

Submission ID #: 71862

Scriptwriter Name: Pallavi Sharma

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Title: Circumferential Transforaminal Endoscopic Lumbar Foraminotomy for 360° Exiting Nerve Root Decompression in Patients with Lumbar Foraminal Stenosis

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Author Questionnaire

- 1. Microscopy:** Does your protocol require the use of a dissecting or stereomicroscope for performing a complex dissection, microinjection technique, or something similar? **No**

- 2. Software:** Does the part of your protocol being filmed include step-by-step descriptions of software usage? **No**

- 3. Filming location:** Will the filming need to take place in multiple locations? **No**

- 4. Testimonials (optional):** Would you be open to filming two short testimonial statements **live during your JoVE shoot**? These will **not appear in your JoVE video** but may be used in JoVE's promotional materials. **No**

Current Protocol Length

Number of Steps: 21

Number of Shots: 40

Interviews

Videographer: Obtain headshots for all authors available at the filming location.

INTRODUCTION:

~~REQUIRED: Summarize your research focus and the main questions it aims to answer.~~

- 1.1. **Yong Ahn:** Our protocol demonstrates full-endoscopic transforaminal circumferential decompression under local anesthesia for complex lumbar foraminal stenosis.
 - 1.1.1. INTERVIEW: Named Talent says the statement above in an interview-style shot, looking slightly off-camera. *Suggested B roll: 3.7.1*

~~Describe the research gap or limitation in existing methods and how this protocol addresses them.~~

- 1.2. **Yong Ahn:** Conventional endoscopic techniques may leave residual compression in complex lumbar foraminal stenosis, whereas this protocol enables circumferential nerve root release.
 - 1.2.1. INTERVIEW: Named Talent says the statement above in an interview-style shot, looking slightly off-camera. *Suggested B roll: 3.5.2*

CONCLUSION:

~~What does this protocol allow researchers to study or measure?~~

- 1.3. **Yong Ahn:** This protocol enables reproducible and complete decompression of the exiting nerve root under direct endoscopic visualization.
 - 1.3.1. INTERVIEW: Named Talent says the statement above in an interview-style shot, looking slightly off-camera.

~~Are there any additional methods or analyses that can be performed following this procedure?~~

- 1.4. **Yong Ahn:** This protocol can be used to correlate intraoperative endoscopic findings with postoperative clinical outcomes.

- 1.4.1. INTERVIEW: Named Talent says the statement above in an interview-style shot, looking slightly off-camera.

~~How can future studies build on this work? Describe the questions or research directions that can be investigated next.~~

- 1.5. **Yong Ahn:** Future studies should establish objective endoscopic criteria that predict long-term clinical outcomes.

- 1.5.1. INTERVIEW: Named Talent says the statement above in an interview-style shot, looking slightly off-camera.

Videographer: Obtain headshots for all authors available at the filming location.

Ethics Title Card

This research has been approved by the Institutional Review Board (IRB) at Kyung Hee University Hospital

Protocol

***Videographer:** Please always record an audio slate while filming each shot mentioned in the shot list.*

NOTE: Use file Captures_Yong Ahn_20260723 (1).pptx as guide for identifying the footage and annotation

***Video editor:** Please use the title card to show the following information*

Perform the following steps:

- Preoperative Evaluation and Patient Selection
- Surgical Planning for Circumferential Exiting nerve root Decompression
- Fluoroscopic-Guided Transforaminal Access
- Working Sheath Placement and Positioning
- Initial Endoscopic Exposure and Anatomical Identification

2. Endoscopic Bony Unroofing

Demonstrator: Yong Ahn

2.1. After inserting the endoscope through the working sheath [1], begin the decompression at the lower pedicle margin [2].

2.1.1. Establishing shot of the talent with the patient positioned for the procedure

***Videographer:** Please obtain CU shot as well for this shot.*

2.1.2. Talent beginning the decompression at the lower pedicle margin.

Scope protocol.mp4: 00:58-01:05

~~2.1.3. Talent maintaining orientation while pointing out the key bony landmarks with an endoscopic probe Scope protocol.mp4~~ **NOTE: Not filmed**

2.2. Undercut the superior articular process and the adjacent portion of the pedicle using an endoscopic burr [1]. Identify the cephalad margin of the lower pedicle as the lower boundary of the foraminal zone and use it as a reference point during decompression [2].

2.2.1. Talent undercutting the superior articular process and the adjacent portion of the pedicle using an endoscopic burr. **Scope protocol.mp4: 01:05-01:17**

2.2.2. Talent locating the cephalad margin of the lower pedicle using the bony landmark to guide the decompression. **Capture 2.2.2**

2.3. Use a straight 3.5-millimeter diamond burr for bony decompression in endoscopic surgery at about 80,000 RPM to undercut bones while minimizing soft tissue injury [1].

2.3.1. Talent performing the bony decompression using the straight 3.5 millimeter

diamond burr. **Scope protocol.mp4: 10:51-11:06**

- 2.4. Undercut the superior articular process and expose the ligamentum flavum [1]. Advance the undercutting toward the exiting nerve root [2].
 - 2.4.1. Talent undercutting the superior articular process and exposing the ligamentum flavum. **Scope protocol.mp4: 11:34-11:54**
 - 2.4.2. Talent advancing the undercutting toward the exiting nerve root until the facet joint cleft is identified. **Scope protocol.mp4: 11:56 - 12:06 and 12:30 - 12:40 and Capture 2.4.2.**
- 2.5. Identify the facet joint cleft during the progressive undercutting of the superior articular process [1]. Recognize the gap between the superior and inferior articular processes containing the synovial tissue as the facet joint cleft [2].
 - 2.5.1. Talent locating the facet joint cleft during the progressive undercutting of the superior articular process. **Scope protocol.mp4: 12:41 - 12:51 and Capture 2.5.1.**
 - 2.5.2. Shot of the gap between the superior and inferior articular processes containing the synovial tissue. **Capture 2.5.2.**
- 2.6. Upon reaching the facet joint cleft, continue removing the bone medially to expose the axillary portion of the exiting nerve root and identify the site of the nerve root impingement [1].
 - 2.6.1. Talent removing the bone medially to expose the axillary portion of the exiting nerve root and showing the site of the nerve root impingement. **Scope protocol.mp4: 16:41 - 17:01**
- 2.7. Extend the decompression toward the upper portion of the foraminal zone [1]. Resect the isthmus and the upper pedicle wall to expose the shoulder portion of the exiting nerve root [2].
 - 2.7.1. Talent extending the decompression toward the upper portion of the foraminal zone. **Scope protocol.mp4: 17:55-18:10**
 - 2.7.2. Talent resecting the isthmus and the upper pedicle wall to expose the shoulder portion of the exiting nerve root. **Scope protocol.mp4: 20:25-20:35**
- 2.8. Continue the resection until the shoulder portion, the origin, and the proximal course of the exiting nerve root are clearly exposed, allowing circumferential decompression around the nerve root [1].
 - 2.8.1. Talent continues the resection showing the shoulder portion, the origin, and the proximal course of the exiting nerve root are exposed. **Scope protocol.mp4: 21:21-21:37**
- 2.9. Extend the decompression to achieve wide unroofing of the foraminal zone from the lower to the upper pedicle [1]. Allow circumferential visualization of the ligamentous structures surrounding the exiting nerve root [2].

- 2.9.1. Talent extending the decompression and showing wide unroofing of the foraminal zone. **Scope protocol.mp4: 21:53-22:07**
- 2.9.2. Shot of the ligamentous structures surrounding the exiting nerve root after circumferential exposure. **Capture 2.9.2.**
- 2.10. Expand the bony resection margin along the pedicle walls from the lower to the upper pedicle while ensuring sufficient working space around the nerve root [1].
 - 2.10.1. Talent expanding the bony resection margin along the pedicle walls. **Scope protocol.mp4: 23:04-23:17**
- 2.11. Confirm adequate foraminal unroofing by identifying the ligamentum flavum located between the lower and upper pedicle walls as well as the facet joint cleft [1]. Ensure that these anatomical landmarks indicate an adequate bony resection margin and sufficient working space. [2].
 - 2.11.1. Talent showing the ligamentum flavum between the lower and upper pedicle walls and the facet joint cleft. **Scope protocol.mp4: 23:20-23:30**
 - 2.11.2. Shot of the completed bony resection margin and working space around the exiting nerve root. **Capture 2.11.2**
- 2.12. ~~Monitor the decompression progress primarily under endoscopic visualization [1].~~ Use intermittent fluoroscopic confirmation to assess the extent of the bony unroofing [2]. Consider the decompression adequate when the resection extends beyond the medial pedicular line on the anteroposterior fluoroscopic view and reaches the lower and upper pedicle margins, corresponding to complete foraminal unroofing [3].
 - ~~2.12.1. Progressive decompression visible under endoscopic visualization. —~~ **NOTE: Not filmed**
 - 2.12.2. Talent obtaining an intermittent fluoroscopic image to assess the extent of the bony unroofing.
 - 2.12.3. Shot of the anteroposterior fluoroscopic view showing the bony resection extending beyond the medial pedicular line and reaching the lower and upper pedicle margins.
- 2.13. ~~Remove the exposed ligamentum flavum using the endoscopic punches and forceps [1].~~
 - ~~2.13.1. Talent removing the exposed ligamentum flavum using the endoscopic punches and forceps. —~~ **NOTE: Not filmed**

3. Soft Tissue Decompression

- 3.1. Using 2.9-millimeter endoscopic micropunches with hook-shaped or beak-shaped tips, remove the ligamentum flavum [1]. Using 2.9 millimeter blunt-tipped grasping forceps and the endoscopic Kerrison punches, remove the hypertrophic foraminal ligaments [2].

- 3.1.1. Talent removing the ligamentum flavum using the 2.9 millimeter endoscopic micropunches. **Scope protocol.mp4: 23:32-23:42**
- 3.1.2. Talent removing the hypertrophic foraminal ligaments using the blunt-tipped grasping forceps and the endoscopic Kerrison punches. **Scope protocol.mp4: 23:56-24:06**
- ~~3.1.3. Talent removing fibrotic adhesions, and other compressive soft tissues surrounding the exiting nerve root.~~ **NOTE: Not filmed**
- 3.2. Using an endoscopic probe, carefully dissect the nerve root and the dural sac with hydrostatic pressure [1].
 - 3.2.1. Talent dissecting the nerve root and the dural sac using an endoscopic probe with hydrostatic pressure. **Scope protocol.mp4: 24:32-24:43**
- ~~3.3. Use an automated irrigation pump for continuous antibiotic saline irrigation, maintaining pressure between 30 and 60 millimeters of mercury to ensure a clear operative field for soft tissue dissection [1].~~
 - ~~3.3.1. Talent placing the irrigation tubing for continuous antibiotic-containing saline irrigation.~~ **NOTE: Not filmed**
- 3.4. Perform decompression along the pedicle wall [1] and dissect the fibrotic adhesions using mechanical and hydrodissection [2]. ~~Use an endoscopic dissector or probe to create the dissection plane, with saline irrigation or hyaluronate solution to aid in separating the adhesions from the nerve root and dural sac [2].~~ **NOTE: The VO is edited according to the shots**
 - Added shot: Talent decompressing along the pedicle wall. Scope protocol.mp4: 24:49-25:08**
 - 3.4.1. Talent dissecting the fibrotic adhesions using mechanical dissection and hydrodissection. **Scope protocol.mp4: 25:12-25:22**
 - ~~3.4.2. Talent separates the adhesions from the nerve root and the dural sac.~~ **NOTE: Not filmed**
- 3.5. Expose the exiting nerve root [1] and remove the compressive soft tissue surrounding it [2]. If necessary, coagulate and reduce or partially remove the redundant disc material [3].
 - 3.5.1. Talent exposing the exiting nerve root. **Scope protocol.mp4: 25:22-25:32**
 - 3.5.2. Talent removing the compressive soft tissue surrounding the nerve root. **Scope protocol.mp4: 26:03-26:20**
 - 3.5.3. Talent coagulating and reducing or partially removing the redundant disc material. **Scope protocol.mp4: 26:32-26:42**
- 3.6. Manage the disc material according to its pathological configuration [1]. ~~Remove the~~

~~extruded fragments beyond the annulus when they contribute to the nerve root compression [2].~~ Manage the redundant but contained disc tissue with coagulation and shrinkage rather than excision to achieve adequate decompression [3]. **NOTE: The VO is edited for the deleted shot**

3.6.1. Talent assessing the pathological configuration of the disc material. **Scope protocol.mp4: 26:34-25:57**

~~3.6.2. Talent removing the extruded disc fragments beyond the annulus.~~ **NOTE: Not filmed**

3.6.3. Talent coagulating and shrinking the redundant contained disc tissue. **Scope protocol.mp4: 27:10-27:20**

3.7. Perform the circumferential decompression along the nerve root from the shoulder portion to the axillary portion [1]. Extend the release distally toward the lateral exit zone to achieve full-length decompression [2].

3.7.1. Talent performing the circumferential decompression along the nerve root from the shoulder portion to the axillary portion. **Scope protocol.mp4: 27:11-27:22**

3.7.2. Talent extending the release toward the lateral exit zone. **Scope protocol.mp4: 27:50-28:10**

3.8. Confirm the circumferential decompression by verifying that the exiting nerve root is completely exposed and released along its entire course [1]. Confirm visualization of the axillary portion, the origin, the shoulder portion, and the lateral exit zone of the exiting nerve root with no residual compressive structures surrounding the nerve root [2].

3.8.1. Shot of the completely exposed and released exiting nerve root along its entire course. **Capture 3.8.1**

3.8.2. Shot of the axillary portion, the origin, the shoulder portion, and the lateral exit zone of the exiting nerve root with no residual compressive structures visible. **Capture 3.8.2.-(1,2,3,4)**

Video editor: Please use the title card to show the following information

Perform the following procedures:

- Neural Release
- Hemostasis and Endoscopic Visualization
- Confirmation of Complete Decompression
- Wound Closure
- Postoperative Assessment and Monitoring

Results

4. Results

- 4.1. A representative clinical case demonstrated severe right-sided L5–S1 foraminal stenosis on preoperative MRI [1]. Intraoperative fluoroscopy confirmed appropriate placement of the working sheath within the target foramen [2].
 - 4.1.1. LAB MEDIA: Figure 3A. *Video editor: Highlight the area indicated by the white arrow*
 - 4.1.2. LAB MEDIA: Figure 3B.
- 4.2. Postoperative MRI demonstrated enlargement of the foraminal space and complete decompression of the exiting nerve root [1].
 - 4.2.1. LAB MEDIA: Figure 3D.
- 4.3. Initial visualization demonstrated foraminal narrowing associated with hypertrophic bony and soft-tissue structures [1]. Progressive bony unroofing was performed using the facet joint cleft as a key landmark [2].
 - 4.3.1. LAB MEDIA: Figure 4A. *Video editor: Highlight the narrowed opening between the labels 'SAP' and 'facet'.*
 - 4.3.2. LAB MEDIA: Figure 4B.
- 4.4. Subsequent soft-tissue decompression enabled removal of ligamentous and fibrotic compressive elements surrounding the exiting nerve root [1].
 - 4.4.1. LAB MEDIA: Figure 4C.
- 4.5. Final inspection demonstrated complete circumferential decompression with exposure of the axillary zone [1] and shoulder zone [2], free mobilization of the exiting nerve root, and visible nerve root pulsation [3].
 - 4.5.1. LAB MEDIA: Figure 4D. *Video editor: Highlight the area labelled 'axillary'.*
 - 4.5.2. LAB MEDIA: Figure 4D. *Video editor: Highlight the area labelled 'shoulder'.*
 - 4.5.3. LAB MEDIA: Figure 4D. *Video editor: Highlight the structure labelled 'ENR'.*
- 4.6. The patient showed early symptomatic improvement after surgery, with leg pain decreasing from a preoperative visual analog scale score of 8 to 1 at follow-up, allowing an early return to daily activities [1].
 - 4.6.1. LAB MEDIA: Table 1. *Video editor: Highlight the row labelled 'Leg pain (VAS)'*

5. Endoscope
Pronunciation link: <https://www.merriam-webster.com/dictionary/endoscope>
IPA: /'en.də,skoʊp/
Phonetic Spelling: en·duh·skoʊp
6. Decompression
Pronunciation link: <https://www.merriam-webster.com/dictionary/decompression>
IPA: /,di:kəm'preʃ.ən/
Phonetic Spelling: dee·kuhm·presh·uhn
7. Pedicle
Pronunciation link: <https://www.merriam-webster.com/dictionary/pedicle>
IPA: /'ped.ɪ.kəl/
Phonetic Spelling: ped·ih·kuhl
8. Superior articular process
Pronunciation link: No confirmed link found
IPA: /su:'pɪr.i.əʊɑ:r'tɪk.jə.lə'prɑ:.ses/
Phonetic Spelling: soo·peer·ee·er ar·tik·yuh·ler proh·sess
9. Endoscopic burr
Pronunciation link: No confirmed link found
IPA: /,en.də'skɑ:.pɪk bɜ:/
Phonetic Spelling: en·duh·skop·ik bur
10. Cephalad
Pronunciation link: <https://www.merriam-webster.com/dictionary/cephalad>
IPA: /'sef.ə,læd/
Phonetic Spelling: sef·uh·lad
11. Foraminal
Pronunciation link: <https://www.merriam-webster.com/dictionary/foraminal>
IPA: /fə'ræm.ənəl/
Phonetic Spelling: fuh·ram·uh·nuhl
12. Ligamentum flavum
Pronunciation link: <https://www.merriam-webster.com/medical/ligamentum%20flavum>
IPA: /,lɪɡ.ə.men'tu:m 'fleɪ.vəm/
Phonetic Spelling: lig·uh·men·toom flay·vuhm
13. Facet joint cleft
Pronunciation link: No confirmed link found
IPA: /fə'set dʒɔɪnt kleft/
Phonetic Spelling: fuh·set joynt kleft
14. Synovial
Pronunciation link: <https://www.merriam-webster.com/dictionary/synovial>
IPA: /sə'nou.vi.əl/
Phonetic Spelling: suh·noh·vee·uhl
15. Axillary
Pronunciation link: <https://www.merriam-webster.com/dictionary/axillary>
IPA: /'æk.sə,lər.i/
Phonetic Spelling: ak·suh·lair·ee

- 16. Isthmus**
Pronunciation link: <https://www.merriam-webster.com/dictionary/isthmus>
IPA: /'ɪs.məs/
Phonetic Spelling: iss·muhs
- 17. Circumferential**
Pronunciation link: <https://www.merriam-webster.com/dictionary/circumferential>
IPA: /səˌkəm.fə'ren.ʃəl/
Phonetic Spelling: ser·kuhm·fuh·ren·shuhl
- 18. Ligamentous**
Pronunciation link: <https://www.merriam-webster.com/dictionary/ligamentous>
IPA: /ˌlɪɡ.ə'men.təs/
Phonetic Spelling: lig·uh·men·tuhs
- 19. Fluoroscopic**
Pronunciation link: <https://www.merriam-webster.com/dictionary/fluoroscopic>
IPA: /ˌflʊr.ə'skɑːpɪk/
Phonetic Spelling: floor·uh·skop·ik
- 20. Anteroposterior**
Pronunciation link: <https://www.merriam-webster.com/dictionary/anteroposterior>
IPA: /ˌæn.tə.roʊ.pɑː'stɪr.i.ə/
Phonetic Spelling: an·ter·oh·pos·teer·ee·er
- 21. Micropunches**
Pronunciation link: No confirmed link found
IPA: /'maɪ.kroʊ.pʌn.tʃɪz/
Phonetic Spelling: my·kroh·pun·chiz
- 22. Kerrison**
Pronunciation link: <https://www.merriam-webster.com/medical/Kerrison%20rongeur>
IPA: /'ker.ɪ.sən/
Phonetic Spelling: ker·ih·suhn
- 23. Hypertrophic**
Pronunciation link: <https://www.merriam-webster.com/dictionary/hypertrophic>
IPA: /ˌhaɪ.pə'trɑːfɪk/
Phonetic Spelling: hy·per·trof·ik
- 24. Hydrodissection**
Pronunciation link: No confirmed link found
IPA: /ˌhaɪ.droʊ.dar'sek.ʃən/
Phonetic Spelling: hy·droh·dye·sek·shuhn
- 25. Hyaluronate**
Pronunciation link: <https://www.merriam-webster.com/medical/hyaluronate>
IPA: /haɪ.ə'lʊr.əˌneɪt/
Phonetic Spelling: hy·uh·loor·uh·nayt
- 26. Coagulate**
Pronunciation link: <https://www.merriam-webster.com/dictionary/coagulate>
IPA: /koʊ'æg.jəˌleɪt/
Phonetic Spelling: koh·ag·yuh·layt

- 27. Annulus**
Pronunciation link: <https://www.merriam-webster.com/dictionary/annulus>
IPA: /'æn.jə.ləs/
Phonetic Spelling: an·yuh·luhs
- 28. Extruded**
Pronunciation link: <https://www.merriam-webster.com/dictionary/extrude>
IPA: /ɪk'struː.dɪd/
Phonetic Spelling: ik·stroo·did
- 29. Neural**
Pronunciation link: <https://www.merriam-webster.com/dictionary/neural>
IPA: /'nɔr.əl/
Phonetic Spelling: noor·uhl
- 30. Hemostasis**
Pronunciation link: <https://www.merriam-webster.com/dictionary/hemostasis>
IPA: /,hiː.mə'steɪ.sɪs/
Phonetic Spelling: hee·muh·stay·sis
- 31. Foraminal stenosis**
Pronunciation link: No confirmed link found
IPA: /fə'ræm.ə.nəl stə'noʊ.sɪs/
Phonetic Spelling: fuh·ram·uh·nuhl stuh·noh·sis
- 32. Intraoperative**
Pronunciation link: <https://www.merriam-webster.com/dictionary/intraoperative>
IPA: /,ɪn.trə'ɑː.pə.ə.tɪv/
Phonetic Spelling: in·truh·op·er·uh·tiv
- 33. Hypertrophic**
Pronunciation link: <https://www.merriam-webster.com/dictionary/hypertrophic>
IPA: /,haɪ.pə'trɑː.fɪk/
Phonetic Spelling: hy·per·trof·ik
- 34. Fibrotic**
Pronunciation link: <https://www.merriam-webster.com/dictionary/fibrotic>
IPA: /fəɪ'brɑː.tɪk/
Phonetic Spelling: fy·brot·ik
- 35. Visual analog scale**
Pronunciation link: <https://www.merriam-webster.com/dictionary/visual%20analog%20scale>
IPA: /'vɪʒ.u.əl 'æn.ə'lɔːg skeɪl/
Phonetic Spelling: vizh·oo·uhl an·uh·log skayl