Subsidence in Nonexpendable, Single-plane Expandable and Dual-plane Expandable TLIFs: A Propensity-Matched Cohort Study

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INTRODUCTION: TLIF has become a common tool to achieve interbody fusion in lumbar spine surgery while avoiding the time, expense and morbidity associated with an anterior approach. NE devices have excellent fusion results but are limited with respect to implant size by spinal anatomy. Expandable implants have been associated with increased intraoperative subsidence but DPE devices are theorized to have reduced subsidence risk given the increased endplate footprint. However, DPE cages have not been directly compared to NE and SPE TLIFs in vivo.

METHODS:

A retrospective review of patients who underwent transforaminal lumbar interbody fusion (TLIF) at a single metropolitan academic medical center from 2018 through 2021 was conducted. Patients were propensity score matched (PSM) by age and bone density according to implant type to compare nonexpendable (NE) with dual plane expandable (DPE) devices. A second PSM cohort comparing DPE with sagittal plane expandable (SPE) devices was performed. Demographic, clinical and radiographic outcomes were reviewed. The primary outcome of the study was to compare intraoperative subsidence between the two PSM cohorts. Secondary outcomes were to evaluate delayed subsidence and lordotic changes.

RESULTS:

402 patients underwent PSM with 46 NE and 49 DPE cases matched. 103 SPE patients were matched with 24 DPE cases. The average age was 59 with 52.5% female patients. Mean BMI was 29. NE TLIF was the most common device implanted 62%, followed by SPE 26% and DPE 12.2%. DPE devices had a significantly greater intraoperative subsidence than NE devices, (12% vs. 0%). No difference was observed for intraoperative subsidence between SPE and DPE devices. There was no difference in delayed cage subsidence between the groups. There were no differences between L1-S1 lordosis, L4-S1 lordosis, and interbody level lordosis between NE and DPE devices and between SPE and DPE devices. NE and SPE devices had significantly larger implant lordosis when compared to DPE (10.93 SPE vs. 6. 17 NE vs. 3.83 DPE). SPE had significantly greater discrepancy between implant lordosis and interbody level lordosis compared to DPE.

DISCUSSION AND CONCLUSION:

In patient's propensity matched for age and bone density, DPE cages are associated with increased intraoperative subsidence compared to NE devices. There is significant difference in subsidence in DPE devices over SPE despite the larger footprint of the DPE implants. Additionally, there was no lordosis alignment differences between the groups, and SPE devices have greater discrepancy between stated implant lordosis and interbody level lordosis compared with DPE devices.

Table 1: Propensity Score Match – Nonexpandable (NE) and Dual Plane Expandable (DPE) TLIF Comparison Group

Demographic Characteristics	NE (N=46)	DPE (N=49)	P-value
Female Sex [# (%)]	28 (61%)	21 (43%)	0.079
Age [mean (95% CI)]	66 (63 - 69)	65 (62 - 69)	0.948
BMI [mean (95% CI)]	30 (28 - 31)	29 (28 - 31)	0.882
CCI [mean (95% CI)]	2.8 (2.1 - 3.4)	3.2 (2.8 - 3.6)	0.276
Non-smoker [# (%)]	36 (78%)	37 (76%)	0.411
Nml Bone Density [# (%)]	44 (96%)	43 (88%)	0.166

Table 2: Propensity Score Match - Sagittal Plane Expandable (SPE) and Dual Plane Expandable (DPE) TLIF Comparison Group

Demographic Characteristics	SPE (N=103)	DPE (N=24)	P-value
Female Sex [# (%)]	54 (52%)	9 (38%)	0.188
Age [mean (95% CI)]	58 (55 - 60)	60 (56 - 65)	0.358
BMI [mean (95% CI)]	29 (28 - 30)	30 (27 - 32)	0.519
CCI [mean (95% CI)]	1.0 (0.7 - 1.3)	2.3 (1.7 - 2.9)	**<0.001**
Non-smoker [# (%)]	75 (73%)	20 (83%)	0.548
Nml Bone Density [# (%)]	99 (96%)	23 (96%)	0.949

Table 3: Surgical Factors NE and DPE

Surgical Factor	NE (N=46)	DPE (N=49)	P-value
Open Approach [#(%)]	43 (68.3)	20 (31.7)	**<0.001**
Average Levels Fused	2.80 (2.54 – 3.06)	1.26 (1.12 – 1.40)	**0.003**
Laminectomies Performed [#(%)]	35 (76%)	33 (67%)	0.13
Op.time (min) [mean (95% CI)]	294 (247 - 341)	228 (212 - 244)	0.007
EBL [mean (95% CI)]	721 (438-1003)	241(208-274)	**<0.001**
Fluoro (sec) [mean (95% CI)]	17.3 (9.7-24.9)	40.9 (33.3-48.5)	**<0.001**
Autograft used [# (%)]	32 (70)	12 (24.5)	**<0.001**
BMP Used [#(%)]	14 (30)	41 (84)	**<0.001**

Table 4: Propensity Score Match - NE and DPE Radiographic Comparison

Radiographic Measure	DPE (N=46)	NE (N = 46)	P-value
Absolute Change in L1-S1 Lumbar Lordosis	6.87 ± 5.76	7.71 ± 5.77	0.5
Absolute Change in L4-S1 Lumbar Lordosis	6.30 ± 4.13	6.45 ± 9.04	0.9
Absolute Change in Lumbar Lordosis at Interbody Level	4.63 ± 3.96	7.20 ± 9.42	0.09
Average Stated Lordosis of Implant	3.13 ± 5.46	6.17 ± 4.12	**0.003**
Difference in Lordosis at Interbody Level vs. Stated Lordosis of Implant	1.50 ± 6.19	1.03 ± 9.47	0.776

Table 5: Surgical Factors SPE and DPE

Surgical Factor	SPE (N=103)	DPE (N=24)	P-value
Open Approach [#(%)]	12 (11.7)	10 (45.5)	**<0.001**
Average Levels Fused	1.70 (1.45 – 1.95)	1.17 (1.01 – 1.32)	0.278
Laminectomies Performed [#(%)]	49 (48%)	13 (54%)	**0.82**
Op.time (min) [mean (95% CI)]	263 (242 - 284)	213 (192 - 233)	**0.028**
EBL [mean (95% CI)]	437 (230 - 644)	229 (179 - 280)	0.338
Fluoro (sec) [mean (95% CI)]	70.7 (57.1 - 84.2)	42.6 (32.2 - 53.0)	**0.045**
Autograft used [# (%)]	66 (64%)	7 (29%)	**0.002**
BMP Used [#(%)]	61 (59%)	20 (83%)	**0.027**

Table 6: Propensity Score Match - SPE and DPE Radiographic Comparison

Radiographic Measure	DPE (N=24)	SPE (N=24)	P-value
Absolute Change in L1-S1 Lumbar Lordosis	7.42 ± 6.75	9.36 ± 8.31	0.378
Absolute Change in L4-S1 Lumbar Lordosis	6.38 ± 5.09	5.56 ± 5.94	0.613
Absolute Change in Lumbar Lordosis at Interbody Level	4.29 ± 3.39	5.77 ± 2.67	0.317
Average Stated Lordosis of Implant	3.83 ± 5.95	10.93 ± 6.02	**<0.001**
Difference in Lordosis at Interbody Level vs. Stated Lordosis of Implant	0.46 ± 5.46	-5.07 ± 8.32	**0.009**