Spinal Instrumentation by Hooks

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First steps

Spinal instrumentation system introduced by Harrington revolutionized treatment of scoliosis, and ushered in modern era of spinal deformity surgery.

A functional classification of spinal instrumentation
Mark R. Foster
A new technic for segmental spinal osteosynthesis using the posterior approach

Orthopaedics & Traumatology: Surgery & Research, Volume 100, Issue 1, February 2014, Pages 37-41

Y. Cotrel, J. Dubousset

Particularly strong and rigid and allows adequate reduction of curve. No postoperative external immobilisation.
Hooks in Competition with Screws

A relatively simple procedure resulting in excellent biomechanical strength and high bone fusion rate.

Transarticular Screw and C1 Hook Fixation for Os Odontoideum with Atlantoaxial Dislocation

World Neurosurgery, Volume 75, Issues 3–4, March–April 2011, Pages 540-546
Bin Ni, Fengjin Zhou, Ning Xie, Xiang Guo, Lili Yang, Qunfeng Guo, Jian Yang, Songkai Li, Feng Zhang, Zhuangchen Zhu, Jinshui Chen
Biomechanical comparison of two-level cervical locking posterior screw/rod and hook/rod techniques

The Spine Journal, Volume 7, Issue 2, March–April 2007, Pages 194-204


In most loading modes, laminar hooks provided similar stability to lateral mass screws or pedicle screws.
Occipitocervical fusion using a hook and rod system between cervical levels C2 and C3


Takao Motosuneya, Shigeru Hirabayashi, Hironobu Yamada, Hiroya Sakai

**Useful**, with **easy** handling, **safe** implantation and a **high rate of bony fusion**. Not useful for C1–2 anterior instability and requires the sacrifice of an extra segment to allow for the C2–3 claw configuration.
Modern posterior instrumentation allows surgeons to recommend earlier return to sports after fusion for AIS.
Hybrid posterior instrumentation and fusion: an efficient and safe technique, with a low rate of pseudoarthrosis and failure.
Debate continues whether constructs that use only pedicle screws perform significantly better than constructs that use hooks in thoracic spine and screws in lumbar spine especially in smaller, more flexible curves.
At this time, insufficient evidence to show that anchor density affects clinical outcomes in AIS.
Both all pedicle screws and hybrid instrumentation offer good correction results of thoracic curve and lumbar curve in posterior selective fusion in patients with adolescent idiopathic scoliosis.
Low-density versus high-density thoracic pedicle screw constructs in adolescent idiopathic scoliosis: do more screws lead to a better outcome?

The Spine Journal, Volume 13, Issue 4, April 2013, Pages 375-381
Neil J. Bharucha, Baron S. Lonner, Joshua D. Auerbach, Kristin E. Kean, Per D. Trobisch

No clinical, radiographic, perioperative, or complication-related advantage of constructs with higher TPS implant density in patient flexible idiopathic scoliosis. Cost significantly higher with HD constructs in comparison with LD constructs.
Influence of screw type on initial coronal and sagittal radiological correction with hybrid constructs in adolescent idiopathic scoliosis. Correction priorities


Hybrid constructs: less iatrogenic hypokyphosis. Sagittal malalignment: poorer clinical outcomes. Main focus: sagittal plane correction, even at expense of a slight decrease in coronal plane correction.
Skeletal immaturity, male gender, and less correction of the major curve may be related to higher rates of coronal decompensation.
Adult thoracolumbar and lumbar scoliosis treated with long vertebral fusion to the sacropelvis: a comparison between new hybrid selective spinal fusion versus anterior-posterior spinal instrumentation

The Spine Journal, Volume 14, Issue 4, 1 April 2014, Pages 637-645
Mitsuru Yagi, Ravi Patel, Thomas W. Lawhorne, Matthew E. Cunningham, Oheneba Boachie-Adjei

Overall curve correction was improved in the hybrid group: fewer levels fused, decreased blood loss, fewer revision procedures, and decreased proximal junctional disease.
Segmental instrumentation for thoracic and thoracolumbar fractures: prospective analysis of construct survival and five-year follow-up

Robert F. McLain, J. Kenneth Burkus, Danial R. Benson

Long rod and hook constructs highly effective in treating thoracic and thoracolumbar injuries. Anterior column mechanically incompetent: pedicle screw augmented with supplemental sublaminar hooks or, preferably, an anterior reconstruction.
Tadpole system as new lumbar **spinal instrumentation**
Yuichi Kasai, Tadashi Inaba, Koji Akeda, Atsumasa Uchida

A **useful, easy**-to-use and **safe** spinal instrumentation technique for **lumbar** fusion surgery.
Pedicle screws placed at top levels are at higher risk for misplacement among all pediatric scoliosis patients.
The safety of spinal pedicle screws in children ages 1 to 12

The Spine Journal, Volume 13, Issue 8, August 2013, Pages 894-901


Rare but major risks are associated with pedicle screw use such as aortic compromise and impingement of the spinal canal because of malpositioned screws.
Surgical treatment of thoracic spine fractures. Outcomes on 50 patients at 23 months follow-up

Orthopaedics & Traumatology: Surgery & Research, Volume 100, Issue 5, September 2014, Pages 475-480
M. Vassal, G. Lonjon, S. Knafo, Y. Thouvenin, F. Segnarbieux, N. Lonjon

Hooks implemented when size of pedicle did not permit insertion of screw, or to increase solidity of montage.
Avoid PJK and/or acute fractures at proximal portion of long segmental pedicle screw constructs.
Type of Anchor at the Proximal Fusion Level Has a Significant Effect on the Incidence of Proximal Junctional Kyphosis and Outcome in Adults After Long Posterior Spinal Fusion

Spine Deformity, Volume 1, Issue 4, July 2013, Pages 299-305

Hamid Hassanzadeh, Sachin Gupta, Amit Jain, Mostafa H. El Daafrawy, Richard L. Skolasky, Khaled M. Kebaish

At UIV, use of TP hooks leads to a lower incidence of PJK.
Junction kinematics between proximal mobile and distal fused lumbar segments: biomechanical analysis of pedicle and hook constructs


Michio Hongo, Ralph E. Gay, Kristin D. Zhao, Brice Ilharreborde, Paul M. Huddleston, Lawrence J. Berglund, Kai-Nan An, Chunfeng Zhao

Semiconstrained hook enhancement considered if patient at a risk of adjacent segment disorders.

![Image of spinal diagrams and graphs]
Cervicothoracic postarachnoiditic hydrosyringomyelia secondary to pedicular hook dislocation: case report

Surgical Neurology, Volume 71, Issue 4, April 2009, Pages 500-503

Pasqualino Ciappetta, Pietro Ivo D'Urso, Carlo Delvecchio, Antonio Colamaria, Giuseppe De Giorgi

Late intracranalar displacement of devices: importance of correct spinal device positioning.
Late Proximal Pedicle Hook Migration Into Spinal Canal After Posterior Correction Surgery of Scoliosis Causing Neurologic Deficit: “Proximal Junctional Scoliosis”? Case Series and a Review of the Literature

*Spine Deformity, Volume 1, Issue 3, May 2013, Pages 229-236* M.P. Vereijken, M. de Kleuver

Transverse connector and/or **claw proximally** to resist medial bending of concave rod and migration of hook.
Rib-based anchors may be considered as an alternative in upper foundation constructs in growing rod techniques.
Are Rib Versus Spine Anchors Protective Against Breakage of Growing Rods?

*Spine Deformity, Volume 2, Issue 6, November 2014, Pages 489-492*

Kent T. Yamaguchi Jr., David L. Skaggs, Shaun Mansour, Karen S. Myung, Muharram Yazici, Charles Johnston, George Thompson, Paul Sponseller, Behrooz A. Akbarnia, Michael G. Vitale, Growing Spine Study Group

Rib-anchored growing rod systems: **less rod breakage** as a result of some “slop” at hook–rib interface, as well as normal motion of **costovertebral joint**.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Rib-anchored</th>
<th>Spine-anchored</th>
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<tr>
<td>Lifetime rod breakage</td>
<td>5.80%</td>
<td>28.90%</td>
<td>.041</td>
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<td>Lifetime pullout</td>
<td>9%</td>
<td>16%</td>
<td>.687</td>
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<tr>
<td>Anchor complications</td>
<td>33%</td>
<td>38%</td>
<td>.117</td>
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Preoperative thoracic hyperkyphosis at higher risk when VEPTR. Patients may be revised to growing rods.
Biomechanical evaluation of pedicle screws versus pedicle and laminar hooks in the thoracic spine

The Spine Journal, Volume 6, Issue 4, July–August 2006, Pages 444-449
Andrew Cordista, Bryan Conrad, MaryBeth Horodyski, Sheri Walters, Glenn Rechtine

Hooks considered when supplemental instrumentation required in thoracic vertebrae, especially in osteoporotic bone.
Analysis of instrumentation/fusion survivorship without reoperation after primary posterior multiple anchor instrumentation and arthrodesis for idiopathic scoliosis

The Spine Journal, Volume 10, Issue 1, January 2010, Pages 5-15

Marc A. Asher, Sue Min Lai, Douglas C. Burton

**Lower** instrumented bilateral **pedicle screws**, and **transverse connector** design, closed drop entry: **most stable and best survival** of implant/fusion without reoperation.
Effectiveness of cross-linking posterior segmental instrumentation in adolescent idiopathic scoliosis: a 2-year follow-up comparative study


No differences in maintenance of correction, SRS scores, and complications with or without cross-linking posterior segmental instrumentation in AIS patients over 2-year follow-up.
Biomechanical comparison of different anchors (foundations) for the pediatric dual growing rod technique

The Spine Journal, Volume 8, Issue 6, November–December 2008, Pages 933-939

Andrew Todd Mahar, Ramin Bagheri, Richard Oka, Patricia Kostial, Behrooz A. Akbarnia

Four pedicle screws in two adjacent vertebral bodies: strongest construct in pullout testing. Cross-link: no enhance of fixation. Hook stronger in lumbar versus thoracic laminae.
Does the size of the rod affect the surgical results in adolescent idiopathic scoliosis? 5.5-mm versus 6.35-mm rod

The Spine Journal, Volume 14, Issue 8, 1 August 2014, Pages 1545-1550

Tsung-Hsi Huang, Hsiao-Li Ma, Shih-Tien Wang, Po-Hsin Chou, Szu-Han Ying, Chien-Lin Liu, Wing-Kwong Yu, Ming-Chau Chang

5.5 and 6.35-mm rod comparable in terms of correction, loss of correction, and coronal global balance.
Study Group

19 patients since 2010 to date.

12 females and 7 males

27 years

1 cervicothoracic, 5 thoracic and 13 thoracolumbar

8 all hooks and 11 hybrids
Future Directions

Spinal instrumentation, a constantly evolving field. Same primary goals: to relieve symptoms and/or to provide rigid internal fixation until solid bony fusion occurred.

Modern spinal instrumentation. Part 1: Normal spinal implants
Clinical Radiology, Volume 68, Issue 1, January 2013, Pages 64-74W.
Nowadays, congenital deformities of spine corrected safely via use of instrumentation in experienced hands.
Instrumentation of the osteoporotic spine: biomechanical and clinical considerations

The Spine Journal, Volume 11, Issue 1, January 2011, Pages 54-63
Karthikeyan E. Ponnusamy, Sravisht Iyer, Gaurav Gupta, A. Jay Khanna

Novel surgical approaches and instruments designed to decrease construct failures by reducing implant pullout, subsidence, and incidence of revision surgery.