

# How to Avoid Complications in dualPortal Spinal Endoscopy

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# Disclosures


- Consultant: Stryker, GS Medical, Seaspine, Alphatec, Globus/Nuvasive
- Royalties: Seaspine, Alphatec
- Strategic Board Member: Amplify Surgical

# What are the Complications in Spine Surgery?

- Infection
- Wound problems
- Dural tear, CSF leak
- Epidural hematoma
- Recurrent disc herniation
- Incomplete decompression/discectomy
- Nerve injury/palsy
- Neurologic deterioration



## Pooled analysis of unsuccessful percutaneous biportal endoscopic surgery outcomes from a multi-institutional retrospective cohort of 797 cases

Wanseok Kim<sup>1</sup> · Seung-Kook Kim<sup>2,3,4</sup>  · Sang-Soo Kang<sup>5</sup> · Hyun-Jin Park<sup>6</sup> · Sangho Han<sup>1</sup> · Su-chan Lee<sup>4</sup>

Acta Neurochirurgica (2020) 162:279–287


# Is dualPortal safe?

- 797 cases, 35 patients required reoperation (4.4%)
- Lesion recurrence and incomplete decompression most common cause for reoperation
- Hematoma, incomplete decompression, dural tears were significantly higher in first 50 cases
- Hematoma, incomplete decompression, dural tear, recurrence, instability associated with unsuccessful outcome
- 1 case of postop infection (0.13%), required I&D, antibiotics

| Unsuccessful outcome type | Operative factors       |                          | Experience factors    |                       | p value |
|---------------------------|-------------------------|--------------------------|-----------------------|-----------------------|---------|
|                           | Reoperation rate (n, %) | Operative time (min, SD) | First 50 cases (n, %) | After 50 cases (n, %) |         |
| Hematoma                  | 5 (0.63)                | 52.56 (16.69)            | 10 (5)                | 8 (1.07)              | 0.04†*  |
| Lesion recurrence         | 16 (2.02)               | 56.16 (11.29)            | 6 (3)                 | 12 (1.62)             | 0.25‡   |
| Incomplete operation      | 8 (1.01)                | 56.38 (8.75)             | 15 (7.5)              | 3 (0.39)              | >0.01†* |
| Dural tear                | 3 (0.38)                | 72.89 (15.60)            | 10 (5)                | 8 (1.34)              | >0.01†* |
| Instability               | 2 (0.25)                | 60 (8.24)                | 3 (1.5)               | 2 (0.34)              | 0.10‡   |
| Ascites                   | 0 (0)                   | 88.5 (7.32)              | 2 (1)                 | 2 (0.34)              | 0.24‡   |
| Infection                 | 1 (0.88)                | 49 (NA)                  | 0 (0)                 | 1 (0.17)              | 0.74‡   |
| Total                     | 35 (4.41)               | 61.29 (15.89)            | 46 (23)               | 36 (6.08)             | 0.01†*  |

| Variable                 | Relationship between unsuccessful outcomes (n = 82) and patient dissatisfaction (n = 97) |          |            |               |
|--------------------------|--|----------|------------|---------------|
|                          | Number (%)   | p value  | Odds ratio | 95% CI        |
| Reoperation              | 35 (4.41)  | > 0.27†  | 0.59       | [-0.47, 1.66] |
| Delayed hospital stay    | 56 (7.02)  | > 0.73†  | 0.01       | [-0.06, 0.08] |
| Hematoma                 | 18 (2.27)  | 0.01†*   | 3.25       | [1.89, 4.62]  |
| Lesion recurrence        | 18 (2.27)  | > 0.01†* | 2.45       | [1.02, 3.88]  |
| Incomplete decompression | 18 (2.27)  | > 0.01†* | 4.06       | [2.53, 5.59]  |
| Dural tear               | 18 (2.27)  | > 0.01†* | 3.02       | [1.77, 4.28]  |
| Instability              | 5 (0.88)   | > 0.01†* | 3.64       | [2.15, 5.12]  |
| Ascites                  | 4 (0.50)   | 0.01†*   | 3.25       | [1.01, 5.49]  |

## Clinical outcomes and complications after biportal endoscopic spine surgery: a comprehensive systematic review and meta-analysis of 3673 cases

Don Y. Park<sup>1</sup>  · Alexander Upfill-Brown<sup>1</sup> · Nora Curtin<sup>1</sup> · Christopher D. Hamad<sup>1</sup> · Akash Shah<sup>1</sup> · Brian Kwon<sup>2</sup> · Yong H. Kim<sup>3</sup> · Dong Hwa Heo<sup>4</sup> · Cheol Woong Park<sup>5</sup> · William L. Sheppard<sup>1</sup>

European Spine Journal

<https://doi.org/10.1007/s00586-023-07701-9>

- Low complication rates (means)
  - Dural tear: 1.8-2.1%
  - Epidural hematoma: 0-2.4%
  - Nerve injury: 0-0.9%
  - Incomplete decompression: 0.4-1.7%
  - Iatrogenic instability: 0-0.4%
  - Infection: 0-0.4%

**Table 4** Subgroup complication analysis

|                          | Group       | Min   | Mean  | Max   |
|--------------------------|-------------|-------|-------|-------|
| Dural tear               | TLIF        | 0.002 | 0.021 | 0.050 |
|                          | Laminectomy | 0.009 | 0.018 | 0.029 |
|                          | Discectomy  | 0.001 | 0.018 | 0.041 |
| Epidural hematoma        | TLIF        | 0.004 | 0.024 | 0.050 |
|                          | Laminectomy | 0.008 | 0.014 | 0.020 |
|                          | Discectomy  | 0.000 | 0.000 | 0.000 |
| Nerve injury             | TLIF        | 0.000 | 0.009 | 0.022 |
|                          | Laminectomy | 0.000 | 0.000 | 0.001 |
|                          | Discectomy  | 0.000 | 0.007 | 0.018 |
| Incomplete decompression | TLIF        | 0.021 | 0.004 | 0.021 |
|                          | Laminectomy | 0.017 | 0.017 | 0.167 |
|                          | Discectomy  | 0.023 | 0.005 | 0.050 |
| Iatrogenic instability   | TLIF        | 0.018 | 0.004 | 0.018 |
|                          | Laminectomy | 0.006 | 0.002 | 0.006 |
|                          | Discectomy  | 0.000 | 0.000 | 0.000 |
| Infection                | TLIF        | 0.014 | 0.004 | 0.014 |
|                          | Laminectomy | 0.001 | 0.000 | 0.001 |
|                          | Discectomy  | 0.002 | 0.001 | 0.002 |

Table depicting the subgroup analysis of the complications for each of the surgery types

# In vivo Comparison of Positive Microbial Culture by Wound Irrigation Methods: Biportal Endoscopic versus Open Microscopic Transforaminal Lumbar Interbody Fusion.

Kang MS, You KH, Hwang JY, Cho TG, Yoon JH, Lee CS, Park HJ.  
Spine (Phila Pa 1976). 2023 Aug 29.

- 137 patients
  - Group A: 68 biportal
  - Group B: 69 open microscopic (OM)
- Intraop cultures with superficial (ligamentum flavum) and deep (nucleus) specimen
- Logistic regression: Gender, alcohol use, OM technique as risk factors
- Most common: *C. acnes*, *Bacillus* sp., coag negative Staph
- 1 patient with *C. acnes* SSI at 7 weeks following OM-TLIF, required I&D and 6 weeks IV antibiotics

|                          | Group A    | Group B    | Total      | <i>p</i> -value |
|--------------------------|------------|------------|------------|-----------------|
| Overall positive culture | 11 (16.67) | 23 (34.85) | 34 (25.8)  | 0.029*          |
| Positive LF culture      | 8 (12.12)  | 16 (24.24) | 24 (18.8)  | 0.113           |
| Positive NP              | 1 (1.5)    | 6 (9.1)    | 7 (5.3)    | 0.16            |
| Negative NP              | 7 (10.6)   | 10 (15.2)  | 17 (12.9)  | 0.6             |
| Positive NP culture      | 4 (6.06)   | 13 (19.70) | 17 (12.88) | 0.035*          |
| Positive LF              | 1 (1.5)    | 6 (9.1)    | 7 (5.3)    | 0.16            |
| Negative LF              | 3 (4.5)    | 7 (10.6)   | 10 (7.6)   | 0.32            |
| Overall negative culture | 55 (83.33) | 43 (65.15) | 98 (74.4)  |                 |
| Total                    | 66         | 66         | 132        |                 |

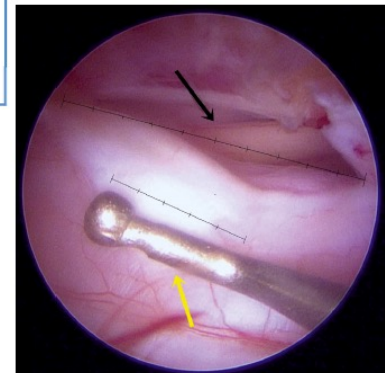
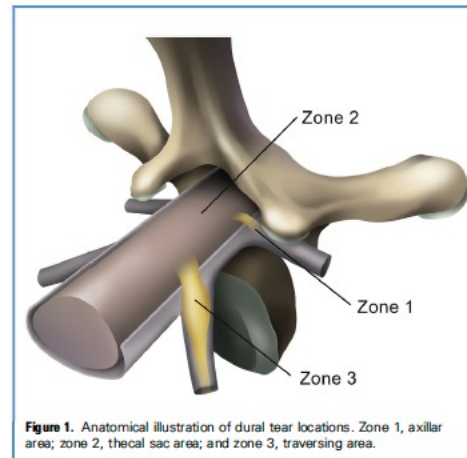
Values are presented as n (%).

## Dural Tears in Percutaneous Biportal Endoscopic Spine Surgery: Anatomical Location and Management

Hyun-Jin Park<sup>1</sup>, Seung-Kook Kim<sup>2-4</sup>, Su-chan Lee<sup>3</sup>, Wanseok Kim<sup>5</sup>, Sangho Han<sup>5</sup>, Sang-Soo Kang<sup>6</sup>

WORLD NEURO SURGERY, <https://doi.org/10.1016/j.wneu.2020.01.080>

- Retrospective study of 643 cases
- Dural tear incidence: 4.5% (29/643)
- Locations of tears
  - Exiting nerve: 2 cases (6.9%)
    - Curette
  - Thecal sac: 18 cases (62.1%)
    - Electric drill, pituitary
  - Traversing nerve: 9 cases (31%)
    - Kerrison

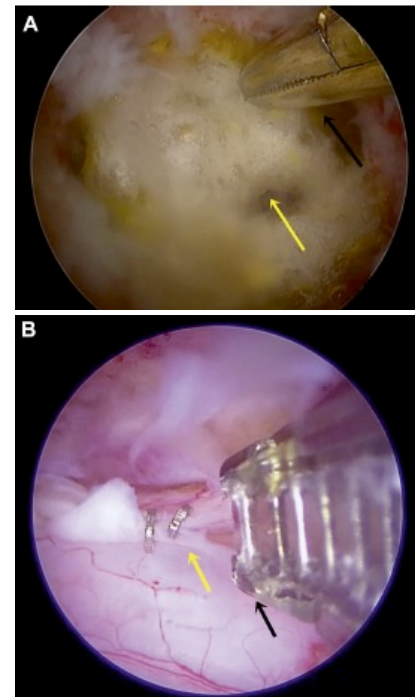


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WORLD NEURO SURGERY, <https://doi.org/10.1016/j.wneu.2020.01.080>

- 12 treated with close observation, 24 hours bed rest
  - 1 developed pseudomeningocele and required revision surgery
- 14 treated with fibrin sealant patch with 24 hour bedrest
- 2 treated with nonpenetrating titanium clip, 48 hour bedrest
- 1 converted to microscopic surgery
- No complications at 6 mo and 12 mo follow up



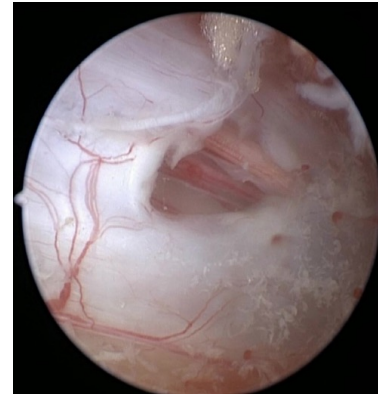


# Unintended dural tears during unilateral biportal endoscopic lumbar surgery: incidence and risk factors

Hang Yu<sup>1,2</sup> · Qingzhong Zhao<sup>1</sup> · Jianwei Lv<sup>1</sup> · Jianjun Liu<sup>1</sup> · Bin Zhu<sup>1</sup> · Lei Chen<sup>1</sup> · Juehua Jing<sup>1</sup> · Dasheng Tian<sup>1</sup>

Acta Neurochirurgica (2024) 166:95  
<https://doi.org/10.1007/s00701-024-05965-8>

- Retrospective study of 608 cases
- Dural tear incidence: 3.95% (24/608)
  - First 100 cases: 5%
  - Last 100 cases: 2%
- Risk factors
  - Age > 65
  - Lumbar stenosis
  - ULBD
  - Revision surgery



**Table 3** Univariate logistic regression analysis results for the risk of dural tears

|                                | OR     | 95% CI       | P        |
|--------------------------------|--------|--------------|----------|
| Age (y), mean (SD)             |        |              |          |
| Age: < 65 years                | 1      | -            | -        |
| Age: > 65 years                | 2.384  | 1.046-5.433  | 0.039    |
| Diagnosis                      |        |              |          |
| Lumbar disc herniation         | 1      | -            | -        |
| Lumbar spinal stenosis         | 2.5    | 1.038-6.019  | 0.041    |
| Degenerative spondylolisthesis | 1.545  | 0.420-5.689  | 0.513    |
| Surgery type                   |        |              |          |
| UD                             | 1      | -            | -        |
| ULBD                           | 2.224  | 0.888-5.568  | 0.020    |
| ULIF                           | 1.654  | 0.520-5.260  | 0.284    |
| LSS-UD                         | 1      | -            | -        |
| LSS-ULBD                       | 4.508  | 0.923-22.022 | 0.063    |
| Revision surgery               |        |              |          |
| Yes                            | 11.480 | 3.315-39.761 | < 0.0001 |
| No                             | 1      | -            | -        |

# Dural Tear Protocol

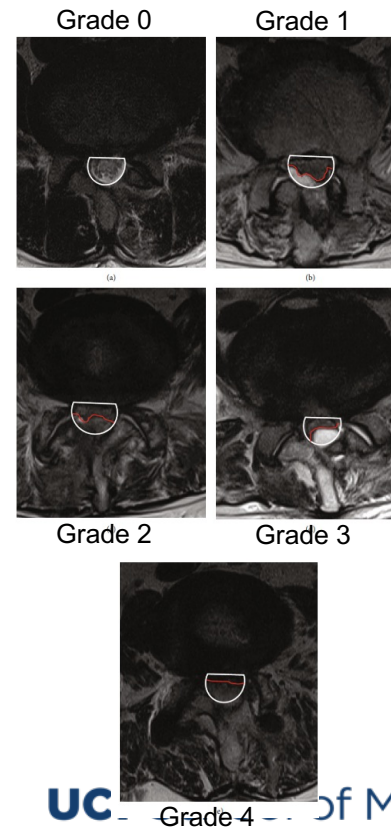
- Dural tears < 3-4 mm in size treated with 24-hour period of bedrest
- 4-12 mm in size closed with fibrin sealant patch, close observation
- > 12 mm, attempted primary closure, fibrin sealant patch
  - Endoscopic closure with AnastoClip
- Large tears, convert to microscopic surgery

## Evaluation of Postoperative Spinal Epidural Hematoma After Biportal Endoscopic Spine Surgery for Single-Level Lumbar Spinal Stenosis: Clinical and Magnetic Resonance Imaging Study

Ju-Eun Kim<sup>1</sup>, Dae-Jung Choi<sup>1</sup>, Eugene J. Park<sup>2</sup>

WORLD NEURO SURGERY, <https://doi.org/10.1016/j.wneu.2019.02.150>

- 158 patients
- 39 patients (24.7%) showed hematoma
  - Grade 1: 14 (8.8%)
  - Grade 2: 19 (12%)
  - Grade 3: 5 (3.1%)
  - Grade 4: 1 (0.6%)

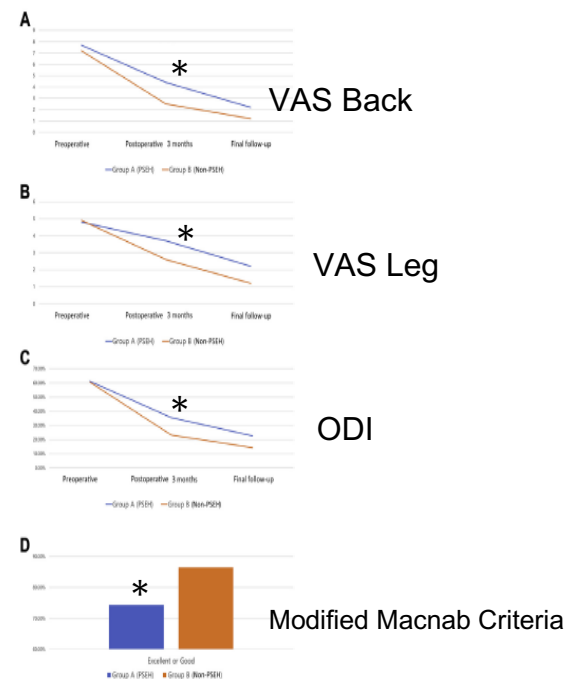


## Evaluation of Postoperative Spinal Epidural Hematoma After Biportal Endoscopic Spine Surgery for Single-Level Lumbar Spinal Stenosis: Clinical and Magnetic Resonance Imaging Study

Ju-Eun Kim<sup>1</sup>, Dae-Jung Choi<sup>1</sup>, Eugene J. Park<sup>2</sup>

WORLD NEURO SURGERY, [HTTPS://DOI.ORG/10.1016/J.WNEU.2019.02.150](https://doi.org/10.1016/j.wneu.2019.02.150)

- Epidural hematoma with significantly worse VAS and ODI scores, clinical outcomes
- 2 patients underwent revision surgery for PSEH evacuation for neurologic Sx, 1 for CES, 2 for severe radiculopathy
  - 2 patients with grade 3 underwent revision surgery (1.9%)



**Effectiveness of Gelatin-Thrombin Matrix Sealants (FloSeal®) on Postoperative Spinal Epidural Hematoma during Single-Level Lumbar Decompression Using Biptoral Endoscopic Spine Surgery: Clinical and Magnetic Resonance Image Study**

Hindawi  
BioMed Research International  
Volume 2020, Article ID 4801641, 10 pages  
<https://doi.org/10.1155/2020/4801641>

Ju-Eun Kim,<sup>1</sup> Hyun-Seung Yoo,<sup>2</sup> Dae-Jung Choi,<sup>1</sup> Eugene J. Park,<sup>3</sup> Jin-Ho Hwang,<sup>1</sup> Jeong-Duk Suh,<sup>2</sup> and Jun-Hyug Yoo<sup>2</sup>

- Group A (No FloSeal): 31 patients with PSEH (26.5%)
  - 2 revision cases
- Group B (FloSeal): 12 patients (13.5%), significant difference between groups
  - No revision cases
- Significantly reduced VAS Leg, ODI, MacNab with PSEH

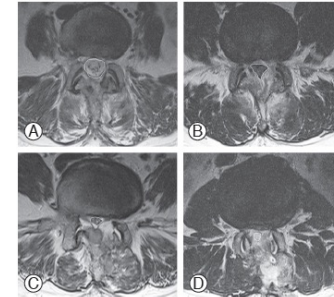
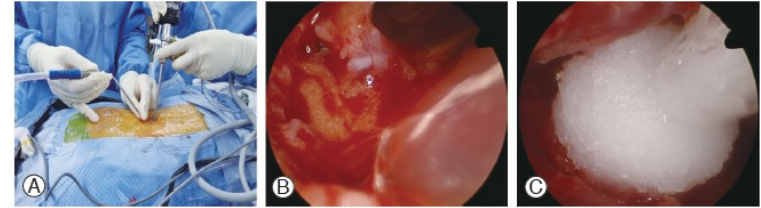


# Effect of Thrombin-Containing Local Hemostatics on Postoperative Spinal Epidural Hematoma in Biptortal Endoscopic Spinal Surgery

Young Rok Ko, Dong Ki Ahn, Jung Soo Lee, Jong Seo Jung, Young Ho Lee, Yong Ho Kim

Asian Spine J 2024;18(1):87-93 • <https://doi.org/10.31616/asj.2023.0208>

- Retrospective case control study, 204 patients
  - Group A: with CollaStat
  - Group B: without CollaStat
  - Routine postop MRI at 7 days
- Lower incidence of epidural hematoma in group A
- Higher incidence of small epidural hematoma in group A, large epidural hematoma in group B
- Multivariate analysis: use of CollaStat and lumbar stenosis as risk factors



| Variable                        | Group A (n=109) | Group B (n=95) | p-value |
|---------------------------------|-----------------|----------------|---------|
| Incidence of symptomatic POSEH  | 5 (4.6)         | 9 (9.5)        | 0.136   |
| Incidence of morphometric POSEH |                 |                |         |
| Small (hG1, hG2)                | 87 (83.6)       | 58 (69.9)      | 0.02    |
| Large (hG3, hG4)                | 17 (16.4)       | 25 (30.1)      |         |

# Does the Use of Tranexamic Acid Intraoperatively Reduce Blood Loss and Complications Following Biportal Endoscopic Lumbosacral Decompression?

Upfill-Brown A, Olson TE, Adejuyigbe B, Shah AA, Park CW, Heo DH, Park DY.


Accepted by Journal of Spine Surgery, January 2024.

- Retrospective case control study, 84 cases
  - Group A: No TXA
  - Group B: TXA
- TXA significantly reduced postop drain output
  - Discectomy, 1 level with the least postop drain output
- No difference in complications

| Comparison       | Group      | N  | Median (IQR) | Difference (95% CI) <sup>1</sup> | P-Value <sup>2</sup> |
|------------------|------------|----|--------------|----------------------------------|----------------------|
| TXA Use          | No TXA     | 39 | 50 (30-95)   | 31.5 (13.4 - 49.7)               | 0.0028               |
|                  | TXA        | 45 | 30 (10-60)   |                                  |                      |
| Procedure Type   | Discectomy | 36 | 30 (13-47.5) | 27.6 (9.2 - 48.2)                | 0.0040               |
|                  | ULBD       | 48 | 53 (30-119)  |                                  |                      |
| Number of Levels | 1 Level    | 67 | 30 (15-65)   | 68.8 (37.0 - 117.9)              | 0.00019              |
|                  | 2 Level    | 17 | 95 (50-155)  |                                  |                      |

| Group      | Statistic    | TXA          | No TXA      | Difference (95% CI) <sup>1</sup> | P-Value <sup>2</sup> |
|------------|--------------|--------------|-------------|----------------------------------|----------------------|
| Discectomy | n            | 10           | 16          | 31.2                             | 0.00223              |
|            | Median (IQR) | 18 (5-33)    | 45 (28-80)  | (15.7 - 48.9)                    |                      |
| ULBD       | n            | 25           | 23          | 24.5                             | 0.167                |
|            | Median (IQR) | 50 (30-80)   | 71 (30-124) | (-8.8 - 57.7)                    |                      |
| 1 Level    | n            | 35           | 32          | 33.3                             | 0.000157             |
|            | Median (IQR) | 25 (6-38)    | 43 (30-89)  | (19.0 - 49.9)                    |                      |
| 2 Level    | n            | 10           | 7           | -9.5                             | 0.815                |
|            | Median (IQR) | 113 (46-135) | 80 (53-173) | (-100.9 - 71.9)                  |                      |

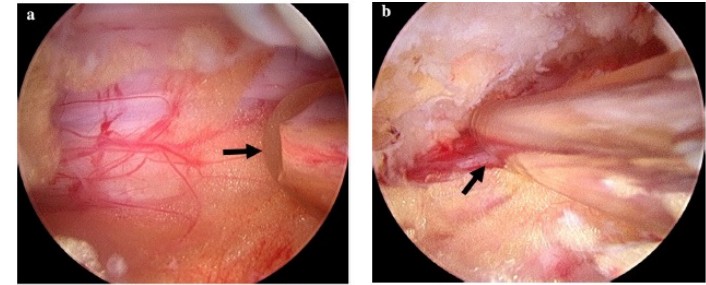
# Temperature change of epidural space by radiofrequency use in biportal endoscopic lumbar surgery: safety evaluation of radiofrequency

Dong Hwa Heo<sup>1</sup> · Don Yong Park<sup>2</sup> · Young Ho Hong<sup>1</sup> · Deahwan Kim<sup>3</sup> · Jin Sung Kim<sup>4</sup> 

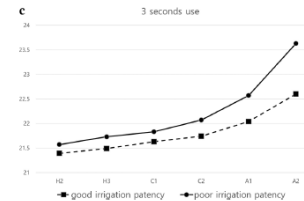
European Spine Journal (2023) 32:2769–2775

<https://doi.org/10.1007/s00586-023-07719-z>

- Investigated RF safety by measuring epidural temp
- In-vitro cadaver study: according to RF mode, power, usage time, and irrigation patency.
  - Temp significantly increased with long duration of RF use, poor outflow.
- In vivo surgery study: temp measured around ipsilateral and contralateral traversing nerve roots after 1-s use of RF.



| A steerable small diameter bipolar 90-degree RF |                       |
|---|-----------------------|
| High 1  | 7W Coagulation 1 17W  |
| High 2  | 10W Coagulation 2 40W |
| High 3  | 13W Ablation 1 40W    |
| –   | Ablation 2 60W        |



| Space                               | Radiofrequency mode | Ipsilateral    | Contralateral  |
|-------------------------------------|---------------------|----------------|----------------|
| Working space (Inter-laminar space) | Coagulation 2 (C2)  | 0.5±0.08 °C    | –              |
|                                     | Ablation 2 (A2)     | 1.2±0.12 °C    | –              |
| Epidural space (Exposure dura)      | Coagulation 1 (C1)  | 0.31 ± 0.16 °C | 0.29 ± 0.09 °C |
|                                     | High 2 (H2)         | 0.21 ± 0.13 °C | 0.18 ± 0.21 °C |



# Safety Evaluation of Biportal Endoscopic Lumbar Discectomy

*Assessment of Cervical Epidural Pressure During Surgery*

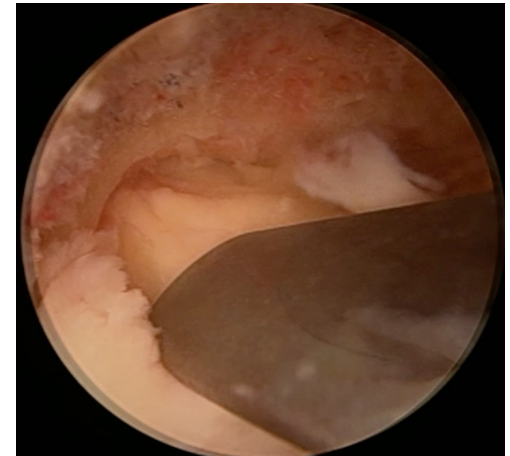
Min-Seok Kang, MD,<sup>a</sup> Hyun-jin Park, MD,<sup>b</sup> Jin-Ho Hwang, MD,<sup>c</sup> Ju-Eun Kim, MD,<sup>c</sup> Dae-Jung Choi, MD,<sup>c</sup> and Hoon-Jae Chung, MD<sup>a</sup>

SPINE Volume 45, Number 20, pp E1349–E1356

- Evaluated safety of biportal discectomy by measuring the real-time cervical epidural pressure (CEP)
- CEP not increased during biportal discectomy
  - No cases of neurological complications (HA, neck pain, seizure)
- Inflow pressure < 50 mmHg with **optimal** outflow to prevent potential neurological risks
  - Pump system inflow pressure set to 30 mmHg

# How to Avoid Complications with dualPortal

- Infection: Low risk due to irrigation
- Wound problems: Tight wound closure
- Dural tear, CSF leak
  - CWP “Butterfly” technique
  - Clear adhesions from dura prior to removal of ligamentum
  - Beware of posterior epidural ligaments



| Lumbar spine level <sup>†</sup> | Posterior epidural ligament (n) | Percentage total (%) |
|---------------------------------|---------------------------------|----------------------|
| L3/L4                           | 3                               | 33.3                 |
| L4/L5                           | 5                               | 55.6                 |
| L5/S1                           | 1                               | 11.1                 |
| Total                           | 9                               | 100.0                |

<sup>†</sup>No ligaments were identified at L1-L2.

*Research Article*

## **The Posterior Epidural Ligaments: A Cadaveric and Histological Investigation in the Lumbar Region**

M. J. Connor,<sup>1</sup> S. Nawaz,<sup>2</sup> V. Prasad,<sup>2</sup> S. Mahir,<sup>2</sup> R. Rattan,<sup>3</sup> J. Bernard,<sup>2</sup> and P. J. Addis<sup>1</sup>

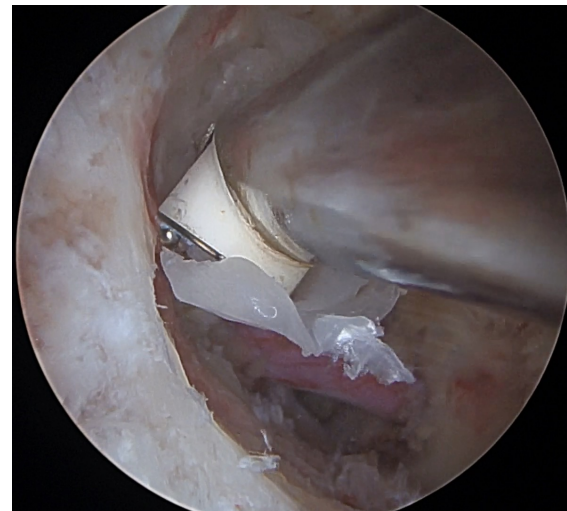
ISRN Anatomy

Volume 2013, Article ID 424058, 4 pages

<http://dx.doi.org/10.5402/2013/424058>

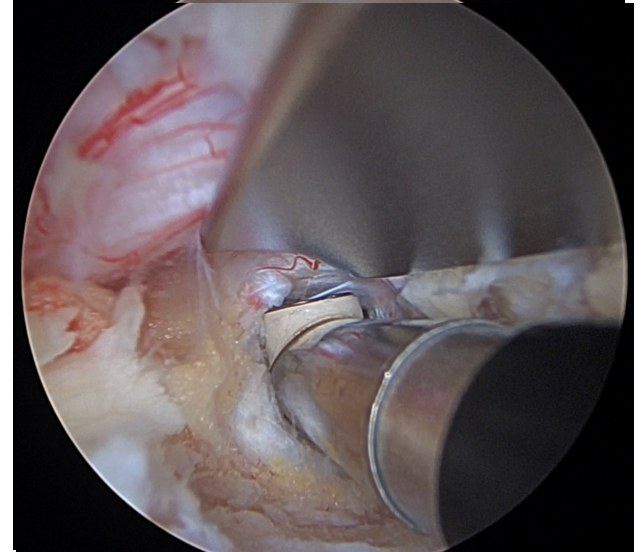
# How to Avoid Complications with dualPortal

- Epidural hematoma
  - Use TXA intraoperatively
  - Place bone wax on cancellous bony surfaces
  - Use hemostatic agents (Flo seal, Surgiflo, etc)
  - Turn off irrigation fluid to identify bleeders
  - Postop drains for ULBD and dualLIF cases with more bony work, exposure of epidural vessels



# How to Avoid Complications with dualPortal

- Incomplete decompression/discectomy
  - Visualize lateral border of dura and traversing nerve root
  - Palpate posterior vertebral body and disc space
  - Visualize pulsations of dura and nerve root
  - Optimize endoscopic visualization
- Recurrent disc herniation
  - Nucleoplasty, annuloplasty



# How to Avoid Complications with dualPortal

- Nerve injury/palsy
  - Maintain RF settings in the lowest setting when dura is exposed
  - Maintain irrigation inflow pressures 30-50 mmHg
  - Must maintain optimal outflow, “bubbling geyser sign”.
  - “What goes in, must come out”

# Thank You.

