correction in the treatment of ADS
- No difference in complication or reoperation rates at 12 months
- In this study, LLIF+OP surgery was associated with:
  - higher OR time
  - higher implant costs
  - longer length of stay
  - higher inpatient transfusion volume

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