

# Spine Surgery - Operative & Post-Operative Management of Degenerative Disorders

## Goals and Objectives

### Course Description

"Spine Surgery" is an online recorded video of a previously presented live CE webinar for physical therapists and physical therapist assistants that presents contemporary information about operative and post-operative management of orthopedic disorders of the spine. This course includes a review of current peer-reviewed literature relating to various vertebral decompressive/stabilizing surgical interventions.

### Course Rationale

The purpose of this course is to provide participants with an understanding of current trends in surgical procedures used to manage non-traumatic orthopedic spinal compressive disorders. The primary emphasis is comparative analysis of contemporary surgical techniques for the cervical, thoracic, and lumbar regions.

### Course Goals and Objectives

Upon completion of this course, participants will be able to:

1. List and identify common anatomical structures of the spine.
2. Distinguish degenerative and non-traumatic spinal pathologies.
3. Recall methods of intraoperative neurophysiological monitoring.
4. Identify decompression and stabilization surgical procedures for the cervical and lumbar spine.
5. Identify methods of thoracic spine sagittal plane balancing and vertebral augmentation.
6. Distinguish different types of bone graft extenders and substitutes.
7. Identify the role of bone growth stimulators as an adjunct to surgical management.
8. Identify post-surgical considerations following spine surgery.
9. Recognize common post-operative braces for the spine.
10. Identify emerging surgical techniques for the spine.

**Course Provider** – Innovative Educational Services

**Provider Contact Information** – [information@cheapceus.com](mailto:information@cheapceus.com)

**Course Instructor** – Jodi Gootkin, PT, Med, CEAS

**Financial/Non-financial Disclosure** - Neither the Provider nor the Instructor have any financial or non-financial conflict of interest related to the presentation of this CE program.

**Target Audience** – Physical Therapists, Physical Therapist Assistants

**Course Educational Level** – This course is applicable for introductory learners.

**Course Prerequisites** – None

**Instructional Method** – Distance Learning – Independent; Asynchronous online video-based home study

**Location** - [Cheapceus.com](http://Cheapceus.com)

**Date** – Continuously available on-demand

**PD Activity Completion Requirements / Criteria for Issuance of CE Credits** – Completion of viewing of 3 hour recorded video, and a score of 70% correct or greater on the course post-test

**Continuing Education Credits** – Three (3) contact hours

**Course Fee** - \$34.95

**Registration Information** – No pre-registration required; available on-demand at [Cheapceus.com](http://Cheapceus.com)

**Special Needs Requests** – Email: [information@cheapceus.com](mailto:information@cheapceus.com) or phone: 954-663-4101

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# Spine Surgery: Operative & Post-Operative Management of Degenerative Disorders

Presented By  
Jodi Gootkin, PT, MED, CEAS  
jodiemail@comcast.net

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## Course Overview

"Spine Surgery: Operative & Post-Operative Management of Degenerative Disorders" presents contemporary information about operative and post-operative management of orthopedic disorders of the spine. This course includes a review of current peer-reviewed literature relating to various vertebral decompressive/stabilizing surgical interventions.

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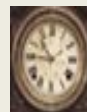
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## Course Outline and Schedule



Topic	Time
Spine Anatomy and Arthrokinematics	0:00-0:10
Spine Pathologies	0:11-0:25
Intraoperative Neurophysiological Monitoring	0:26-0:35
Bone Graft and Substitutes	0:36-0:45
Bone Stimulators	0:46-0:50
<b>Interactive Discussion of Clinical Applications</b>	<b>0:51-1:00</b>
Cervical Anterior and Posterior Fusion	1:01-1:10
Post-Surgical Considerations	1:11-1:25
Thoracic Procedures	1:26-1:35
Post-Surgical Considerations	1:36-1:40
Lumbar Decompression	1:41-1:50
<b>Interactive Discussion of Clinical Applications</b>	<b>1:51-2:00</b>
Lumbar Interbody Fusion	2:01-2:15
Post-Surgical Considerations	2:16-2:20
Total Disc Replacement	2:21-2:25
Vertebroplasty and Kyphoplasty	2:26-2:30
Rehabilitation Considerations	2:31-2:45
Emerging Surgical Techniques	2:46-2:50
<b>Interactive Discussion of Clinical Applications</b>	<b>2:51-3:00</b>

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- After watching the video go to **cheapceus.com**
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  - May be retaken multiple times
- Submit online payment for course
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## Course Post Test

- Slides with "Consider This" icon in bottom right corner will be helpful in completing the post-test.



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## Spine Anatomy

- Functional unit of the spine is composed of two adjacent vertebrae, intervertebral disc, connecting ligaments, and facet joints.
- Lamina is between spinous and transverse process.
- Pedicle notches create intervertebral foramen.
- Uncovertebral joints in cervical spine limit lateral movement.



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## Spine Ligaments

- Posterior longitudinal ligament runs along posterior aspect of vertebral body inside spinal canal.
- Ligamentum flavum connects lamina of adjacent vertebrae inside spinal canal.

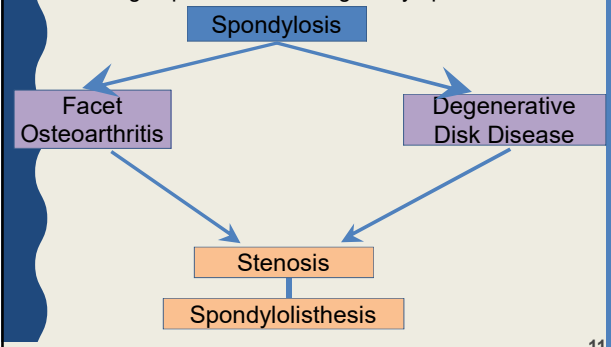
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## Spondylosis

- General term for degenerative changes of the spine leading to pain and neurological symptoms.



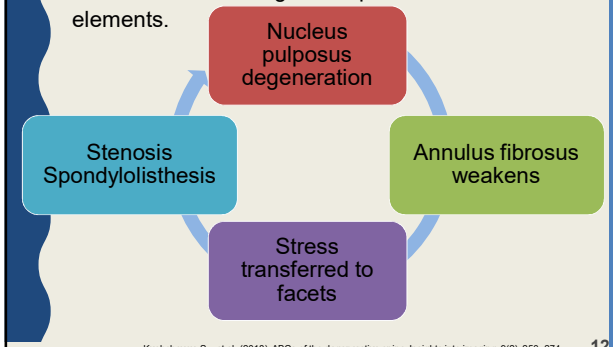
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## Degenerative Disc Disease (DDD)

- Precipitating factors contribute to structural deterioration resulting in compression of neural elements.



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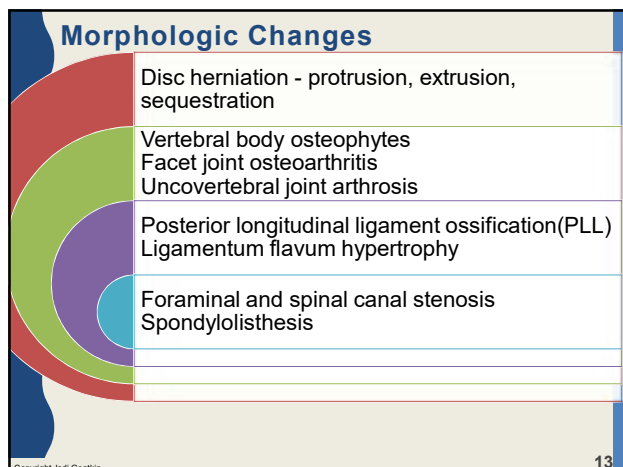
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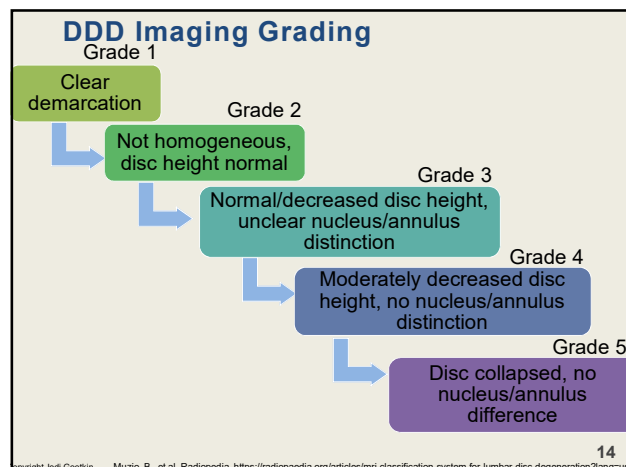
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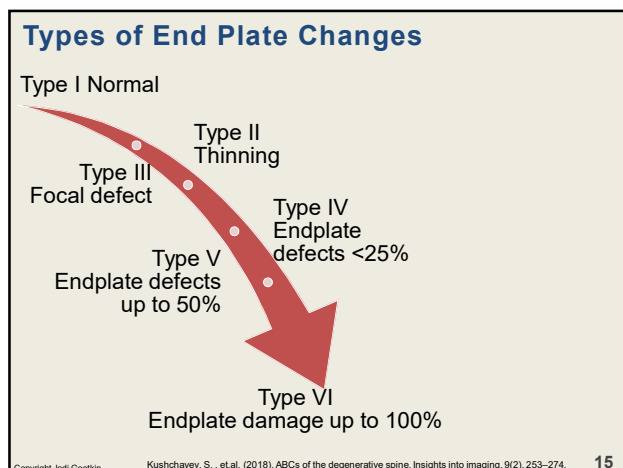
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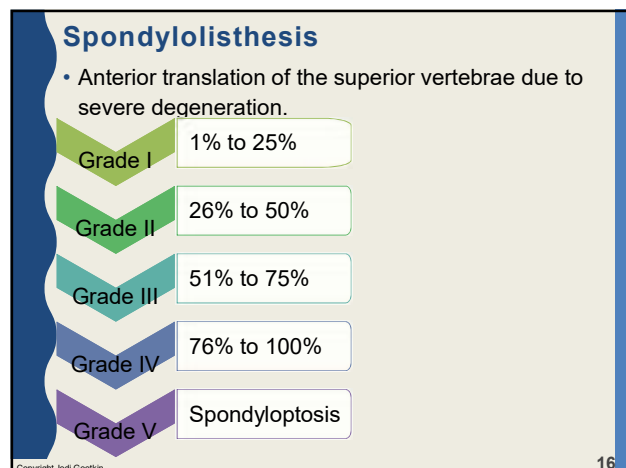
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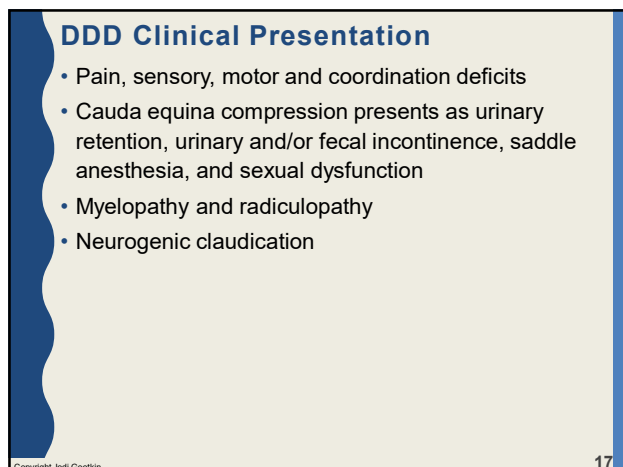
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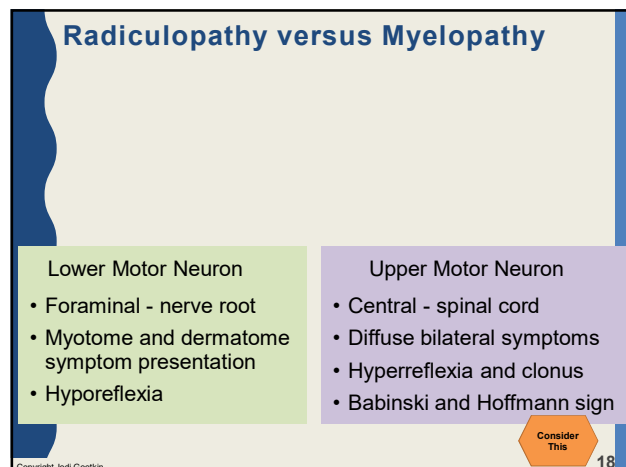
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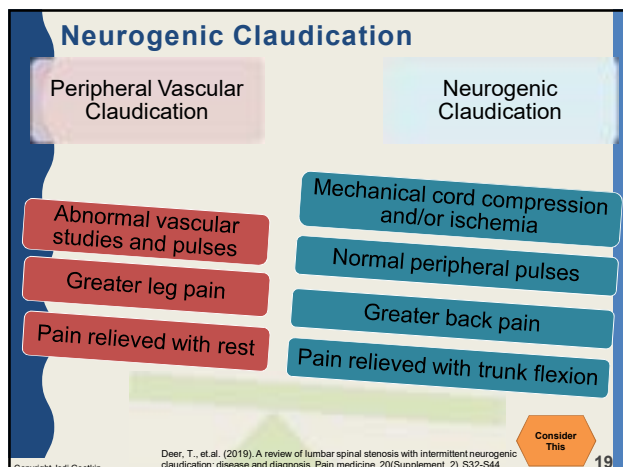


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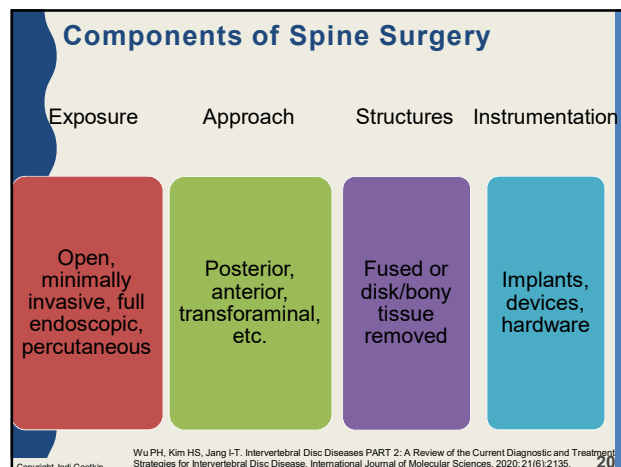
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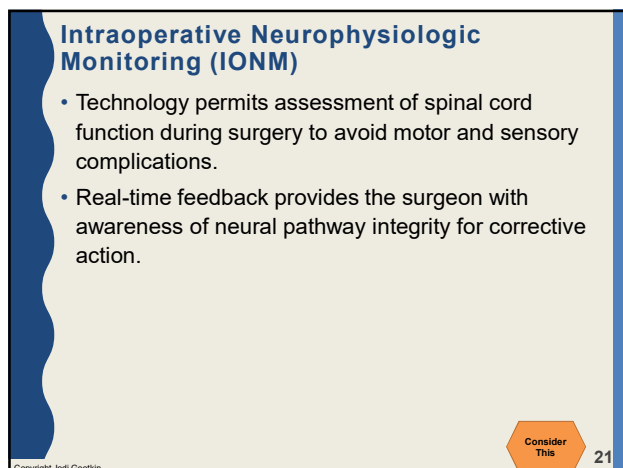
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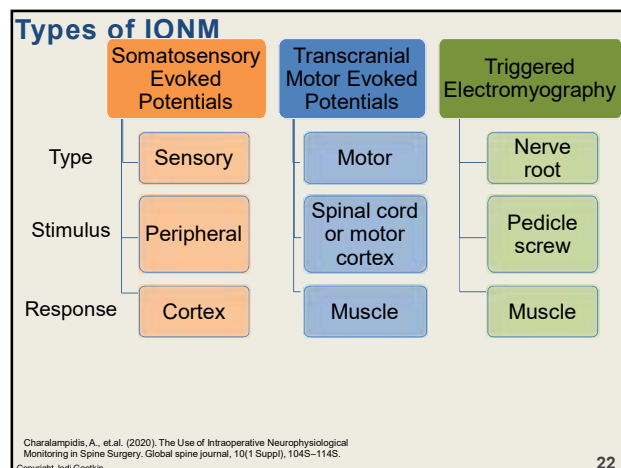
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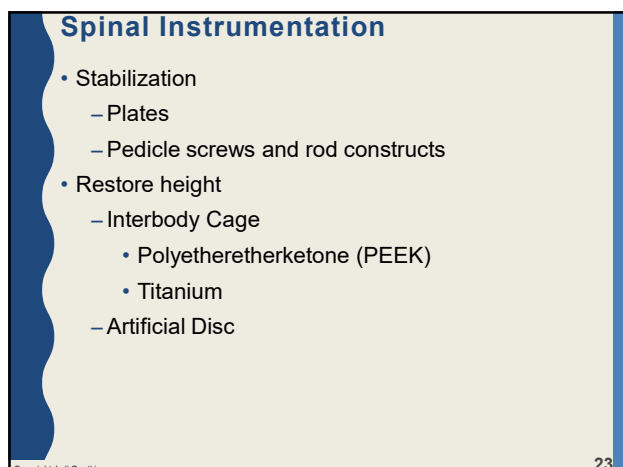
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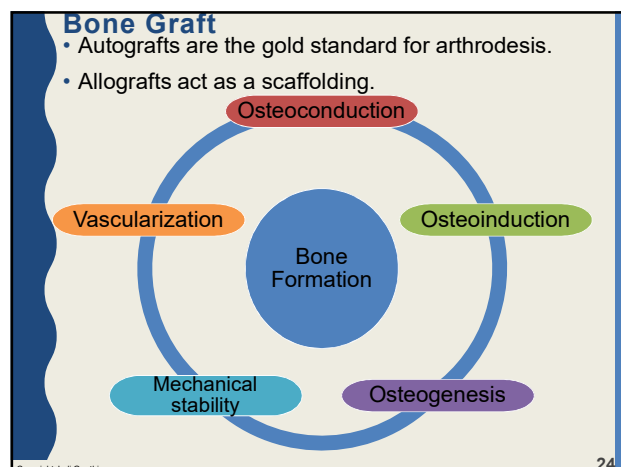
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## Bone Graft Substitutes

- Demineralized bone matrix (DBM) derived from allografts contains a collagen matrix and growth factors offering osteoinductive and osteoconductive properties.
- Typically combined with other types of grafting.

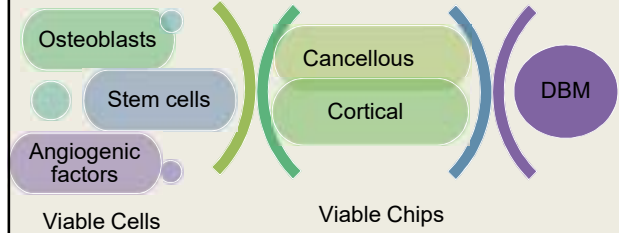
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Copyright Jodi Gootkin Cohen, J. et al. (2021). Allografts and Spinal Fusion. International Journal of Spine Surgery, 15(s1), 68-93.

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## Bone Graft Substitutes Continued

- Cellular bone matrix is an allograft product that mimics all critical properties of autographs eliminating the complications associated with harvesting.



Lin, C., et al. (2020). Comparing cellular bone matrices for posterolateral spinal fusion in a rat model. JOR spine, 3(2), e1084.  
Diaz, R. et al. (2021). Investigating the efficacy of allograft cellular bone matrix for spinal fusion: a systematic review of the literature. Neurological Science, 50(9), F11.

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## Grafting Complications

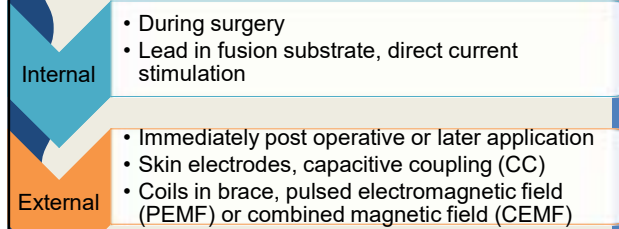
- Autograft
  - Donor site for infection, bleeding, and sensory deficits.
- Allograft
  - Infections

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## Bone Growth Stimulator (BGS)

- Augment surgical management in patients at risk for pseudarthrosis following fusion.



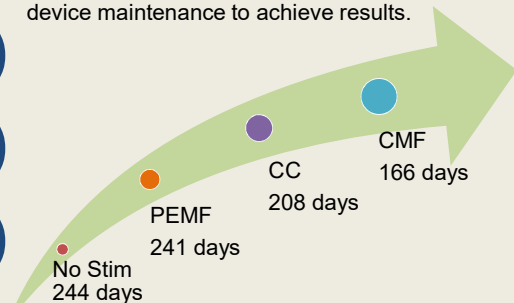
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## BGS Considerations

- Encourage compliance with wearing schedule and device maintenance to achieve results.



Elsabeh R., et al (2020) Increased Spinal Lumbar Fusion with Combined Magnetic Field (CMF) Bone Growth Stimulation. J Orthop Surg Tech 3(1):84-91

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## Spine Surgical Procedures

- Cervical
  - Anterior Cervical Discectomy and Fusion
  - Posterior Cervical Fusion
- Thoracic
  - Traditional Growing Rods
  - Vertical Expandable Prosthetic Titanium Rib
  - Magnetically Controlled Growing Rods
  - Vertebral Body Tethering
- Lumbar
  - Lumbar Decompression
  - Lumbar Interbody Fusion
- Total Disc Replacement

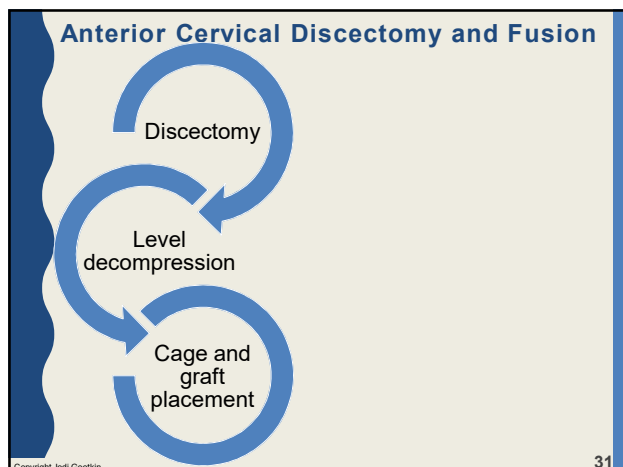
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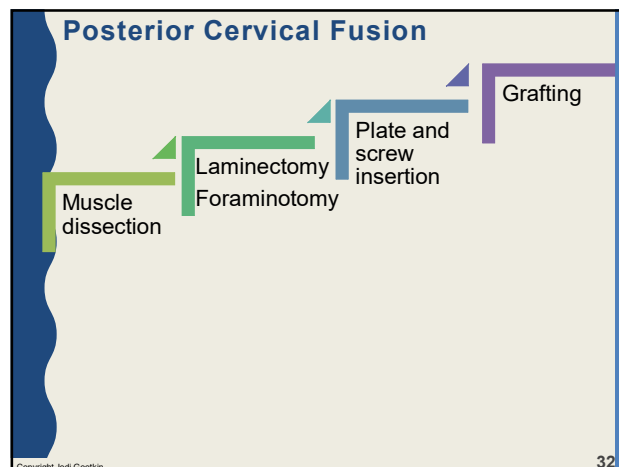
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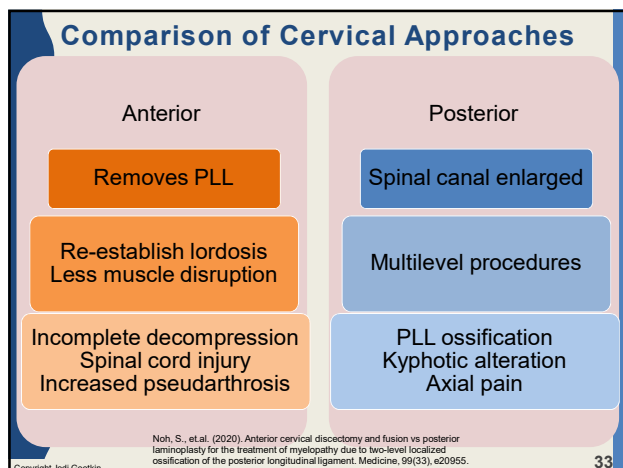
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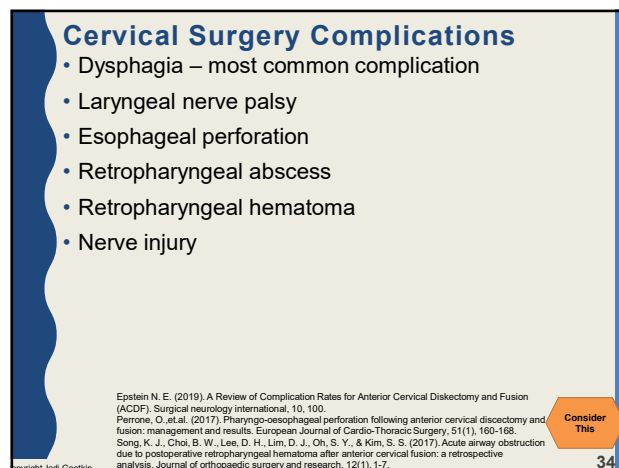
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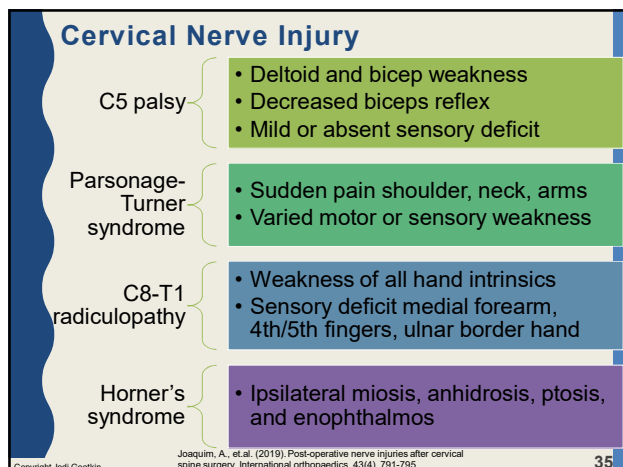
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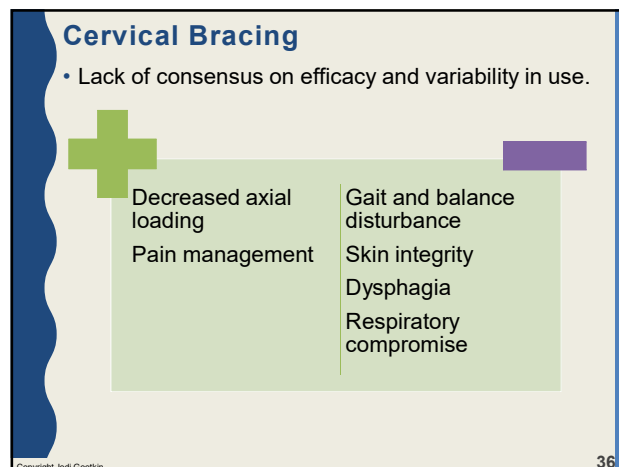
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## Cervical Bracing Outcomes

### Outcome

5-8 weeks of wearing - most significant improvement of neck disability index (NDI) score  
9-12 weeks of wearing - new axial symptom development

Equivalent quality of life outcomes  
Not braced - longer length of stay, increased ER visits

Worse early NDI scores with bracing  
Focal kyphosis and disc space loss without bracing  
No significant difference in fusion rate or clinical outcomes

Qian, Y., Yu, Z., Liu, Z., Duan, W., Zhao, Z., Zheng, H., & Jian, F. (2020). Optimal Time Period of Wearing Protective Collar After Anterior Cervical Discectomy and Fusion. Caplan, I. et al. (2020). The Utility of Cervical Spine Bracing As a Postoperative Adjunct to Multilevel Anterior Cervical Spine Surgery. International journal of spine surgery, 14(2), 151-157. Elkazaz, M., et al. (2020). Cervical Intervertebral Cages: Past, Present, Innovations, and Future Trends with Review of the Literature. Egyptian Spine Journal, 35(1), 2-29.

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## Post-Surgical Interventions

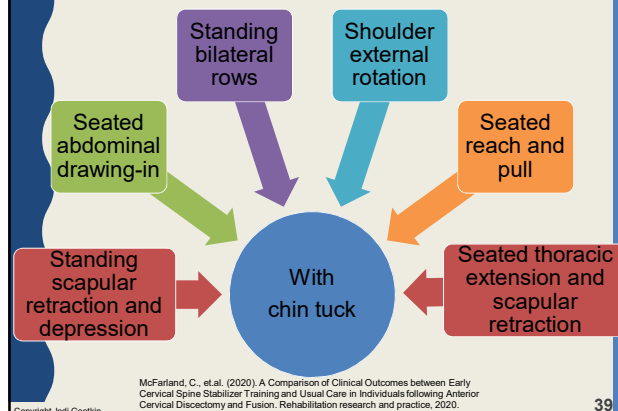
- Nonpharmacologic pain management
- Walking program
- Breathing exercises
- Activity restrictions
- Postural training
  - Avoid cervical extension
  - Deep cervical flexors and cervical multifidi

Coronado, R., et al. (2020). Early Self-directed Home Exercise Program After Anterior Cervical Discectomy and Fusion. SPINE, 45 (4), 217-225

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## Cervical Spine Stabilizer Training



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## Rehabilitation Progression

- Physician protocols vary.

### Phase 1 Post-op

Transfers  
Ambulation  
Basic exercise  
Posture  
ADLs

### Phase 2 Out-pt. or home

Low impact aerobic exercise  
Nerve gliding  
Upper extremity and cervical strengthening  
Baseline weakness strengthening  
Balance and coordination

### Phase 3 Return to function

Progressive strengthening and aerobic exercise

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## Thoracic Procedures For Scoliosis

- Adolescent idiopathic scoliosis (AIS) gold standard is fusion.
- Early onset scoliosis trend is growth friendly strategies.

### Adult

- Fusion
- Osteotomy
- Vertebral resection

### Pediatrics

- Fusion
- Hemivertebra resection
- Traditional growing rods
- Vertical expandable prosthetic titanium rib
- Magnetically controlled growing rod
- Vertebral body tethering

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## Flatback Syndrome

- Individuals with long term Harrington rod placement may present with an inability to stand erect.
- Realignment surgery is required to restore function.

Coronal plane alignment

Lumbar kyphosis

Center of gravity anterior translation

Postural alterations and DDD

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### Traditional Growing Rods

- Distraction-based spinal growth modulation rods require additional procedures for lengthening during the child's development.

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### Vertical Expandable Prosthetic Titanium Rib (VEPTR)

- Progressive curvature may lead to the development of thoracic insufficiency syndrome (TIS).
  - Thoracic volume is structurally decreased and asymmetrical impairing ventilatory capacity.
- Devices attached to ribs and spine may have high complication rates.

Petro-Garcia, A., et al. (2021) Early Complications in Vertical Expandable Prosthetic Titanium Rib and Magnetically Controlled Growing Rods to Manage Early Onset Scoliosis. International Journal of Spine Surgery, 15(2), 368-375

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### Magnetically Controlled Growing Rod (MCGR)

- Pedicle screws and hooks anchor a telescoping rod with an external remote to rotate magnet for lengthening.
- Minimizes additional surgery for lengthening, but high rate of mechanical failure.

USFDA. (2021). Potential Concerns with NuVasive MAGEC System Implants - FDA Safety Communication <https://www.fda.gov/medical-devices/safety-communications/potential-concerns-nuvasive-magec-system-implants-fda-safety-communication>

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### Vertebral Body Tethering

- Non-fusion spinal device designed to prevent spinal curve progression and avoid spinal fusion.
- A polymer cord is attached to bone anchors and screws on the side of the curve.
- Tension encourages spine alignment as individual grows.

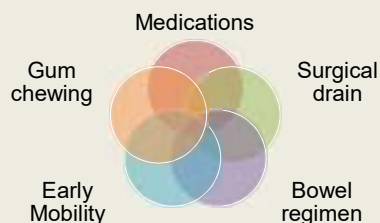
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### Thoracic Post-Surgery Considerations

- Orthostatic hypotension may occur.
- Monitor for gastrointestinal complications.
- Address pulmonary function.



Yang, Y., et al. (2021). Orthostatic Hypotension Following Posterior Spinal Fusion Surgeries for Spinal Deformity Correction in Adolescents: Prevalence and Risk Factors.  
Fletcher, N., et al. (2017). Development of consensus-based best practice guidelines for postoperative care following posterior spinal fusion for adolescent idiopathic scoliosis. Spine, 42(9), E647-E654.

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### Lumbar Surgical Decompression

- Discectomy
  - Full or partial disc removal
- Laminectomy
  - Lamina, facet joints, ligaments
- Laminotomy
  - Portion of lamina and ligament
- Foraminotomy
  - Enlarges intervertebral foramen

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## Full-Endoscopic Lumbar Discectomy (FELD)

- Less neuromuscular trauma and alteration to bony anatomy.
- Transforaminal (TELD) and interlaminar (IELD) approaches utilize natural anatomical entry into spinal canal.

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## FELD Outcomes

Procedure	Outcome
Transforaminal vs. microdiscectomy	Pain and disability outcomes similar. TELD shorter hospital stay
Transforaminal longitudinal review	Pain, function, satisfaction improved long-term 5 years
FELD obese vs. non-obese adolescents	Comparable function and hospital stay

Gibson, J. A., Subramanian, A. S., & Scott, C. E. (2017). A randomised controlled trial of transforaminal endoscopic discectomy vs microdiscectomy. *European spine journal*, 26(3), 847-856.  
 Yu, H., et al. (2021). Evaluation of full-endoscopic lumbar discectomy in the treatment of obese adolescents with lumbar disc herniation: a retrospective study. *BMC Musculoskeletal Disorders*, 22(1), 1-9.  
 Ahn, Y., et al. (2018). Five-year outcomes and predictive factors of transforaminal full-endoscopic lumbar discectomy. *Medicine*, 97(48).

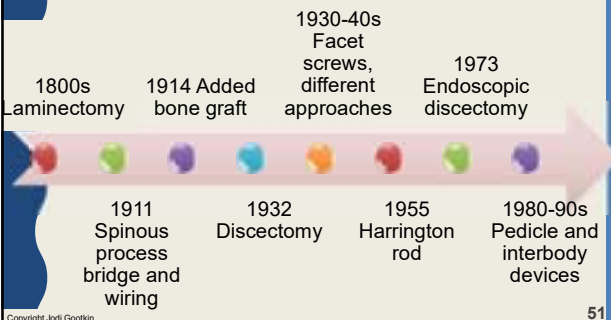
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## Lumbar Interbody Fusion (LIF)

- Procedure to restore intervertebral space and stabilize segments.

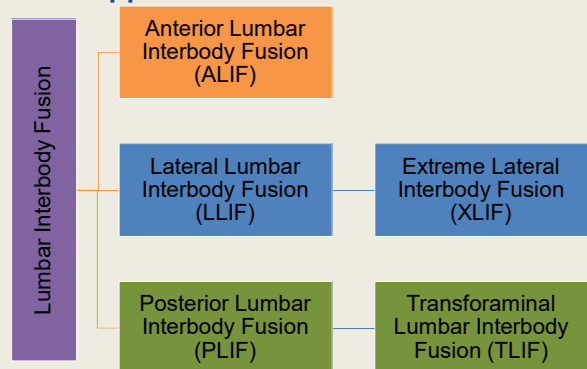


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## LIF Approaches



Mobbs, R., et al. (2015). Lumbar interbody fusion: techniques, indications and comparison of interbody fusion options including PLIF, TLIF, MLIF, OLIF/ATP, LLIF and ALIF. *Journal of spine surgery (Hong Kong)*, 1(1), 2-18.

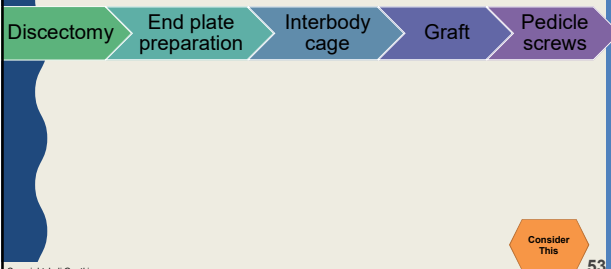
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## Anterior Approach - ALIF

- Direct disc access.
- Restores disc height and sagittal alignment.
- Challenges with visceral structures.
- Greater vascular complications.



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## Lateral Approach - LLIF and XLIF

- Minimizes neuromuscular and abdominal structure trauma.
- Psoas and lumbar plexus injury
- Vascular structures to avoid
- Not for patients with prior retroperitoneal surgery.

Epstein N. E. (2016). Extreme lateral lumbar interbody fusion: Do the cons outweigh the pros? *Surgical neurology international*, 7(Suppl 25), S692-S700.

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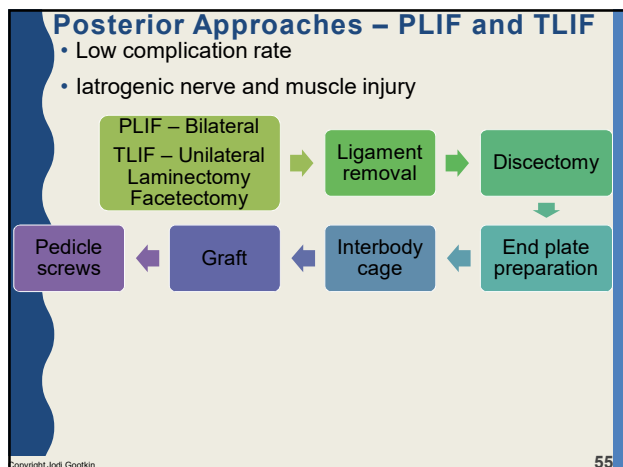
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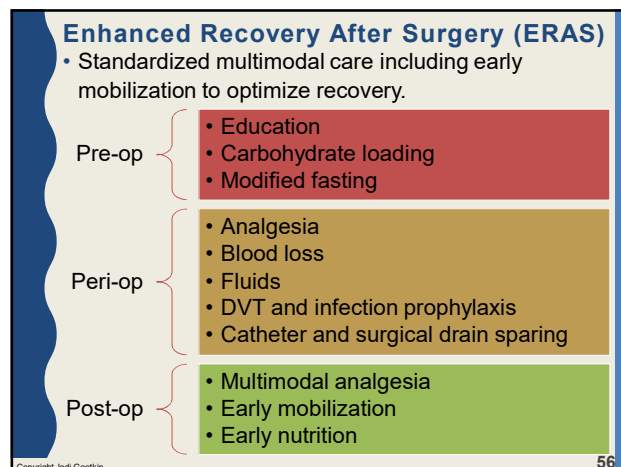
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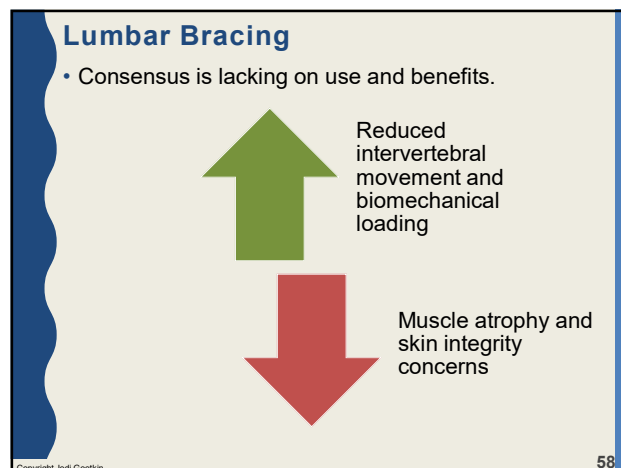
### ERAS Spine Outcomes

Cohort	Outcome
Lumbar fusion	Shorter PCA and opioid use
Microdiscectomy and fusion	Decreased length of stay and adverse events without increased readmissions
Cervical or lumbar minor and major procedures	Reduced length of stay and opioid use

Soffin, E., et al. (2020). Enhanced Recovery after Lumbar Spine Fusion: A Randomized Controlled Trial to Assess the Quality of Patient Recovery. *Anesthesiology*, 133(2), 350-363.  
Staarjes, V., et al. (2019). Improving recovery after elective degenerative spine surgery: 5-year experience with an enhanced recovery after surgery (ERAS) protocol. *Neurosurgical focus*, 46(4), E7.  
Tong, Y., et al. (2020). Enhanced Recovery After Surgery Trends in Adult Spine Surgery: A Systematic Review. *International Journal of Spine Surgery*, 14(4), 623-640.

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### Lumbar Bracing Outcomes

Procedure	Outcome
PLIF, TLIF, IELD trials bracing vs. control	No difference in pain and disability levels
TLIF bracing vs. control	No difference in complications or fusion rates
Survey of Surgeons	More than half did not prescribe bracing

Nasi, D., et al. (2020). The efficacy of postoperative bracing after spine surgery for lumbar degenerative diseases: a systematic review. *European Spine Journal*, 29(2), 321-331.  
Ma, H., et al. (2021). Postoperative spinal orthosis may not be necessary for minimally invasive lumbar spine fusion surgery: a prospective randomized controlled trial. *BMC Musculoskeletal Disorders*, 22(1), 1-7.  
Pathak, N., et al. (2021). Postoperative bracing practices after elective lumbar spine surgery: A questionnaire study of US spine surgeons. *North American Spine Society Journal (NASSJ)*, 5, 100055.

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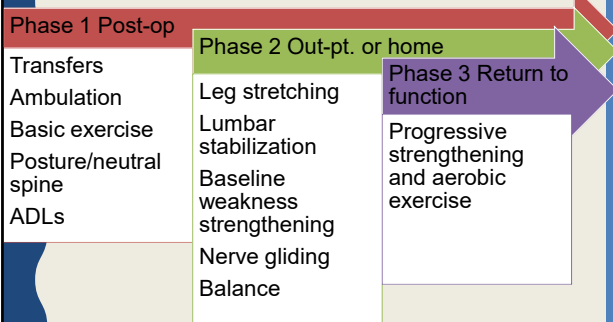
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- ### Post-Surgical Interventions
- Nonpharmacologic pain management
  - Early ambulation and walking program
  - Activity restrictions
  - Neutral spine control
  - Abdominal bracing exercises
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## Rehabilitation Progression

- Physician protocols vary.



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## Total Disc Replacement

- Advantages compared to fusion:
  - Retains ROM
  - Bone graft not utilized
  - Less risk of adjacent segment disease
  - Earlier ROM post surgery

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## Cervical Disc Replacement

- Intractable cervical radicular pain or myelopathy with failed conservative management OR severe progressive symptoms of compression
- AND imaging nerve root or spinal cord compression
- AND DDD from C3 to C7
- AND free from absolute contraindications including extreme obesity and osteoporosis.

Medicare Coverage Database, LCD Cervical Disc Replacement (L38033).  
<https://www.cms.gov/medicare-coverage-database/details/lcd-details.aspx?lcdid=38033&ver=9&keyword=cervical%20artificial%20disc&keywordType=start&areaid=all&docType=NCA,CAL,NCD,MEDCAC,TA,MCD,6.3.5,1.F,P&contractOption=all&sortBy=relevance&bcc=AAAAAQAQAAAA&KeyWordLookUp=Doc&KeyWordSearchType=Exact>

Consider This

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## Lumbar Disc Replacement

- National coverage determination is that lumbar artificial disc replacement is a non-covered service for beneficiaries over 60 years of age.
- For beneficiaries age 60 years and younger, the NCD leaves the determination to local Medicare Administrative Contractors (MACs).

Medicare Coverage Database, Local Coverage Determination (LCD) Lumbar Artificial Disc Replacement (L37826) <https://www.cms.gov/medicare-coverage-database/details/lcd-details.aspx?lcdid=37826&ver=21&keyword=lumbar%20artificial%20disc&keywordType=starts&areaid=all&docType=NCA,CAL,NCD,MEDCAC,TA,MCD,6.3.5,1.F,P&contractOption=all&sortBy=relevance&bcc=AAAAAQAQAAAA&KeyWordLookUp=Doc&KeyWordSearchType=Exact>

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## Vertebroplasty

- Injection of bone cement into the crushed vertebral body through posterior cannulas to stabilize loose bone fragments.

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## Kyphoplasty

- Expansion of the compressed vertebral cavity to restore lost height allowing improved sagittal spinal alignment.

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## Rehabilitation Considerations

- In addition to surgery specific considerations, general areas to address for all post-surgical spine patients.
  - Surgical complications
  - Medication and diet
  - Tobacco use
  - Mobility restrictions
  - Physical activity level

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## Spine Surgery Complications

- Incision and drain care
- Sleep apnea
  - Deep vein thrombosis and pulmonary complications
- Worsening radicular symptoms
- Bowel and bladder incontinence
- Pseudarthrosis
- Adjacent segment disease

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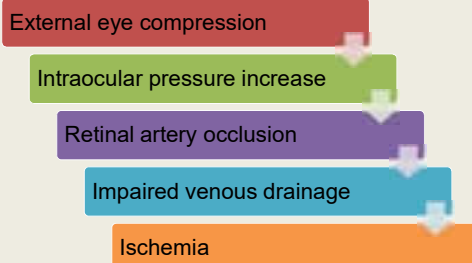
Chung A. et.al. (2018). Obstructive Sleep Apnea in Elective Spine Surgery: National Prevalence and Inpatient Outcomes. Global spine journal, 8(6), 550-556.

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## Perioperative Vision Loss

- Operative positioning combined with risk factors may result in ischemic optic neuropathy.



Apfelbaum, J. et al (2019). Practice advisory for perioperative visual loss associated with spine surgery 2019: an updated report by the American society of anesthesiologists task force on perioperative visual loss, the North American neuro-ophthalmology society, and the society for neuroscience in anesthesiology and critical care. Anesthesiology, 130(1), 13-30.

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## Medications and Diet

- Prescribed pain medications and avoid anti-inflammatories
- Constipation
- Adequate protein intake
- Avoid driving while taking narcotics.

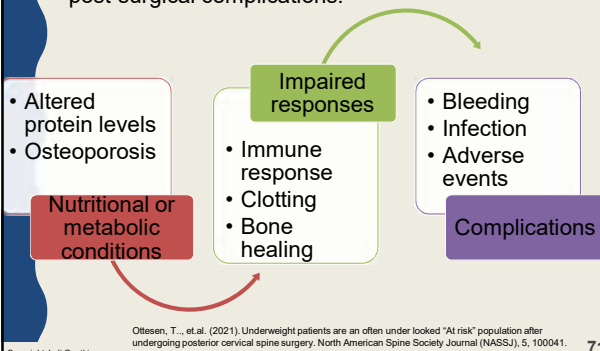
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## Low Body Mass Index (BMI)

- Underweight patients may be at increased risk for post-surgical complications.



Ottosen, T., et al. (2021). Underweight patients are an often under looked "At risk" population after undergoing posterior cervical spine surgery. North American Spine Society Journal (NASSJ), 5, 100041.

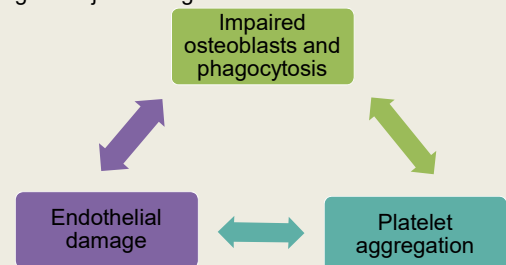
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## Tobacco Use

- Increased risk of post-surgical incision necrosis and dehiscence, delayed wound healing, and infection.
- Significantly increased risk of pseudarthrosis and surgical adjacent segment disease.



Khurana V. G. (2021). Adverse impact of smoking on the spine and spinal surgery. Surgical neurology international, 12, 118.

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## Mobility Restrictions

- Postural alignment
- Log rolling
- Sitting and sleeping position
- Lifting restrictions
- Adaptive equipment
- Ergonomics

**NO**  
**Bending**  
**Lifting**  
**Twisting**

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## Physical Activity Level

- Long term functional gains do not appear to correlate to physical activity level.

Intervention	Outcome
Lumbar fusion	No change in physical activity from 6 weeks to 3 and 6 months but significant functional improvement
Lumbar or cervical surgery	Return to pre-op level at 12 weeks and improvement beyond uncommon. Depression associated with low activity level.

Coronado, R., et al. (2020). Early postoperative physical activity and function: a descriptive case series study of 53 patients after lumbar spine surgery. BMC Musculoskeletal Disorders, 21(1), 1-10.

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## Emerging Techniques

- Monitoring technology
  - Skin Anchored Intra-operative Navigation
- Instrumentation
  - 3D printing
  - Interspinous process devices

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## Skin Anchored Intra-operative Navigation

- Image guidance facilitating visualization with skin-anchored trackers providing anatomical reference points.
- Shorter operative time and low patient radiation exposure.

Vaishnav, A., et al. (2021). Technique, time demand, radiation exposure, and outcomes of skin-anchored intraoperative 3d navigation in minimally invasive posterior cervical laminoforaminotomy. Clinical Spine Surgery: A Spine Publication.

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## 3D Printing

- Trussed design provides light weight but strong implants.
- Custom fit and pressure distribution can contribute to strength of fusion.

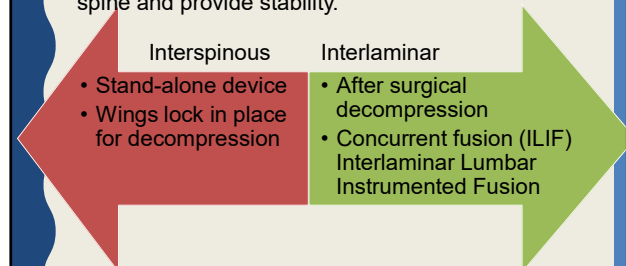
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## Interspinous Process Devices (ISP)

- Distract the spinous processes to unload the lumbar spine and provide stability.



Faulkner, J., et al. (2021). Interspinous Process (ISP) Devices in Comparison to the Use of Traditional Posterior Spinal Instrumentation. Cureus, 13(3), e13886.

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## Conclusion

- Technology advances allowing surgical approaches with less disruption of anatomical structures combined with rehabilitation strategies can improve quality of life for individuals with degenerative disc disease.

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1. Which statement best describes the uncovertebral joints?

- A. Located between lumbar levels 3 to 7
- B. Formed by superior and inferior facets
- C. Limit lateral movements of the cervical vertebrae
- D. Supported by ligamentum flavum

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2. What condition is an upper motor neuron lesion involving compression of the spinal cord?

- A. Blepharopathy
- B. Myelopathy
- C. Neuropathy
- D. Radiculopathy

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3. How does intraoperative neurophysiologic monitoring enhance surgical outcomes?

- A. Decreased hypoxic events through blood gas monitoring
- B. Reduce need for post-operative transfusions
- C. Sedation monitoring allowing lower levels of anesthesia
- D. Awareness of neural pathway integrity for corrective action

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4. What is the osteoinductive and osteoconductive material derived from allografts that is used during spinal fusion surgery?

- A. Bone morphogenetic proteins
- B. Demineralized bone matrix
- C. Iliac crest bone graft
- D. Polyetheretherketone cage

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5. Which of the following statements accurately describes direct current bone stimulation?

- A. Recommended in low risk pseudarthrosis cases
- B. Enhances healing following discectomy
- C. Utilizes superficial electrodes adjacent to surgical site
- D. Inserted within fusion substrate

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6. What is the most common immediate post-operative complication following anterior cervical discectomy and fusion (ACDF)?

- A. Dysphagia
- B. Dyspnea
- C. Infection
- D. Thrombosis

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7. Which procedure is considered the gold standard surgical option to manage adolescent idiopathic scoliosis?

- A. Traditional growing rod
- B. Magnetically controlled growing rod
- C. Vertebral body tethering
- D. Fusion

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8. A greater risk of vascular complications exists with which lumbar fusion surgical approach?

- A. ALIF
- B. PLIF
- C. TLIF
- D. XLIF

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9. A patient presenting with intractable radiculopathy and \_\_\_\_\_ would be a candidate for total disk replacement.

- A. Extreme BMI
- B. Osteoporosis
- C. Myelopathy
- D. Only axial pain

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10. Following lumbar spine surgery patients should avoid what activities?

- A. ADLs
- B. BLTs
- C. LSSP
- D. TFRS

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## References

- Barbanti-Brodano, G., Grifoni, C., Halme, J., Tedesco, G., Terzi, S., Bandiera, S., ... & Gasbarrini, A. (2020). Spinal surgery complications: an unsolved problem—Is the World Health Organization Safety Surgical Checklist an useful tool to reduce them?. *European Spine Journal*, 29(5), 927-936.
- Beighley, A., Zhang, A., Huang, B., Carr, C., Mathkour, M., Werner, C., ... & Kalyvas, J. (2022). Patient-reported outcome measures in spine surgery: a systematic review. *Journal of Craniovertebral Junction and Spine*, 13(4), 378-389.
- Bisson, E. F., Dimar, J., Harrop, J. S., Hoh, D. J., Mohamed, B., Mummaneni, P. V., ... & Dhall, S. (2021). Congress of neurological surgeons systematic review and evidence-based guidelines for perioperative spine: preoperative nutritional assessment. *Neurosurgery*, 89(Supplement\_1), S26-S32.
- Blue Cross Blue Shield of North Carolina. (2020). Corporate Medical Policy-Bone growth stimulation. [https://www.bluecrossnc.com/sites/default/files/document/attachment/services/public/pdfs/medicalpolicy/electrical\\_bone\\_growth\\_stimulation.pdf](https://www.bluecrossnc.com/sites/default/files/document/attachment/services/public/pdfs/medicalpolicy/electrical_bone_growth_stimulation.pdf)
- Butler AJ, Donnally III CJ. Discectomy. (2020 Mar 24). In: StatPearls (Internet). Treasure Island (FL): StatPearls Publishing; 2020 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK544281/>
- Caplan, I. F., Sinha, S., Osiemo, B., McClintock, S. D., Schuster, J. M., Smith, H., ... & Malhotra, N. R. (2020). The utility of cervical spine bracing as a postoperative adjunct to multilevel anterior cervical spine surgery. *International Journal of Spine Surgery*, 14(2), 151-157.
- Coronado, R. A., Master, H., White, D. K., Pennings, J. S., Bird, M. L., Devin, C. J., ... & Aaronson, O. S. (2020). Early postoperative physical activity and function: a descriptive case series study of 53 patients after lumbar spine surgery. *BMC Musculoskeletal Disorders*, 21(1), 1-10.
- Crutchfield, J. S., Medley, A., & Roddey, T. (2020). A Comparison of Clinical Outcomes between Early Cervical Spine Stabilizer Training and Usual Care in Individuals following Anterior Cervical Discectomy and Fusion. *Rehabilitation Research and Practice*, 2020.
- De Cicco FL, Camino Willhuber GO. Nucleus Pulposus Herniation. (2020 Aug 10). In: StatPearls (Internet). Treasure Island (FL): StatPearls Publishing; 2020 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK542307/>
- Dimar, J., Bisson, E. F., Dhall, S., Harrop, J. S., Hoh, D. J., Mohamed, B., ... & Mummaneni, P. V. (2021). Congress of neurological surgeons systematic review and evidence-based guidelines for perioperative spine: preoperative osteoporosis assessment. *Neurosurgery*, 89(Supplement\_1), S19-S25.
- Donnally III CJ, Hanna A, Varacallo M. Lumbar Degenerative Disk Disease. (2020 Apr 13). In: StatPearls (Internet). Treasure Island (FL): StatPearls Publishing; 2020 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK448134/>
- Dydyk AM, M Das J. Vertebral Augmentation. (2020 Oct 24). In: StatPearls (Internet). Treasure Island (FL): StatPearls Publishing; 2020 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK547726/>
- Estefan M, Camino Willhuber GO. Laminectomy. (2020 Jul 31). In: StatPearls (Internet). Treasure Island (FL): StatPearls Publishing; 2020 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK542274/>
- Evans, L., O'Donohoe, T., Morokoff, A., & Drummond, K. (2023). The role of spinal surgery in the treatment of low back pain. *Medical Journal of Australia*, 218(1).
- Fernández-de Thomas RJ, De Jesus O. Thoracolumbar Spine Fracture. (2020 Nov 14). In: StatPearls (Internet). Treasure Island (FL): StatPearls Publishing; 2020 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK562204/>
- Ghatol D, Widrich J. Intraoperative Neurophysiological Monitoring. (2020 Oct 12). In: StatPearls (Internet). Treasure Island (FL): StatPearls Publishing; 2020 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK563203/>
- Gupta, M. C. (2020). Vertebral column resection for severe kyphosis. *Neurosurgical Focus: Video*, 2(1), V10. <https://thejns.org/video/view/journals/neurosurg-focus-video/2/1/article-pV10.xml>
- Haddad, A. F., Ames, C. P., Safaee, M., Deviren, V., & Lau, D. (2020). The Effect of Systemic Tranexamic Acid on Hypercoagulable Complications and Perioperative Outcomes Following Three-Column Osteotomy for Adult Spinal Deformity. *Global Spine Journal*, 2192568220953812.
- Hatef, J., Katzir, M., Toop, N., Islam, M., Clark, T., Roscoe, C., ... & Mendel, E. (2020). Damned if you monitor, damned if you don't: medical malpractice and intraoperative neuromonitoring for spinal surgery. *Neurosurgical Focus*, 49(5), E19.
- Jo Kim, H. (n.d.). Large curves. AO Foundation Surgery Reference. Retrieved December 18, 2020, from <https://surgeryreference.aofoundation.org/spine/deformities/adolescent-idiopathic-scoliosis/basic-technique/large-curves>

- Ju, C. I., & Lee, S. M. (2023). Complications and management of endoscopic spinal surgery. *Neurospine*, 20(1), 56.
- Katsevan, G. A., Daffner, S. D., Brandmeir, N. J., Emery, S. E., France, J. C., & Sedney, C. L. (2020). Complications of Spine Surgery in "Super Obese" Patients. *Global Spine Journal*, 2192568220953393.
- Kim D, Davis DD, Menger RP. Spine Sagittal Balance. (2020 Aug 11). In: StatPearls (Internet). Treasure Island (FL): StatPearls Publishing; 2020 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK534858/>
- Kİm, D. S., CHOI, H. Y., KIM, G. W., SEO, J. H., & WON, Y. H. (2020). Differences in Electrophysiologic Values between Preoperative and Intraoperative Neurophysiologic Monitoring. *Turkish Neurosurgery*.
- Kreiner, D. S., & Matz, P. (2020). North American Spine Society (NASS). Evidence-based clinical guidelines for multidisciplinary spine care. Diagnosis and treatment of Low Back Pain. <https://www.spine.org/Portals/0/assets/downloads/ResearchClinicalCare/Guidelines/LowBackPain.pdf>
- Kuo DT, Tadi P. Cervical Spondylosis. (2020 Jul 8). In: StatPearls (Internet). Treasure Island (FL): StatPearls Publishing; 2020 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK551557/>
- Kwon, H., & Park, J. Y. (2023). The role and future of endoscopic spine surgery: a narrative review. *Neurospine*, 20(1), 43.
- Lee, S. H., Son, D. W., Lee, J. S., Sung, S. K., Lee, S. W., & Song, G. S. (2020). Relationship Between Endplate Defects, Modic Change, Facet Joint Degeneration, and Disc Degeneration of Cervical Spine. *Neurospine*, 17(2), 443–452. <https://doi.org/10.14245/ns.2040076.038>
- Lopez, I. B., Benzakour, A., Mavrogenis, A., Benzakour, T., Ahmad, A., & Lemée, J. M. (2023). Robotics in spine surgery: systematic review of literature. *International orthopaedics*, 47(2), 447-456.
- Lorio, M., Kim, C., Araghi, A., Inzana, J., & Yue, J. J. (2020). International Society for the Advancement of Spine Surgery Policy 2019—Surgical Treatment of Lumbar Disc Herniation with Radiculopathy. *International Journal of Spine Surgery*, 14(1), 1-17.
- Lubelski, D., Hersh, A., Azad, T. D., Ehresman, J., Pennington, Z., Lehner, K., & Sciubba, D. M. (2021). Prediction models in degenerative spine surgery: a systematic review. *Global spine journal*, 11(1\_suppl), 79S-88S.
- Magableh, H. M., Ibrahim, S., Pennington, Z., Nathani, K. R., Johnson, S. E., Katsos, K., ... & Bydon, M. (2024). Transforming outcomes of spine surgery—exploring the power of enhanced recovery after surgery protocol: a systematic review and meta-analyses of 15 198 patients. *Neurosurgery*, 95(1), 3-25.
- McKenzie, D. M., Westrup, A. M., O'Neal, C. M., Lee, B. J., Shi, H. H., Dunn, I. F., ... & Smith, Z. A. (2021). Robotics in spine surgery: a systematic review. *Journal of Clinical Neuroscience*, 89, 1-7.
- Menger RP, Davis DD, Bryant JH. Spinal Osteotomy. (2020 Jun 23). In: StatPearls (Internet). Treasure Island (FL): StatPearls Publishing; 2020 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK499872/>
- Naidu, R., Varun, G. B. S., Damani, R. K., & Lavadi, R. (2020). Role of DBM in lumbar spinal fusion surgery. *International Journal of Orthopaedics*, 6(4), 487-491.
- Nasi, D., Dobran, M., & Pavesi, G. (2020). The efficacy of postoperative bracing after spine surgery for lumbar degenerative diseases: a systematic review. *European Spine Journal*, 29(2), 321-331.
- Noh, S. H., Kim, K. H., Park, J. Y., Kuh, S. U., Chin, D. K., Kim, K. S., & Cho, Y. E. (2020). Anterior cervical discectomy and fusion vs posterior laminoplasty for the treatment of myelopathy due to two-level localized ossification of the posterior longitudinal ligament. *Medicine*, 99(33), e20955. <https://doi.org/10.1097/MD.00000000000020955>
- Nunley, P., Frank, K., & Stone, M. (2020). Patient Selection in Cervical Disc Arthroplasty. *International journal of spine surgery*, 14(s2), S29–S35. <https://doi.org/10.14444/7088>
- Oster, B. A., Kikanloo, S. R., Levine, N. L., Lian, J., & Cho, W. (2020). Systematic Review of Outcomes Following 10-Year Mark of Spine Patient Outcomes Research Trial (SPORT) for Spinal Stenosis. *Spine*, 45(12), 832-836.
- Oster, B. A., Kikanloo, S. R., Levine, N. L., Lian, J., & Cho, W. (2020). Systematic Review of Outcomes Following 10-Year Mark of Spine Patient Outcomes Research Trial (SPORT) for Degenerative Spondylolisthesis. *Spine*, 45(12), 820-824.
- Oster, B. A., Kikanloo, S. R., Levine, N. L., Lian, J., & Cho, W. (2020). Systematic Review of Outcomes Following 10-Year Mark of Spine Patient Outcomes Research Trial for Intervertebral Disc Herniation. *Spine*, 45(12), 825-831.
- Perfetti, D. C., Kisinde, S., Rogers-LaVanne, M. P., Satin, A. M., & Lieberman, I. H. (2022). Robotic spine surgery: past, present, and future. *Spine*, 47(13), 909-921.
- Prabhakar, N. K., Chadwick, A. L., Nwaneshiudu, C., Aggarwal, A., Salmasi, V., Lii, T. R., & Hah, J. M. (2022). Management of postoperative pain in patients following spine surgery: a narrative review. *International Journal of General Medicine*, 4535-4549.

- Ravinsky, R. A., Crawford, E. J., Rasouli, A., & Saadat, E. (2020, March). Posterior cervical laminoforaminotomy. In *Seminars in Spine Surgery* (Vol. 32, No. 1, p. 100776). WB Saunders.  
<https://www.sciencedirect.com/science/article/pii/S1040738319301029>
- Saini A, Mukhdomi T. Cervical Discogenic Syndrome. (2020 Jun 9). In: StatPearls (Internet). Treasure Island (FL): StatPearls Publishing; 2020 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK555960/>
- Sinha, S., Caplan, I., Schuster, J., Piazza, M., Glauser, G., Sharma, N., ... & Malhotra, N. R. (2020). Evaluation of lumbar spine bracing as a postoperative adjunct to single-level posterior lumbar spine surgery. *Asian Journal of Neurosurgery*, 15(2), 333.
- Soffin, E. M., Beckman, J. D., Tseng, A., Zhong, H., Huang, R. C., Urban, M., ... & Schwab, F. J. (2020). Enhanced Recovery after Lumbar Spine Fusion: A Randomized Controlled Trial to Assess the Quality of Patient Recovery. *Anesthesiology*, 133(2), 350-363.
- Stienen, M. N., Rezaii, P. G., Ho, A. L., Veeravagu, A., Zygorakis, C. C., Tomkins-Lane, C., ... & Desai, A. M. (2020). Objective activity tracking in spine surgery: a prospective feasibility study with a low-cost consumer grade wearable accelerometer. *Scientific Reports*, 10(1), 1-11.
- Telfeian, A. (2020). Four Complications Associated with Lateral and Oblique Fusion Treatable with Endoscopic Spine Surgery: Technical Note and Case Series. *Pain Physician*, 23, E665-E671.
- Thomas, J. A., Thomason, C. I., Braly, B. A., & Menezes, C. M. (2020). Rate of failure of indirect decompression in lateral single-position surgery: clinical results. *Neurosurgical Focus*, 49(3), E5.
- Tong, Y., Fernandez, L., Bendo, J. A., & Spivak, J. M. (2020). Enhanced Recovery After Surgery Trends in Adult Spine Surgery: A Systematic Review. *International Journal of Spine Surgery*, 14(4), 623-640. McFarland, C., Wang-Price, S., Gordon, C. R., Danielson, G. O.,
- Valero-Moreno, F., Clifton, W., Damon, A., & Pichelmann, M. (2020). Total Anterior Uncinectomy During Anterior Discectomy and Fusion for Recurrent Cervical Radiculopathy: A Two-dimensional Operative Video and Technical Report. *Cureus*, 12(3), e7466. <https://doi.org/10.7759/cureus.7466>
- Veronesi, F., Borsari, V., Martini, L., Visani, A., Gasbarrini, A., Brodano, G. B., & Fini, M. (2021). The impact of frailty on spine surgery: systematic review on 10 years clinical studies. *Aging and disease*, 12(2), 625.
- Wu, Z., Zhou, B., Chen, L., Wang, X., Abdelrahim, M. E., & Wei, C. (2020). Bone morphogenetic protein-2 against iliac crest bone graft for the posterolateral fusion of the lumbar spine: A meta-analysis. *International Journal of Clinical Practice*, e13911.
- Yang, H., Li, P., Jia, N., Wang, J., & Jin, X. (2020). Comparison of different transforaminal endoscope approaches in treatment of serious lumbar disc herniation. *Chinese journal of reparative and reconstructive surgery*, 34(3), 300-307. <http://www.rrsurg.com/article/10.7507/1002-1892.201811005>
- Yee, T. J., Swong, K., & Park, P. (2020). Complications of anterior cervical spine surgery: a systematic review of the literature. *Journal of Spine Surgery*, 6(1), 302.
- Zaed, I., Bossi, B., Ganau, M., Tinterri, B., Giordano, M., & Chibbaro, S. (2022). Current state of benefits of enhanced recovery after surgery (ERAS) in spinal surgeries: a systematic review of the literature. *Neurochirurgie*, 68(1), 61-6