Evaluating the Effect of an Off-the-Shelf Hip Orthosis on Balance in Post-operative Hip Arthroscopy: A Pilot Study

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  ▪ Stock: Johnson & Johnson
  ▪ Research Support: Bauerfeind
  ▪ Department Support: Smith & Nephew Endoscopy, Depuy, Mitek
  ▪ Boards/Committees: AOSSM, ISHA, AANA

▪ All other authors report no declarations of interest

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Background

▪ Hip orthoses commonly utilized in post-op rehab

▪ Primary functions
  ▪ Restrict range of motion
  ▪ Protect compromised tissue
  ▪ Role in balance?

▪ Limitations in literature
  ▪ Variations in post-op rehab protocols
  ▪ Lack of randomized control trials
  ▪ Expert opinion

Methods

▪ Patient Selection
  ▪ Wake Forest Baptist Medical Center
  ▪ Hip arthroscopy for pathology associated with FAI

▪ Data Collection
  ▪ WFU Human Performance and Biodynamics Laboratory
  ▪ Four weeks post-operative appointment

▪ Off-The-Shelf Hip Orthosis
  ▪ Sof-Tec Coxa®, Bauerfeind AG, Zeulenroda, Germany

Methods

▪ Initial testing side and bracing status randomized

▪ Unbraced trials
  ▪ Alternated between legs
  ▪ Separated by at least one minute of rest

▪ Braced trials
  ▪ Limited to one leg
  ▪ Separated by at least two minutes of rest

▪ Three valid trials recorded for each condition or until six unsuccessful attempts per condition

▪ Two best trials included in final data analysis
Methods

- MatLAB® Software
  - Mathworks, Natick, MA
- Center of pressure trajectory
- Ground reaction forces
  - $F_x$, $F_y$, $F_z$
- Ground reaction moments
  - $M_x$, $M_y$, $M_z$
- Stabilograms

Results: Demographics

<table>
<thead>
<tr>
<th></th>
<th>IMPROVED (N=10)</th>
<th>WORSENED (N=7)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>9F / 1M</td>
<td>7F / 0M</td>
<td>0.17</td>
</tr>
<tr>
<td>Age (yrs)</td>
<td>25.27 ± 5.61</td>
<td>28.29 ± 7.11</td>
<td>0.17</td>
</tr>
<tr>
<td>Height (m)</td>
<td>1.66 ± 0.05</td>
<td>1.68 ± 0.04</td>
<td>0.27</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>68.35 ± 15.23</td>
<td>64.04 ± 4.57</td>
<td>0.24</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>24.66 ± 4.99</td>
<td>22.75 ± 2.03</td>
<td>0.18</td>
</tr>
</tbody>
</table>

Data presented as mean ± SD

Results: Braced vs. Unbraced

- Patients improved by average 16% (82.25 mm²)
- Patients worsened by average 18% (110.29 mm²)

<table>
<thead>
<tr>
<th></th>
<th>IMPROVED (N=10)</th>
<th>WORSENED (N=7)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Braced COPEA (mm²)</td>
<td>426.64 ± 22.71</td>
<td>616.06 ± 75.89</td>
<td>0.002</td>
</tr>
<tr>
<td>Unbraced COPEA (mm²)</td>
<td>508.89 ± 31.95</td>
<td>550.77 ± 28.18</td>
<td>0.04</td>
</tr>
</tbody>
</table>

Data presented as mean ± SD

Results: Pre-Op Physical Exam

- No differences between improved vs. worsened patients

<table>
<thead>
<tr>
<th></th>
<th>IMPROVED (N=10)</th>
<th>WORSENED (N=7)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain Duration (min)</td>
<td>16.50 ± 11.11</td>
<td>10.71 ± 5.35</td>
<td>0.22</td>
</tr>
<tr>
<td>Hip Flexion (deg)</td>
<td>91.70 ± 13.33</td>
<td>91.43 ± 16.14</td>
<td>0.49</td>
</tr>
<tr>
<td>Hip Internal Rotation (deg)</td>
<td>6.50 ± 5.80</td>
<td>10.00 ± 5.77</td>
<td>0.12</td>
</tr>
</tbody>
</table>

Data presented as mean ± SD

Results: Pre-Op Radiographic Indices

- No differences between improved vs. worsened patients

<table>
<thead>
<tr>
<th></th>
<th>IMPROVED (N=10)</th>
<th>WORSENED (N=7)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Center Edge Angle</td>
<td>35.70 ± 4.83</td>
<td>29.29 ± 9.55</td>
<td>0.08</td>
</tr>
<tr>
<td>Lateral Center Edge Angle</td>
<td>28.40 ± 5.30</td>
<td>28.43 ± 5.32</td>
<td>0.50</td>
</tr>
<tr>
<td>Acetabular Index</td>
<td>38.80 ± 6.56</td>
<td>42.71 ± 3.35</td>
<td>0.08</td>
</tr>
</tbody>
</table>

Data presented as mean ± SD
Results: Intra-Op Findings

- No differences between improved vs. worsened patients

<table>
<thead>
<tr>
<th></th>
<th>IMPROVED (N=10)</th>
<th>WORSENED (N=7)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSI Acetabulum</td>
<td>361.65 ± 236.52</td>
<td>201.14 ± 65.19</td>
<td>0.66</td>
</tr>
<tr>
<td>CSI Femoral Head</td>
<td>163.55 ± 146.75</td>
<td>172.00 ± 289.32</td>
<td>0.47</td>
</tr>
<tr>
<td>CSI Total</td>
<td>525.20 ± 377.89</td>
<td>373.14 ± 289.70</td>
<td>0.19</td>
</tr>
<tr>
<td>IP Release (Y/N)</td>
<td>7 / 3</td>
<td>6 / 1</td>
<td></td>
</tr>
</tbody>
</table>

Data presented as mean ± SD

Conclusions

- Some patients benefit from off-the-shelf bracing in the form of balance control

- Certain patients benefit from the protective range of motion function of the brace early on in the rehab cycle, but should come out of the brace when achieving independent ambulation

- Future research needed to define the role of a custom (vs. off-the-shelf) hip orthosis for the group that did not show benefit at four weeks after surgery

Literature Cited


Questions
Risk Factors for Infection following Knee Arthroscopy: Analysis of a Large U.S. Cohort

Carter Clement, Kevin Haddix, Alexander Creighton, Jeffrey Spang, Joshua Tennant, Ganesh Kamath


Background

• Knee arthroscopy is extremely common
• Infections rare
  – Cited as low as 0.04%
  – But potentially devastating
• Risk factors for infection unknown
  – Historically difficult to study due low incidence

Goal

To identify risk factors for infection following knee arthroscopy

Methods

• An administrative healthcare database was used
  – Pearldiver, Fort Wayne, IN, USA
  – Complete records from a large private insurer
  – 5% Medicare sample
• Patients identified by CPT code
  – 20 codes representing knee arthroscopy procedures

Methods

• Infections developed within 90 days
• Deep infections
  – CPT code for I&D
• Superficial infections
  – ICD-9 infection code without CPT for I&D

Methods

• Patients identified by CPT codes
  – 20 codes representing knee arthroscopy procedures
  – Closed procedures considered low-risk (13)
    • e.g. synovectomy, chondroplasty, microfracture
  – Partially open procedures considered high-risk (7)
    • e.g. mosaicplasty or ACL/PCL

Methods

• Patients identified by CPT codes
  – 20 codes representing knee arthroscopy procedures
  – Closed procedures considered low-risk (13)
    • e.g. synovectomy, chondroplasty, microfracture
  – Partially open procedures considered high-risk (7)
    • e.g. mosaicplasty or ACL/PCL
Methods

- Infected vs. non-infected patients compared by:
  - Age
  - Sex
  - Diabetes
  - Overweight/obesity
  - Tobacco use
  - Comorbidities (using Charlson Index)
  - High-risk vs. low-risk procedures

Results

- 433,423 patients underwent 501,691 knee scopes
- Deep infection rate 0.20%
- Superficial infection rate 0.26%

<table>
<thead>
<tr>
<th></th>
<th>Median (IQR)</th>
<th>Compared to “No Infection”</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Infection</td>
<td>2 (0,3)</td>
<td>-</td>
</tr>
<tr>
<td>Deep Infection</td>
<td>1 (0,2)</td>
<td>P = 0.074</td>
</tr>
<tr>
<td>Superficial Infection</td>
<td>1 (0,3)</td>
<td>P &lt; 0.001</td>
</tr>
<tr>
<td>All Infections</td>
<td>1 (0,2)</td>
<td>P &lt; 0.001</td>
</tr>
</tbody>
</table>

Conclusion

- Largest risk factor = “high risk” procedure (RR 2.27)
- Other risks: male sex, tobacco user, diabetes, morbid obesity, CCI, and age under 50 years
  - Age likely confounded by procedure risk
- Helpful for pre-op counseling
- May aid in patient selection
- Can facilitate infection prevention efforts by targeting high-risk patients

Thank You
Appendices

Table 2. Infection Codes:

<table>
<thead>
<tr>
<th>CPT Codes for Knee Incision &amp; Drainage Procedures</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>29871</td>
<td>Arthroscopic Knee I&amp;D</td>
</tr>
<tr>
<td>27310</td>
<td>Open Knee Arthroscopy</td>
</tr>
<tr>
<td>10580</td>
<td>Complex and/or Postoperative I&amp;D</td>
</tr>
</tbody>
</table>

ICD-9 Codes for Postoperative infection:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>711.0</td>
<td>Septic Arthritis</td>
</tr>
<tr>
<td>998.51</td>
<td>Postoperative Sepsis</td>
</tr>
<tr>
<td>999.3</td>
<td>Other Postoperative infection</td>
</tr>
</tbody>
</table>

Table 1. CPT Codes for Arthroscopic Knee Index Surgeries

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Rate</th>
<th>Relative Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>29888</td>
<td>ACL Reconstruction</td>
<td>High</td>
<td>13.84%</td>
</tr>
<tr>
<td>29889</td>
<td>PCL Reconstruction</td>
<td>High</td>
<td>0.23%</td>
</tr>
</tbody>
</table>

Table 4. Arthroscopic Knee Procedures and I&D’s (2005-2012)

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Patients undergoing arthroscopy</th>
<th>Number of Arthroscopic Procedures</th>
<th>Number of arthroscopic codes used</th>
<th>Average number of arthroscopic codes per procedure</th>
<th>Number undergoing I&amp;D’s within 90 days</th>
<th>Number of infections within 90 days not requiring I&amp;D</th>
<th>Total number of infections within 90 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005-2012</td>
<td>433,423</td>
<td>501,691</td>
<td>1,682,466</td>
<td>3.35</td>
<td>1001</td>
<td>0.20%</td>
<td>2311</td>
</tr>
</tbody>
</table>

Appendix II

Appendix III

Appendix IV

Appendix V
### Appendix V (abridged)

<table>
<thead>
<tr>
<th>Infection Status</th>
<th>Relative Risk</th>
<th>95% CI</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-risk procedure</td>
<td>2.27 (1.98-2.60)</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Known tobacco use</td>
<td>1.68 (1.39-2.03)</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Sex (Male vs. Female)</td>
<td>1.67 (1.47-1.88)</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Overweight</td>
<td>1.36 (0.68-2.71)</td>
<td>0.003</td>
<td></td>
</tr>
<tr>
<td>Obese</td>
<td>1.27 (1.02-1.59)</td>
<td>0.003</td>
<td></td>
</tr>
<tr>
<td>Morbidly Obese</td>
<td>1.57 (1.19-2.09)</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Diabetes</td>
<td>1.38 (1.21-1.58)</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Age (&lt;50 vs. &gt;50 yrs)</td>
<td>1.38 (1.21-1.58)</td>
<td>&lt;0.001</td>
<td></td>
</tr>
</tbody>
</table>

### Appendix VI

<table>
<thead>
<tr>
<th>Infection Status</th>
<th>CCI Median (IQR)</th>
<th>P-Value (Compared to “No Infection”)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Infection</td>
<td>2 (0,3)</td>
<td>-</td>
</tr>
<tr>
<td>Infection Undergoing I&amp;D</td>
<td>1 (0,2)</td>
<td>0.074</td>
</tr>
<tr>
<td>Infection not Undergoing I&amp;D</td>
<td>2 (0,3)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>All Infections</td>
<td>2 (0,3)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Trend toward patients with infections having higher CCI despite lower median because data distribution skewed with long upper tail

No difference between infections undergoing or not undergoing I&D (P=0.968)
Randomized Prospective Study of Anesthetic Techniques in Unicondylar Knee Arthroplasty

**Disclosures**

- No conflicts of interest related to the material presented in this presentation.

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**Study Details**

- Prospective, randomized, double-blind equivalency trial
- Medial unicondylar knee arthroplasty
- 150 patients (147 analyzed)
  - 75 Psoas compartment block
  - 75 Adductor canal block
- All had posterior capsule injection
- Multimodal analgesics
  - Celecoxib, Acetaminophen, Pregabalin

---

**Rest Pain**

Mean verbal pain scores (Numerical Rating Scale 0-10) at 6, 12, 18, and 24-hours. Error bars represent standard error of the mean.

- P < 0.001
- **P < 0.002**
- ***P < 0.003***

P < 0.025 denotes equivalency at 6 hours; P < 0.05 denotes equivalency at 12,18 and 24 hours

---

**Movement Pain**

Mean verbal pain scores (Numerical Rating Scale 0-10) at 6, 12, 18, and 24-hours. Error bars represent standard error of the mean.

- P < 0.001
- **P < 0.002**
- ***P < 0.003***

P < 0.025 denotes equivalency at 6 hours; P < 0.05 denotes equivalency at 12,18 and 24 hours
**Quadriceps Strength**

<table>
<thead>
<tr>
<th></th>
<th>Adductor Canal Block (n=32)</th>
<th>Psoas Compartment (n=28)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strength (kg meter)</td>
<td>4.9</td>
<td>4.3</td>
<td>-0.003**</td>
</tr>
<tr>
<td></td>
<td>(6-14)</td>
<td>(6-14)</td>
<td></td>
</tr>
</tbody>
</table>

**Opioids and Side Effects**

- No differences in:
  - Time to first analgesic.
  - Cumulative opioids consumed over 24 hours.
  - Incidence of nausea or vomiting at any time point.
  - Incidence of itching at 12,18 or 24 hours.
- Only difference found:
  - Higher incidence of itching at 6 hours in adductor canal group; ($p=0.046$)

**Conclusion**

- Adductor canal blockade:
  - Equivalent analgesia to a psoas compartment block.
  - Significantly less quadriceps motor weakness.
  - Similar side effect profile, except for increased itching at 6 hours.
- Should be considered as an analgesic option for patients undergoing medial unicompartmental arthroplasty.
MRI findings versus intra-operative pathology in hip arthroscopy

32nd Southern Orthopaedic Association Annual Meeting
Asheville, North Carolina
July 16, 2015

Duke Orthopaedic Surgery
Kathleen D Reay, MD
Julie A Neumann, MD
Thomas Hash II, MD
Steven A. Olson, MD

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• None of the authors have any disclosures to report.

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• None of the authors received funding in the production of this research.

Introduction
• MRIs and MRAs are standard of care to evaluate intra-articular hip pathology
• Arthroscopy: gold standard to evaluate hip labral pathology
• MRI has been reported to accurately identify labral pathology in 91-95% of cases
• Determine accuracy of MRI compared to intra-operative labral and chondral pathology specifically in setting of hip dysplasia

Methods
• Retrospective review
• PI performed all surgeries
• Indications: CEA < 20, failed non-op mgmt X 6 months, mechanical symptoms
• Combined hip arthroscopy and periacetabular osteotomy (PAO) for treatment of intraarticular pathology and hip dysplasia
• January 1, 2013 to December 31, 2013

Methods
• 17 patients (19 hips)
  - 14 females: 3 males
  - 11 left hips: 8 right hips
• Average age at surgery 29.49 years (range, 17-42 years)
• Fellowship trained musculoskeletal radiologist blinded to intra-op findings reviewed 19 pre-op MRIs (taken avg 83 days before surgery)
  - MRI findings directly compared to operative note findings
Operative Procedure

- Supine on fracture table – arthroscopic perineal post
- Single prep and drape – for arthroscopy and PAO
- Hip arthroscopy followed by PAO
- Single surgeon performs both arthroscopy and PAO

Case Example

- 24 yr female
- Pain for 18 months
- Failed non-op care (NSAIDs, rest, injections)
- CE angle 17 degrees

Pre-operative MRI

- Labral tear
- Hypertrophied ligamentum teres

Post-op CEA 32 degrees

Results

- Labrum
  - MRI correctly correlated to intraop pathology 18/19 (PPV = 94.7%) of hips
  - 1 of 19 (5.3%) hips MRI demonstrated labral tear when labrum was intact

Results

- Chondral lesions
  - Discrepancy between MRI and intra-operative findings in 9/19 (47.4%) of hips
    - MRI noted possible acetabular cartilage delamination vs softening in 4/19 (21.1%) of the hips when intact
    - 3/19 (15.8%) hips MRI showed cartilage delamination with full or partial thickness loss when cartilage was intact
    - 1/19 (5.3%) hips demonstrated questionable acetabular chondral loss when grade III/IV changes were noted in the acetabulum
    - 1/19 (5.3%) hips demonstrated no chondral defect when mild delamination was noted
  - MRI correlated with intraoperative findings in 10/19 (52.6%) hips
    - No chondral defect in the acetabulum in 1/19 (5.3%) of hips when no delamination
Results

• Ligamentum teres:
  - Discrepancy between MRI and intra-operative findings in 7/19 (36.8%) of hips
    - Frayed, degenerative or partial tear in the ligamentum teres in 5/19 (26.3%) of hips when no tear was noted (hypertrophied or normal)
    - Ligamentum teres rupture in 1/19 (5.3%) hip when a small tear was noted
    - Intact ligamentum teres in 1/19 (5.3%) of hips when hypertrophied
  - Intraoperative findings
    - Torn 4/19 (21.1%)
    - Hypertrophied 8/19 (42.1%)
  - Overall accuracy of diagnosis on MRI was found to be 63.2%

Overall Results

• PPV - 56%
• NPV - 33%
• Sensitivity - 82%
• Specificity - 12.5%
• Accuracy - 52.6%

Limitations

• Retrospective
• Small cohort
• One MSK radiologist reviewing MRI
• Non-standardized MRI sequences
• Observation, time and selection bias

Conclusion

• MRI findings compared to intra-operative hip arthroscopy findings
  - Correlate with labral pathology in 94.7% of patients
  - Did not correlate as well for chondral (52.6%) or ligamentum teres (63.2%) pathology
  - Caution when using MRI to diagnose cartilaginous or ligamentum teres pathology
  - Consider having a MSK trained radiologist to review preoperative MRIs

References

Advantages to Non-arthrographic MRI

- Noninvasive
- Free of radiation and gadolinium exposure
- Least resource intensive and thus less costly
- Logistically easier to coordinate compared to d-MRA and i-MRA

HASH MRI Protocol

- Cor T1
- Obl Ax fs pd
- Cor fs pd
- Sag fs pd
- Axial VIBE sequence: allows for reformatting
- Ax haste (pd-proton density)
Introduction to Musculoskeletal Infection

- Incidence is rising
- Can cause
  - Permanent impairment
  - Systemic disease

Diagnosis

- Gold standard: culture
- Diagnostic algorithms
  - WBC
  - ESR
  - Fever
  - Nonweightbearing
  - CRP
- Axial imaging (e.g. MRI)

Kocher criteria

Purpose

- To evaluate the prevalence and complications of MSK infections in older children and adolescents
- To determine whether the Kocher criteria are predictive of septic arthritis in older children and adolescents

Results

- Retrospective review
- 30 patients age 10-18 years
  - Demographic data
  - Historical information
  - Vital signs
  - Lab data
  - Microbiology data
  - Functional/clinical outcomes
- Septic hip cohort: 14 patients

- Time to diagnosis 9.3 days (range 0-30 days)
- 83% had seen ≥1 provider prior to diagnosis
- 44% had seen ≥2 providers prior to diagnosis
- Chief complaint
  - Focal pain 93%
  - Subjective fever 82%
  - Objective fever (temperature > 38C) 7%
Results

Laboratory values
• WBC 11,600
• ESR 50.6
• CRP 15.5

Cultures
• 68% OSSA
• 9% MRSA

Results

• Patients with…
  – 1 positive criterion: n = 7
  – 2 positive criteria: 6
  – 3 positive criteria: 1
  – 4 positive criteria: 0
• Most common positive finding: ESR
• Mean CRP: 16.8mg/L

Results: Complications

<table>
<thead>
<tr>
<th>Systemic Complications</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Deep venous thrombosis</td>
<td>3</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>2</td>
</tr>
<tr>
<td>Pulmonary embolism</td>
<td>1</td>
</tr>
<tr>
<td>Clostridium difficile infection</td>
<td>1</td>
</tr>
<tr>
<td>Wound infection</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Musculoskeletal Complications</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Avascular necrosis</td>
<td>3</td>
</tr>
<tr>
<td>Persistent limp</td>
<td>3</td>
</tr>
<tr>
<td>End-stage arthrosis</td>
<td>2</td>
</tr>
<tr>
<td>Heterotopic ossification</td>
<td>2</td>
</tr>
<tr>
<td>Loss of terminal motion</td>
<td>2</td>
</tr>
<tr>
<td>Recurrent idiopathic effusion</td>
<td>1</td>
</tr>
<tr>
<td>Chronic osteomyelitis</td>
<td>1</td>
</tr>
</tbody>
</table>

Complications: AVN

Discussion

In teens and adolescents with MSK infection,
• There is a trend toward longer symptom duration before definitive treatment
• Kocher criteria are inconsistently present
• CRP is almost uniformly elevated
• MRI is an important diagnostic tool
• Complications occur in one third of patients
References

The Utility of a Screening MRI for Pediatric Patients with Suspected Musculoskeletal Infection

Paulvalery Roulette, MD
Franklin Gettys, MD
Brian Scannell, MD
Steven Frick, MD
Nigel Rozario, BS
Kelly VanderHave, MD
Brian Brighton, MD, MPH

Background
• Septic Arthritis or Benign Process?
• Multifocal Musculoskeletal Infections
• Utility of MRI

Study Purpose
• Describe our imaging protocol
• Report on a cohort of patients who underwent a screening MRI for suspected musculoskeletal infection prior to any procedural intervention.
• Determine the clinical and/or laboratory values that are predictive of patients presenting with septic arthritis versus multifocal musculoskeletal infection

Methods
• Single institution retrospective review from 2008-2014
• Patients age <19 years
• Include all who underwent a screening MRI for a suspected musculoskeletal infection prior to intervention
  • A screening MRI was defined as an MRI that examined 1 joint and at least 1 continuous bony structure
• Exclusion criteria:
  • Incomplete medical records
  • Incomplete MRI images
  • MRI for non-infectious work up

MRI Protocol
• Hip to toe
• SAG IR Lumbar
• COR IR, COR T1 Pelvis to Ankles
• AX T1, AX T2 FS
• Gadolinium per MD order or Rad request

Analysis
Patients were analyzed in 4 groups:
• no infection
• musculoskeletal infection
• septic arthritis of a joint without concomitant infection (SAJ)
• multifocal/musculoskeletal infection (MMI)
Analysis

Independent Variables
• Age, gender
• Weight bearing status (WBS) at admission,
• White blood cell count (WBC), CRP (mg/dL), ESR, hemoglobin (HGB), temperature at admission.
• Number of positive Kocher criteria (temperature > 101.3 °F, ESR > 40 mm/hr, non weight bearing on affected side, WBC ≥ 12,000 cells/mm³)

Results

Musculoskeletal Infections
• SAJ 19/53 (35.8%)
  • 13 hip, 4 knee, 1 ankle, 1 tarsal/metatarsal
• MMI 13/53 (24.5%)
  • 12 septic arthritis of hip with osteomyelitis (8), pyomyositis (2), abscess (1)
  • 1 septic arthritis of knee, abscess, osteomyelitis, (1)

Results

MMI vs. SAJ
• MMI older
  • 7 years MMI vs. 3.3 years SAJ (p=0.09)
• MMI higher CRP
  • 13.09(6.24-19.94) vs. 4.52(2.83-6.2) p=0.01.
• MMI lower WBC count
  • 12.05(7.33-16.77) vs. 13.77(12.08-15.45) p=0.02.
• No differences in age, ESR, number of Kocher criteria, and temperature on admission.

Musculoskeletal Infection
• Transient Synovitis
• Cellulitis
• Other

Results

Patients with Multifocal Musculoskeletal Infection (MMI) and their Subsequent Procedure

<table>
<thead>
<tr>
<th>Patient</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>I&amp;D Hip, Abscess, Drilling Femoral Head</td>
</tr>
<tr>
<td>#2</td>
<td>I&amp;D Hip, Knee, Ankle, Foot</td>
</tr>
<tr>
<td>#3</td>
<td>I&amp;D Hip &amp; Pelvis</td>
</tr>
<tr>
<td>#4</td>
<td>I&amp;D Hip &amp; Drilling Ilium</td>
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<tr>
<td>#5</td>
<td>I&amp;D Hip &amp; Bilateral Tibia Aspiration</td>
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<tr>
<td>#6</td>
<td>Hip and Proximal Femur Aspiration</td>
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<tr>
<td>#7</td>
<td>I&amp;D Gluteus Maximus, Minimus, Iliac wing</td>
</tr>
<tr>
<td>#8</td>
<td>I&amp;D Hip</td>
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<tr>
<td>#9</td>
<td>I&amp;D Hip</td>
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<tr>
<td>#10</td>
<td>I&amp;D Hip</td>
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<tr>
<td>#11</td>
<td>I&amp;D Hip</td>
</tr>
<tr>
<td>#12</td>
<td>I&amp;D Hip</td>
</tr>
<tr>
<td>#13</td>
<td>I&amp;D Knee</td>
</tr>
</tbody>
</table>

Those with CRP of 9 were 9.7 times more likely to have MMI
• 14.7 times more likely with CRP of 13
• 22 times more likely with CRP of 15
## Results

### Musculoskeletal infection (MI) vs. No infection (NI)

- **CRP**
  - (NI) 3.7 (1.57-5.83) vs. (MI) 9.66 (7.21-12.1) \( p = <0.001 \)

- **ESR**
  - (NI) 25.96 (18.39-33.53) vs. (MI) 60.36 (49.01-71.71) \( p = <0.001 \)

- **Temperature on admission**
  - (NI) 98.86 (98.06-99.66) vs. (MI) 99.63 (99.14-100.13) \( p = 0.02 \)

- **Number of Kocher criteria**
  - (NI) 1.14 (0.85-1.43) vs. (MI) 1.87 (1.56-2.17) \( p = 0.002 \)

## Study Limitations

- Retrospective study that only included patients from an MRI database

## Conclusions

- Screening MRI was useful in the diagnosis and management of patients presenting with musculoskeletal infection.
- Nearly 25% of our cohort of musculoskeletal infections had a multifocal musculoskeletal infection.
- The odds of having a multifocal musculoskeletal infection on MRI versus an isolated septic arthritis was 9.7 times higher with a CRP > 11, however no other clinical factors were significant in determining the presence of an associated bone or soft tissue infection on MRI.
- The use of MRI is recommended in the evaluation and management of children with musculoskeletal infections as clinical factors alone may not be adequate in determining the presence of multifocal infection.
- The early recognition of a multifocal infection allows one to make the appropriate diagnosis and provide proper surgical care at the initial operation.
Treatment of Pelvic Chondroblastoma with Denosumab: The Role of RANK Signaling in Benign-Aggressive Tumors

Mitchell Klement, MD, Julia Visgauss, MD, Will Eward DVM, MD
NCOA Annual Meeting Oct 10, 2015

Case Presentation
- 15 yoM with eight months of progressive, mechanical right hip pain
- PE: antalgic gait and tenderness to palpation over the right buttock and groin

In Benign Aggressive Tumors, who are the main cellular players?
- Stromal Tumor Cells
  - RANK-L +
  - They are driving the bus.

In Benign Aggressive Tumors, who are the main cellular players?
- Osteoclast like Giant Cells
  - RANK receptor +
  - They are doing the dirty work.

Rank-Rank L Signaling Pathway

Stromal Tumor Cells

Osteoclast like Giant Cells
Role of Denosumab in Benign Aggressive Tumors

Denosumab Induces Tumor Reduction and Bone Formation in Patients with Giant-Cell Tumor of Bone

Pre-treatment: numerous RANK-L positive tumor stromal cells
Pre-treatment: numerous RANK receptor positive tumor giant cells

Post-treatment: minimal RANK-L positive tumor stromal cells
Post-treatment: No RANK receptor positive tumor giant cells

What is the effect of Denosumab on Chondroblastoma?

Immunofluorescence and Immunohistochemical staining of RANK-L

Pre-Denosumab Sample

Post-Denisumab Sample
What is the effect of Denosumab on Chondroblastoma?

Post-Denosumab Sample

What is the effect of Denosumab on Chondroblastoma?

- Treatment of Chondroblastoma with Denosumab results in abrogation of osteoclast-like giant cell formation with decrease in resultant osteolysis.
- However, UNLIKE GCT, we don’t see over-expression of RANK-L in the stromal cells of Chondroblastoma, and see little effect on neoplastic mononuclear cells following treatment with Denosumab.

Summary

- The RANK/RANK-L signaling pathway plays an important role in the osteolytic process of benign aggressive tumors such as GCT and Chondroblastoma.
- Indications, dosing, and duration of Denosumab treatment are still being investigated.
- The success with Denosumab treatment in our patient is encouraging, which may have implications on future management.

What is the effect of Denosumab on Chondroblastoma?

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Acknowledgements

- Brendan Dickson (Univ. Toronto)
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- Suzanne Bartholf (Duke)
- Jason Somarelli (Duke)

References


What is the effect of Denosumab on Chondroblastoma?
Risk Factors For Disease Progression After Surgical Treatment of Extremity Metastatic Bone Disease

Elizabeth Scott, Mitchell R. Klement, MD, Brian E. Brigman, MD, PHD, William C. Eward, MD DVM

Purpose / Hypothesis

one-year postoperative survival for metastatic skeletal disease has improved with better adjuvant therapies:

0.3% Wedin, R, et al 1999
36% Ratasvouiri et al 2013

We aimed to assess risk factors associated with:
- radiographic disease progression
- surgical failure
- survival

in "longer-term" (6+ month) survivors

Materials and Methods

Retrospective Review: surgical treatment of 89 metastatic bone lesions, extremity only treated between 2004-2014 by Duke Orthopaedic Oncology
6+ months of radiographic imaging

Variables Considered:
- lesion characteristics, surgical details, radiotherapy timing, antiresorptive medication use, Mirels score

Statistical Analysis: Fisher's Exact Test, t-test, Cox proportional-hazards models

1. Radiographic Disease Progression
- plain radiographs assessed at 3 month intervals
- Harada, H., et al. (2010) criteria

2. Surgical Failure
- hardware failure, infection

3. Survival

Results

<table>
<thead>
<tr>
<th>Failure &amp; Radiographic Progression Rates</th>
<th>Failure</th>
<th>Progression</th>
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</thead>
<tbody>
<tr>
<td>Overall</td>
<td>43.82%</td>
<td>0.504</td>
</tr>
<tr>
<td>Renal Cell Carcinoma</td>
<td>36.54%</td>
<td>0.481</td>
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<tr>
<td>Other Carcinomas:</td>
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<tr>
<td>Breast, Prostate, Thyroid</td>
<td>12.0%</td>
<td>0.812</td>
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<tr>
<td>Lung (vs. RCC)</td>
<td>0.32%</td>
<td>0.205</td>
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<tr>
<td>Prostate (vs RCC)</td>
<td>0.32%</td>
<td>0.205</td>
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<tr>
<td>Femoral Lesions (vs. Femoral): HR 0.481</td>
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<tr>
<td>Round Cell Cancers: HR 0.481</td>
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<td>Round Cell Cancers: HR 0.422</td>
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<tr>
<td>Male: HR 0.361, p&lt;0.01</td>
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<tr>
<td>Surgical Failure (Fisher)</td>
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<td>Tumor Origin</td>
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<tr>
<td>Female: HR 0.481, p=0.066</td>
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<td>All Fixation</td>
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<tr>
<td>Survival</td>
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<tr>
<td>Antiresorptive Use (BP) HR 0.504, p=0.020</td>
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<tr>
<td>Tumor Origin</td>
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<td>Prostate (vs RCC)</td>
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<td>Male: HR 0.361, p&lt;0.01</td>
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<td>Humeral Lesions (vs. Femoral): HR 0.399</td>
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<td>Male: HR 0.361, p&lt;0.01</td>
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<td>Male: HR 0.361, p&lt;0.01</td>
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<td>Humeral Lesions (vs. Femoral): HR 0.399</td>
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<tr>
<td>Male: HR 0.361, p&lt;0.01</td>
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</tbody>
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1. Radiographic Disease Progression
- Gender (Female): HR 0.361, p<0.01
- Round Cell Carcinoma (vs. RCC): HR 0.441
- Non-Renal Carcinomas (vs. RCC): HR 0.481
- Humeral Lesions (vs. Femoral): HR 0.399
- Bisphosphonates (vs Densoumab): HR 0.422

2. Surgical Failure (Fisher)
- Tumor Origin: p=0.005
- Extremity: p=0.059
- Gender: p=0.087
- Procedure: p=0.066
- Mirels Score: p=0.048

3. Survival
- Antiresorptive Use (BP) HR 0.504, p=0.020
- Tumor Origin: p=0.05
- Lung (vs. RCC): HR 3.32, p=0.025
- Prostate (vs RCC): HR 3.22, p=0.005
- Male: HR 0.361, p<0.01

Conclusion

1. Endoprosthetic Replacement > Fixation for Some Groups
- Tumor Type: Renal Cell Carcinoma > Non-Renal Carcinomas > Round-Cell
- Location: Femoral > Humeral lesions
- Gender: Men > Women

2. Antiresorptive Therapy should be utilized
- strong association with patient survival
- increased time to radiographic progression (bisphosphonates > denoumab)

Questions?

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