Castellvi Spine
Single Level: Important or Not Important

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DISCLOSURE

- Spine Wave: Consultant/Stock/Royalties
- Spinal Kinetics: Consultant/Stock
- Medtronic: Consultant
- Globus Medical: Consultant
- DiscGenics: Consultant/Stock
- Premia Spine: Consultant
- United HealthCare: Spine Advisory Board

INTERBODY FUSION

- Lumbar Lordosis/Balance
  - All interbody fusions are biomechanically superior constructs, generally with high arthrodesis rates.
  - ALIF enjoys an advantage over other interbody techniques (LLIF, PLIF, TLIF) in maintaining/restoring sagittal balance.
  - Large spacer (heights 12, 14, 16) with anterior–posterior height discrepancy allows for greater lordosis (14°, 16°, 18° spacers).
ALIF/Sagittal Balance

- ALIF
  - Can powerfully correct sagittal balance at the levels most important for maintaining lumbar lordosis (L4-5, L5-S1: 66% lumbar lordosis).
  - Relatively easily achieves 5-10 degrees of lordosis/level treated.
  - Can be modified with hyperlordotic spacers and posterior facet release/SPO to gain 10-20 degrees of lordosis.
  - Excellent anterior column support without compromising posterior tension band.

Lumbar Lordosis/Balance

- Even though the other interbody techniques (LLIF, TLIF/PLIF) do not have an intrinsic ability to easily improve lordosis, they each may be modified to pay greater attention to sagittal balance.
  - LLIF: release of ALL with hyperlordotic wedge spacer.
  - PLIF/TLIF: Smith-Peterson Osteotomy, (SPO)-type decompression with expandable spacers placed anteriorly in the disc space.

LLIF/Sagittal Balance

- LLIF: Standard transpsoas approach
  - Minimally invasive approach
  - Ability to address sagittal balance is limited.
    - Lordosis +2-4° to -2°
    - Difficult to address L5-S1, L4-5 may be limited by lumbar plexus.

**LLIF/Sagittal Balance**

- LLIF: Anterior release
- Able to address lordosis in a powerful fashion to by effecting an anterior column release by resecting ALL followed by placing hyperlordotic wedge spacer.
- 20-30° lordosis level (similar to PSO).
- Facilitates anterior psoas sparing approach.
  - Requires an additional incision for posterior release and stabilization.
  - Requires greater lateral exposure with some increased vascular risk to the great vessels.

**P/TLIF/Sagittal Balance**

- The most recent quantum improvement in posterior and transfemoral interbody fusion (P/TLIF) include expandable interbody spacers.
- Minimize the need for dural retraction, reducing the complications of nerve root injury and neuropathic pain as well as graft displacement.
- Maximizing disc space height, bone grafting and ability to restore lordosis and minimizing postop malalignment.

**PLIF/TLIF**

- Expansible interbody spacers
  - Over the past decade, expandable interbody spacers were introduced showing a steady evolution with design modifications including the addition of lordotic and hyper-lordotic options as well as graft chamber and titanium plasma sprayed endplates.
INTERBODY FUSION

• Expandable cages: Advantages
  • Biomechanical stability.
  • Load sharing.
  • Graft under compression.
  • Maximize bone grafting.
    • Disc space.
    • Posterolateral.
    • Graft chamber.
  • Post-expansion packing.
  • Minimize neural retraction.
  • Maximize lumbar lordosis.

• TLIF/PLIF
  – Bilateral approach allows for maximal disc debulking and local bone harvest as well as interbody bone placement.
  • Limited ability to address sagittal balance with traditional PLIF and minimally invasive TLIF techniques.
  • Standard PLIF or minimally invasive TLIF procedures result in +2° to -4° of lordosis.


INTERBODY FUSION

**PLIF/TLIF**
- Surgical technique:
  - (A) Positioning: extension
  - (B) Decompression: SPO, Ponte
  - (C) Implant: lordotic, expandable
  - (D) Instrumentation: compression


**PLIF/TLIF: Lumbar lordosis**
- INTERBODY SPACERS
  - PLIF: parallel lordotic, expandable implants facilitate lumbar lordosis.
  - TLIF: unilateral implant placed anteriorly in disc space.
  - Expandable implant maximizes disc space height, effecting indirect foraminal decompression and further maximizing lordosis with decreased neural retraction.

**Interbody Fusion**
- Preservation/restoration of lumbar lordosis is crucial to the success of any lumbar fusion.
  - **Clinical outcome: pain/disability.**
  - Sagittal balance is directly correlated to clinical outcome: avoid sagittal decompensation.
  - **Decreased adjacent level degeneration.**


INTERBODY FUSION
• The consequences of failure to achieve postop alignment objectives include:
  – (A) Poor clinic outcome: persistent pain and disability.
  – (B) Failure of fusion/instrumentation: increased stress at caudal and cephalad aspects of the construct.
  – (C) Adjacent level disease: junctional stresses.
• These negative consequences are applicable for short construct degenerative cases as well as long segment deformity cases.


INTERBODY FUSION
• Not necessarily going to turn a 1- or 2-level fusion into a multi-level deformity procedure in order to address sagittal balance, but compensated patients with pelvic retroversion (loss of lordosis or high pelvic tilt/low sacral slope) should undergo open PLIF/TLIF with SPO (as opposed to standard posterolateral fusion, LLIF or minimally invasive TLIF) in order to maximize lordosis.

INTERBODY FUSION
• Patients with good sagittal balance (lordosis and spinopelvic parameters) are certainly candidates for minimally invasive surgery (TLIF or LLIF).
• In order to correct deformity, ALIF or LLIF with ALL release can be combined with posterior release (SPO or Ponte osteotomy) and stabilization in order to avoid more morbid PSO procedure.
CASE STUDY

• DH: Pt is 45 yo F who presents with LBP and bilat LE pain 2 yrs s/p L3-S1 fusion.
  • Pt initially underwent L5-S1 decompress and pedicle screw fixation with posterolateral fusion.
  • Subsequently undergoes exploration and extension of posterolateral fusion L3-S1.
  • Pt noted to have instrumentation failure, treated nonsurgically.

• Pt undergoes exploration/revision of fusion, with Smith-Peterson osteotomy at L4-5 with PLIF with expandable, lordotic spacers.
Conclusion

• The negative consequences of postop malalignment are not limited to long segment deformity cases.
• Malalignment after ‘simple’ degenerative cases leads to poor clinical outcome with higher risk of instrumentation/fusion failure, adjacent level disease and, ultimately, reoperation.

Conclusion

Sagittal balance is critical to success of virtually any fusion procedure, large adult deformity or single level degenerative cases.

– It is much easier to maintain sagittal balance than to correct sagittal malalignment.

• Every surgical plan should take into account goals for maintaining or improving sagittal balance/lordosis.
Conclusion

- Adjacent level disease above and below previous fusion, should be treated with posterior extension of fusion with decompression/SPO at L3-4 and L5-S1 with expandable, lordotic interbody spacers placed anteriorly in the disc space with compression across posterior pedicle screws.

THANK YOU!