

# Oblique Lateral Lumbar Interbody Fusion (OLLIF)

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# Why Interbody Fusion?

- Goal(s) of surgery
  - Sagittal Balance
  - Indirect Decompression (foraminal or central)
  - Improved Fusion Rates
  - Stabilization of Instability
  - Reduction of Spondylolisthesis (combination of all the above)

# Lumbar Spondylolisthesis Surgery

## IDEAL SURGICAL CANDIDATE



# Interbody Options

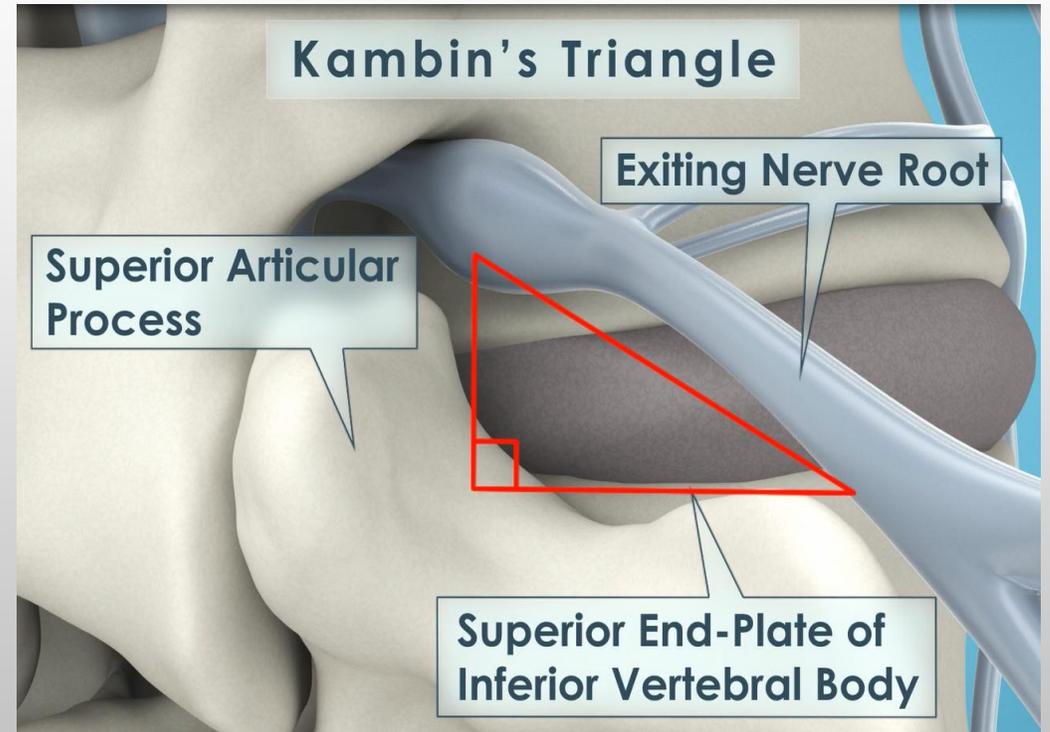
- TLIF/PLIF
  - Advantages
    - Able to perform in prone position (lordosis, screws, time)
    - Concomitant decompression (cyst, extruded disc)
    - Pack entire disc with graft for fusion
  - Disadvantages
    - Smaller cages (height and width) than ALIF/Lateral
    - Radiculitis
- Lateral fusion – DLIF/XLIF
  - Advantages
    - Larger cages (also aid in indirect decompression)
    - Multiple levels in faster time
    - Larger coronal corrections
  - Disadvantages
    - Thigh pain/radiculitis
    - Lateral Position/Additional incisions
    - Graft limited to cage (can't place in entire disc space)
- ALIF
  - Advantages
    - Largest cage size (height and width)
    - Maximal lordosis restoration (although lateral fusion with ALL release almost similar now)
  - Disadvantages
    - Abdominal approach (great vessel injury, retrograde ejaculation, approach surgeon)

# What if there is an additional way?

- A tale of 2 OLLIFs (Oblique Lateral)
  - Medtronic- OLIF – anterior oblique lateral
  - Amendia- OLLIF- posterior oblique lateral
- Amendia OLLIF Advantages
  - Prone Positioning (use Jackson frame to help restore lordosis)
  - Larger cage height than TLIF (but not quite XLIF or ALIF)
  - Pack graft into entire disc space
  - Multiple levels, single incision with time equivalent or faster than XLIF
  - Possible L5-S1 option (approx. 75-80% of the time)

# Kambin's Triangle & OLLIF

- Within neuroforamen
- Takes advantage of this anatomical safe area
- Preserves facets
- Does not violate interlaminar space
- Minimizes endplate scarring
- Disc decompression parallel to disc space

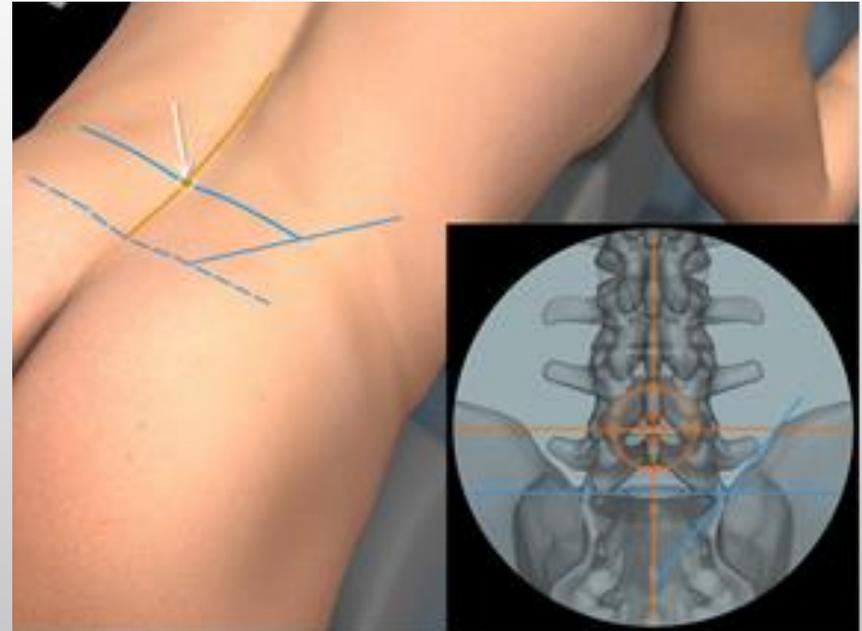


# Targeting (Achieve Skin Window)

- Patient positioned on a radiolucent operating table in a modified prone position on a kyphotic padded frame
- Fluoroscopic monitoring must demonstrate that the patient is in neutral position and not rotated (equal spacing of the pedicles from the spinous process on a true A/P fluoroscopic image)
- Table inclination should be adjusted so the sacral height and the apex of the thoracic kyphosis are level.

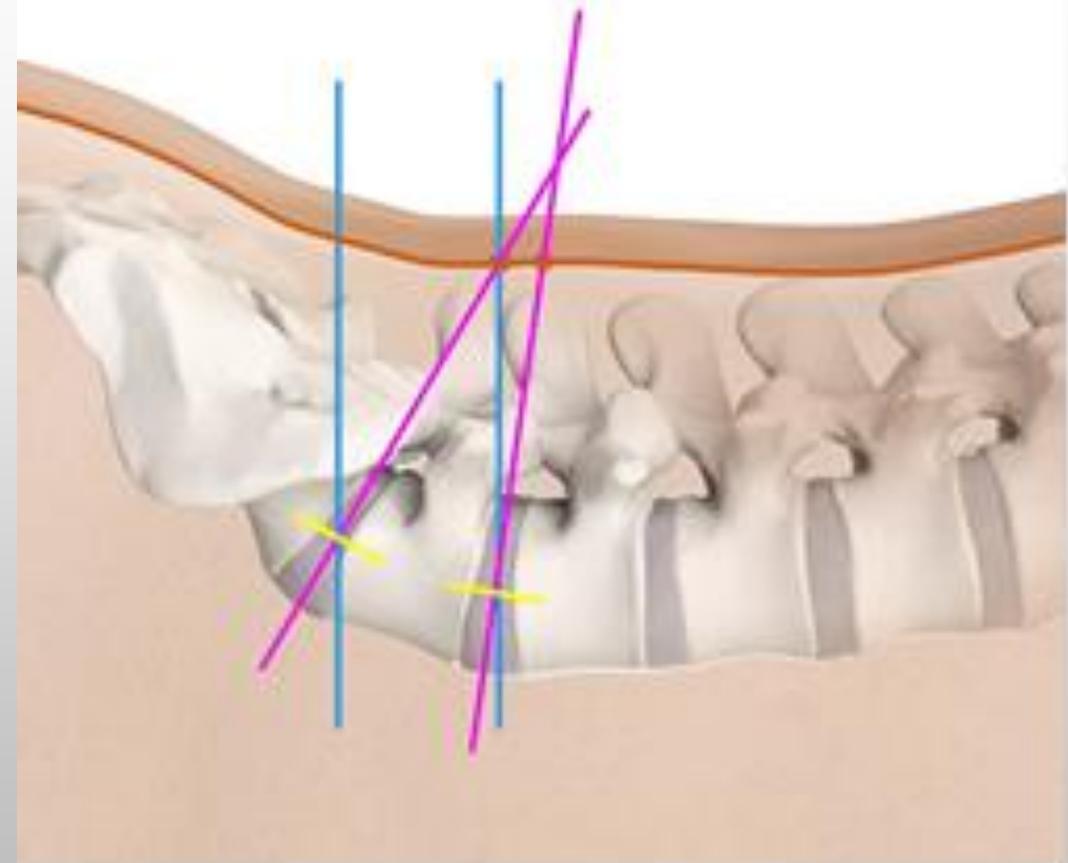
# Targeting

- On an A/P view, without adjusting for lordosis, with the proposed target disc centered in the fluoroscopic image, identify the center of the disc in the horizontal and vertical planes
- Using a radiopaque rod and a skin marker, mark the midline (Gold) and the transverse plane (Blue) lines on the patient's back
- Also, if the approach includes the L5-S1 disc, the superior inclination angle of the iliac crest should be identified in the A/P plane.



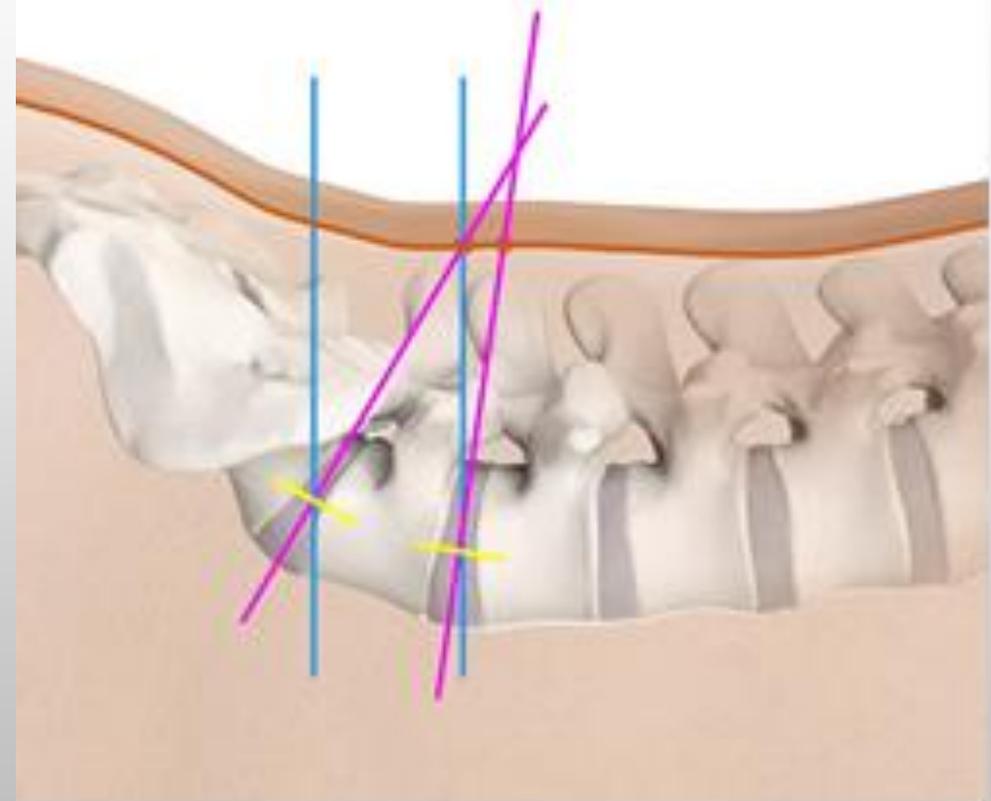
# Targeting

- On a true lateral view, with the proposed target disc centered in the fluoroscopic image, identify the average disc inclination angle.
- It is important to adjust the fluoroscopic wag so that the endplates are square and the beam parallels the disc space.
- By paralleling the disc inclination angle, the disc removal and endplate preparation are performed without compromising the endplates.



# Targeting

- Lastly, the distance off the midline where the incision site is located must be determined.
- The disc nucleus tends to be located posterior to the true center of the disc. A starting point can be determined based on one more measurements from the lateral fluoroscopic view.
- Utilizing the lateral view, using a radiopaque rod and a skin marker, mark a line at the center to anterior third location of the disc (Yellow) on the side of the patient. This line should intersect the disc inclination line marked as seen in Figure 4.



- Measure the distance along the disc inclination line (Magenta) from the dorsal skin to the center of the disc (Yellow) (Figure 5)
- Measure this same distance laterally from the midline (Gold) along the transverse plane line (Blue) and mark a line (Green) at that distance parallel to the midline (Gold) (Figure 6)
- The intersection of the Green and Magenta lines is the calculated incision point (Figure 7)
- Once this point is calculated, preparing and draping is carried out in standard fashion. (Figure 8) shows the surgical approach as the Red line.

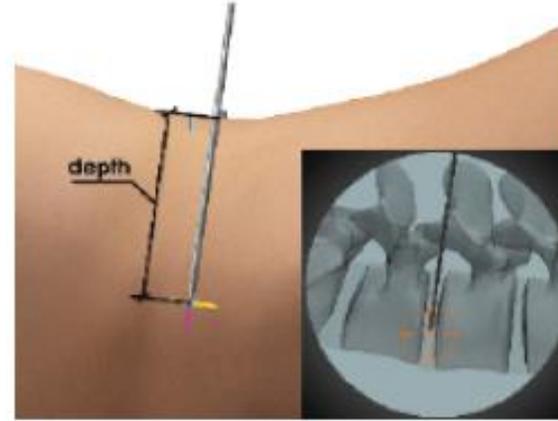


Figure 5

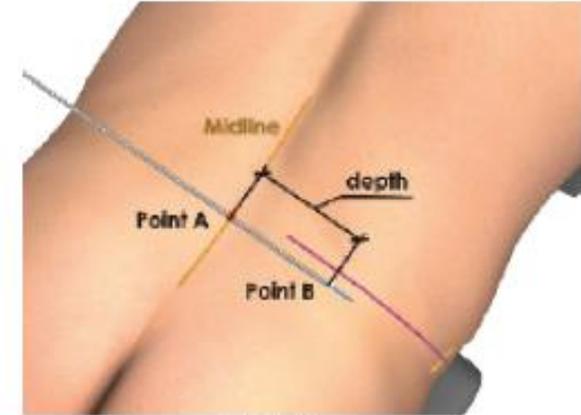


Figure 6

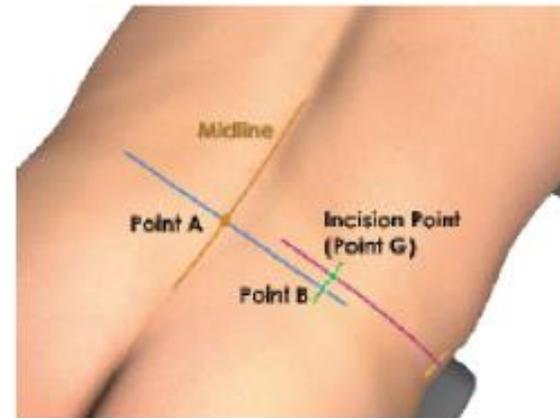


Figure 7

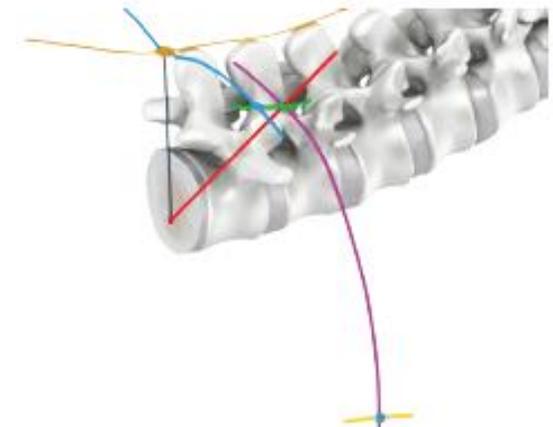


Figure 8

# Surgical Access to the Disc through Kambin's Triangle

- Prior to any incision, injecting the skin and subcutaneous tissue with a lidocaine epinephrine solution at the operating site is helpful.
- Also, use of a 3 inch spinal needle will verify that the calculated incision point is accurate for the target disc.
- A 9 mm skin incision is made at the verified incision point.
- A Neuro Monitoring Probe with Transfer Sleeve is inserted, with fluoroscopic guidance (Figure 9-A), through the incision to the target disc annulus through Kambin's Triangle.
- Ideal placement of the Neuro Monitoring Probe is accomplished when the tip of the Neuro Monitoring Probe is in contact with the annulus and there is no depolarization of the nerve root at a minimum stimulation level of 3 mA.
- The ideal target is visualized on fluoroscopic imaging when the tip of the probe is between the medial and lateral border of the pedicle on the A/P view and in the inferior part of the foramen in the lateral view (Figure 9-B).

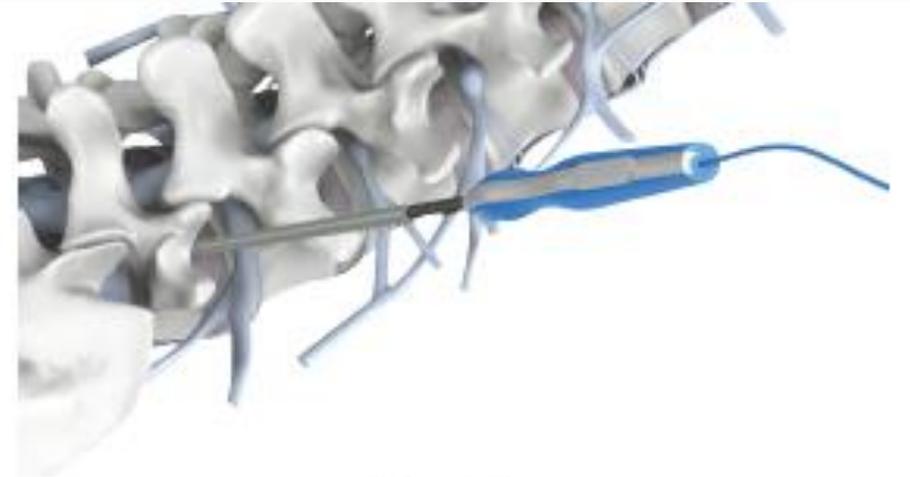


Figure 9-A

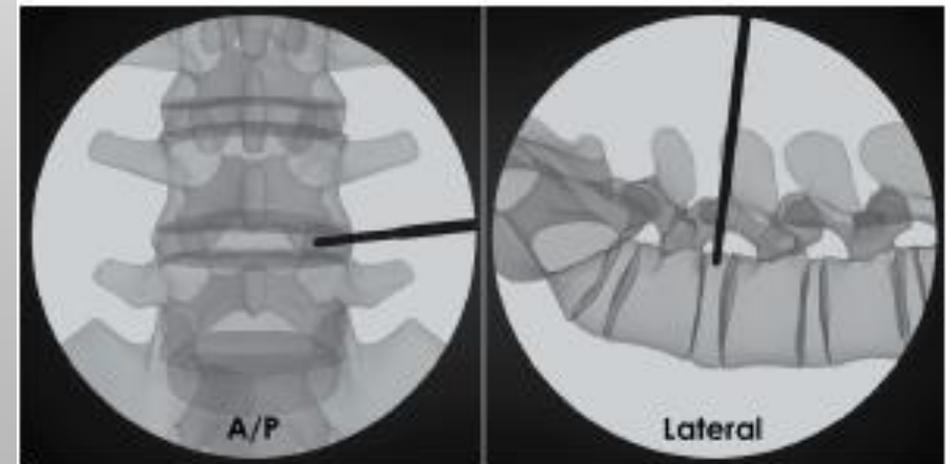
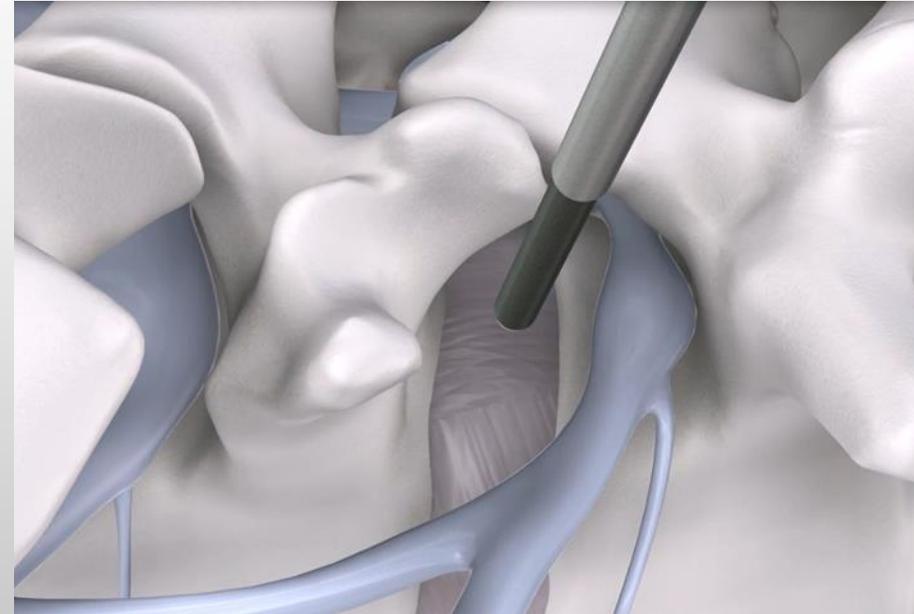
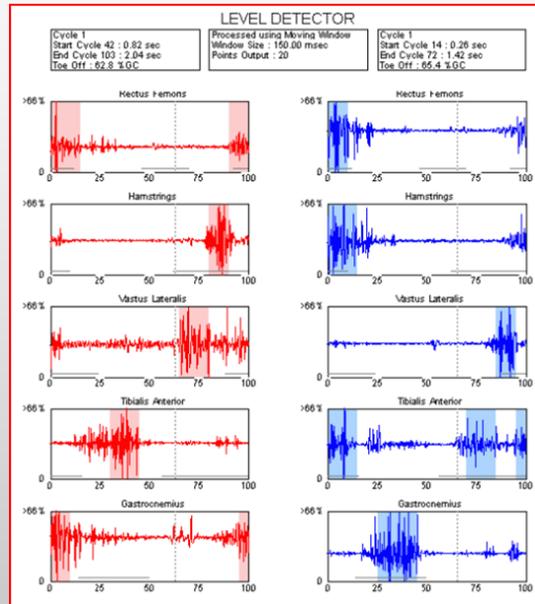


Figure 9-B

# OLIF Monitored Placement

## Neuromonitoring

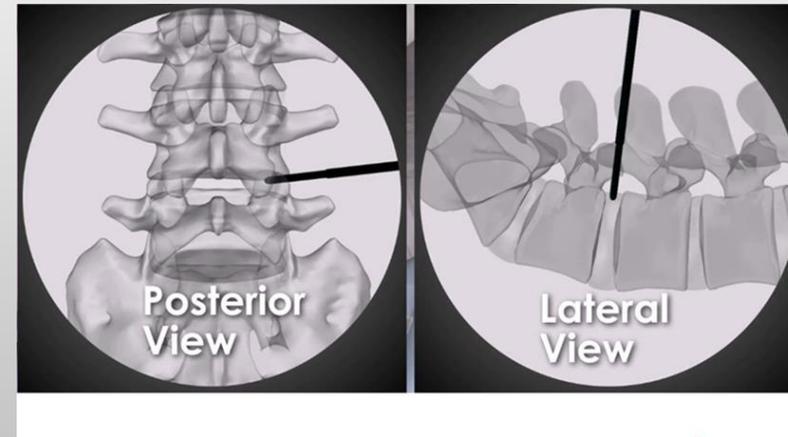


- Triggered EMG to ensure adequate working window
- 3mA minimum corresponds to 2mm separation

## Fluoroscopy

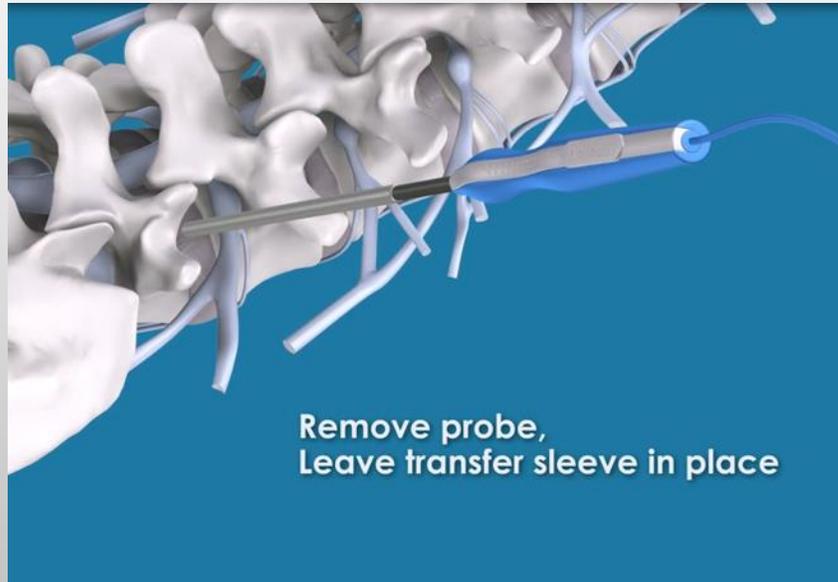


## Targeting

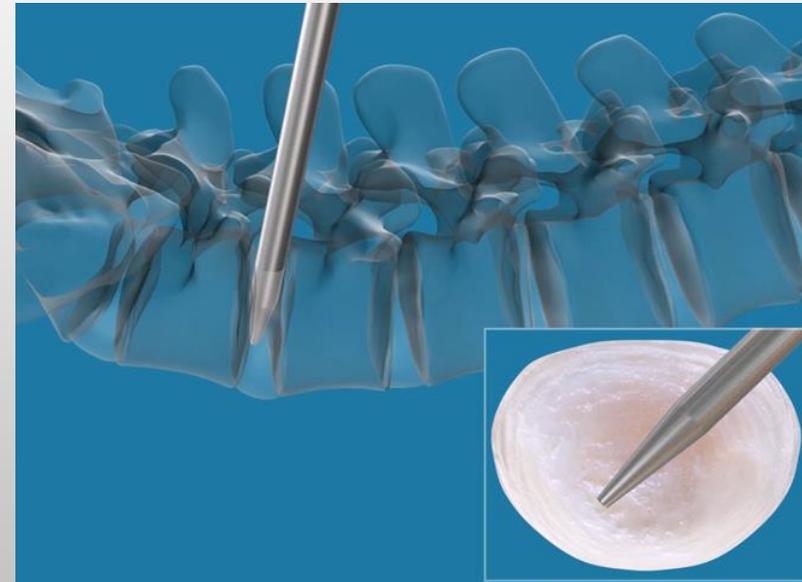


# Procedure Steps

Hold starting point



Dilate over guide wire



# Surgical Access to the Disc through Kambin's Triangle

- The Transfer Sleeve is advanced into the annulus and held in place as the Neuro Monitoring Probe is removed.
- A blunt tipped Guide Wire is placed through the Transfer Sleeve and inserted into the disc with the tip positioned at the center of the disc (Figure 10,11-A,11-B)
- The Transfer Sleeve is removed leaving the Guide Wire in place (Figure 12).

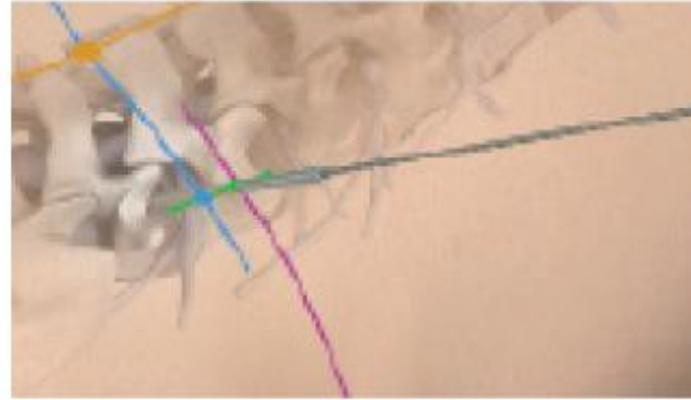


Figure 10



Figure 12

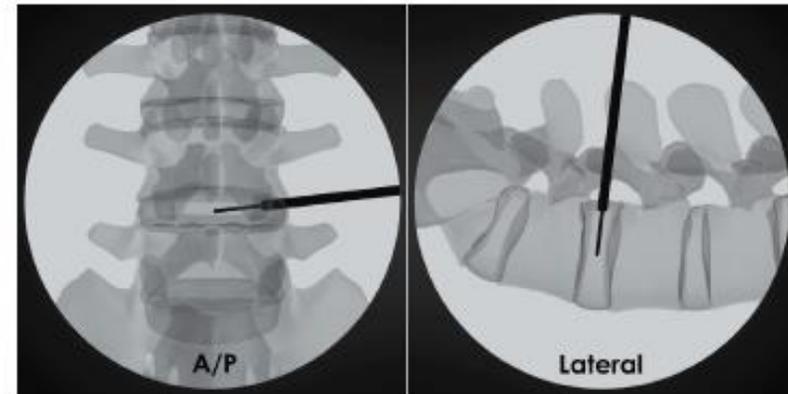


Figure 11-A

Figure 11-B

# Surgical Access to the Disc through Kambin's Triangle

- An 8 mm Dilator is inserted over the Guide Wire to divide the tissue through Kambin's Triangle down to the disc.
- The Dilator is advanced into the disc by controlled tapping with a Mallet.
- The Dilator should be positioned so that the tapered end is fully inside the apophyseal ring and the distal tip is positioned at the center of the disc.
- To redirect for optimal placement, retract the Dilator to the annulus and slightly lower or raise the hands before reintroducing the Dilator.
- A Dilator tip placed in the center of the disc on both A/P and lateral fluoroscopy is centered in the disc (Figure 13, 14-A, 14-B).



Figure 13

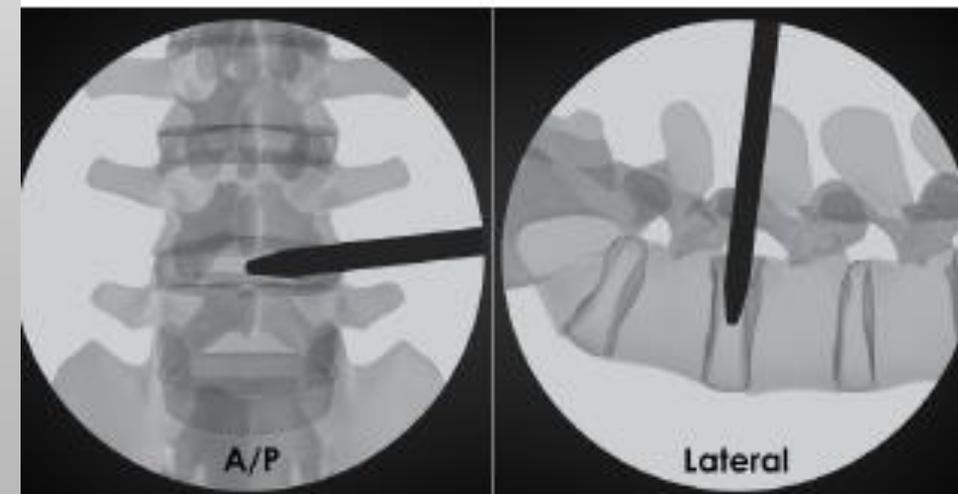


Figure 14-A

Figure 14-B

# Surgical Access to the Disc through Kambin's Triangle

- Advance the Access Portal over the Dilator and seat it on the annulus (Figure 15-A)
- The impactor and mallet (Figure 15-A) are used to advance the tapered tip of the Access Portal into the disc, further dilating the disc space.
- The Access Portal should be positioned with the tip in line with the medial border of the pedicles in the A/P fluoroscopic view (Figure 15-B,15-C).
- Remove the Dilator.



Figure 15-A

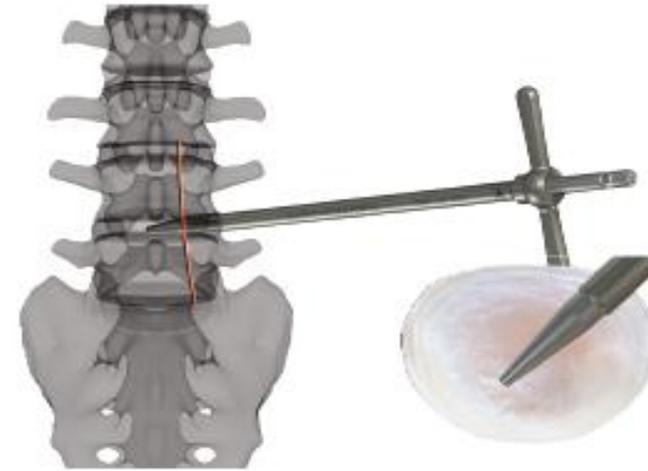


Figure 15-B

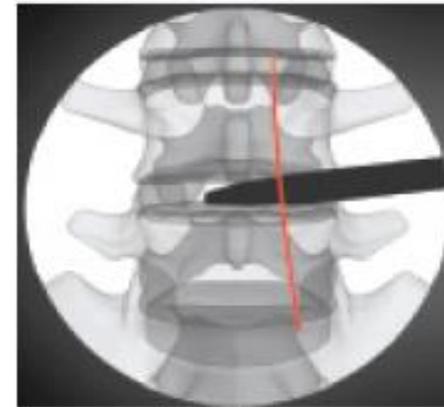


Figure 15-C

- Anchored between the endplates, the Access Portal (Figure 16) provides safe access to the disc for discectomy.
- A unique assortment of discectomy instruments are used to perform the discectomy through the Access Portal.
- The discectomy begins with an 8 mm Disc Drill (Figure 17) used to core out a path for the subsequent instruments.
- The Disc Drill should be rotated in the clockwise direction and wagged with gentle pressure under fluoroscopic guidance until the tip reaches the anterior annulus.
- It is important to avoid excess pressure as this could violate the anterior annulus.
- NOTE: The depth should be noted as this is useful for determining the appropriate size of implant.
- The Disc Drill has depth indicator markings on the proximal end of the shaft.



Figure 16



Figure 17

- These markings indicate the protrusion of the tip 28 mm, 32 mm, and fully seated against the handle at 34 mm past the tip of the Access Portal (Figure 18-A, 18-B, 18-C, 18-D).
- Remove the Disc Drill by holding the Access Portal in place while continuing the clockwise rotation of Disc Drill.
- The continuous clockwise rotation of the Disc Drill removes significant disc material in the flutes.
- Repeat use of the Disc Drill as deemed necessary to provide an open path for further discectomy and endplate preparation.

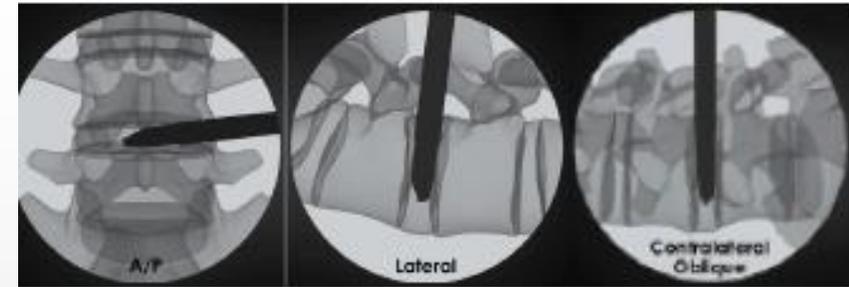


Figure 18-A

Figure 18-B

Figure 18-C



Figure 18-D

# Disc and Endplate Preparation

- The channel created in the disc by the Disc Drill will allow passage for the Disc Shaper
- The Disc Shaper is an expandable rotary shaver that is deployed in 1 mm increments by way of a ratcheting device.
- The size of the blades of the instrument range from 6 mm fully collapsed to a maximum size of 16 mm. Rotating the Disc Shaper clockwise and moving from a distal to proximal position will remove the cartilaginous endplate and loosen disc material.
- The point of expansion which allows good contact with adjacent endplates is a guide to the height of the appropriate Implant.
- Disc Shaper also has depth indicator markings on the proximal end of the shaft, below the body. These markings indicate the protrusion of the instrument tip 28 mm, 32 mm, and fully seated against the body at 34 mm past the tip of the Access.



Figure 19-A

Figure 19-B

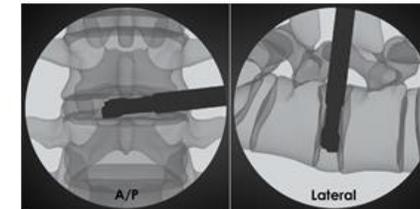
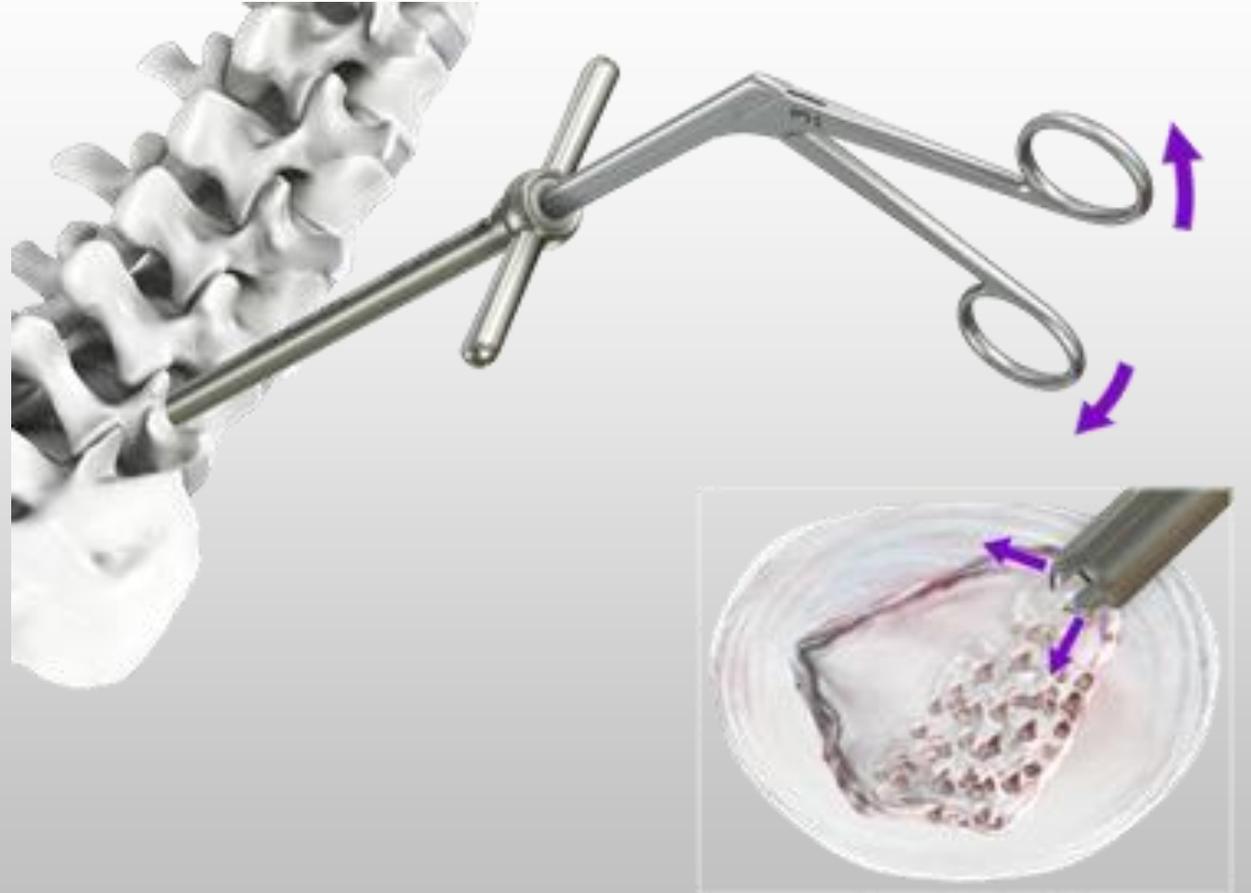


Figure 20-A

Figure 20-B

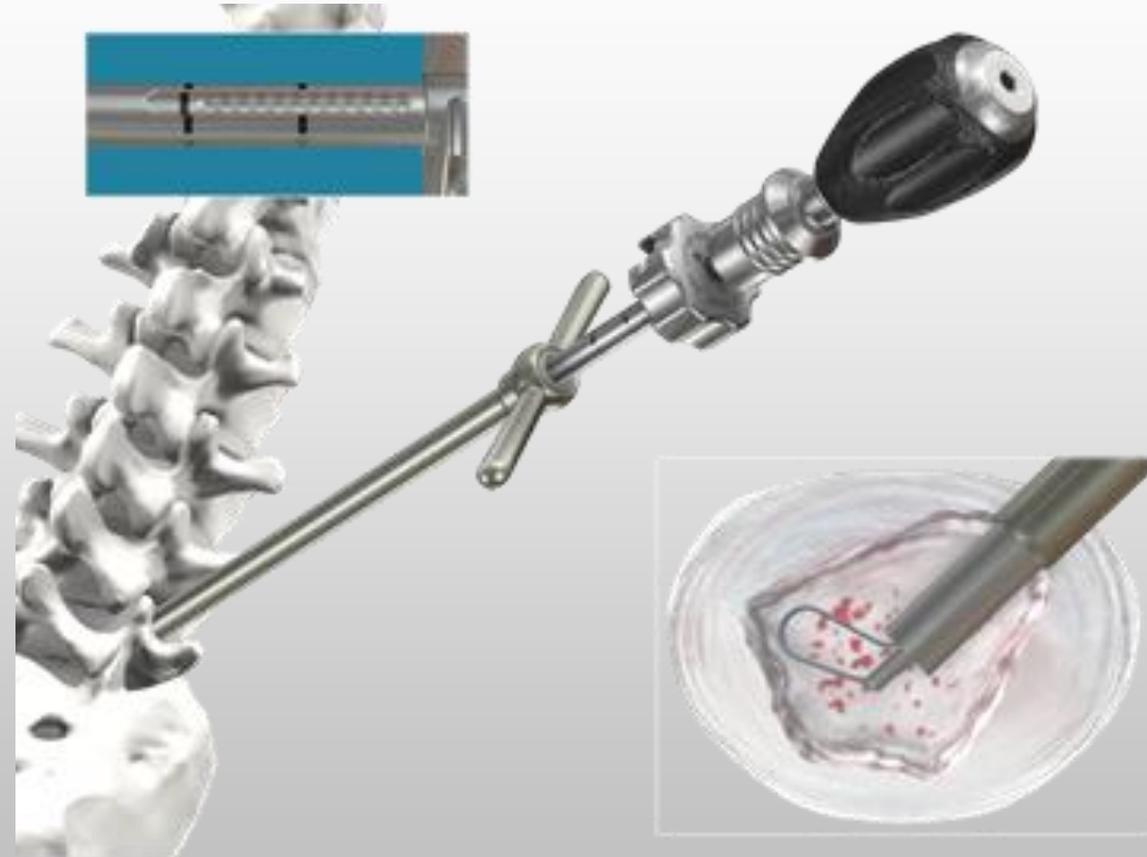
# Disc and Endplate Preparation

- Remove loosened disc material through the Access Portal using the Pituitary Rongeur taking care not to violate the anterior annulus.



# Shaping the Fusion Footprint

- To further expand the discectomy anteriorly and posteriorly, the Disc Cutter may be used. The Disc Cutter may also be used as a loop curette for roughing the endplates.
- The Disc Cutter allows us to remove disc asymmetrically away from our evacuated cavity. As this instrument can be expanded to a wider width than the Access Portal, it is always necessary to retract the blade and stabilize the Access Portal prior to removal of the instrument..
- Insert the fully collapsed Disc Cutter through the Access Portal and into the disc space with fluoroscopic guidance. Use the instrument as a traditional loop curette, moving distally and proximally and slightly rotating to make contact with each endplate. Use the Pituitary Rongeur to remove any additional loosened disc material.



# Irrigation and Final Disc Prep

- To finish the discectomy, use the Access Portal as an irrigation channel and insert the Suction Tube to remove small disc fragments from the disc space.



# Bone Graft Delivery

- With the discectomy complete and the endplates prepared as a bleeding host bone bed, a graft material is inserted into the disc space.
- Place approximately 2 cc of graft material into each of the Graft Filler Tubes (Figure 26).
- The distal tip of the Graft Filler Tube is beveled, allowing for directional graft placement.
- The direction of graft flow is opposite the black bar mark on the proximal end of the tube.
- Place the Graft Filler Tube into the Access Portal, and use the Graft Tamp to gently tamp the graft into the disc space
- Repeat until the prepared disc space is filled with graft material.



Figure 27



Figure 26

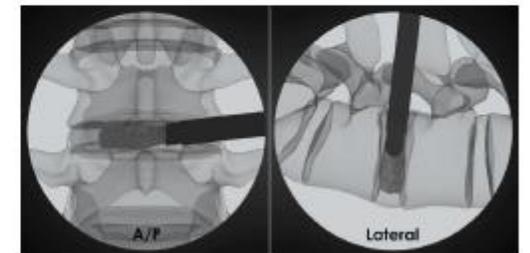


Figure 28-A

Figure 28-B

# Interbody Preparation

- Attach the selected size Zeus-O Implant to the Implant Inserter, ensuring that the Implant is threaded and seated firmly onto the Inserter.
- Place the Implant attached to the Inserter into the Packing Block slot corresponding to the Implant height.
- Pack graft material into the vertical opening in the Implant. The Guide Wire will maintain a path for delivering the Implant over a Guide Wire.



# Interbody Delivery

- Insert the blunt 24 inch Guide Wire through the Access Portal (Figure 31) and into the center of the disc, now filled with bone graft. Remove the Access Portal, leaving the Guide Wire in place.
- Deliver the Zeus-O Implant and Inserter over the Guide Wire and to the annulus of the disc with fluoroscopic guidance to assure containment of the Guide Wire within the disc.
- The Implant should be inserted in its final orientation without any rotation within the disc space. It is important to insert the Implant in its final orientation since the exiting nerve root crosses obliquely over the disc space and Kambin's Triangle narrows anteriorly.
- To insert the Implant in this orientation, the T-handle of the Implant Inserter should be parallel with the spine (Figure 32). Once the tip of the Implant is seated inside the disc space, the Guide Wire should be removed. This ensures the wire will not advance anteriorly with the Implant.

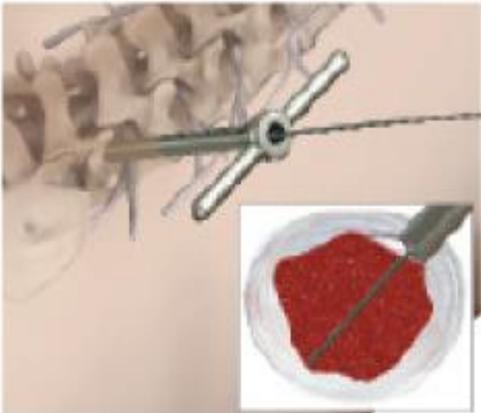


Figure 31

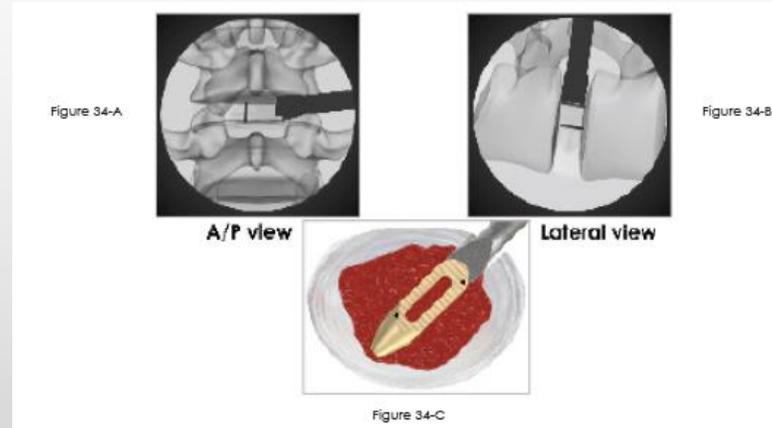


Figure 32

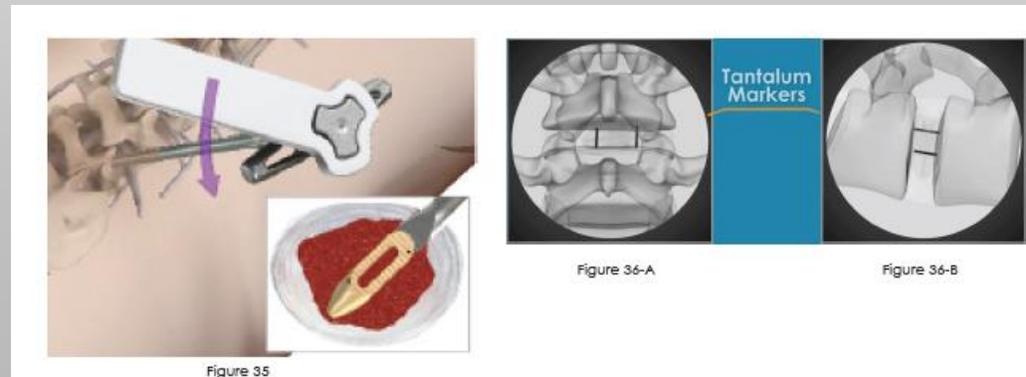
- \* Use the Mallet to tamp the Implant Inserter (Figure 33), distracting the endplates, and seat the Zeus-O Implant within the apophyseal ring. Rapid, small tamping of the Mallet on the Inserter will allow for incremental positioning.

# Interbody Delivery

- The tantalum markers in the Zeus-O Implant should be orientated on either side of the spinous process in the A/P view and splitting the disc center in the lateral view.

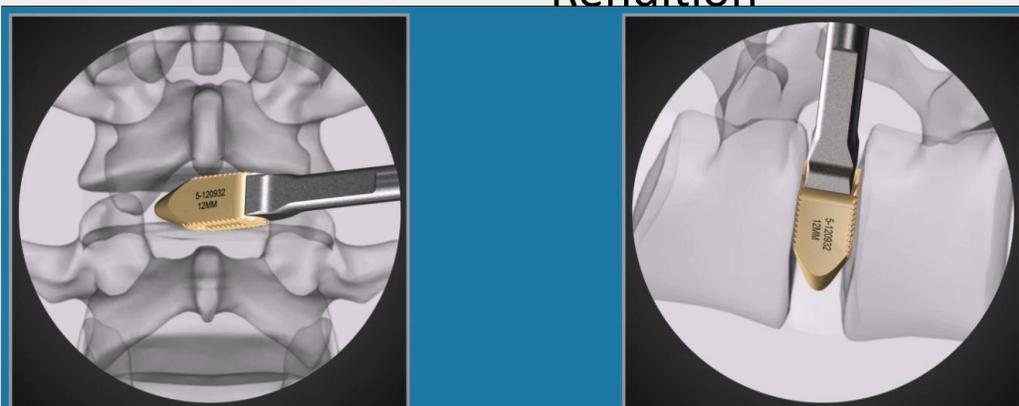


- Release the Zeus-O Implant by unthreading the inner shaft of the Implant Inserter. This can be done with ease using the Knob Release Wrench (Figure 35). Confirm the final placement of the Implant with all instrumentation removed.



# Final Implant Position

Rendition

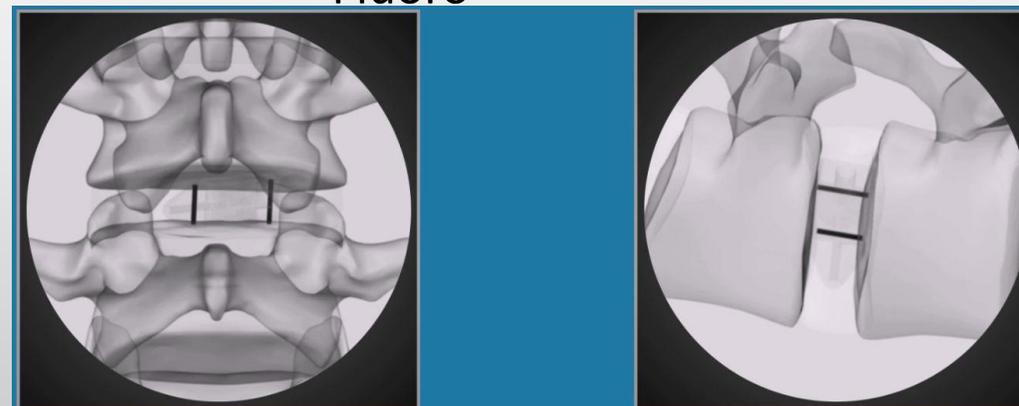


A/P view

Lateral view



Fluoro



A/P view

Lateral view



# Advantages

- Percutaneous
- TLIF always a bailout (either open or MIS)
- Endoscopic-assisted (if inclined)
- Bone/facet sparing

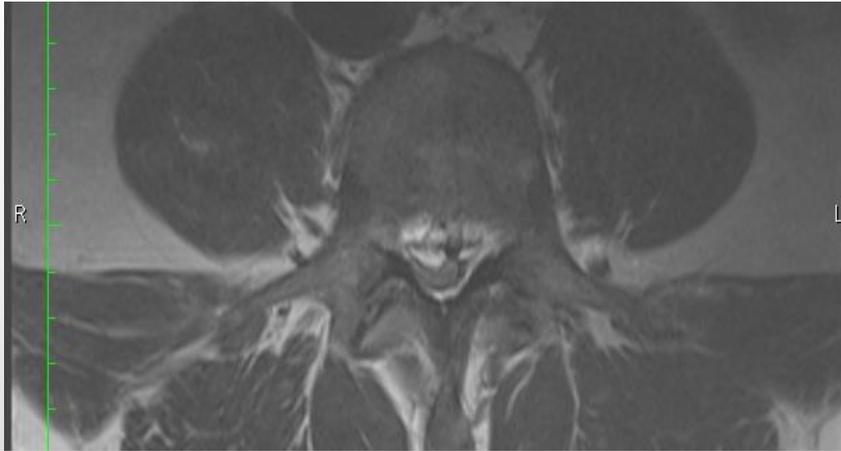
# Case presentation

- 54 year old male
- Severe back and rt leg pain
- 3 level dx
- Pre-op weakness rt foot

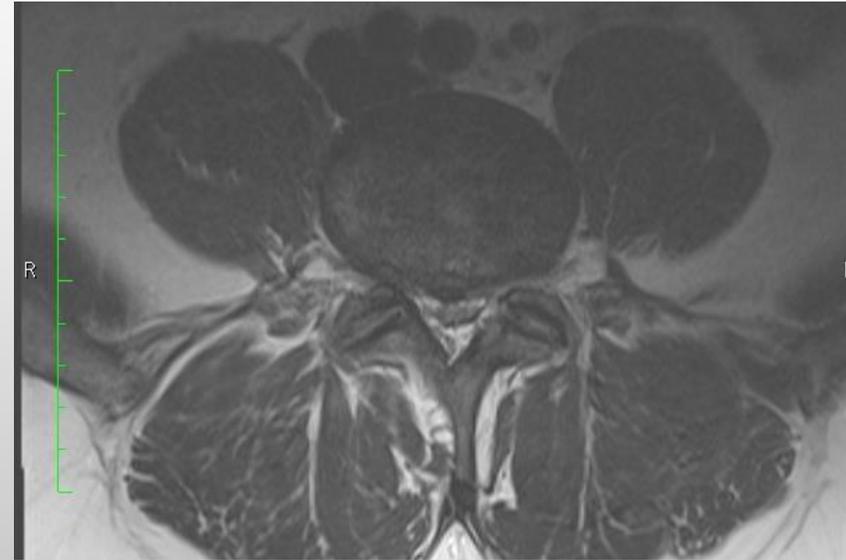
# MRI T2/Stir



# Axial L3-4



# L4-5

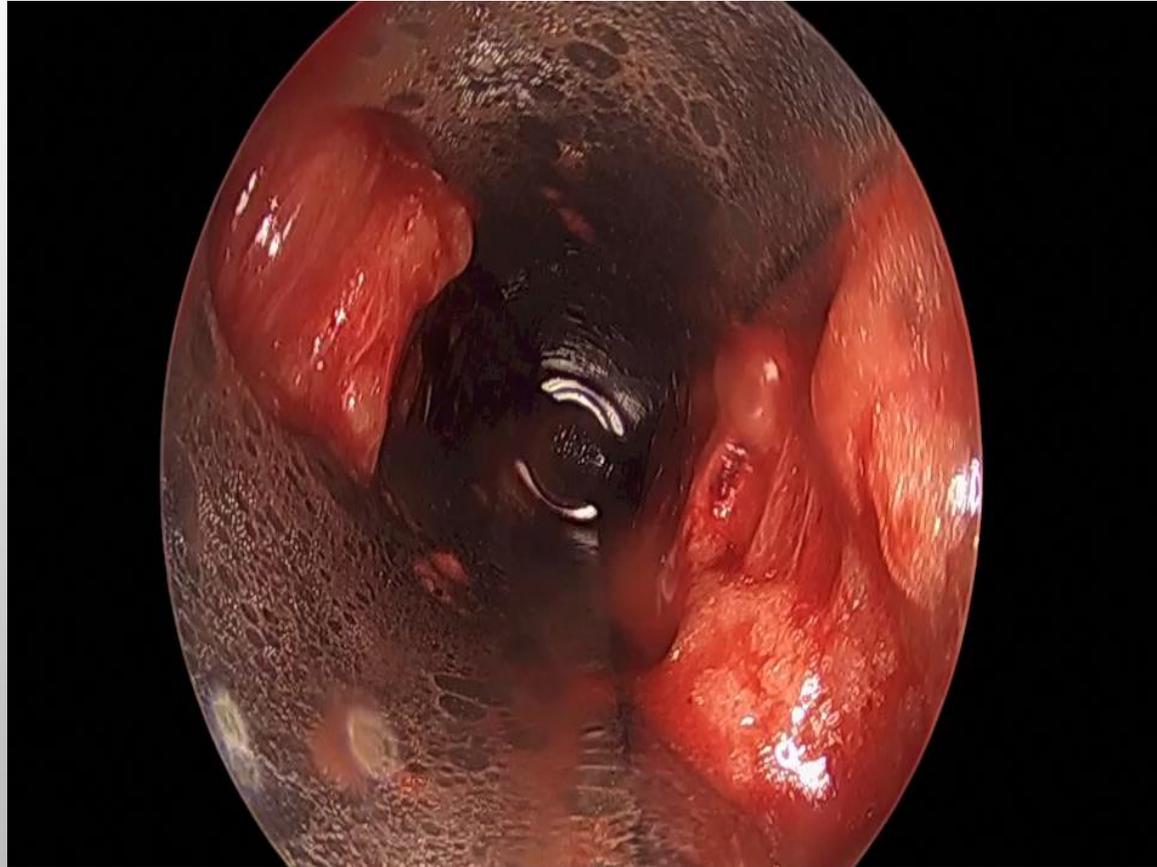


# L5-S1

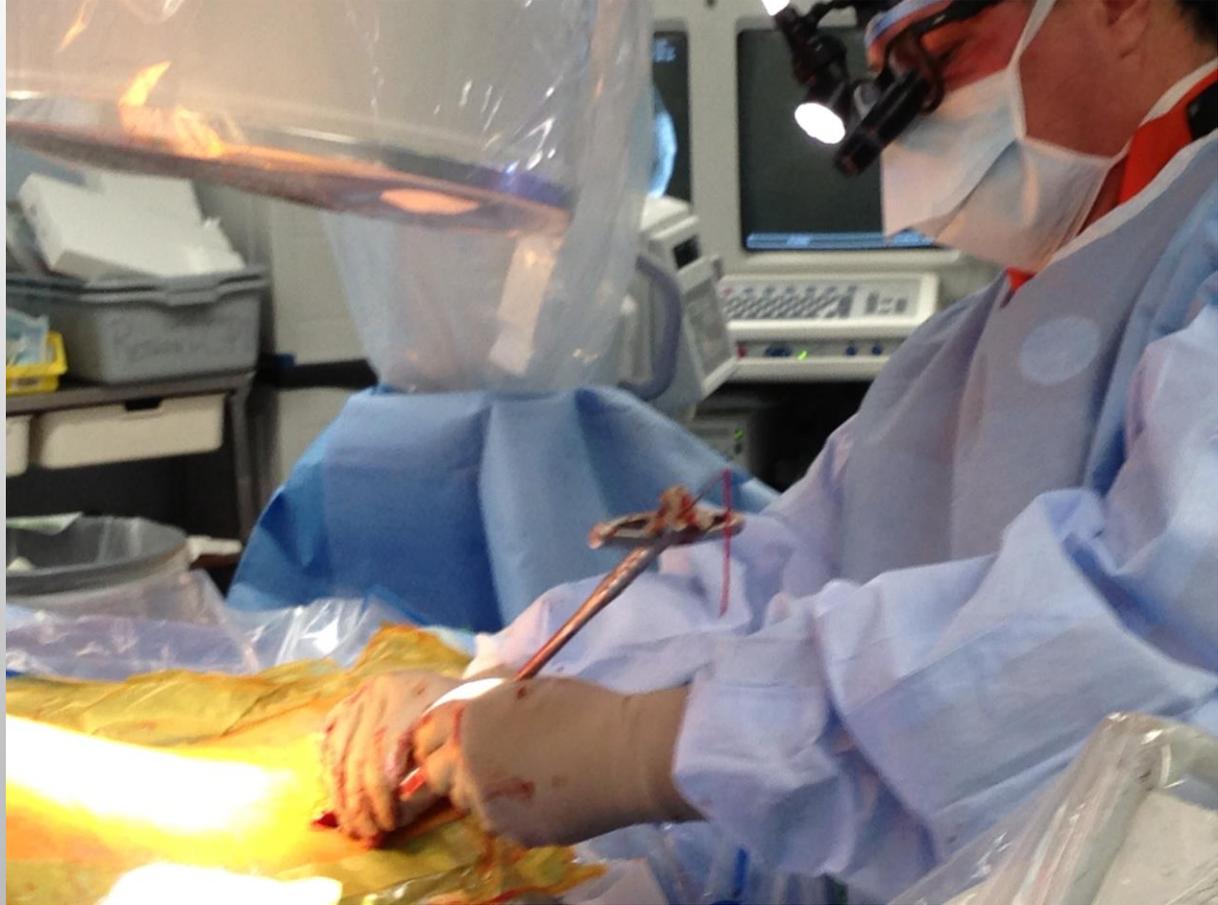




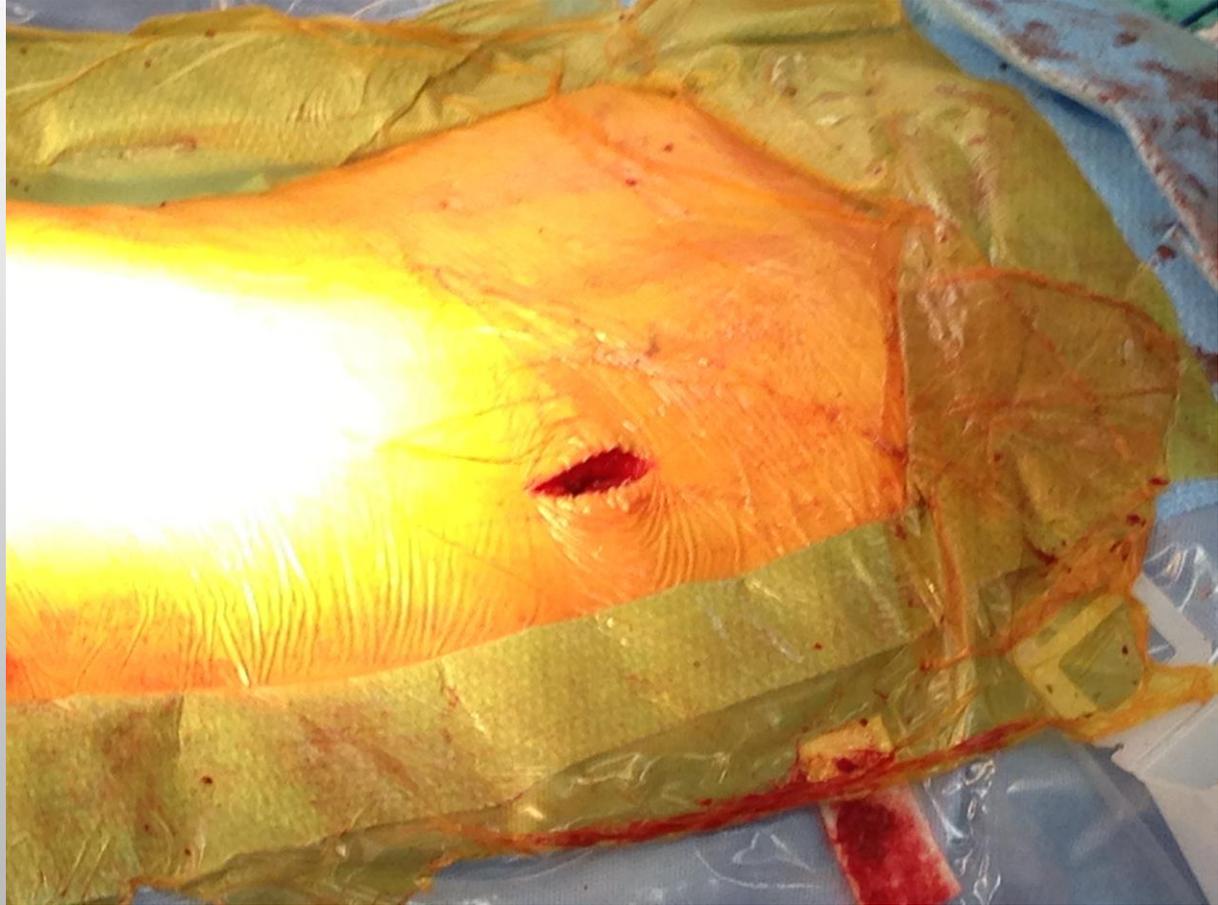
# Endoscopic Rod Passage











# Demographics

- 45 OLLIF (50 Levels)Tally MD
  - One pt converted to MIS TLIF due to stim threshold 2mA
- Mean Age 64
- 20 males
- 26 females
- 40 One Level
- 5 Two Level
- Levels from L2-3 to L5-S1

# Methods

- Pts were seen and imaged at 2,6,12 weeks
- They were specifically asked about dysesthesia and paresthesia
- Tested for BLE motor strength

# Results

- Mean anesthesia time
  - 73 min (one level)
- Mean Hospital Stay
  - 29.5 hours (range 5.25-120hours)
  - 21.6 hours (one level)
- Mean Blood loss
  - 145cc (including Pt that had scoli correction 1000cc EBL)
  - 80.4cc (one level)

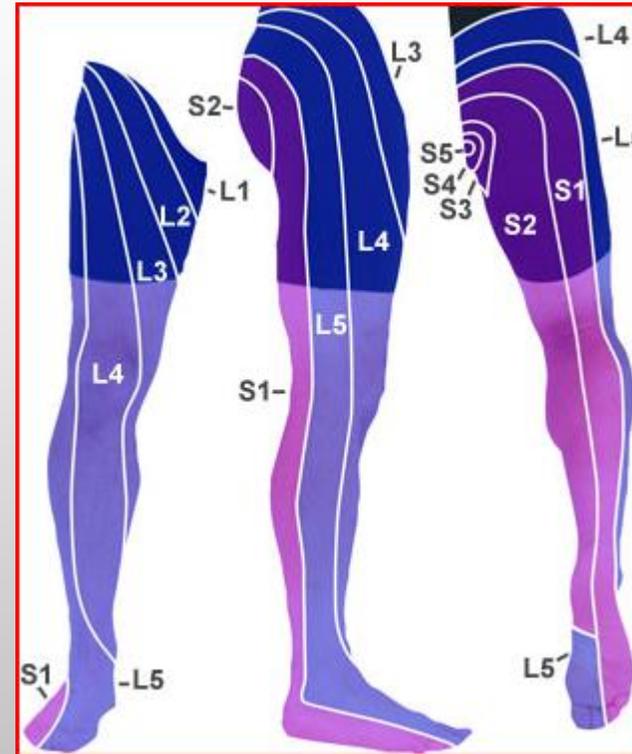
# Neurological Results

- Paresthesia  
6/45 (13%) (1 two level)  
5 resolved by 2 weeks  
1 resolved by 6 weeks

- Dysesthesia  
4/45(8.5%)

4 one level/ resolved by 2 weeks

One pt had both



# Complications

- No Graft migration or Extrusion
- No Motor deficits
- No infections

# Summary

- Neurologically Safe
  - No motor deficits
- Complication Rate Within the Norms of Published Literature
- Facet complex sparing
- Soft Tissue sparing
  - Only **truly percutaneous** fusion technique
- Short Surgical and Anesthesia Time
- Outpatient Compatible

Thank-You

