

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 occupational therapists and occupational therapy 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

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 – Occupational Therapists, Occupational Therapy Assistants

OT Scope of Practice – Foundational Knowledge

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

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 / .3 AOTA CEUs

Course Fee - \$34.95

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

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

1

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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Goals and Objectives

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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
Interactive Discussion of Clinical Applications	0:51-1:00
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
Interactive Discussion of Clinical Applications	1:51-2:00
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
Interactive Discussion of Clinical Applications	2:51-3:00

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Course 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.

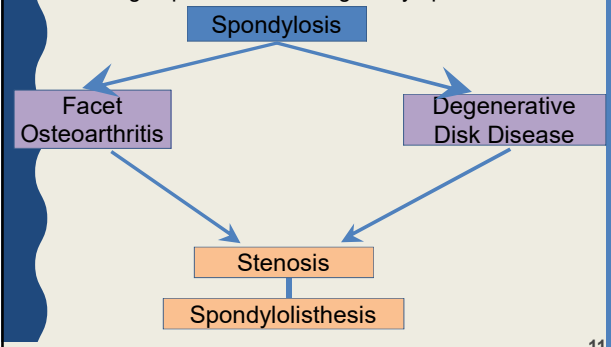
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Spondylosis

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



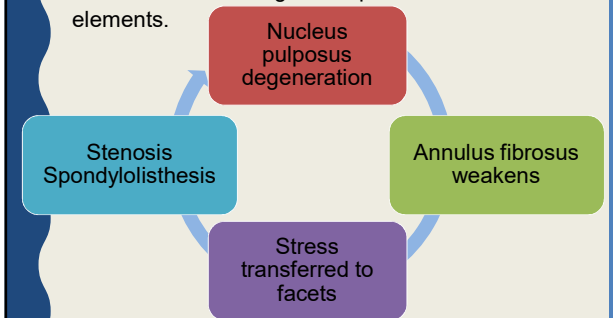
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Degenerative Disc Disease (DDD)

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



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Kushchayev, S., et al., (2018). ABCs of the degenerative spine. Insights into imaging, 9(2), 253–274.

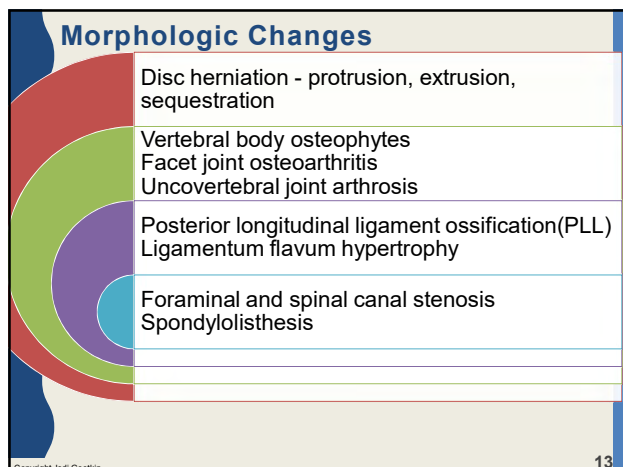
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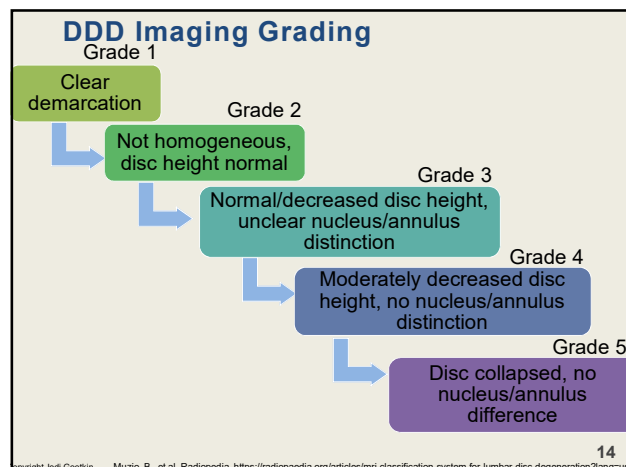
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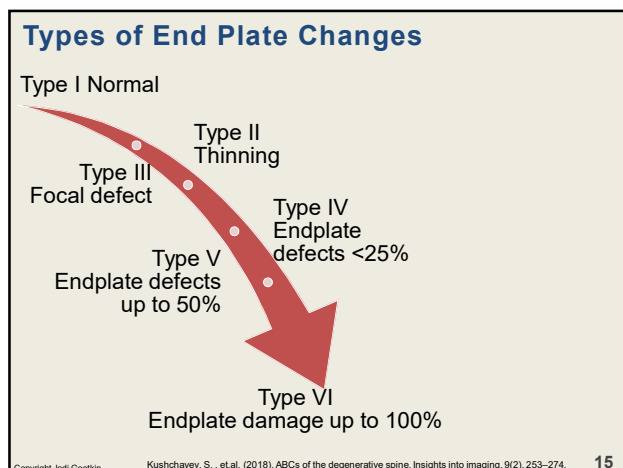
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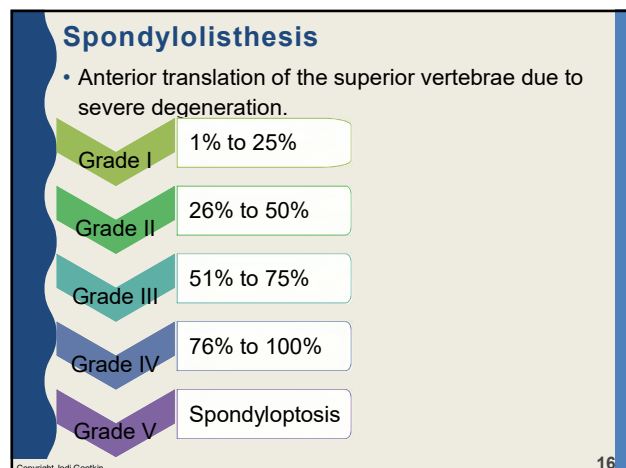
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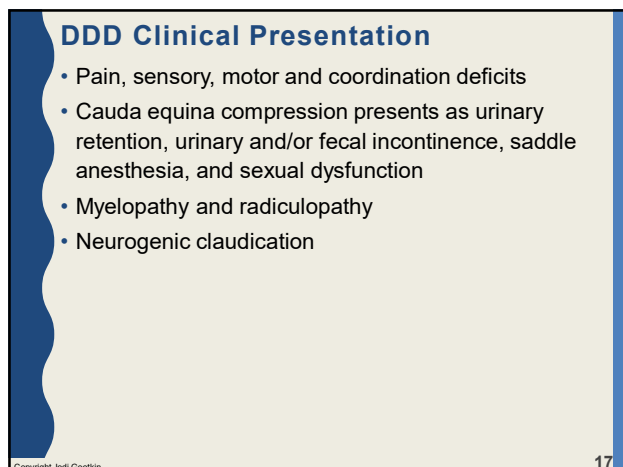
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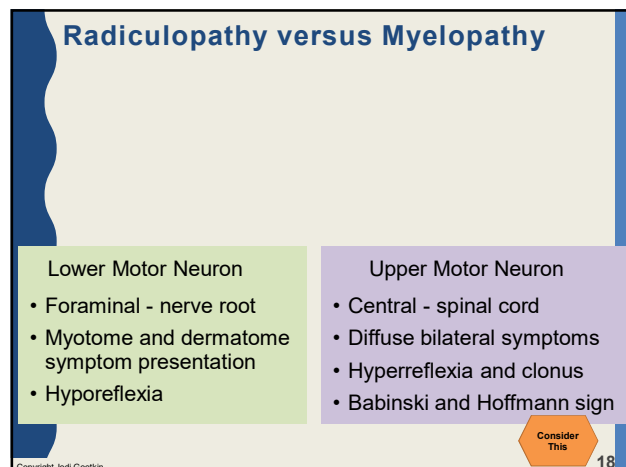
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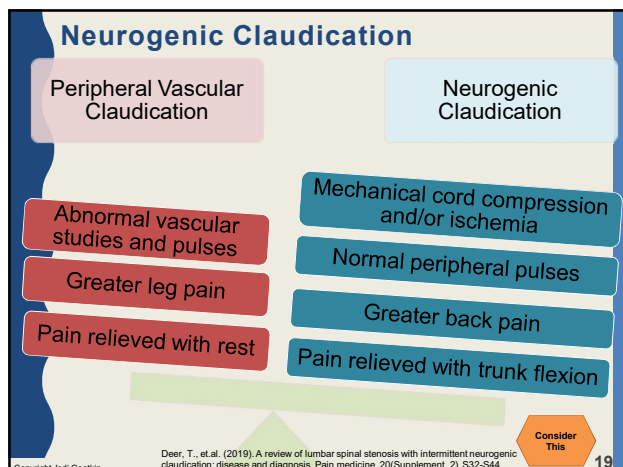


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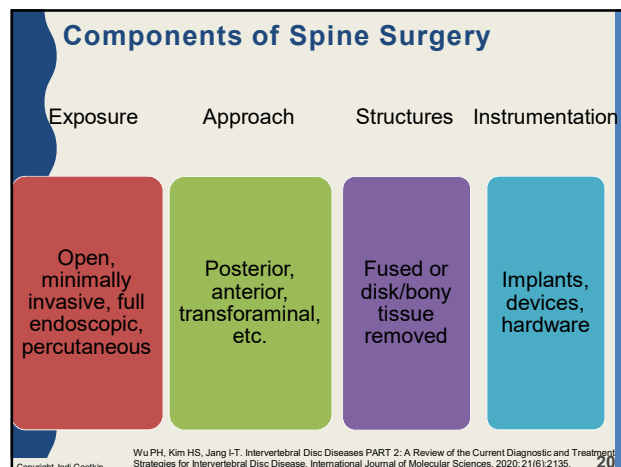
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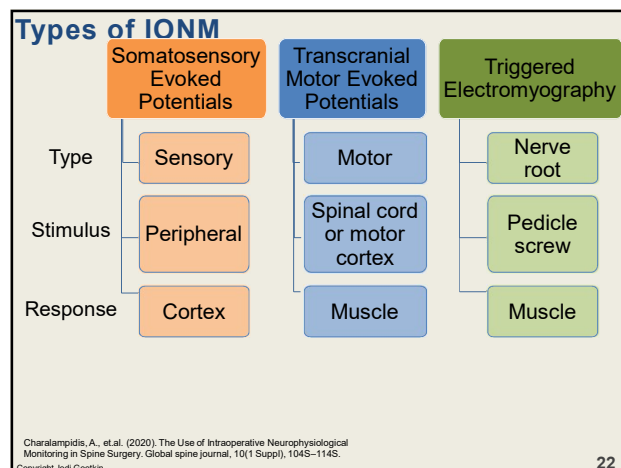
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Intraoperative Neurophysiologic Monitoring (IONM)

- Technology permits assessment of spinal cord function during surgery to avoid motor and sensory complications.
- Real-time feedback provides the surgeon with awareness of neural pathway integrity for corrective action.

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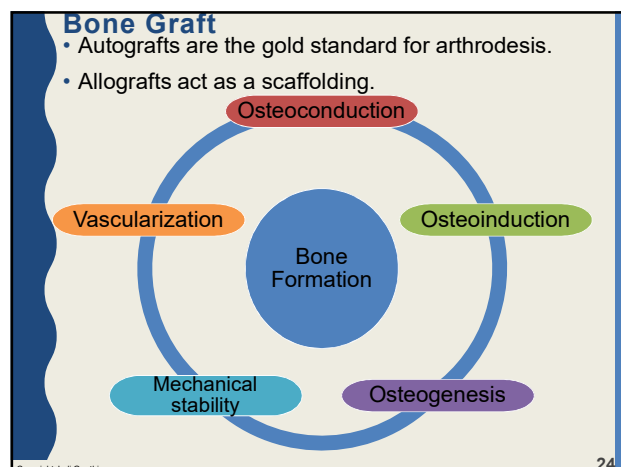


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Spinal Instrumentation

- Stabilization
 - Plates
 - Pedicle screws and rod constructs
- Restore height
 - Interbody Cage
 - Polyetheretherketone (PEEK)
 - Titanium
 - Artificial Disc

23



24

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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.

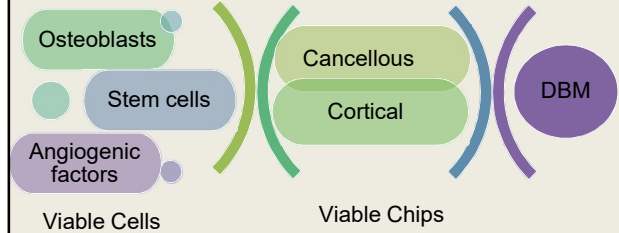
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Copyright Jodi Gootkin Cohen, J. et al. (2021). Allografts and Spinal Fusion. International Journal of Spine Surgery, 15(s1), 68-93. 25

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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

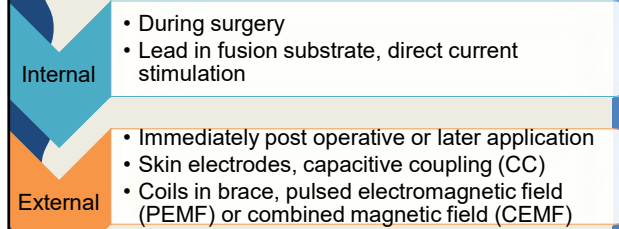
- Autograft
 - Donor site for infection, bleeding, and sensory deficits.
- Allograft
 - Infections

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Bone Growth Stimulator (BGS)

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



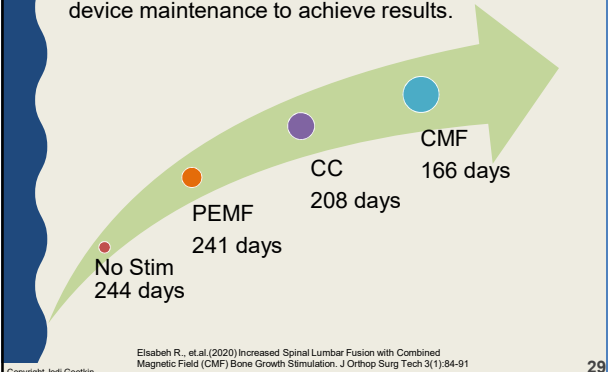
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BGS Considerations

- 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

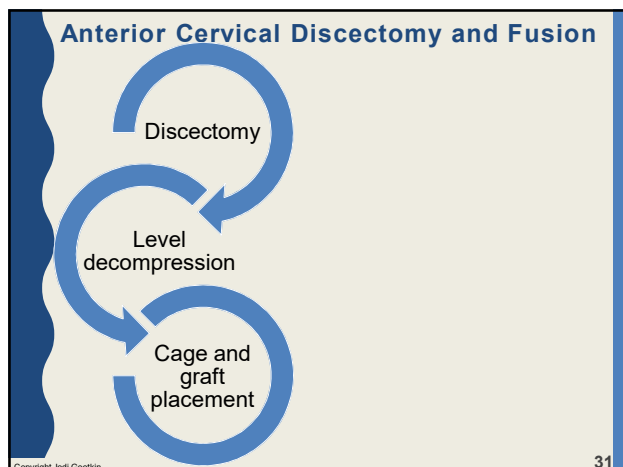
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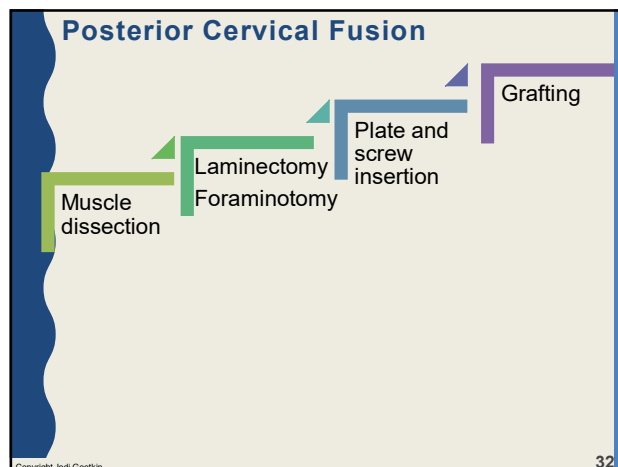
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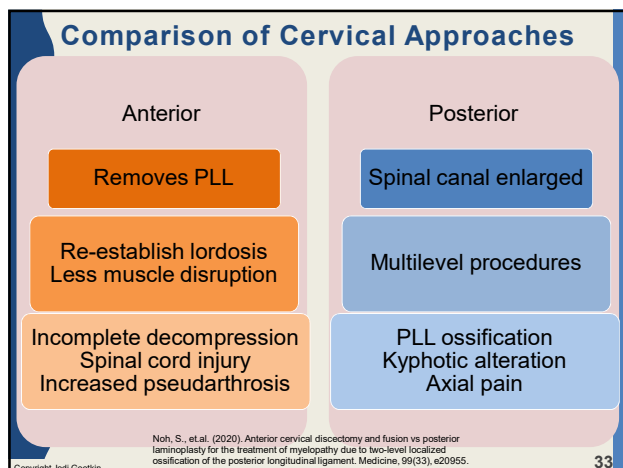
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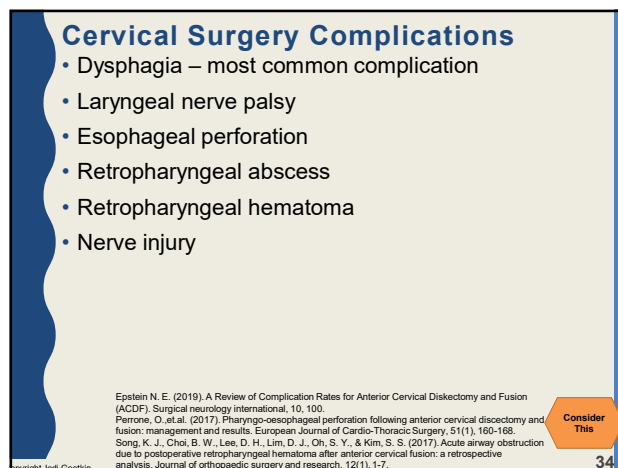
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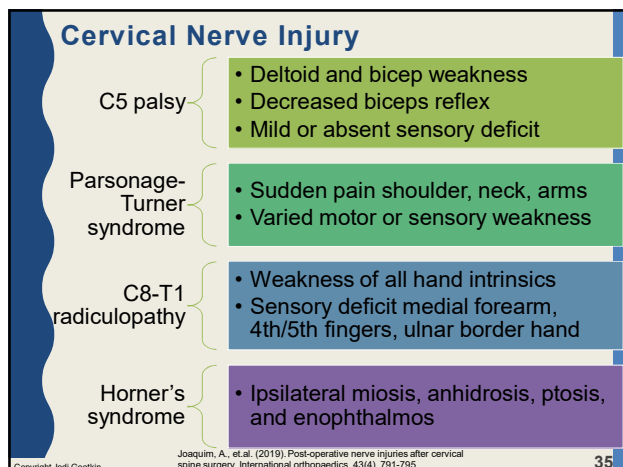
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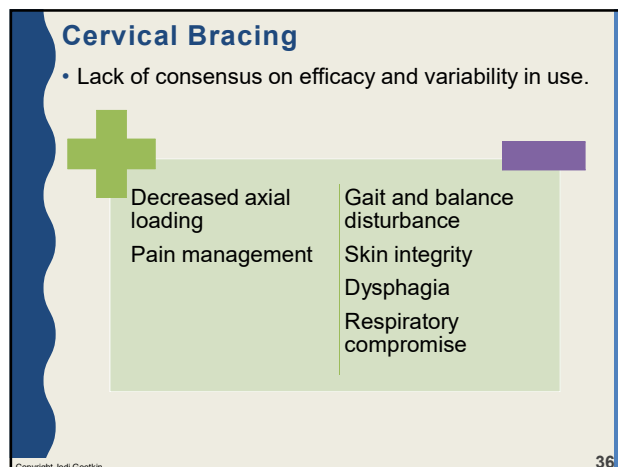
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36

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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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37

Post-Surgical Interventions

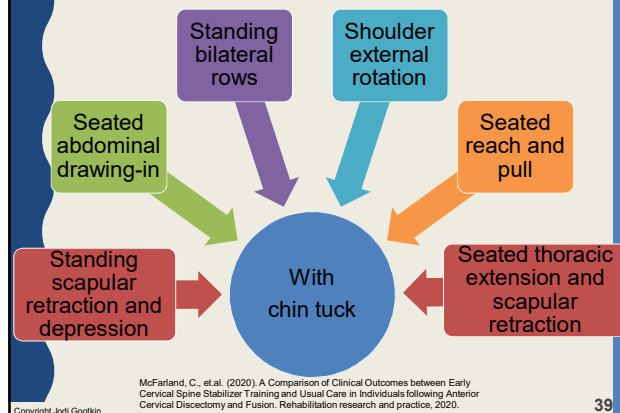
- Nonpharmacologic pain management
- Walking program
- Breathing exercises
- Activity restrictions
- Postural training
 - Avoid cervical extension
 - Deep cervical flexors and cervical multifidi

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

38

38

Cervical Spine Stabilizer Training



39

39

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

Consider This

41

41

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

44

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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45

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.

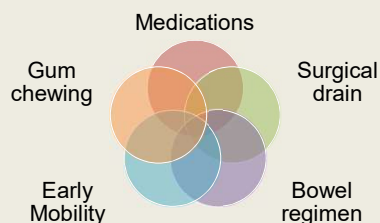
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Thoracic Post-Surgery Considerations

- 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.

47

47

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).

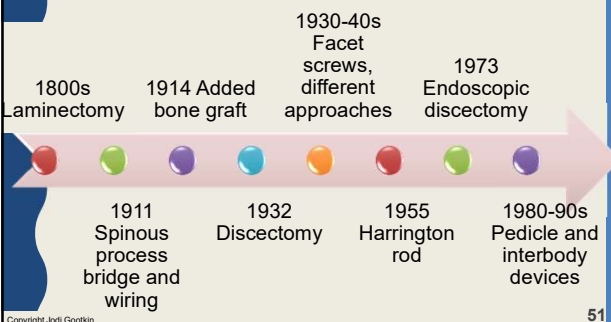
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Lumbar Interbody Fusion (LIF)

- Procedure to restore intervertebral space and stabilize segments.

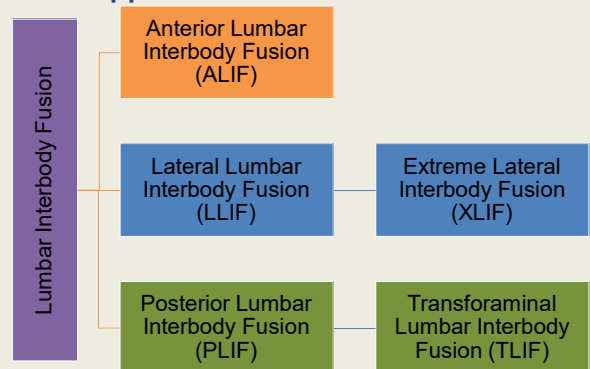


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LIF Approaches



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

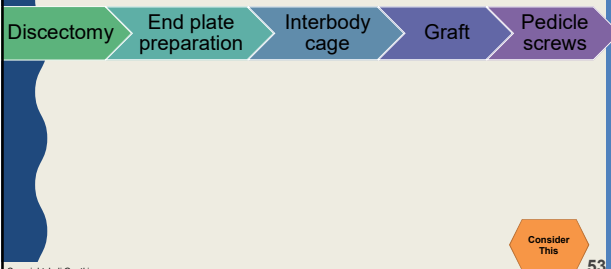
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Anterior Approach - ALIF

- 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

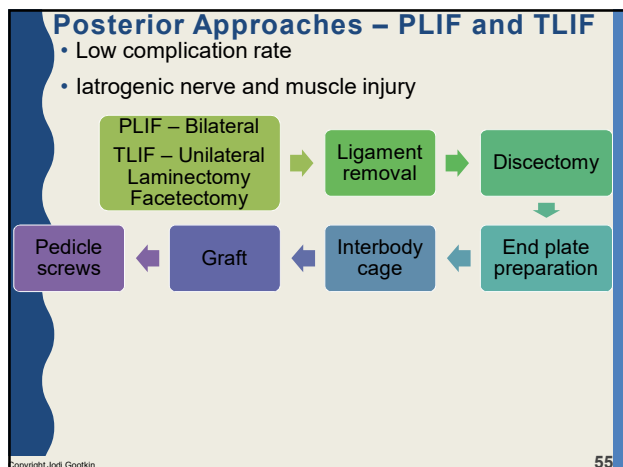
- Minimizes neuromuscular and abdominal structure trauma.
- Psoas and lumbar plexus injury
- Vascular structures to avoid
- Not for patients with prior retroperitoneal surgery.

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

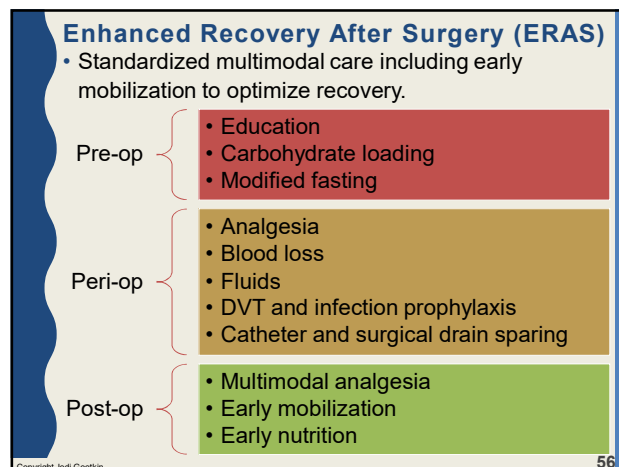
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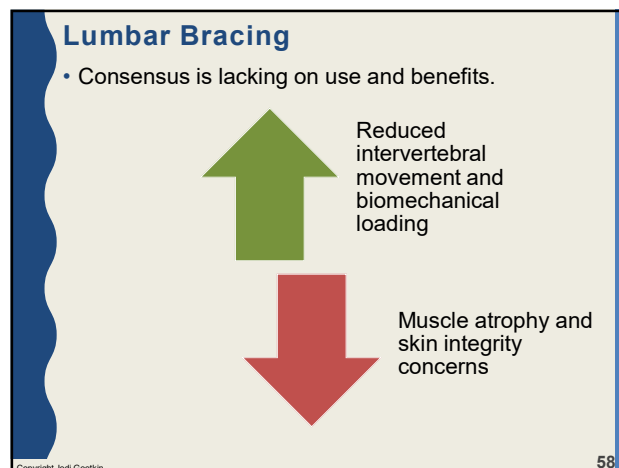
ERAS Spine Outcomes

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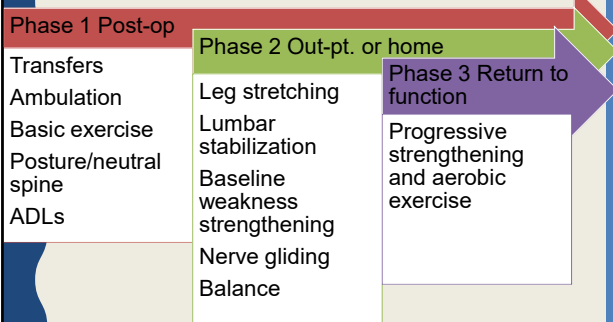
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Rehabilitation Progression

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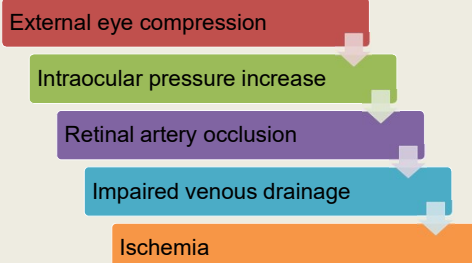
Chung A. et.al. (2018). Obstructive Sleep Apnea in Elective Spine Surgery: National Prevalence and Inpatient Outcomes. Global spine journal, 8(6), 550-556.

68

68

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.

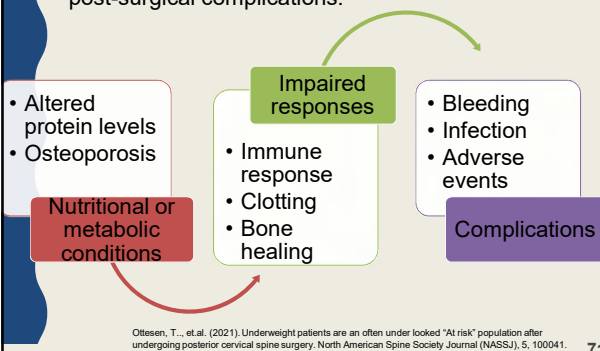
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Low Body Mass Index (BMI)

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



Olsen, 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.

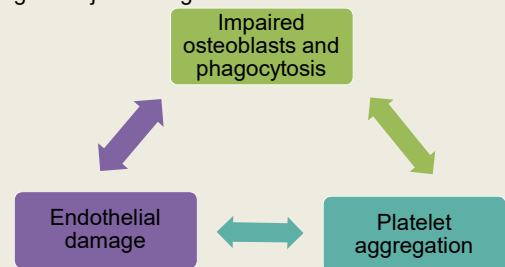
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Tobacco Use

- 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.

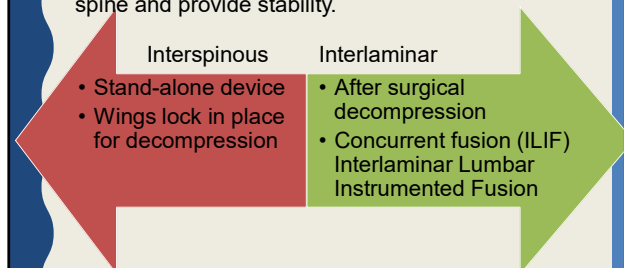
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Interspinous Process Devices (ISP)

- 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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89

89

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