Proximal junctional kyphosis (PJK)

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Adjacent Segment Disease (ASD)

ASD is a broad term encompassing many complications of spinal fusion including :

- ✓ Listhesis
- Instability
- Herniated disc
 - Stenosis
- Hypertrophic facet arthritis
- ✓ Scoliosis
 - Vertebral compression fracture

incidence of ASD is about 4% per year.

Adjacent Segment Degeneration

 ✓ Adjacent Segment Degeneration is defined as degeneration that develops at mobile segment above or below a fused spinal segment.

 The rate of Adjacent Segment Degeneration ,considered radiologic changes without symptoms ranges from 5.2 to 49%.



Definition

Proximal junctional kyphosis (PJK) is defined as 10-20 degrees of kyphosis measured by the sagittal Cobb angle between the inferior end plate of the upper instrumented vertebra (UIV) and the superior end plate of the second vertebral body above the UIV (UIV+2).



Presentation :

PJK likely represents a spectrum of disorders ranging from asymptomatic radiographic kyphosis to severe kyphosis with pain, disability, neurological deficit, and instrumentation failure.

CLASSIFICATION OF PJK/PJF (Boachie-Adjei)

TABLE 1. Classification of PJK/PJF		
Туре		
1	Disc and ligamentous failure	
2	Bone failure	
3	Implant/bone interface failure	
Grade		
A	Proximal junctional increase 10°-19°	
В	Proximal junctional increase 20°–29°	
С	Proximal junctional increase 30°	
Spondylolisthesis		
PJF-N	No obvious spondylolisthesis above UIV	
PJF-S	Spondylolisthesis above UIV	
PJK indicates proximal junctional kyphosis; PJF, proximal junctional failure; UIV, upper instrumentation vertebra.		







Radiographical example of type 3 bone/interface failure PJF. Type 3CN PJK 2 level (49 °)

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TABLE 352.2 Hart-International Spine Study Group Proximal Junctional Kyphosis Severity Scale

Component	Score
NEUROLOGIC DEFICIT	
None Radicular pain Myelopathy/motor deficit	0 2 4
FOCAL PAIN	
None VAS ≤4 VAS ≥5	0 1 3
INSTRUMENTATION PROBLEM	
None Partial fixation loss Prominence Complete fixation loss	0 1 2
CHANGE IN KYPHOSIS/PLC INTEGRITY	
0–10 degrees 10–20 degrees >20 degrees PLC failure	0 1 2 2
UIV/UIV+1 FRACTURE	
None Compression fracture Burst fracture Translation	0 1 2 3
LEVEL OF UIV	
Thoracolumbar junction	0

The Clinical Correlation of the Hart-ISSG Proximal Junctional Kyphosis Severity Scale With Health-Related Quality-of-life Outcomes and Need for Revision Surgery

Darryl Lau ¹, Haruki Funao, Aaron J Clark, Fred Nicholls, Justin Smith, Shay Bess, Chris Shaffrey, Frank J Schwab, Virginie Lafage, Vedat Deviren, Robert Hart, Khaled M Kebaish, Christopher P Ames, International Spine Study Group

Conclusion: The Hart-ISSG PJKSS was strongly correlated with validated functional outcomes and higher scores were associated with higher rates of revision surgery. The Hart-ISSG PJKSS may be a useful clinical tool in the treatment of patient with PJK.

Risk Factors :

- ✓ Increased age
- ✓ poor bone mineral density
- disruption of the posterior ligamentous complex or facet violation
- magnitude of curvature correction
 - increased preoperative sagittal imbalance
 - use of pedicle screws at the UIV
 - fusion to lower lumbar vertebrae or the sacrum
- age-related disk degeneration and deformity
- vertebral body fractures
- instrumentation failure

Prevention strategies

- ✓ Soft tissue preservation
- Careful selection of UIV and avoidance of overcorrection
- ✓ Hook fixation
- Augment the anterior column with cement
- Ligament augmentation
 - Terminal rod contouring

Soft tissue preservation

Damage to soft tissue, including muscle, facet capsule, and interspinous ligaments at the UIV, are considered risk factors for PJK. Preservation of these structures is believed to decrease the risk of PJK, particularly for constructs terminating in the upper thoracic spine because soft tissue fatigue is a common mechanism of failure.

Upper Instrumented Vertebra Selection and Spinopelvic Correction

- UIV selection is important; however, no level is immune to PJK!
- The presence of thoracic hyperkyphosis has important implications for surgical planning because it is a well-recognized risk factor for the development of PJK.
 In patients with thoracic hyperkyphosis, extending the fusion to upper thoracic levels beyond the apex of kyphosis is recommended in order to mitigate the risk of PJK and to achieve appropriate sagittal realignment.

Cement Augmentation

 Cement augmentation at the UIV, including vertebroplasty and kyphoplasty, are frequently used to provide additional strength to the upper segments

 This technique offers significant benefit for constructs terminating at the thoracolumbar junction

Ligament Augmentation



Figure 352.2. Ligament augmentation for proximal junctional kyphosis prevention. A matchstick bur is used to drill holes through the spinous processes of the upper instrumented vertebra (U), first vertebral body above the upper instrumented vertebra (+1), and first vertebral body below the upper instrumented vertebra (-1). (A) A tether is passed through each level in a stepwise fashion. (B) This is repeated for the contralateral side and the tethers are secured to the primary rod under the desired tension. (C) An intraoperative photograph demonstrates the final construct. (© Kenneth

Terminal Rod Contouring

Pressuring undercontoured rods into the top pedicle screws of a long fusion construct may predispose the patient to proximal junctional degeneration by introducing a pullout preload. We recommend careful and meticulous in situ contouring of the proximal rod such that the rods lay fully seated within the screw heads at the proximal two levels. This can be verified when locking caps are placed; ideally no additional force should be required to secure the rods into the screw heads.

Hook Fixation

For constructs terminating in the upper thoracic spine, transverse process hook fixation has been used in an attempt to reduce rates of PJK because failure at these levels is often caused by ligamentous fatigue.

Hooks involve less soft tissue dissection and improve dynamic fixation at the top of the construct by reducing the stress transition to the UIV.

EVALUATION

Hostin and colleagues found that **fractures** were the most common mechanism of failure (47%), followed by soft tissue disruption (44%); therefore it is important to ask patients about recent falls. To that effect, prevention of mechanical falls in the postoperative period are critical as a potentially preventable cause of early PJK.

History taking

✓ Pain

Worsening pain at the UIV
 recent falls
 change in posture

physical examination

- ✓ Strength
- ✓ Gait
- ✓ Posture
- palpable or visible hump (in some cases)
 erosion of hardware through the skin (in severe case)
 neurological deficit evaluation

Surgical indications ?

There are no evidence-based guidelines for the treatment of PJK; however, the presence of worsening pain, disability, and neurological deficit are all strong indications for revision surgery.

Treatment

Depending on the severity of the kyphotic deformity, low-grade (type 1 or 2) osteotomies can adequately restore normal alignment; however, severe cases often require three-column osteotomies such as pedicle subtraction osteotomy (PSO) or vertebral column resection. ✓ The UIV should be extended past the apex of thoracic kyphosis, which is often T6-T7

✓ Patients at high risk for fractures without the need for emergent surgery warrant consideration for preoperative optimization of bone density with adjuncts such as teriparatide.

- One must also consider the rare possibility of indolent infection as a contributing factor, and there should be a low threshold for sending intraoperative cultures.
- In cases in which the revised construct will be extended to the cervical spine, we recommend consideration of cervical pedicle screws, anterior cervical discectomy and fusion as an adjunct at the UIV, or extension to the C2 level in order to obtain adequate fixation in an already vulnerable patient.

REPRESENTATIVE CASES

CASE 1

62-year-old woman presented with severe back and leg pain after undergoing an T12–L5 instrumented fusion.She presented 2 years later after a minor mechanical fall with pain, leg weakness and positive sagittal balance. MRI showed stenosis with minor spinal cord compression.

Pre 1st operation X-Ray

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Physician: LSpine

دکتر Physician: دکتر LSpine LAT

9/05/15

کبري دبيري ز

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کبري دبيري نيا :Name ID: 9905 exten Sex: F Age: 064Y Date:1399/05/15



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Pre 2nd operation X-Ray



Pre 2nd operation MRI



Post operation X-Rays







CASE 2

71-year-old woman presented with severe back and leg pain.She has positive sagittal balance and mild paraparesia.she underwent T12/S2-alar instrumented fusion.

Post operation X-Ray (1)





200m: 0.16 WW:4064 WL:2048 WHAT HAS HAPPENED? Patient visited with: SEVERE PARAPARESIA SPHYNCTER DYSFUNCTION

2 Weeks post op (after suspicious minor trauma during physiotherapy)









The patient underwent second surgery. But we didn't find any obvious pathology except minor collection in surgical site. We proposed cord ischemia(?) for her.

Case 3

 67-year-old woman presented with severe back and leg pain. She was undergoing an T11–S2 instrumented fusion.She presented 2 years later after a minor mechanical fall with pain, leg weakness and positive sagittal balance.







After surgery





Case 4

 56-year-old woman presented with severe back and leg pain. She was undergoing an L2–L5 instrumented fusion.She presented 2 years later with pain, leg weakness and scoliosis.





After surgery





SOME REFERENCES

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The Clinical Correlation of the Hart-ISSG Proximal Junctional Kyphosis Severity Scale With Health-Related Quality-of-life Outcomes and Need for Revision Surgery. Darryl Lau et al. ROTHMAN-SIMEONE SPINE SURGERY 2017 REVISION SPINE SURGERY,VACARRO 2020 Proximal Junctional Kyphosis, Han Jo Kim et al

