Lumbar RFN: Does it lead to more rapid DDD?

Matthew Smuck, MD
Associate Professor
Chief, PM&R
Stanford University

3-17-12
26th Annual Update in PM&R
DISCLOSURES

- Consulting
  - Arthrocare
  - EMKinetics

- Research support
  - Cytonics
WHAT IS MY BIAS?

- Good or Bad?
  - Facet joint injection
  - Medial branch RFN
FACET JOINT INJECTION

- Good or Bad?
  - Outcomes

- Patient selection

- Consequences
FACET JOINT INJECTION

• Good or Bad?
  • Outcomes
    • Mixed results
  • Patient selection
  • Consequences
FACET JOINT INJECTION

- Good or Bad?
  - Outcomes
    - Mixed results
  - Patient selection
    - Poor
  - Consequences
FACET JOINT INJECTION

• Good or Bad?
  • Outcomes
    • Mixed results
    • Good
  • Patient selection
    • Poor
    • Good
  • Consequences
FACET JOINT INJECTION

- Good or Bad?
  - Outcomes
    - Mixed results
    - Good
  - Patient selection
    - Poor
    - Good
  - Consequences
    - Cartilage injury
    - Chondrocyte toxicity
MEDIAL BRANCH RFN

- Good or Bad?
  - Outcomes
- Patient selection
- Consequences
MEDIAL BRANCH RFN

- Good or Bad?
  - Outcomes
    - Good
  - Patient selection
  - Consequences
MEDIAL BRANCH RFN

- Good or Bad?
  - Outcomes
    - Good
  - Patient selection
    - Good
  - Consequences
MEDIAL BRANCH RFN

- Good or Bad?
  - Outcomes
    - Good
  - Patient selection
    - Good
  - Consequences
    - Medial Branch Neurotomy
MEDIAL BRANCH RFN

- Target specific
  - Afferent nerve fibers

- What are the potential concerns?
  - Altered segmental proprioception
  - Multifidus denervation
  - Altered segmental control/stability
MEDIAL BRANCH RFN

• Target specific
  • Afferent nerve fibers

• What are the potential RESEARCH ?’s
  • Altered segmental proprioception
  • Multifidus denervation
  • Altered segmental control/stability
MEDIAL BRANCH RFN

- Target specific
  - Afferent nerve fibers

- What are the potential RESEARCH ?’s
  - Altered segmental proprioception
  - Multifidus denervation
  - Altered segmental control/stability

- Easier research ?’s
  - Changes in:
    - Multifidus size
    - Segmental anatomy
Morphologic changes in the lumbar spine following lumbar medial branch RFN: A quantitative radiologic study

Smuck M, Crisostomo RA, Demirjian R, Kennedy DJ, Geisser ME.

- **Design**
  - Retrospective Single Cohort
    - All lumbar RFN patients during 6-year period

- **Hypothesis**
  - RFN leads to
    - A large measureable decrease in multifidus muscle size
    - A small measureable increase in facet joint arthropathy
MRI CHANGES POST RFN

• Methods
  • Inclusion
    • Lumbar RFN
    • Pre- and Post-treatment MRI
  • Exclusion
    • Outside MRI

• N = 27
MRI CHANGES POST RFN

- Outcome Measures
  - Interval change in:
    - Multifidus size
    - Facet joint degeneration
    - Disc degeneration

- Controls
  - Segmental levels unaffected by RFN
OUTCOME MEASURES

- Multifidus CSA
OUTCOME MEASURES

- Multifidus CSA

Image J
OUTCOME MEASURES

- Multifidus CSA
OUTCOME MEASURES

- Multifidus CSA

Bilateral L4-5 and L5-S1

Fat-subtracted CSA

Image J: grayscale
OUTCOME MEASURES

- Facet joint degeneration
  - Weishaupt disease severity grading scale*

<table>
<thead>
<tr>
<th>Grade</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Normal facet joint space (2–4 mm width)</td>
</tr>
<tr>
<td>1</td>
<td>Narrowing of the facet joint space (&lt; 2 mm) and/or small osteophytes and/or mild hypertrophy of the articular process</td>
</tr>
<tr>
<td>2</td>
<td>Narrowing of the facet joint space and/or moderate osteophytes and/or moderate hypertrophy of the articular process and/or mild subarticular bone erosions</td>
</tr>
<tr>
<td>3</td>
<td>Narrowing of the facet joint space and/or large osteophytes and/or severe hypertrophy of the articular process and/or severe subarticular bone erosions and/or subchondral cysts</td>
</tr>
</tbody>
</table>

Bilateral L1-2 to L5-S1

OUTCOME MEASURES

- Disc degeneration
  - Pfirrmann grading scale*

<table>
<thead>
<tr>
<th>Grade</th>
<th>Appearance on FSE T2W sag images of spine</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Structure of disc is homogeneous, with bright, hyperintense, white signal intensity and a normal disk height.</td>
</tr>
<tr>
<td>II</td>
<td>Structure of disc is inhomogeneous, with hyperintense, white signal intensity. The distinction between the annulus and nucleus is clear, &amp; the disk height is normal, with or without horizontal gray bands.</td>
</tr>
<tr>
<td>III</td>
<td>Structure of the disc is inhomogeneous with intermediate, gray signal intensity. The distinction between the annulus and nucleus is unclear and the disk height is normal or slightly decreased.</td>
</tr>
<tr>
<td>IV</td>
<td>Structure of the disc is inhomogeneous with hypointense, dark gray signal intensity. The distinction between the annulus and nucleus is lost and the disk height is normal or moderately decreased.</td>
</tr>
<tr>
<td>V</td>
<td>Structure of the disc is inhomogeneous with hypointense, black signal intensity. The distinction between the annulus and nucleus is lost and the disc space is collapsed.</td>
</tr>
</tbody>
</table>

L1-2 to L5-S1

The Significance of Multifidus Atrophy After Successful Radiofrequency Neurotomy for Low Back Pain

Paul Dreyfuss, MD, Alison Stout, DO, Charles Aprill, MD, Steve Pollei, MD, Blake Johnson, MD, Nikolai Bogduk, MD, PhD

Objective: To determine the presence of lumbar multifidus atrophy and pain after successful lumbar medial branch radiofrequency neurotomy for zygapophysial joint mediated pain.

Design: A prospective observational analysis of 5 patients who had undergone successful unilateral radiofrequency neurotomy (RFN) of the lumbar medial branch divisions of the lumbar dorsal rami. At 17 to 26 months after RFN, 3 blinded radiologists evaluated the relative composition and size of the multifidus muscle at different segmental levels on lumbar magnetic resonance imaging (MRI). They were asked to determine the lesioned levels by evidence of multifidus atrophy. The accuracy of predicting the correct side and level lesioned was evaluated.

Setting: Private spine practice in Tyler, Texas.

Patients: Five patients who had unilateral lumbar medial branch RFN for proven lumbar zygapophysial joint-mediated pain were selected.

Interventions: MRI of the lumbar spine at a mean of 21 months (range, 17-26) after successful lumbar RFN.

Outcome Measures: Multifidus atrophy on a lumbar MRI, pain assessment and use of cointerventions.

Results: Diffuse lumbar multifidus atrophy was detectable with MRI. However, radiologists could not reliably predict the side and segments lesioned. Despite denervation of the multifidus, at 12 months after RFN all subjects had ongoing pain relief and did not require or request additional treatment.

Conclusions: This preliminary study provides evidence that successful medial branch RFN for lumbar zygapophysial-mediated pain does cause initial denervation but no discernable segmental atrophy of the multifidus at long-term follow-up. Previous denervation and diffuse atrophy in these subjects was not associated with pain.
MRI CHANGES POST RFN

• Results
  • Pre- and Post-tx QUANTITATIVE measures of:
    • Multifidus size
    • Facet joint degeneration
    • Disc degeneration
  • Controls !!
MRI CHANGES POST RFN

- Analysis
  - Treatment = levels affected
  - Controls = levels unaffected

<table>
<thead>
<tr>
<th>Structure</th>
<th>Affected levels</th>
<th>Unaffected levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervertebral disc</td>
<td>L4-5</td>
<td>L1-2, L2-3, L3-4, L5-S1</td>
</tr>
<tr>
<td>Zygapophyseal joint</td>
<td>Right L4-5</td>
<td>Left L4-5 &amp; bilateral L1-2, L2-3, L3-4, L5-S1</td>
</tr>
<tr>
<td>Mutifidus muscle</td>
<td>Right L4-5 and L5-S1</td>
<td>Left L4-5 and L5-S1</td>
</tr>
</tbody>
</table>

Table 1. – All MRI measurements were placed into one of two groups: levels affected by RFN treatment or levels unaffected. The table demonstrates the classification of the different segmental measures in the case of a right L3 and L4 medial branch RFN.
MRI CHANGES POST RFN

• Statistical Analysis
  • Facet and Disc degeneration
    • Categorical outcome = same or worse
    • Spearman rank-order correlations examined relationships with covariates:
      • age, gender, time between the first and second MRI
    • Logistic regression analysis
  • Multifidus CSA
    • Continuous outcome
    • Pearson correlations examined relationships with covariates:
      • age, gender, time between the first and second MRI
    • Hierarchical Linear Modeling (HLM)
MRI CHANGES POST RFN

- Results
  - N = 27

- MRI timing (mean)
  - Pre-MRI to RFN  →  12.7 mo
  - RFN to Post-MRI  →  7.5 mo
  - Pre- to Post- MRI  →  22 mo
Results

- N = 27

<table>
<thead>
<tr>
<th>Level affected by RFN</th>
<th>Number of patients</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>L3-L4</td>
<td>3</td>
<td>11.1%</td>
</tr>
<tr>
<td>L4-L5</td>
<td>20</td>
<td>74.1%</td>
</tr>
<tr>
<td>L5-S1</td>
<td>22</td>
<td>81.5%</td>
</tr>
</tbody>
</table>
MRI CHANGES POST RFN

• Results
  • Multifidus CSA
    unaffected (n=59)
    affected (n=47)

  p = 0.06

Included as covariates in the analysis:
  Older age (r = -0.30, p = 0.002) and female gender (r = -0.26, p = 0.007)  
  (Pearson correlations)
MRI CHANGES POST RFN

• Results
  • Interval increase in FACET degeneration grade
    • 9.74% at unaffected levels (19/195)
    • 6.76% at affected levels (5/74)

  $p = 0.63$
MRI CHANGES POST RFN

• Results
  • Interval increase in DISC degeneration grade
    unaffected (4/88)
    affected (7/47)

\[ p < 0.05 \]
MRI CHANGES POST RFN

- Disc Degeneration after RFN
  - Surprising finding?
MRI CHANGES POST RFN

- Disc Degeneration after RFN
  - Surprising finding?

- What are the potential RESEARCH ?’s
  - Altered segmental proprioception
  - Multifidus denervation
  - Altered segmental control/stability
MRI CHANGES POST RFN

- Disc Degeneration after RFN
  - Surprising finding?

- What are the potential RESEARCH ?’s
  - Altered segmental proprioception
  - Multifidus denervation
  - Altered segmental control/stability

- Is there another possible answer?

<table>
<thead>
<tr>
<th>Level affected by RFN</th>
<th>Number of patients</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>L3-L4</td>
<td>3</td>
<td>11.1%</td>
</tr>
<tr>
<td>L4-L5</td>
<td>20</td>
<td>74.1%</td>
</tr>
<tr>
<td>L5-S1</td>
<td>22</td>
<td>81.5%</td>
</tr>
</tbody>
</table>
Morphologic changes in the lumbar spine following lumbar medial branch RFN: A quantitative radiologic study

Smuck M, Crisostomo R, Demirjian R, Kennedy DJ, Geisser M.

- **Strengths**
  - Largest N
  - Pre- and Post-tx MRIs
  - Control levels
  - Quantitative and validated outcome measures

- **Weaknesses**
  - Timing of MRIs not standardized
  - Single physician rater
  - Post-MRI for clinical reasons
    - Bias toward >change
Morphologic changes in the lumbar spine following lumbar medial branch RFN: A quantitative radiologic study

Smuck M, Crisostomo R, Demirjian R, Kennedy DJ, Geisser M.

• Conclusion

• Are the risks of RFN greater than those previously known?

• How does this impact your practice?
Thank You!

Matthew Smuck, MD

msmuck@stanford.edu

STANFORD UNIVERSITY SPINE CENTER