Proximal junctional kyphosis

Although surgical techniques about adult spinal deformity (ASD) have advanced over the last decade, proximal junctional kyphosis (PJK) is still a complication following surgery for ASD that continues to significantly challenge clinicians [1)]

Proximal junctional kyphosis is defined by two criteria: a proximal junctional sagittal Cobb angle (1) ≥ 10° and (2) at least 10° greater than the preoperative measurement. PJK is multifactorial in origin and likely stems from surgical, radiographic, and patient-related risk factors. The diagnosis of PJK represents a broad spectrum of disease ranging from asymptomatic patients with recurrence of deformity to those presenting with increased pain, functional deficit, and, in the most severe cases, neurologic deficits. Recent studies have demonstrated increased pain levels in select patients with PJK. In keeping with the broad spectrum of the disease, classification schemes are needed to better describe and stratify the severity of PJK. The most severe form is proximal junctional failure. A consensus on a uniform definition of proximal junctional failure is needed to allow for more systematic study of this phenomenon [2)].

Etiology

Proximal junctional kyphosis (PJK) is a common postoperative complication after adult spinal deformity surgery and may manifest with neurological decline, worsening spinal deformity, and spinal instability, which warrant reoperation. Rates of PJK may be as high as 69.4% after ASD surgery.

Osteoporosis may contribute to high rates of fracture and instrumentation failure after long posterior spinal fusions, resulting in proximal junctional kyphosis and recurrent spinal deformity. As increasing numbers of elderly patients present for surgical intervention for degenerative and traumatic spinal pathologies, current and future generations of spine surgeons will increasingly be faced with the challenge of obtaining adequate fixation in osteoporotic bone [3)].

A study demonstrates high inter- and intraobserver reliability of PJK measurement following instrumented fusion for ASD, independent of the presence or absence of PJF. Although slightly lower for upper thoracic than for thoracolumbar proximal endpoints, all ICCs consistently reached at least “substantial agreement” and “near perfect agreement” for most [4)].

Retrospective observational studies

Postoperative reciprocal changes (RC) in the cervical spine associated with varying factors of proximal junctional kyphosis (PJK) following fusions of the thoracopelvic spine are poorly understood.

Purpose: Explore reciprocal changes in the cervical spine associated with varying factors (severity, progression, patient age) of PJK in patients undergoing adult spinal deformity (ASD) correction.

Patients and methods: Retrospective review of a multicenter ASD database.

Inclusion: ASD patients > 18 y/o, undergoing fusions from the thoracic spine (UIV: T6-T12) to the pelvis with two-year radiographic data. ASD was defined as: Coronal Cobb angle ≥ 20°, Sagittal

Vertical Axis ≥ 5 cm, Pelvic Tilt ≥ 25°, and/or Thoracic Kyphosis ≥ 60°. PJK was defined as a ≥ 10° measure of the sagittal Cobb angle between the inferior endplate of the UIV and the superior endplate of the UIV + 2. Patients were grouped by mild (M; 10°-20°) and severe (S; > 20°) PJK at one year. Propensity Score Matching (PSM) controlled for CCI, age, PI and UIV. Unpaired and paired t test analyses determined difference between RC parameters and change between time points. Pearson bivariate correlations analyzed associations between RC parameters (T4-T12, TS-CL, cSVA, C2-Slope, and T1-Slope) and PJK descriptors.

Results: 284 ASD patients (UIV: T6: 1.1%; T7: 0.7%; T8: 4.6%; T9: 9.9%; T10: 58.8%; T11: 19.4%; T12: 5.6%) were studied. PJK analysis consisted of 182 patients (Mild = 91 and Severe = 91). Significant difference between M and S groups were observed in T4-T12 Δ1Y(- 16.8 v - 22.8, P = 0.001), TS-CLΔ1Y(- 0.6 v 2.8, P = 0.037), cSVAΔ1Y(- 1.8 v 1.9, P = 0.032), and C2 slopeΔ1Y(- 1.6 v 2.3, P = 0.022). By two years post-op, all changes in cervical alignment parameters were similar between mild and severe groups. Correlation between age and cSVAΔ1Y(R = 0.153, P = 0.034) was found. Incidence of severe PJK was found to correlate with TS-CLΔ1Y(R = 0.142, P = 0.049), cSVAΔ1Y(R = 0.171, P = 0.018), C2SΔ1Y(R = 0.148, P = 0.040), and T1SΔ2Y(R = 0.256, P = 0.003).

Conclusions: Compensation within the cervical spine differed between individuals with mild and severe PJK at one year postoperatively. However, similar levels of pathologic change in cervical alignment parameters were seen by two years, highlighting the progression of cervical compensation due to mild PJK over time. These findings provide greater evidence for the development of cervical deformity in individuals presenting with proximal junctional kyphosis [5].

Case series

PJK was defined as a proximal junctional angle (PJA) >10° and 10° greater than the corresponding preoperative measurement. Patient demographics, operative details, standard radiographic scoliosis measurements (including PJA and assessment of PJK), and complications were analyzed.

Results: Of 184 patients, 146 (79.3%) achieved minimum 2-yr follow-up (mean = 45 mo; mean age = 67 yr; 67.8% women). PJK rates reported for the NT, TO, and TC cohorts were 60.7% (37/61), 35.7% (15/42), and 23.3% (10/43), respectively. PJK rates among TC patients were significantly lower than NT (P = .01601).

Conclusion: Junctional tethers with crosslink significantly reduced the incidence of PJK and revisions for PJK among ASD patients treated with long-segment posterior instrumented fusions who achieved minimum 2-yr follow-up [6].

Videos

<html><iframe width="560" height="315" src="https://www.youtube.com/embed/f5iLwqbU26Q" title="YouTube video player" frameborder="0" allow="accelerometer; autoplay; clipboard-write; encrypted-media; gyroscope; picture-in-picture" allowfullscreen></iframe></html>

1)
Diebo BG, Shah NV, Stroud SG, Paulino CB, Schwab FJ, Lafage V. Realignment surgery in adult spinal deformity : Prevalence and risk factors for proximal junctional kyphosis. Orthopade. 2018 Apr;47(4):301-309. English. doi: 10.1007/s00132-018-3536-5. PMID: 29445843.

2)
Kim HJ, Iyer S. Proximal Junctional Kyphosis. J Am Acad Orthop Surg. 2016 May;24(5):318-26. doi: 10.5435/JAAOS-D-14-00393. PMID: 26982965.
3)
Goldstein CL, Brodke DS, Choma TJ. Surgical Management of Spinal Conditions in the Elderly Osteoporotic Spine. Neurosurgery. 2015 Oct;77 Suppl 4:S98-S107. doi: 10.1227/NEU.0000000000000948. PubMed PMID: 26378363.
4)
Rastegar F, Contag A, Daniels A, Hiratzka J, Lin C, Chang J, Than K, Raslan A, Kong C, Nguyen NL, Hostin R, Kane M, Hart RA. Proximal Junctional Kyphosis: Inter- and Intraobserver Reliability of Radiographic Measurements in Adult Spinal Deformity. Spine (Phila Pa 1976). 2018 Jan 1;43(1):E40-E44. doi: 10.1097/BRS.0000000000002261. PubMed PMID: 29232355.
5)
Passias PG, Naessig S, Williamson TK, Lafage R, Lafage V, Smith JS, Gupta MC, Klineberg E, Burton DC, Ames C, Bess S, Shaffrey C, Schwab FJ; International Spine Study Group (ISSG). Compensation from mild and severe cases of early proximal junctional kyphosis may manifest as progressive cervical deformity at two year follow-up. Spine Deform. 2023 Dec 2. doi: 10.1007/s43390-023-00763-1. Epub ahead of print. PMID: 38041769.
6)
Rabinovich EP, Snyder MH, McClure JJ, Buell TJ, Smith JS, Shaffrey CI, Buchholz AL. Posterior Polyethylene Tethers Reduce Occurrence of Proximal Junctional Kyphosis After Multilevel Spinal Instrumentation for Adult Spinal Deformity: A Retrospective Analysis. Neurosurgery. 2021 May 10:nyab123. doi: 10.1093/neuros/nyab123. Epub ahead of print. PMID: 33971008.