FOUR LEG NEWS

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TRIPOD GAIT

What is there to learn?

As Canine Rehab Professionals, we all know that the 3-legged dog has a much different gait pattern than the typical 4-legged dog. In this issue, the available research from 1970 to 2024 was analyzed to create a summary of findings over this 50+ year span.

The research provided focus on the biomechanical, kinematic, and kinetic adaptations in dogs following forelimb or hindlimb amputation. Below are the common findings and themes that emerge across these studies. ENJOY THE LEARNING!

Cheers,

Laurie Edge-Hughes

What's new?

In this newsletter, I attempted to not just summarize the literature, but to compile the information into concise digestible thematic bites of information! Let me know what you think!

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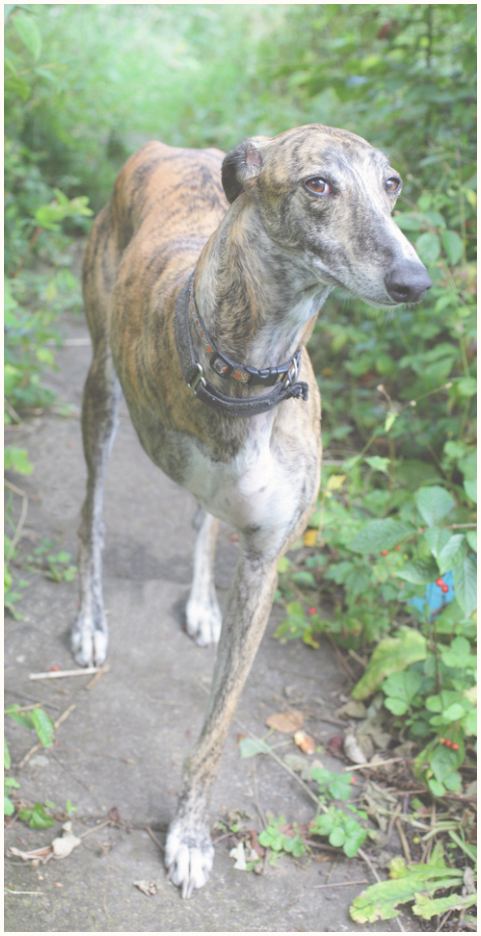
1. Weight Redistribution and Load Shifting

- **Common Finding:** After amputation, dogs redistribute their body weight to compensate for the missing limb, with a consistent shift toward the remaining limbs. The contralateral (opposite side) limb and ipsilateral (same side) limbs often bear increased loads, though the extent depends on whether the amputation involves a forelimb or hindlimb.
  - Forelimb amputation: Increased weight on the remaining forelimb (e.g., 46.9–55.5% of body weight) and hindlimbs (e.g., 53.1–56%).
  - Hindlimb amputation: Greater weight on forelimbs (e.g., 71.5–73.6%) and less on the remaining hindlimb (e.g., 26.4–29.7%).
- **Theme:** The redistribution of weight reflects the dog's attempt to maintain stability and balance, with forelimb amputees relying more on hindlimbs and hindlimb amputees shifting weight forward to the forelimbs.

2. Changes in Ground Reaction Forces (GRFs)

- **Common Finding:** Amputation leads to altered GRFs, including increased peak vertical forces, braking forces, and vertical impulses in the remaining limbs, particularly the contralateral ones.
  - Forelimb amputees show higher braking and propulsive forces in the remaining forelimb and ipsilateral pelvic limb.
  - Hindlimb amputees exhibit increased vertical forces in forelimbs and higher propulsive forces in the remaining hindlimb.
- **Theme:** These changes indicate compensatory mechanisms to support locomotion and propulsion, with the remaining limbs adapting to handle greater mechanical demands.



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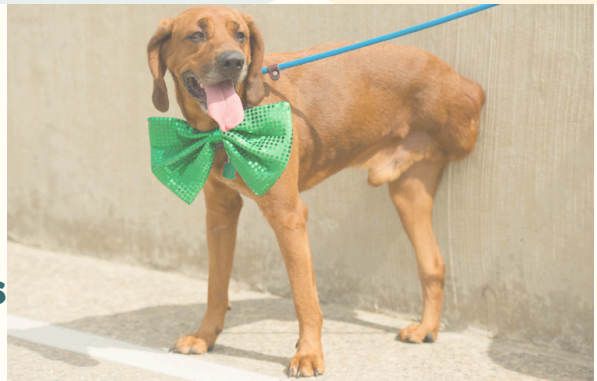
3. Gait and Kinematic Adjustments

- **Common Finding:** Dogs adapt their gait through changes in stance duration, stride length, joint angles, and limb positioning.
  - Decreased stance time and increased cadence are noted in amputees, reflecting faster limb cycling to maintain velocity.
  - Joint-specific adaptations include increased tarsal joint motion (hindlimb amputees), carpal joint range of motion (forelimb amputees), and vertebral column adjustments (e.g., increased flexion/extension and lateral bending).
- **Theme:** Kinematic adaptations are tailored to the specific limb lost, with the musculoskeletal system adjusting to maintain mobility and stability, often through increased motion in remaining joints or the spine.

4. Role of the Vertebral Column and Tail

- **Common Finding:** The vertebral column and tail play significant roles in compensation.
  - Increased flexion/extension and lateral bending in the cervicothoracic, thoracolumbar, and lumbosacral regions are observed in amputees.
  - The tail is used for balance and stabilization, especially in hindlimb amputees (e.g., positioned flat on the ground when seated).
- **Theme:** These structures provide dynamic support, helping dogs adjust their center of gravity and maintain equilibrium during movement.



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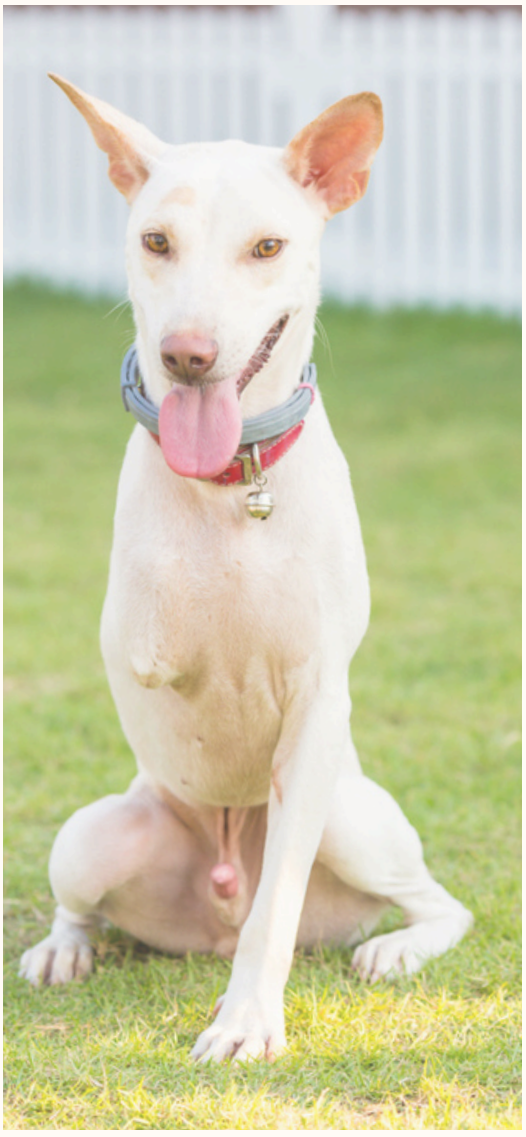
5. Muscle Activity and Compensation

- **Common Finding:** Muscle activity increases in the remaining limbs and back to support the altered gait.
  - Hindlimb amputees show heightened activity in muscles like the vastus lateralis and longissimus dorsi.
  - Forelimb amputees exhibit increased triceps brachii activity, particularly contralaterally.
- **Theme:** Muscular adaptations enhance stability and propulsion, compensating for the reduced limb count and altered force distribution.

6. Adaptation Speed and Recovery

- **Common Finding:** Dogs adapt relatively quickly to amputation, with significant gait stabilization within 10–30 days post-surgery, though full compensation may take longer.
  - Owners report high satisfaction and note improvements in mobility and comfort over time.
- **Theme:** Despite initial coordination challenges, dogs demonstrate resilience and adaptability, with recovery timelines similar for forelimb and hindlimb amputations.



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7. Impact on Remaining Limbs and Joints

Common Finding: Increased forces and weight-bearing in remaining limbs elevate stress and potential injury risk.
o Forelimb amputees show greater stress on the ipsilateral pelvic limb, while hindlimb amputees place more load on forelimbs.
o No significant osteoarthritis was observed in contralateral joints in some studies, though joint angles and motion ranges adjust.
Theme: The compensatory overload on remaining limbs highlights the need for monitoring for long-term musculoskeletal health, such as lameness or discomfort.

8. Differences Between Forelimb and Hindlimb Amputation

- **Common Finding:** The biomechanical impact varies by limb type.
  - Forelimb amputation leads to greater gait changes, balance issues, and reliance on hindlimbs.
  - o Hindlimb amputation affects propulsion more, with less pronounced balance problems but increased forelimb loading.
- **Theme:** The functional roles of forelimbs (weight-bearing) versus hindlimbs (propulsion) drive distinct compensatory patterns, influencing the degree and type of adaptation.

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9. No Significant Influence of Weight or Amputation Level

- **Common Finding:** Neither body weight nor the level of amputation (high vs. low) consistently alters adaptation outcomes significantly.
  - Studies found no major differences between high and low amputations in terms of GRFs or weight distribution, except in specific cases (e.g., contralateral hindlimb overload).
- **Theme:** Dogs adapt effectively regardless of size or amputation extent, suggesting robust compensatory mechanisms.

10. Clinical and Owner Implications

- **Common Finding:** Studies emphasize practical implications for veterinarians and owners.
  - Owners observe coordination issues early post-surgery but report satisfaction with long-term outcomes.
  - o Increased joint stress suggests monitoring for overuse injuries.
- **Theme:** Understanding these adaptations aids in managing recovery, informing surgical decisions (e.g., prosthesis candidacy), and improving quality of life for amputee dogs.

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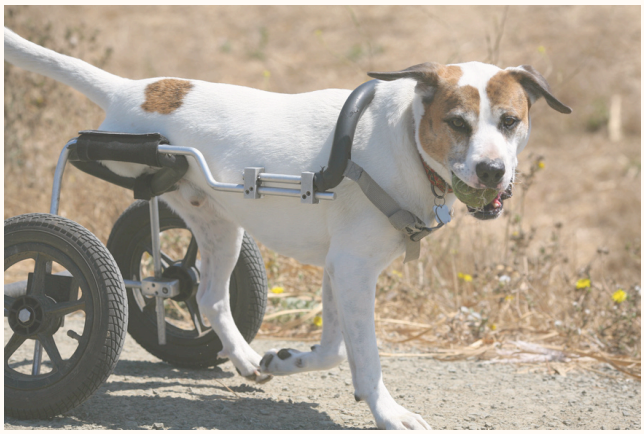
Overarching Insight

Across these studies, dogs demonstrate remarkable plasticity in adapting to tripedal locomotion, employing a combination of weight redistribution, altered forces, kinematic adjustments, and muscular compensation. The vertebral column and remaining limbs work synergistically to maintain function, with adaptations varying by the amputated limb's location. These findings underscore the resilience of dogs and provide a foundation for optimizing post-amputation care and rehabilitation.



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Drop me a line! Send me your questions!

Four Leg Rehab Inc
PO Box 1581,
Cochrane, AB T4C 1B5
Canada
Laurie@Fourleg.com