Lumbar pedicle screw insertion and thoracolumbar junction fixation techniques

Cumhur KILINÇER, MD, PhD

Trakya University Faculty of Medicine
Neurosurgery Department
Edirne, Türkiye

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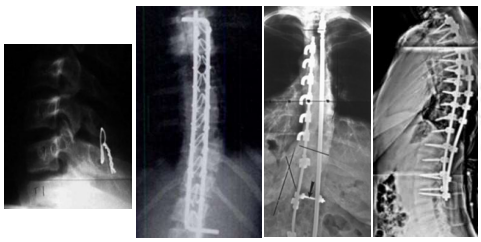
Lumbar pedicle screw insertion and thoracolumbar junction fixation techniques

- Educational objectives
  - Explain evolution of pedicle screw insertion
  - Describe insertion technique in lumbar region
  - Explain problems with thoracolumbar junction fixation and solutions
- Level
  - Advanced
- Duration
  - 35 Slides, 15 minutes
- Disclosure/conflict of interest
  - None

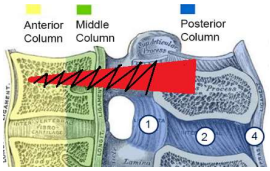
Evolution of spinal implants



Wire *1891* | Wire/rod | Hook | Screw *2023*

Pedicle screws

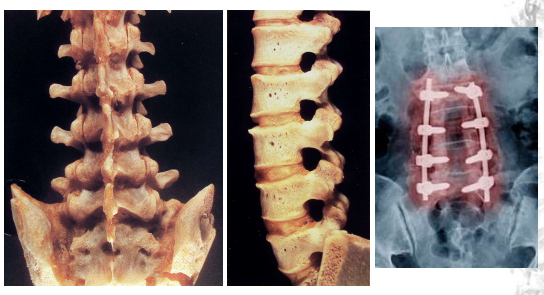
- Strong, three-column fixation
- Revolution of internal stabilization
- Now, the gold standard



- **Pedicle screw insertion**
  Started with lumbar (1944-King, 1959-Boucher, 1970-Roy-Camille)
  Extended to thoracic (1980s: low-thoracic, 1990s: upper thoracic)
  C2 (1964-Leconte, Subaxial cervical (1994-Abumi)

In lumbar: Advantage: Large pedicles
Disadvantage: Depth, musculature

Screw insertion in lumbar spine



Pedicle screw fixation

- Many insertion techniques are currently being used
  - Anatomical landmarks
  - Intraoperative image intensifier
  - Free running EMG /Electrical Stimulation
  - 3D computer-assisted intraoperative navigation
  - 2D computer-assisted techniques
  - Laminoforaminotomy

Pedicle screw fixation - Steps

1. Exposure
2. Selection of entry point
3. Determination of angles (medial and sagittal)
4. Screw insertion
5. Rod bending/placement/maneuvers

Pedicle screw fixation - Steps

1. **Exposure**

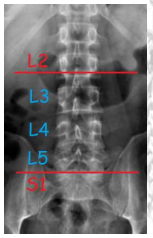
Skin incision: One pedicle above, one pedicle below

Superiostal dissection up to the base of the transverse processes

For fusion: Uppermost facet capsule should be preserved, others opened

For fusionless (dynamic) stabilization: all facet capsules should be preserved

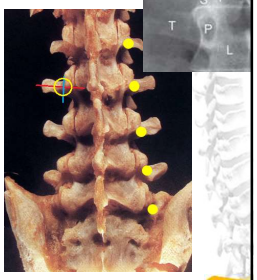
Cautery should be in «cut» mode



Pedicle screw fixation - Steps

2. Selection of entry point

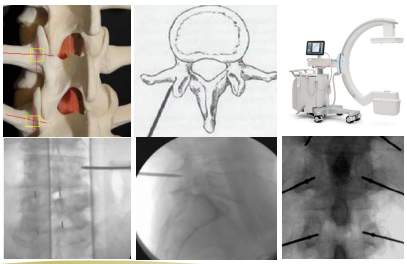
- Pedicle Entry
  - ***Midline Tr.Pro. and lateral edge of SAP***
  - Accessory process ??
- Beware of "overgrown facets"
- Entry site may move superior higher in spine (not always, check xray)



Pedicle screw fixation - Steps

2. Selection of entry point

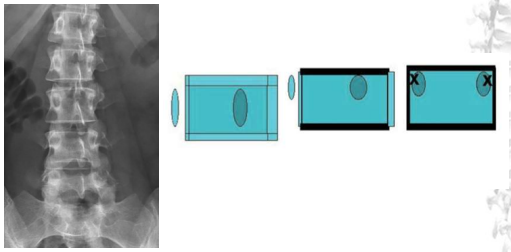
Marker placement and C-arm check increases safety



Pedicle screw fixation - Steps

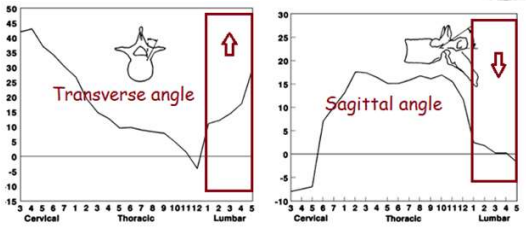
2. Selection of entry point

- Eliminate rotation by turning the C-arm tube



Pedicle screw fixation - Steps

3. Determination of angles (medial and sagittal)



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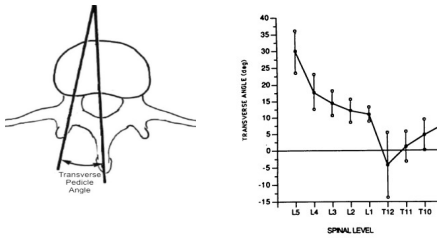
Pedicle screw fixation - Steps

- Medial angulation: ***Gradually increases from L1 (10 degrees) to L5 (30 degrees)***



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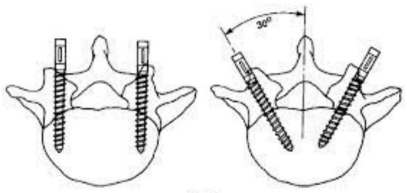
Pedicle screw fixation - Steps

- Convergents screws are better



- Longer screws are possible
- Pullout resistance is higher ***(triangulation effect)***

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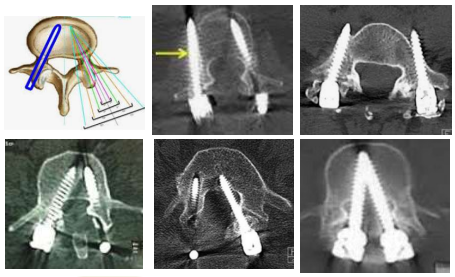
Pedicle screw fixation - Steps

- Problems with ***entry point*** and/or ***medial angulation***



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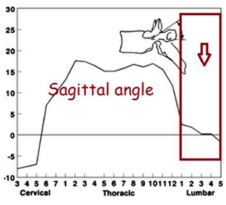
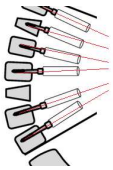
Pedicle screw fixation - Steps

- Sagittal angulation



- No fixed sagittal angle, varies individually based on posture
- Sagittal angle changes with patient positioning
- Real-time (xray) control is needed



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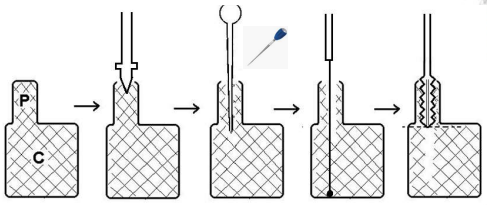
Pedicle screw fixation - Steps

4. Screw insertion

- Awling (cortical penetration)
- Pedicle probing (pedicle guide)
- Pedicle sounder
- Tapping
- Insertion



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Pedicle screw fixation - Steps

4. Screw insertion

Is tapping necessary?
- Frequently. A real self-tapping screw is rare

Self-tapping screw should have:
- A non-blunt tip
- Flute
- Sharp treads

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Pedicle screw fixation - Steps

4. Screw insertion

- Screw sizes: Length and thickness
  - Based on actual pedicle sizes and measurements

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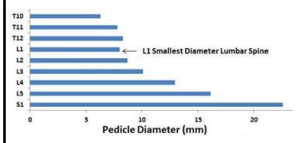
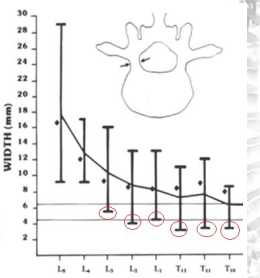
Lumbar pedicle sizes





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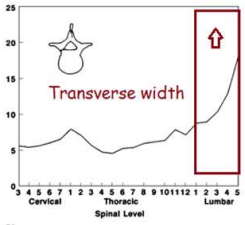
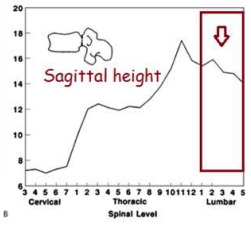
Lumbar pedicle sizes





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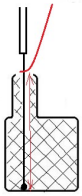
Pedicle screw fixation - Steps

4. Screw insertion



- Length: as measured (generally 45 to 50 mm)
- Thickness: 6 to 7 mm
  - Should never be thinner than 5,5 mm
  - Should be thick, not the thickest (consider revisions)

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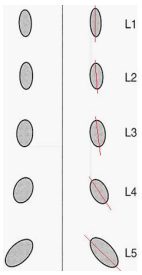
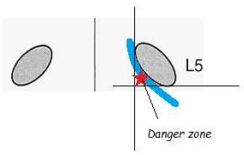
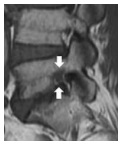
Lumbar pedicle orientation

Coronal view







L5 root is very vulnerable to medial and inferior screws

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Pedicle screw fixation - Steps

1. Exposure
2. Selection of entry point
3. Determination of angles (medial and sagittal)
4. Screw insertion
5. ***Rod bending/placement/maneuvers***

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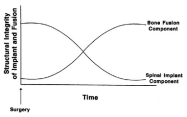
Pedicle screw fixation - Steps

5. Rod bending/placement/maneuvers

- Rod bending and connection
- Maneuvers (compression, distraction), if needed
- Bone grafting (if fusion intended)



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Thoracolumbar junction problem

- TL junction bears high stress
- The most frequent location of the spine trauma
- Prone to kyphotic deformity and construct failure
- Instrumentation should be strong enough

- Solutions:
  - Longer instrumentation
  - Anterior column support (cage, vertebroplasty)

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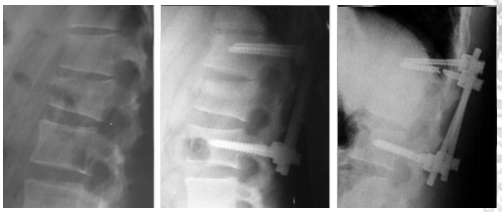
Short segment fixation



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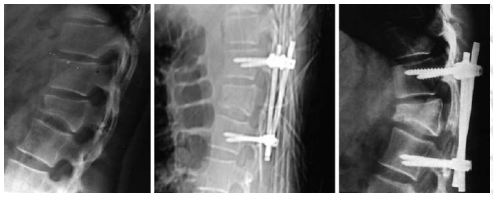
Short segment fixation



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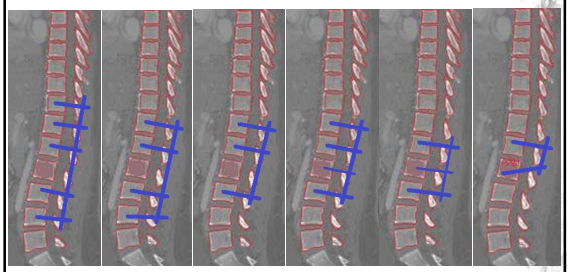
Options



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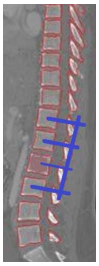
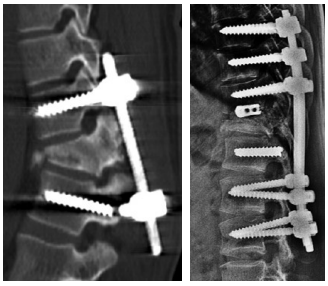
Factors affecting decision



- Anterior column support
- Posterior ligamenteous competency
- Canal encroachment, neurological status
- Kyphosis angle, posture and pelvic parameters
- Age, body habitus, weight, osteoporosis

Anterior support

Convertion to long segment fixation



Summary

- Pedicle screws offer the strongest spinal fixation and started with the lumbar region
- Lumbar anatomy is favorable for pedicle screw fixation, but each case should be evaluated individually
- Lumbar pedicle fixation with C-arm is safe and effective
- In thoracolumbar junction trauma, instrumentation should be strong enough to bear high stress of that region

ISTANBUL SPINE CADAVER COURSE

Thoracic, Lumbar, Sacral Spine Surgery

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... thank you

Questions / Comments ?

E-mail: ckilincer@hotmail.com