Dorsal Endoscopic Lumbar Rhizotomy
A Review of Outcomes and Literature

- John A. Yarjanian D.O., M.S.
  Assistant Professor
  University of Michigan Department of PM&R

AOCPMR Conference
Thursday, April 9, 2015
San Antonio TX

No disclosures
Radiofrequency Rhizotomy - History

- Introduction in 1975 by Shealy.
  - 207 patients
  - 6 to 21 months (mean 31 months)
  - Relief of pain was achieved in
    - 79% of previously non surgical patients
    - 41% with prior laminectomy but no fusion
    - 27% with prior fusion.

No neurological complications were encountered.
Anatomical Overview – Facet Joint

Paired Diarthroidial Articularion between vertebrae
Syovial Membrane
Hyaline Cartilage Surface
Fibrous Capsule
Accommodate 1.0-1.5 cc fluid
Back pain upon mechanical or chemical stimulation
Dual innervation by medial branch of dorsal ramus
Endoscopic Rhizotomy – Rationale and History

- Ablates a larger area of the transverse process where the medial branch crosses to innervate the facet.

- Denature nerves innervating facet joint, and block (destroy) afferent pathway

- Endoscopically guided visualization provides confirmation of nerve ablation or transection in the most common location of the branches of the dorsal ramus innervating the facet joint.

- Minimal outcomes date and clinical evidence

- International Studies –
  - South Korea, Germany, India.

- Evolving technique
Yeung and Gore, 2014 ISASS

- Retrospective non-randomized study/ Non IRB Approved
- *Compared to fluoroscopically guided pulsed RFA*
- 50 initial patients with lumbar spondylosis, facet arthrosis
- 50% relief by medial branch blocks
- Special designed endoscope
- Low temperature
- High frequency (1.7-4.0 MHz)
- Follow up 1 year to 22 months
- Non ISIS Guideline –
  - Six sites treated with 10 cc bolus of .5% Marcaine mixed with 2 ml 80 mg of depomedrol (12 cc total ).
  - 2 cc was then injected to 6 sites at 3 levels on the transverse process bilaterally
  - Purpose was to achieve a “wider block” – in accordance with that of the endoscopic approach
Yeung and Gore, 2014 ISASS

- 400 subsequent patients added to study May 2013
- 75% relief by medial branch blocks – patients reporting 70-90% relief with MBB’s were more satisfied with RFA results.
- Technique guided by study of cadaveric variations
- Variable locations of dorsal ramus including medial branch
- Authors content anatomic variation merit need for visualization

Inclusion Criteria
- Lumbar DDD
- Lumbar Spondylosis
- Axial Lumbar Pain worsened with Extension and Rotation
- Adjacent segment degeneration status post fusion
Yeung and Gore, 2014 ISASS

Results

- One and two year follow up
- VAS improved 6.2-2.5
- Oswestry scores decreased 48-28
- All subjects with VAS improvement equal to or greater than MBB – ie, no patient was worse
- Results improved with improved technique and greater anatomical visualization (anecdotal)
- Mild recurrence of axial back pain in approximately 10% at two years
- No return to baseline axial low back pain at two years
- Additional rhizotomy at other levels undertaken in few patients
- Level 3 evidence
Level 3 Evidence Yeong and Gore

Level 3 (lacking direct) Evidence - representing reports that are not based on scientific analysis of clinical outcomes. Examples include case series, case reports, expert opinion, and conclusions extrapolated indirectly from scientific studies.
Considerable variability in location of medial and lateral branches of the dorsal primary ramus

Variability most common cephalad to L3-4

Dorsal ramus and branches can also be visualized in the foramen ventral to the intertransverse ligament

Neuromas and entrapment of the dorsal ramus identified endoscopically, and confirmed by H and E slides

Lack of consistency of medial branch location in the upper lumbar segments

Medial branch to facet does not always cross transverse process

Some branches enter the facet joint before crossing the transverse process adjacent to the tip of the SAP

The nerve can be mistaken for a furcal nerve or foraminal ligament

Nerve Ablation L3-4 or above may require lesioning of the dorsal ramus on the facet wall, pedicle or capsule.
Endoscopic RFA provides more consistent ablation of the medial branch and lateral branch of the dorsal ramus compared to pulsed RFA.

Variations in facet innervation can explain variable outcomes in fluoroscopically guided pulsed RFA.

Normal and variant anatomy contribute to clinical and surgical understanding of the innervation of the facet joint.

Current fluoroscopically guided radiofrequency techniques had technical and anatomic limitations.
RF probe ventral to the transverse process plane, penetrate the inter-transverse ligament.

Temporary dysesthesia only experienced in surgery or for a few hours or days post-op.

No permanent complications and no infections.
Foraminal View of Branch of Dorsal Ramus
Yeung et al, 2013

In foramen at SAP
Nerve courses the ventral lateral aspect of the superior facet to the tip
May course in the vicinity of the foraminal ligament.
Attempt preservation of medial branch without transection
Transection of nerve
Branches of the dorsal ramus originate in the foramen before crossing transverse process – difficult to differentiate from furcal nerves originating from spinal nerve
Facet Innervation – Furcal Nerves
Kambin’s Triangle  Yeung et al, 2013

Nerves in the foramen described as “furcal nerves” are branches from the dorsal ramus.
Includes medial branch before it exits to cross the transverse process transforaminally.

Medial branch may be visualized and transected/ablated
1. In the foramen
2. Interosseous tunnel crossing the transverse process.
Al-Hadi et al., November 2013

Annual Meeting of the German Spine Society

- E-RFA on previous pain relief of at least 50% on the numeric analog scale (NAS)
- Based on response to facet joint injections.
- The primary clinical outcome was evaluated as relative difference at discharge, and at the first follow-up after 8 weeks
- 33 patients
- Average age 60
- 88 lumbar facet joints and 12 sacroiliac joints
- At discharge, 28 of 33 patients (84%) and at follow-up 26 of 33 (78%) patients reported a pain relief of > 50% on the NAS.
- One patient complained of postoperative newly acquired painful dysesthesia in the leg.
- Average time per treated joint was 17 minutes (7.5 to 62 minutes).
Target Point For Endoscopic Dorsal Ramus Rhizotomy
Zhen-Zhou et al, 2014

- **TP** - Transverse Process
- **AP** - Accessory Process
- **MAL** – Mammillar-accessory ligament
- **MB** – Medial Branch
Prospective study
58 patients – 45 Endoscopic RFA, 13 NSAIDS, PT, CBT
One year follow up

Inclusion Criteria
Low back pain at least 3 months duration
Back pain upon rotation, and from flexion to extension
Lumbar instability, spondylolisthesis, scoliosis, facet arthropathy
Greater than 80% relief with two comparative MBB’s with lidocaine and bupivacaine.

Exclusion Criteria
Radicular pain
Infection, tumor, trauma
Target junction at base of SAP and TP

18 guage needle docked into target point

Target point injected with 2 ml of solution
- 1.6 ml Omnipaque
- 0.4 ml Methylene Blue

Guide wire, soft tissue dilator, and beveled working cannula inserted.

Forceps used to remove fatty tissue between muscles.

Normal anatomical morphology of medial branch of the dorsal ramus of the spinal nerve
Post Rhizotomy patients followed 1 day, 3 months, 6 months, and 12 months post-operatively

- VAS 0-10 scale used to score pain
- Percentage of pain relief:
  \[
  \text{Percentage of pain relief} = \left( \frac{\text{VAS score after treatment} - \text{VAS score before}}{\text{VAS score before}} \right) \times 100
  \]

- McNab Score:
  - Excellent: 75-100% pain relief
  - Good: 50-74%
  - Fair: 25-49%
  - Poor: 0-24%

Chi square test for relation of qualitative variables
Statistical significance with \( p < 0.05 \)
Post Operative Outcomes

- 45 patients
- No complications
- Observed anatomical variants of dorsal ramus including number, thickness, and positioning.
- Relief of back pain and referred pain at any time post operatively in the RFA group was higher in comparison to the conservative treatment group (p < 0.01)

Excellent and Good Mc Nab outcomes at 1 year

- Operation (rhizotomy) group at 97.8%, significantly higher than conservative group (p <0.01)
- History of lumbar surgery including fusion at 91.7%

Relief of distant pain referral

- 27/58 cases (46.6%) had referred pain into buttock and legs
- 22/58 cases (37.9%) with distant lower extremity pain referral
Conclusions

Require further prospective studies with larger sample sizes

Previous study reports effectiveness of percutaneous lumbar medial branch rhizotomy 43-80%

Endoscopic visualization improves outcomes of lumbar rhizotomy.
   Directly denatures medial branch with greater accuracy
   Reduces possibility (rate?) of nerve regeneration
   Low recurrence rate
   Recurrence rate of 2.2% at one year (Zhen-Zhou et al)

Failure rate of conventional RFA relates to
   Technical skill and experience of interventionalist
   Anatomical variations of medial branch of dorsal ramus
   Incorrect electrode placement due to variability or technical skill
   Incomplete ablation
   Nerve regeneration
Puncture Needle Docked into dorsal region of transverse process
Zhen-Zhou et al, 2014
Richard Wolfe Rhizotomy Set
Cannula, Endoscope, Bi-Tip and Bipolar RF Probes
Yeung and Gore, 2013
Technique Steps 1 and 2, Richard Wolfe

1. Position the Patient

Use a radiolucent table, preferably with a kyphotic frame. Position the patient with the lumbar spine level to the floor. Rotate the patient so that the spinous processes are centered between the pedicles on AP images.

2. Mark Guide Lines (Optional)

If helpful, draw guide lines to assist in placing the needles. Using the C-arm, mark the following lines on the patient’s skin:

1. Transverse lines across disc spaces to assist in obtaining exact lateral views.
2. Longitudinal line down the spinous processes to identify midline.
3. Longitudinal lines down the lateral borders of the pedicles to aid in the medial-lateral positioning of needles.
4. Transverse lines along the centers of the transverse processes of each level to be addressed. This will assist in cephalad-caudal positioning of the needles.
3. Insert Spinal Needles

Under C-arm guidance, direct the spinal needles straight down onto the transverse process. Place the needles just lateral to the facet, and center them cephalo-caudally. (Directing the needles slightly more cephalad may help in accessing the lateral branch, but care should be taken to avoid the intertransverse space.)

Place one needle at each level to be addressed. The needles will pass between the longissimus and multifidus muscles.
4. Inject Indigocarmine Dye

Mix Isovue with indigocarmine dye in a ratio of 9:1 and inject it through each placed spinal needle.

The indigocarmine dye stains the area blue and makes it easier to identify the intertransverse ligament. Staining dorsal to the intertransverse ligament helps prevent bleeding and damage to the dorsal root ganglion which can cause post-operative dysesthesia.

The Isovue dye can demonstrate a communication through the foramen.
5. Insert the Dilator

Working one level at a time, replace the needle with a guide wire. Make a small incision and insert the dilator over the guide wire until the tip touches the transverse process. Remove the guide wire.

Wand the dilator cephalad and caudal to create a tissue plane between the multifidus and longissimus (to aid in visualizing the intermediate and lateral branches). Be sure to return the tip of the dilator to the transverse process.
6. Insert the Working Sleeve

Attach the fluid adapter to the working sleeve and ensure the valve on the fluid adapter is open. (Optionally connect suction to the fluid adapter.) Place the working sleeve over the dilator and rotate the bevel of the sleeve toward the facet joint. (The bevel is aligned with the rectangular bar marked on the proximal end of the sleeve.) Remove the dilator.

The working sleeve can be changed over the dilator as conditions warrant. Four sleeves are available with different tips and working lengths:

- The 110 mm working length gives the widest field of view
- The 120 mm working length prevents the endoscope lens from contacting tissue and becoming obscured.
- The beveled tip provides a convenient window for working with the Bi-Tip FlexTrode RF probe.
- The flat tip keeps blood and surrounding tissue out of the view.

Working Sleeves:

- Beveled Tip, 110 mm WL . . . . . . . . . . . . . . . . . . . . . . 89220.7017
- Flat Tip, 110 mm WL . . . . . . . . . . . . . . . . . . . . . . . 88100.7017
- Beveled Tip, 120 mm WL . . . . . . . . . . . . . . . . . . . . . 89220.3007
- Flat Tip, 120 mm WL . . . . . . . . . . . . . . . . . . . . . . . 88100.3007
- Fluid Adapter . . . . . . . . . . . . . . . . . . . . . . . . . . . . 89220.1307
7. Remove Soft Tissue with the Ronguer

Insert the rongeur in the working sleeve and remove the fat and soft tissue at the end of the sleeve. This fat (which contains small nerve branches) is found in the intermuscular plane between the longissimus and multifidus.

At this time, the rongeur may also be used to remove fibrous tissue from the transverse process. When doing so, the position of the rongeur should be confirmed with the C-arm.

This step can also be performed later under endoscopic visualization.

Rongeur ........................................ 89240.3003
8. Coagulate with the Trigger-Flex (Optional)

The Trigger-Flex RF probe can be used in addition to the Bi-Tip FlexTrode. If desired, use the Trigger-Flex through the working sleeve to coagulate bleeders. Additionally, use the Trigger-Flex to ablate tissue on the transverse process. This step can also be performed later under endoscopic visualization using the Trigger-Flex (step 10) or the Bi-Tip FlexTrode (step 11).

Trigger-Flex Probe: ........................................ 4793.692
Surgi-Max Plus ........................................ 2345.0011
9. Insert the Spine Endoscope

Connect the endoscope camera, the light cable, and the irrigation tube to the Spine Endoscope. Insert the tip of the endoscope into the working sleeve. Visualize the tissue on the transverse process, looking specifically for the medial branch just lateral to the facet joint and the lateral branch on the cephalad border of the transverse process.

Short Vertebrais Spine Endoscope .................................. 89210.7253

Optional: Sealing Attachment ........................................... 8792.451
Optional: Qui-Connect Adapter ........................................ 8791.751
10. Ablate Tissue with the Trigger-Flex (Optional)

If using the Trigger-Flex RF probe, ablate tissue on the transverse process, coagulate bleeders and cut nerves. It is possible that the medial branch will be cut in this process. Optionally, move cephalad and ablate tissue on the superior portion of the transverse process, potentially ablating the lateral branch.
11. Cut Nerve Branches Using the Bi-Tip FlexTrode

Using the Bi-Tip FlexTrode under endoscopic visualization, the branches of the dorsal ramus may be identified and transected. Being able to visualize and cut larger branches may lead to longer lasting results.

As the curved tip of the Bi-Tip FlexTrode emerges from the bevel of the working sleeve, it is able to access structures on the transverse process.

With the bevel of the working sleeve facing the base of the SAP, look for the medial branch and transect it if still intact. Trace the medial branch back toward the dorsal ramus, looking for other branches.

Rotate the bevel of the working sleeve toward the cephalad border of the transverse process, look for the lateral branch, and transect it if still intact. Trace the lateral branch back toward the dorsal ramus, looking for other branches.

Optionally, the Bi-Tip can be swept around in a circle to cut through the tissue in an approximately 1 cm arc. Even though the branches are not always visualized, they are usually transected by the described techniques.

Throughout the procedure, take care to stay dorsal to the intertransverse ligament. Small vessels and the dorsal root ganglion lie deep to the ligament and, if disrupted, can cause bleeding and neuroma formation. Note: the dorsal ramus itself is often deep to the intertransverse ligament and may not be visualized.

Bi-Tip FlexTrode .......... .47220.7105
12. Repeat at Each Level

Repeat the procedure at each level until all dorsal rami have been addressed. Inject Steroids (Depo-Medrol) and anesthetic (Bupivicaine 0.5%) at each site.

Close the Incisions

Using a Steri-Strip or, optionally, a single suture, close each incision.


Siddiqi et al. Five Year Long Term Results of Endoscopic Dorsal Ramus Rhizotomy and Anatomic Variations of the Painful Lumbar Facet Joint. SMISS 2013 Annual Conference.

