Anterior Column Release / Realignment (ACR) vs. Pedicle Subtraction Osteotomy (PSO)

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Disclosures

- Consultant - DePuy Synthes Spine, Biomet, Amendia, Stryker
- Stock - Innovative Surgical Solutions, Safe Wire
- Royalties - Biomet

Case JB

- 66 y/o male 74” 235 lbs
- Retired police officer
- C/O low back pain, bilateral leg pain with weakness, numbness and tingling.
- S/P fusion L2-S1 in 2004
  - History of smoking 3 ppd (stopped 10 years ago)
Pedicle Subtraction Osteotomy (PSO)

- PSO yields approximately 20 to 30º lordosis, in comparison to approximately 8 to 10º per level with posterior column osteotomies (PCOs).
- SCO procedures, however, also carry high morbidity:
  - 30% risk of new motor weakness
  - Increased EBL
  - 100% risk of any complication, especially in older patients
  - Surgical
  - Medical
- Published data suggests open approaches remain advantageous for more severe and fixed deformities.
- In a multicenter minimally invasive database, patients with marked sagittal deformities (SRS-Schwab +++) saw improvement in back pain (VAS), but did not significantly improve in leg pain (VAS), pelvic parameters (pelvic incidence–lumbar lordosis mismatch, pelvic tilt, or sagittal vertical axis), or disability (ODI).
Anterior Column Realignment (ACR) in Adult Sagittal Deformity Correction

Twelve papers met inclusion criteria.

Ten to 278 of segmental lordosis were reported with use of hyper-lordotic cages. 198 increase in mean intradiscal angle was reported when ACR was combined with posterior column osteotomy, 138 more than lateral lumbar interbody fusion alone without a hyperlordotic implant.

Reported complication rates ranged from 10 to 47%.

- Most common minor complications were transient hip flexion weakness (9.3%) and transient paresthesia or dysesthesia (12%).
- There were few reports of major complications, such as bowel perforation (0%) or vascular injury (0%).

Motor deficit was reported in 11 of 75 cases (15%).

ACR is an emerging, less invasive technique for correction of sagittal deformity. ACR has similar restorative capacity as other techniques with same or lower complication rates.

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- Superficial wound infection with peritonitis | 1 | 1.3% |
- Subsidence requiring revision | 1 | 1.3% |
- Deep infection (all posterior) | 5 | 6.7% |
- PK requiring revision | 3 | 4% |
- Retrograde ejaculation | 2 | 2.7% |
- Kidney injury | 0 | 0% |
- Implant failure | 1 | 1.3% |
- Neurologic | 32 | 42.7% |
- New, permanent sensory or motor deficit | 2 | 2.7% |
- Motor deficit | 11 | 14.7% |
- Dysthesia requiring medication | 1 | 1.3% |
- Medical | 8 | 10.7% |
- Pulmonary edema | 1 | 1.3% |
- Pneumothorax | 1 | 1.3% |
- Respiratory failure | 3 | 4% |
- Cardiac arrest | 1 | 1.3% |
- Severe hypotension | 1 | 1.3% |
- PE | 1 | 1.3% |

vs. 20%
11 out of 12 patients had a complete data set and were enrolled in this study.

The mean preoperative and postoperative lumbar lordosis values were, respectively, \(-20^\circ \pm 17^\circ\) and \(-51^\circ \pm 9.8^\circ\) (p< 0.001), while a mean value of \(27^\circ\) of lordosis were restored at a single ACR level.

Two major complications occurred, a bowel perforation and a postoperative early infection of the posterior wound that required surgical debridement.

Preliminary data show that ACR allows corrections similar to those obtained with a Pedicle Subtraction Osteotomy, avoiding risks related to this technique.

Thirty-one patients underwent a total of 47 MIS-ACRs. The mean age of the cohort was 62. Mean follow up was 12 months (range 3–38 months). The average change from in lumbar lordosis (LL) was 17.6º, in pelvic tilt was 4.3º, coronal Cobb was 13.9 and in SVA was 3.8 cm.

Of the 47 MIS-ACR procedures, there were 9 (19%) major complications related to the ACR.

- Iliopsoas weakness was seen in eight patients.
- Retrograde ejaculation in one patient.
- One patient remained with mild motor deficit at the most recent follow-up.
- No revision surgeries were required for the anterolateral approach.
- No vascular, visceral, or infectious complications associated with the MIS-ACR.

The MIS-ACR is one of the MOST TECHNICALLY DEMANDING PROCEDURES performed from the lateral transpsoas approach. This procedure has the advantage of maintaining and improving spinal global alignment while minimizing blood loss and excessive tissue dissection. It comes with its own unique set of potentially catastrophic complications and should only be performed by surgeons proficient in both deformity correction and the lateral approach.
A Novel Approach to the Pedicle Subtraction Osteotomy

- We report on a novel technique, where fixed-angled (25°, 30°, and 35°) triangular shavers are utilized to perform the PSO.
- Their utilization in theory allows for a more reproducible and time-efficient osteotomy.
- As a result, we hypothesized their use would lead to a decrease in associated blood loss.

Methods

- A retrospective review from August 2010 to January 2014
  - All patients who underwent a single-level PSO, regardless of prior surgical history, were included.
  - Patients were divided into two groups depending on the technique used to perform the PSO.
- Group 1 (PSO) - included all patients prior to August 2012, in which traditional straight osteotomes were utilized.
- Group 2 (ZSO) - included patients where fixed-angled triangular shavers were used after their adoption in August 2012.

Novel PSO Technique
Results

- Total study population 18 patients (Consecutive Enrollment)
  - Group 1 (PSO with traditional straight osteotomes) – 8 patients
  - Group 2 (ZSO with fixed triangular shavers) – 10 patients

- No statistical difference between the groups regarding:
  - Age
  - Height
  - Weight
  - Total operative time
  - Total estimated blood loss
  - Number of levels fused

Revision Status:

- Group 1 included 2 patients who had fusion take-downs (2/6 revisions, 33%)
- Group 2 included 8 patients (8/8 revisions, 100%). \( p=0.018 \)

Smith-Peterson Osteotomies (SPOs):

- Group 1 included 4 patients (4/8, 50%)
- Group 2 included 10 patients (10/10, 100%). \( p=0.008 \)
- Amongst all patients with SPOs in both groups, there was no difference in the number of SPOs performed (mean=4.5)

PSO associated Operative Time and Blood Loss:

- Mean PSO time in Group 1 was 52 vs 33 minutes in Group 2 \( p=0.032 \)
- Mean PSO associated blood loss in Group 1 was 1018 vs 463 ml in Group 2 \( p=0.47 \)

Length of Hospital Stay (LOS):

- ICU LOS in Group 1 was 6 vs 3 days in Group 2 \( p=0.030 \)
- Total Hospital LOS in Group 1 was 9.3 vs 6.1 days in Group 2 \( p=0.041 \)

Complications:

- Group 1: 6 patients with 8 major complications
- Group 2: 3 patients with 3 major complications \( p=0.029 \)
  - Complications included:
    - Cerebellar stroke, Pulmonary Embolism, Heart Failure, Aspiration Pneumonia, Altered Mental Status
    - Revision Operation

- Group 2 utilized fewer blood products than Group 1 however not statistically significant
Conclusions

- Group 2 (ZSO) patients
  - # of revision patients
  - # of osteotomies / fusion badeowns
  - # of SPOs
  - Propensity for increased blood loss

- YET…..ZSO technique resulted in a ↓ in associated PSO times by 37%
  - Decrease in associated PSO blood loss by 55%
  - Decrease in overall LOS by 34%
  - Decrease in peri-operative complications / morbidity

- ZSO is a less technically demanding and more efficient technique to perform PSOs resulting in shorter PSO times and resultant blood loss.

- Prospective study is warranted

Thank you