# Comparison of temporal-spatial and pressure gait analysis between resting and exercised Labrador retrievers

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## Introduction

Exercise-induced muscle damage and subsequent inflammation and soreness are frequently studied topics in both human and animal trials[1,2]. Gait analysis using a commercial mat system is a newer technology that identifies the temporal and spatial qualities of a subject's gait. Gait analysis in healthy canines, especially in an exercise model, has been infrequently studied. Our objectives were to compare gait analysis metrics between exercised and non-exercised dogs, to identify which parameters were most impacted by running exercise, and to identify the ideal time to perform gait analysis post-exercise.

## Materials and Methods

Animals and Housing
- All dogs selected from colony of Labrador retrievers at Four Rivers Kennel.
- 24 Labrador retrievers (12m/12f).
- All dogs housed in temperature controlled individual kennels overnight and aired outside in social groups for appx 6hrs daily.
- Water was provided *ad libitum* via automatic waterers
- All dogs fed a standard kennel diet of poultry and corn and fed once daily in the morning.

Experimental Design
- Twenty-four Labrador retrievers were used in this trial, with 12 untrained dogs performing one 5km run, and 12 untrained dogs providing a resting comparison.
- All dogs were walked across a Gait4Dogs (CIR Systems, Inc; Sparta, NJ) pressure walkway system at baseline (pre-run), within 30-min post-run, 3h post-run, and 24h post-run enough times to obtain at least 3 valid walks at each timepoint.
- All dogs were walked by the same handler for the duration of the trial and all attempts were made to ensure consistency in handling.
- Walks were processed after data collection. Video of each walk was recorded and any walks which appeared inconsistent (dog distracted, stopping, stepping off the mat, etc) were discarded .

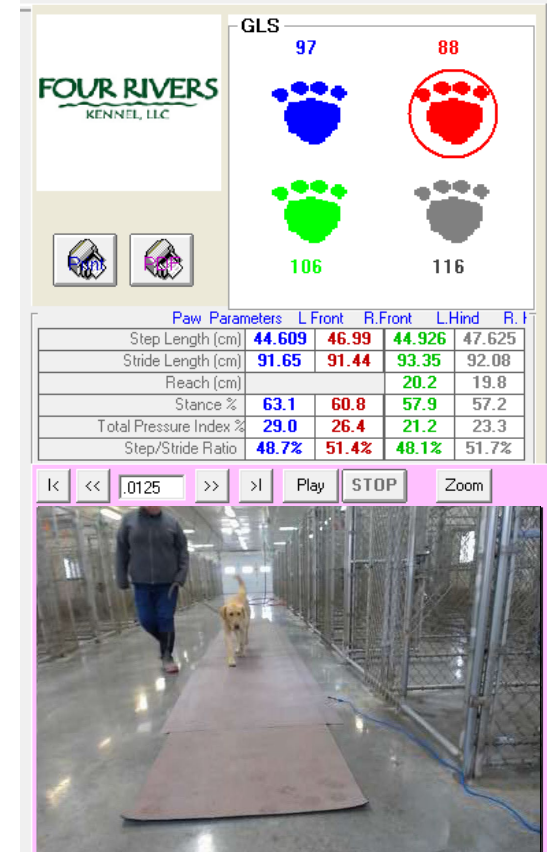## Results and Discussion

### Pressure Measurements

- No significant differences were found between timepoints in resting dogs.
- In exercised dogs, the number of activated sensors for the symmetry ratio of the left/right forelimbs improved from baseline to 30min post-run (p<0.01)
- In exercised dogs, pressure time was significantly slower 30min post-run compared to 3h post-run (p<0.01), indicating discomfort during the walk immediately after exercising.

| Pressure Measurements in Exercised Dogs | | | | | | |
|---|---|---|---|---|---|---|
| Parameter | Limb | Pre-Run | 30min Post-Run | 3h Post-Run | 24h Post-Run | P-value |
| Number of Activated Sensors | Left/Right Forelimb Symmetry | $1.03 \pm 0.01^a$ | $1.00 \pm 0.01^b$ | $1.01 \pm 0.01^{ab}$ | $1.01 \pm 0.01^{ab}$ | 0.049 |
| Pressure Time | All | $1521 \pm 0.27^{ab}$ | $1601 \pm 27^a$ | $1471 \pm 25^b$ | $1544 \pm 26^{ab}$ | 0.007 |

### Temporal-Spatial Measurements

- No significant differences were found between timepoints in resting dogs.
- In exercised dogs, step time was significantly lower at 3h post-run compared to 30min and 24h post-run (p=0.006), indicating discomfort at 3h post-run
- In exercised dogs, cycle time was significantly longer at 30min post-run compared to 3h post-run. This indicates a slower speed at 30min post-run.
- In exercised dogs, swing percent was significantly lower at 30min post-run compared to baseline (p<0.01, indicating reduced flexion.
- In exercised dogs, stance percent was significantly higher at 30min post-run compared to all other timepoints (p<0.01), indicating an affected gait and discomfort during the walk
- In exercised dogs, stance time was significantly lower at 3h post-run compared to 30min and 24h post-run (p<0.01), indicating and affected gait and discomfort during the walk

| Temporal-Spatial Measurements in Exercised Dogs | | | | | | |
|---|---|---|---|---|---|---|
| Parameter | Limb | Pre-Run | 30min Post-Run | 3h Post-Run | 24h Post-Run | P-value |
| Step Time | All | $0.37 \pm 0.01^{ab}$ | $0.38 \pm 0.01^a$ | $0.35 \pm 0.01^b$ | $0.37 \pm 0.01^a$ | 0.006 |
| Cycle Time | All | $0.73 \pm 0.01^{ab}$ | $0.75 \pm 0.01^a$ | $0.71 \pm 0.01^b$ | $0.74 \pm 0.01^{ab}$ | 0.008 |
| Swing Percent | All | $38.05 \pm 0.23^a$ | $37.10 \pm 0.23^b$ | $38.44 \pm 0.21^a$ | $38.07 \pm 0.21^a$ | <0.001 |
| Stance Percent | All | $61.94 \pm 0.23^b$ | $62.91 \pm 0.23^a$ | $61.57 \pm 0.21^b$ | $61.93 \pm 0.22^b$ | <0.001 |
| Stance Time | All | $0.45 \pm 0.01^{ab}$ | $0.47 \pm 0.01^a$ | $0.44 \pm 0.01^b$ | $0.46 \pm 0.01^a$ | 0.001 |



| Paw Parameters | L.Front | R.Front | L.Hind | R. |
|---|---|---|---|---|
| Step Length (cm) | 44.609 | 46.99 | 44.926 | 47.625 |
| Stride Length (cm) | 91.65 | 91.44 | 93.35 | 92.08 |
| Reach (cm) | | | 20.2 | 19.8 |
| Stance % | 63.1 | 60.8 | 57.9 | 57.2 |
| Total Pressure Index % | 29.0 | 26.4 | 21.2 | 23.3 |
| Step/Stride Ratio | 48.7% | 51.4% | 48.1% | 51.7% |

## Conclusion

In summary, untrained Labrador retrievers had a significantly affected gait primarily thirty minutes and three hours after exercise compared to resting dogs. More research is necessary to identify the primary gait parameters affected after endurance exercise.

## References

[1]Faie M.A., Cortez, J.C., Ledesma M., and Su Y. (2018) Pressure Mat Analysis of Walk and Trot Gait Characteristics in 66 Normal Small, Medium, Large, and Giant Breed Dogs. *Front Vet Sci,* 5:256.
[2]Light V.A., Steiss J.E., Montgomery R.D., Rumph P.F., Wright J.C. (2010) Temporal-spatial gait analysis by use of a portable walkway system in healthy Labrador Retrievers at a walk. *Am J Vet Res,* (71) 9, 997-1002.