Pedicle Subtraction Osteotomy (PSO) in the Revision Versus Primary Adult Spinal Deformity (ASD) Patient: IsThere a Difference in Correction and Complications?

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Introduction

PSO is most often performed to correct sagittal plane deformity. However, these are difficult procedures that have risk for complications. Our goal was to compare the amount of deformity correction achieved and perioperative complication rates following PSO in the primary versus revision surgery setting for ASD.

Methods

Multicenter, retrospective analysis of consecutive ASD patients. Inclusion criteria: age=18yrs, lumbar PSO, minimum 6-week complication data. Patients were classified according to SRS-Schwab [L=lumbar scoliosis, T=thoracic scoliosis, D=T+L, N=no scoliosis, and modifiers PT (pelvic tilt), SVA (sagittal vertical axis) and pelvic mismatch (pelvic incidence-lumbar lordosis)]. Patients divided into primary (P=no previous spine fusion) or revision (R=previous fusion). Baseline and 1 yr demographic and radiographic parameters were analyzed. Complications and revision rates evaluated.

Results

260 patients met inclusion criteria (**Figures 1 and 2**). Mean previous posterior spinal fusion (PSF) levels for R group=5.6. P (n=37) and R (n= 223) were similar for age, BMI, gender, mean total PSF levels (P=10.5; R=11.7), PSO level (L3), PSO angle (P=27°; R=24°) EBL (P=2.65L; R=2.69L), and OR Time (P=404min; R=455min). Distribution

Figure 1

Example of Primary Case

Figure 2

Example of Revision Case

of SRS-Schwab ASD deformity type differed for L (P=51.4%; R=26%) and N curves (P=40.5%; R=54.3%). Sagittal modifiers were similar P versus R. Both groups demonstrated improvement in all sagittal spinopelvic parameters from baseline to 1 year, with similar changes in sagittal modifiers, except for pelvic mismatch, which was improved to 0 more often for the P group (P=81.1%; R=58.6%; p<0.001) (**Tables 1 and 2**). Complications were similar for: motor deficit (P=6.9%, R=10.7%), bowel/bladder deficit (P=10.3%, R=14.6%), deep infection (P=6.9%, R=3.9%), implant failure (P=5.4%, R=4.48%), and 1-year

Table 1: Analysis of the change in radiographic parameters from pre-op to post-op (paired t-test) for the Primary group

	Pre-op		Post		Δ pre to post		t-test
	Mean	SD	Mean	SD	Mean	SD	p
Thoracic Kyphosis T2-T12	30.1	22.0	47.6	14.9	17.4	16.6	.0000
Thoracic Kyphosis T4-T12	28.8	21.5	41.5	13.5	12.7	19.4	.0003
Lumbar Lordosis L1-S1	-24.0	25.1	-53.3	11.9	-29.3	26.0	.0000
Sagittal Vertical Axis	127.9	78.4	30.8	52.9	97.2	80.1	.0000
T1 Spino-Pelvic Inclination	3.6	7.0	-4.3	4.8	8.0	7.0	.0000
Pelvic Tilt	31.2	12.2	23.2	9.6	7.9	10.5	.0001
PI minus LL	30.8	25.8	1.9	12.4	28.9	25.8	.0000

Table 2: Analysis of the change in radiographic parameters from pre-op to post-op (paired t-test) for the Revision group

	Pre-op		Post		Δ pre to post		t-test
	Mean	SD	Mean	SD	Mean	SD	p
Thoracic Kyphosis T2-T12	30.2	19.1	44.6	17.3	14.4	14.6	.0000
Thoracic Kyphosis T4-T12	27.2	17.7	37.4	16.8	10.1	14.7	.0000
Lumbar Lordosis L1-S1	-23.2	19.1	-52.6	14.7	-29.3	16.7	.0000
Sagittal Vertical Axis	141.8	76.5	40.9	59.8	100.9	74.2	.0000
T1 Spino-Pelvic Inclination	4.4	7.2	-3.4	5.5	7.8	7.0	.0000
Pelvic Tilt	32.3	10.6	24.5	11.0	7.8	8.6	.0000
PI minus LL	36.3	18.4	7.0	16.8	29.2	16.6	.0000

Table 3: Incidence of major complications

Complication	ALL	Primary	Revision
Intra-op Bleeding >4L	20.3%	27.6%	19.1%
Intra-op Cardiac Arrest	0.5%	0.0%	0.5%
Intra-op Cord Deficit	2.4%	3.4%	2.2%
Intra-op Unplanned Stage	1.4%	0.0%	1.6%
Intra-op Vessel/Organ Injury	0.5%	0.0%	0.5%
Post-op Acute Respiratory Distress/Failure	2.8%	0.0%	3.3%
Post-op Arrhythmia	1.5%	0.0%	1.7%
Post-op Bowel Bladder Deficit	14.0%	10.3%	14.6%
Post-op Cauda Equina Deficit	1.0%	0.0%	1.1%
Post-op Deep Infection	4.3%	6.9%	3.9%
Post-op DVT	1.9%	0.0%	2.2%
Post-op Motor Deficit Paralysis	10.2%	6.9%	10.7%
Post-op Optic Deficit	0.5%	3.4%	0.0%
Post-op PE	2.4%	3.4%	2.2%
Post-op Pneumonia	1.5%	0.0%	1.7%
Post-op Reintubation	0.5%	0.0%	0.6%
Post-op Sepsis	1.0%	0.0%	1.1%
Post-op Tracheotomy	0.5%	0.0%	0.6%
Post-op Unplanned Return OR	14.0%	17.2%	13.5%

revision rate (P=8.1%, R=15.2%;p>0.05), but statistically different for pseudarthrosis (P=5.41%; R=3.59%; p<0.05) (**Tables 3 and 4**).

Table 4: Rates of revision surgery

	ALL	Primary	Revision	Odds ratio
Before 3M	8.1%	2.7%	9%	3.5
Between 3M and 1Y	6.5%	5.4%	6.7%	1.3
Before 1Y	14.2%	8.1%	15.2%	2

Conclusions

PSO may be performed in the primary or revision ASD patient with similar sagittal deformity correction and similar complication rates. Primary PSO patients are more likely to achieve better spinopelvic realignment, and lower rate of pseudarthrosis.

Learning Objectives

By the conclusion of this session, participants should be able to: (1) Understand that pedicle subtraction osteotomy (PSO) for sagittal plane correction can be used in either the primary or revision setting for adult spinal deformity correction; (2) Appreciate that there are no significant differences in the ability of a PSO to achieve surgical correction and no difference in complication rates in the revision or primary setting.

References

1. Bridwell KH, Lewis SJ, Edwards C, et al. *Spine* 2003;28(18):2093-101.
2. Schwab FJ, Patel A, Shaffrey CI, et al. J Neurosurg Spine. 2012; 16(6):539 -46.