Prevention of Iatrogenic Deformity

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Why do we care?

• Significant cause of post-operative pain
• Increased morbidity
  – Revision surgery for deformity correction
  – Never small surgery
  – Progressive deformity (adjacent segments)
  – Progressive neurologic issues
What is normal?

• **Neutral sagittal alignment:**
  - Vertical axis from C2, in front of C7, behind L3 and within 3 cm of dorsal wall of the sacrum
  - Alt: C2 in line with femoral head

— Line from C2 to Sacrum is perpendicular to horizontal (across top of iliac crest)
Iatrogenic Deformity

• AKA Post-surgical deformity
  – Abnormal alignment created as a direct result of surgery

• Can be immediate or delayed

Iatrogenic Deformity

• Delayed
  – Pseudoarthrosis
  – Failure of unfused / uninstrumented levels
    – Adjacent level degen, crankshaft, etc
Iatrogenic Deformity

• Immediate
  – Surgeon failure
  – Fixed the patient in malalignment
Flat Back

- Lumbar spine
- Loss of normal lordosis
- Seen originally with distraction fixation (Doherty 1973)
- Can occur with pedicle fixation

Flat Back

- Creates a sagittal imbalance
- Classically patients stand with hips extended, knees flexed and pelvis tilted to compensate
- Patients c/o back pain, fatigue
Prevention

• Positioning
  – Flexed posture helps with decompression
  – BUT Places spine in flexed posture
  – OK for decompression
  – Bad for fusion
Prevention

• Understand pre-operative imaging
  – 3’ films
  – Sagittal balance
  – May not matter much w/ short segment
  – Long constructs it is critical – remove patients ability to compensate
Spinal Alignment

Sagittal vertical axis

Spinopelvic inclination

Pelvic Parameters?

Pelvic incidence  Pelvic Tilt  Sacral Slope

PI = PT + SS
Compensation for flat back

Lumbar lordosis: $LL = PI + 9$

Construct design
- Re-create / preserve lordosis
  - Interbody fusion with lordotic implant
  - Facet osteotomy w/ compression
  - Curved rod
  - Note: contour spine to rod, not screw heads

Prevention

Correction, immediate

• Immediate is easiest
• Early recognition is key
  – Standing X-rays post-op to assess alignment
• If unacceptable, go back and fix it !!!

Correction, delayed

• Over correct above or below
  – ALIF
  – DLIF
  – TLIF
  – Facet osteotomies
• Correct through the fusion – PSO
Kyphotic decompensation syndrome

• Spine fused in kyphosis
  – Can be over single segment or multiple
  – Common cervical
  – Can occur
What went wrong?

• Failure to recognize position of CT junction intra-operatively
• Failure to assess posture in immediate post-operative period
• Failure to recognize deformity at all...

Prevention

• Preoperative evaluation of alignment
  – 3’ x-ray
  – Physical exam
• Positioning
• Positioning
• Positioning
Prevention

• Pay attention to CT jxn on x-rays
• Exaggerate extension of subaxial cervical spine
  – Military position
• Don’t be afraid to re-position intraoperatively

Correction

• Immediate
  – Easy
  – Re-open, loosen nuts / remove rod; reposition; replace nuts/rods; close
• Delayed
  – Big whack
  – Ostotomies
  – Multistage procedures common (back-front, front-back, back-front-back, front-back-front, etc)
Coronal Deformity

• AKA “the banana”

• Significant malalignment can cause:
  – Trunk shift
  – Shoulder asymmetry
  – Apparent leg length discrepancy
  – Pelvic obliquity with imbalance
  – Unacceptable cosmesis
Coronal deformity

• Causes:
  – Small amount of malalignment at lumbosacral levels can cause significant trunk shift
  – Asymmetrical correction of balanced curves (double major deformity)
  – Thoracolumbar scoliosis with oblique lumbosacral take-off
Prevention

• Pre-operative imaging
  – 3’ films
  – Note oblique take off of L-S junction
  – Plan correction ahead of time
Prevention

• Intraoperatively
  – Positioning
    – Appropriate bed (jackson table)
  – Imaging
    – AP x-ray; keep shooting until you’re happy
    – Visual confirmation (easily fooled)

Correction

• #1 make the diagnosis
  – Examine patient
    – New trunk shift?
  – Standing x-rays
Correction

• If recognized early
  – Go back and fix it

• If recognized late
  – Revision surgery
  – Likely will need multiplanar osteotomy
Conclusions:

• Iatrogenic deformities are preventable

• Look before you leap
  – Pre-op standing films
  – 36° films
  – PE

• Position appropriately
  – Patients will stay in whatever position you put them in

Conclusions

• Be aware of sagittal and coronal alignment during the surgery

• Check alignment / posture in early postoperative period
Thank You!