Pelvic limb muscle mass & bone mineral density in dogs with CCL disease treated with medical management or medical management & surgery

Justin Uhl, DVM, MS
Small Animal Intern, University of Minnesota

Katja Wucherer, DVM
Michael Conzemius, DVM, PhD, DACVS
Vicki Wilke, DVM, PhD, DACVS

University of Minnesota
Veterinary Medical Center
Cranial Cruciate Ligament Disease

- Most common disease of canine stifle
- Damage leads to instability
Treatment Options For Cranial Cruciate Ligament Disease

• Surgical treatment
  – Many different surgical options

• Non-surgical treatment:
  – Non-surgical treatment for CCLD by Vasseur and Pond; dogs >20kg wide range of outcomes (20-78%)
  – Non-surgical therapy: Exercise Modification, Weight Loss, NSAIDS, Canine Rehabilitation
Measuring Outcomes

- Owner surveys
- Physical and orthopedic exams
- Weight
- Gait analysis

- Bone mineral density and lean tissue mass changes (DEXA)
  
  - Advantages:
    - Indirect objective measure of musculoskeletal use
    - Measure of tissue lost during weight loss
Dual-energy X-ray absorptiometry

- X-ray beams of 2 different energies
- Allows measurements of bone mineral density, lean tissue mass, and tissue fat
Objective

- Measure and compare bone mineral density and lean tissue mass changes in the rear limbs of dogs with CCL disease when treated with a combination of surgical and medical management or medical management alone.
Hypothesis

• We hypothesized that dogs receiving surgery and medical management would have increased BMD, increased LTM, and decreased % tissue fat as compared to medical alone.
Inclusion Criteria

- 40 client owned dogs
- Unilateral CCL Disease
- ≥ 15 kg
- BCS of ≥6/9
- Not currently medically managed
  - NSAIDs, steroids, weight loss or OA diet
- PE and labs -> WNL
Randomized Groups

• Non-surgical management (n=20)
  – Weight loss plan and Hills r/d® diet, Deramaxx®, Canine Rehabilitation
    • 12 wks of treatment

• Combination management (n=20)
  – TPLO (12 meniscal surgeries, 8 left as normal)
  – Weight loss plan and Hills r/d® diet, Deramaxx®, Canine Rehabilitation
    • 12 wks of treatment beginning at suture removal
Outcome Measures

• DEXA scan data collected pre-intervention and at 3 and 6 months after.
• DEXA scan data analyzed (affected and control limb):
  – bone mineral density (g/cm$^2$)
  – lean tissue mass (g)
  – % fat
• Composite change
  • $\Delta$ BMD + $\Delta$ lean tissue mass + $\Delta$ %fat
Dexa Scan Measurements

Bone View

Lean Tissue View

Image not for diagnosis
Statistics

• Affected vs. contralateral limb at all time points using paired t-tests
• Change over time (pre-, 3-mo., 6-mo.) using paired t-tests
Enrollment

• Surgical Group (n=20):
  – 3 Month: 18 dogs
    • Lost: 1 to bilateral CCLD and 1 to non-related injury
  – 6 Month: 14 dogs
    • Lost: 3 additional dogs to bilateral CCLD and 1 to hardware removal

• Non-surgical group (n=20):
  – 3 Month: 17 dogs
    • Lost: 3 to bilateral CCLD
  – 6 Month: 15 dogs
    • Lost: 2 additional dogs to bilateral CCLD
Descriptive Data
Pre-intervention

<table>
<thead>
<tr>
<th></th>
<th>Non surgical</th>
<th>Surgical</th>
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<tbody>
<tr>
<td>F/S</td>
<td>11</td>
<td>8</td>
</tr>
<tr>
<td>M/N</td>
<td>9</td>
<td>12</td>
</tr>
<tr>
<td>Age (yrs)</td>
<td>5.6</td>
<td>5.5</td>
</tr>
<tr>
<td>Left leg</td>
<td>17</td>
<td>9</td>
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<tr>
<td>Right leg</td>
<td>3</td>
<td>11</td>
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http://www.typesofdogs.org/labrador-retriever.html
Bone Mineral Density

![Graph showing bone mineral density over time with two lines representing combination and medical treatments.](image)

- BMD (g/cm²)
- Time (months)
- Combination
- Medical
Combination group showed a significant increase at 6 months vs. 3 months but no increase when compared to pre-intervention.
Percent Tissue Fat

Time (months)

Combination
Medical
Significant increase from 3 to 6 months but not when compared to pre-intervention
No difference between contralateral and affected limb.
CCL Disease

Combination

3 Months
Decrease BMD
Decrease Tissue Fat
No Change LTM

6 Months
No Change BMD
Decrease Tissue Fat
Increase LTM vs. 3 Months

Medical Alone

3 Months
Decrease BMD
Decrease Tissue Fat
No Change LTM

6 Months
Decrease BMD
Decrease Tissue Fat
No Change LTM
Contralateral Limb

- **Combination**
  - 3 Months: Decrease BMD, Decrease Tissue Fat, No Change LTM
  - 6 Months: No Change BMD, Decrease Tissue Fat, No Change LTM

- **Medical Alone**
  - 3 Months: No change BMD, Decrease Tissue Fat, No Change LTM
  - 6 Months: Decrease BMD, Decrease Tissue Fat, No change LTM
## Composite Tissue Change

<table>
<thead>
<tr>
<th>Variable</th>
<th>3 Month Change</th>
<th>6 Month Change</th>
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<tbody>
<tr>
<td>BMD</td>
<td>-5.32%</td>
<td>-0.76%</td>
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<tr>
<td>LTM</td>
<td>1.96%</td>
<td>10.51%</td>
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<tr>
<td>% Fat</td>
<td>13.86%</td>
<td>27.00%</td>
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</table>

**Combo unaffected**

| BMD      | -2.01%        | -6.21%        |
| LTM      | -1.62%        | 14.10%        |
| % Fat    | 17.74%        | 27.55%        |

**Med unaffected**

| LTM      | 10.34%        |
| % Fat    | 10.51%        | 24.70%        |
## Composite Tissue Change

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<tr>
<th>Variable</th>
<th>3 Month Change</th>
<th>6 Month Change</th>
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<tbody>
<tr>
<td>BMD</td>
<td>-5.68%</td>
<td>-1.88%</td>
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<tr>
<td>LTM</td>
<td>-0.19%</td>
<td>7.58%</td>
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<tr>
<td>% Fat</td>
<td>13.45%</td>
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</tr>
<tr>
<td>BMD</td>
<td>-4.17%</td>
<td>-6.78%</td>
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<tr>
<td>LTM</td>
<td>0.24%</td>
<td>15.05%</td>
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<tr>
<td>% Fat</td>
<td>18.99%</td>
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## Composite Tissue Change

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<th>6 Month Change</th>
<th>12 Month Change</th>
<th>24 Month Change</th>
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<tbody>
<tr>
<td>Combo Affected</td>
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<tr>
<td>BMD</td>
<td>-5.68%</td>
<td>-1.88%</td>
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<tr>
<td>LTM</td>
<td>-0.19%</td>
<td>7.58%</td>
<td>9.73%</td>
<td>40.72%</td>
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<td>% Fat</td>
<td>13.45%</td>
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<tr>
<td>Med Affected</td>
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</tr>
<tr>
<td>BMD</td>
<td>-4.17%</td>
<td>-6.78%</td>
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</tr>
<tr>
<td>LTM</td>
<td>0.24%</td>
<td>15.05%</td>
<td>-6.71%</td>
<td>14.89%</td>
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<tr>
<td>% Fat</td>
<td>18.99%</td>
<td>28.38%</td>
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Limitations

• Measurements end at 6 months
• One outcome measure reported
• Variation in positioning for DEXA scan
• Measured all muscle mass together
DEXA measures of separate muscles
Conclusions

• Both groups improved at 6 months
• Combination group showed greatest improvement
  – Increase LTM
  – Return to near pre-intervention BMD
Thank You

• Dr. Vicki Wilke
• Dr. Katja Wucherer
• Dr. Michael Conzemius
• Clinical Investigation Center
• Novartis Animal Health
• Internmates
Questions?
Meniscus Data

- 6 Torn Menisci: 5 menisectomy and 1 release
- 14 Intact Menisci: 6 released and 8 left intact
- Stifle Explore: 11 arthrotomy and 9 scope
Ground Force Reaction

• 3 months
  – Surgery Limb 85% of contralateral limb
  – Medical Limb 78% of contralateral limb

• 6 months
  – Surgery limb 90% of contralateral limb
  – Medical limb 82% of contralateral limb

• Can visually observe lameness at less than 85% of contralateral limb
Validation of DEXA scan

- Dogs and cats weighing 1.8-22.1kg
- Compared DEXA to chemical analysis
- Found good correlation between the 2
- Some variation due to hydration status

DEXA Variation

• Sex: Males > LTM and BMD then females
• Age: Decreased LTM and fat % in young dogs

Hamstring Muscles

• 2 dimensional computerized knee model
• Increased Hamstring force increases stifle stability.
• Should we be targeting rehab based on hamstring function in these dogs?

Bone Mineral Density Changes

- 14 dogs with forelimb immobilized for 16 weeks
  - DEXA and MTS properties
  - Significant decrease in all bone properties
- Remobilized for 32 weeks and repeated analysis
  - Return to normal properties
- Cancellous bone more effected then Cortical

Muscle Loss with CCLD

• 16 dogs with CCLD and 14 control
• Decreased lean tissue measured with DEXA and radiographic measurements
  – Quadriceps most decreased