Comparison of Vertical Forces in Normal Dogs Between the AMTI Model OR6-5 Force Platform and the Tekscan (I-scan Pressure Measurement System) Pressure Walkway

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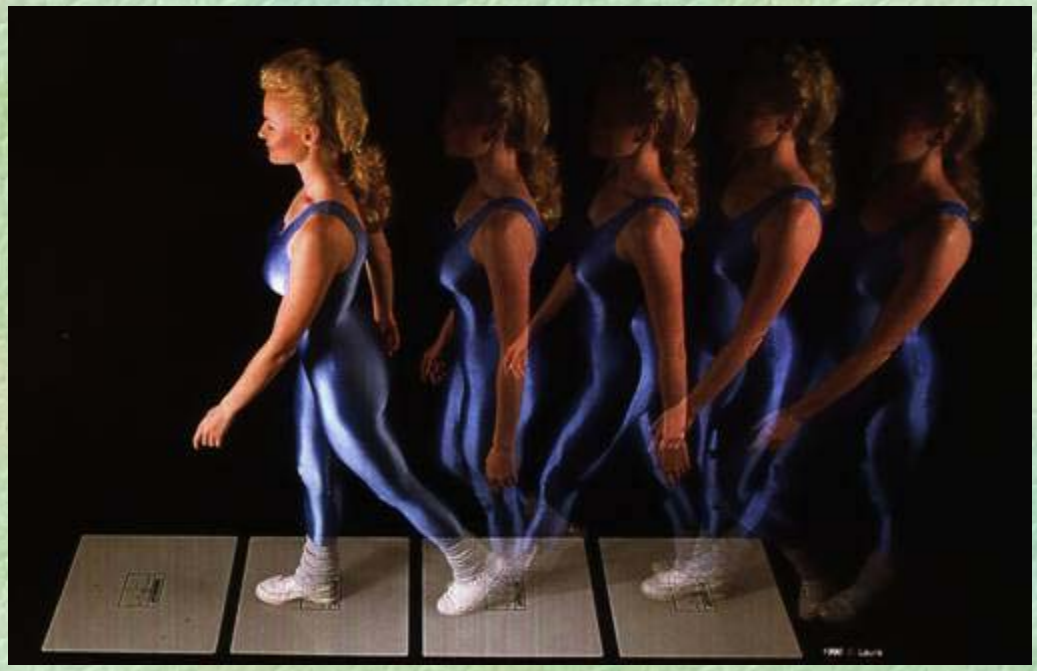
Gait

The manner of walking on foot or a sequence of foot movements

Analysis

- Subjective
- Objective



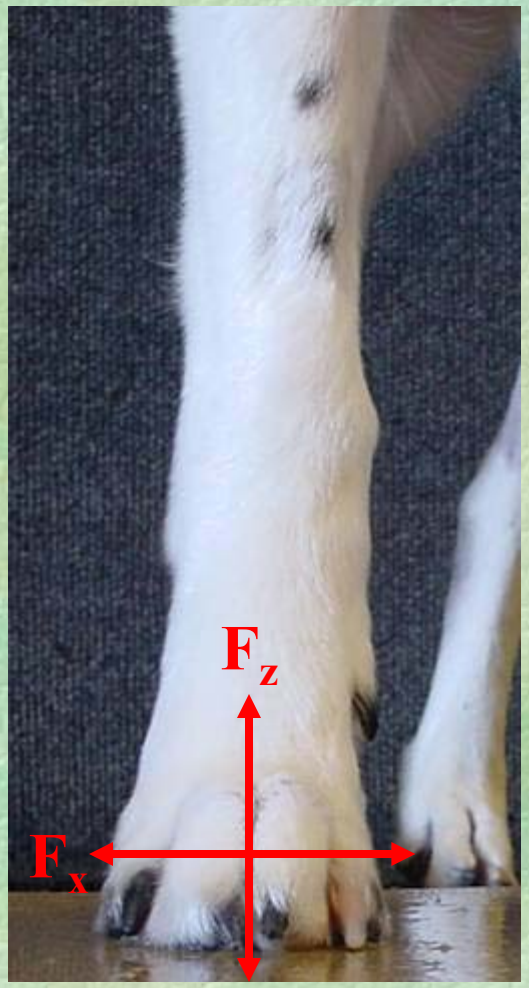
Kinesiology

Kinematics

- Temporal and geometric characteristics of motion
- Cinematography, electrogoniometry and accelerometery

- **Kinetics**
  - Forces that produce, stop or modify motion
  - Force plate or force shoe

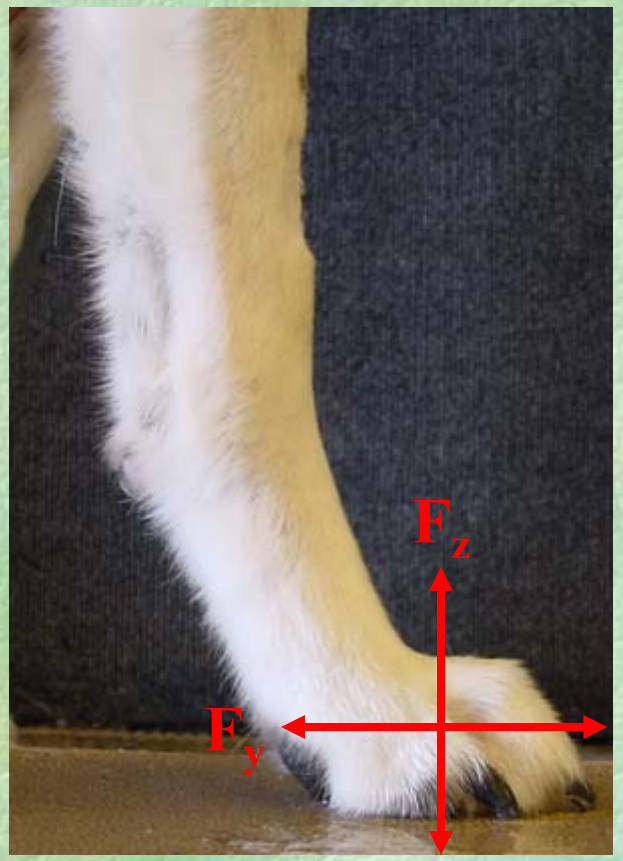
Ground Reaction Forces



Fx - Mediolateral

Fy - Craniocaudal

Fz - Vertical



VERTICAL FORCES

Peak Vertical Force (PVF) Vertical Impulse (VI)

‘Ideal’ Gait Analysis System

- **Reliable, accurate and reproducible data**
- **Detect sensitive changes in gait**
- **Ability to analyze various speeds of locomotion**
- **Rapid data collection**
- **Lack of interference with the animal**
- **Generates sufficient data for diagnostics**
- **User-friendly software**
- **Easy setup and use**
- **Economical**

- The biomechanical analysis of gait involves numerous kinematic, kinetic, and physiologic aspects that no one method of analysis can document adequately

Force Plates

Advantages

- Ease of use
- Non-invasive
- Objective

Disadvantages

- Inability to measure successive events during locomotion
- Multiple trials needed for sufficient data acquisition
- Limits to size of animals able to be evaluated
- Physical size and immobility

Contributions to Variance

Velocity and Acceleration

- Torso vs. Limb velocity

Trial variation

- >97% of variance attributed to trial repetition variation *(Budsberg et al. AJVR 1993)*

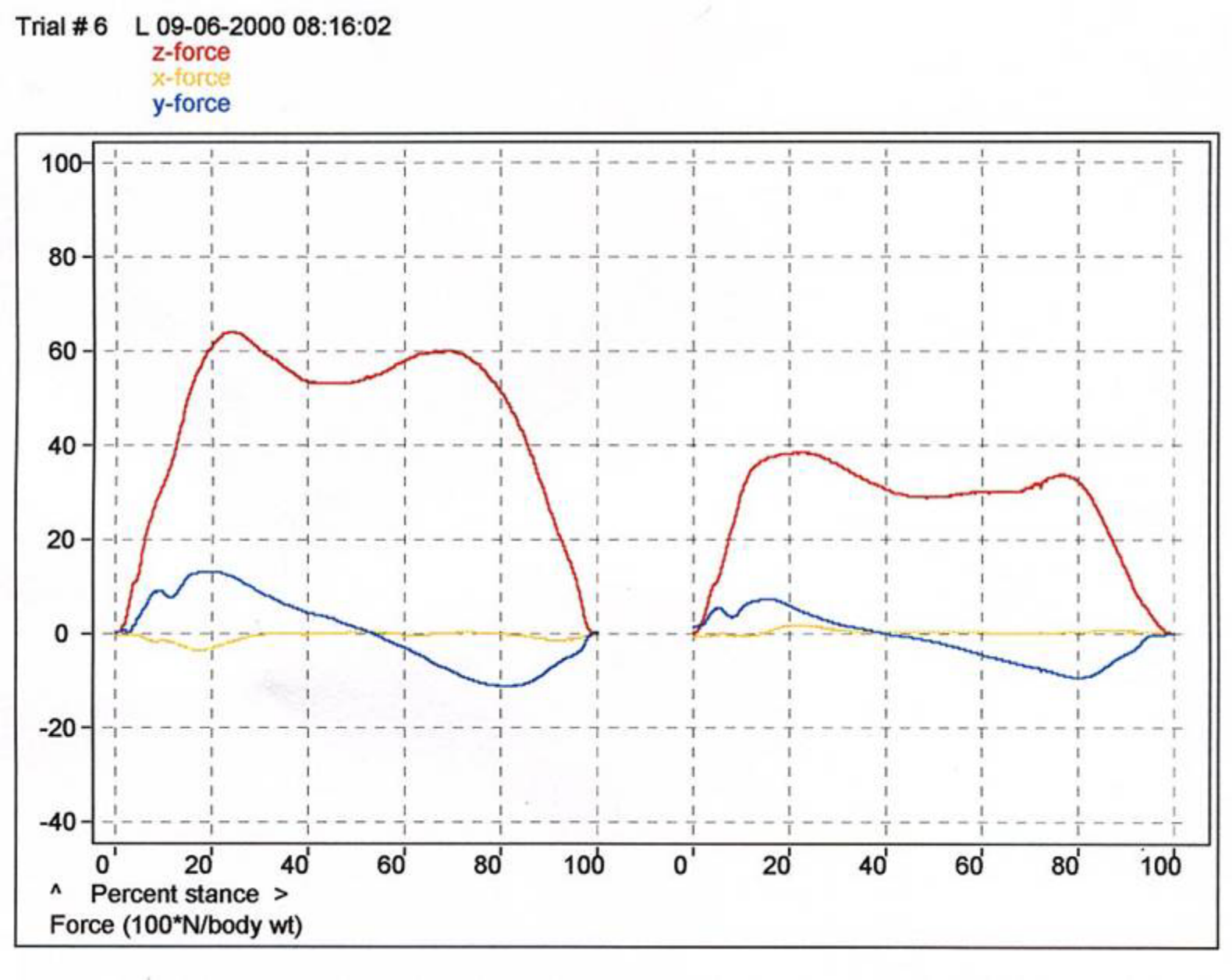
Others

Individual morphometrics

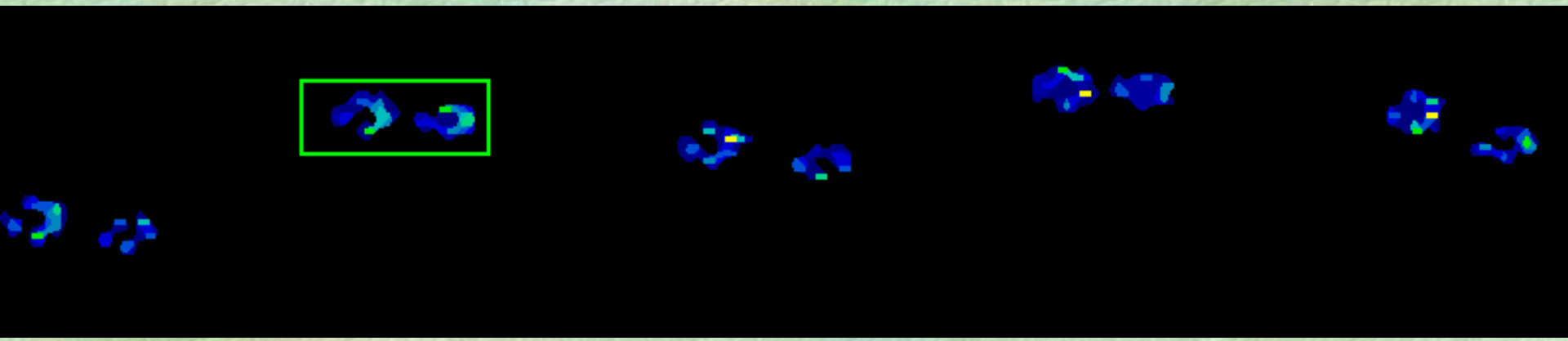
Selection and Habituation

Use of multiple handlers

Data


Trial # 6 L 09-06-2000 08:16:02
z-force
x-force
y-force
100
80
60
40
20
0
-20
-40
0
20
40
60
80
100
0
20
40
60
80
100
^ Percent stance >
Force (100*N/body wt)

Tekscan Pressure Walkway



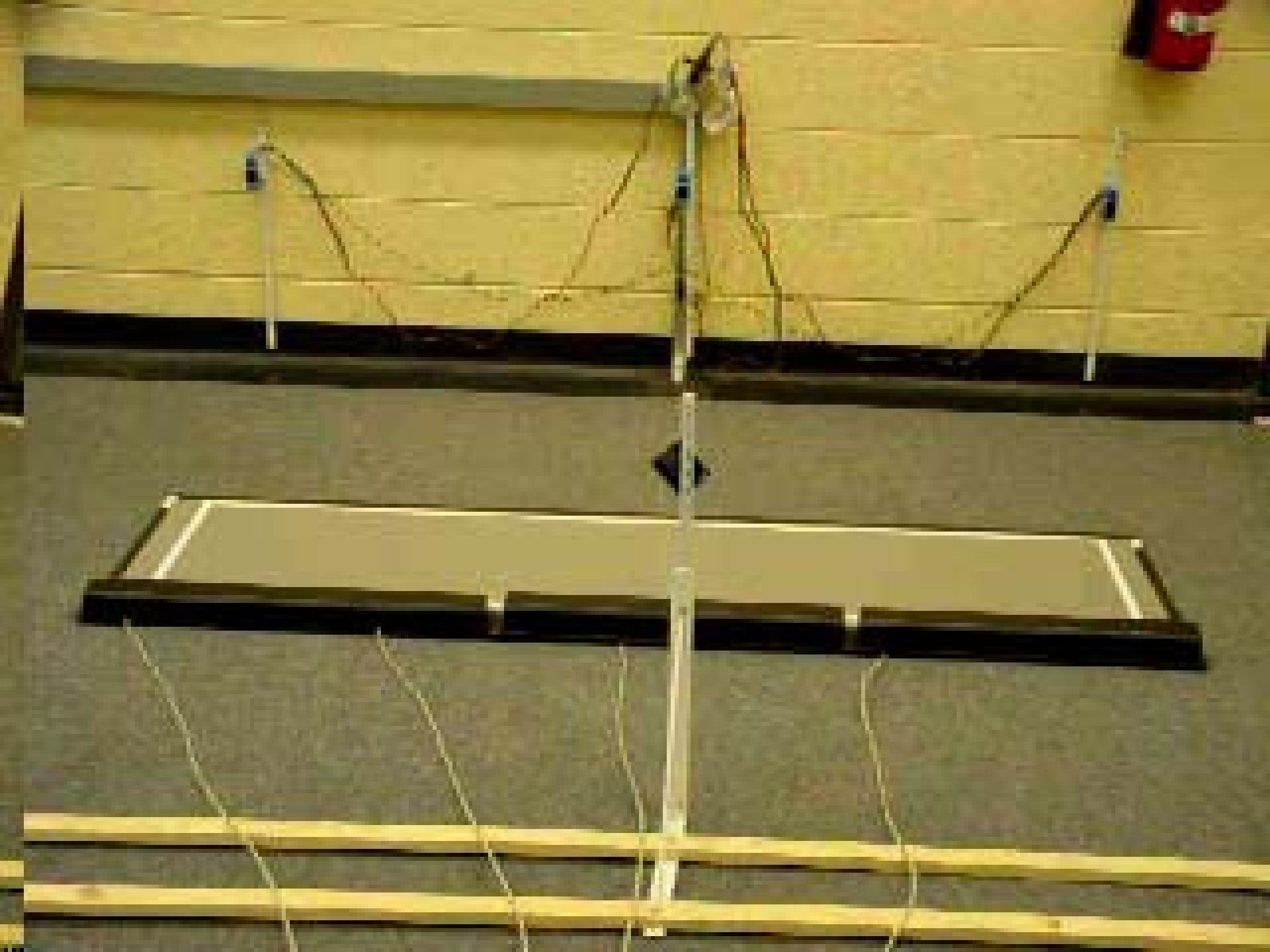
2m x 0.75m walkway

Sensing elements

- Act as variable resistors
- Arranged in rows and column
- Able to measure pressure differences throughout the foot strike

Specialized software

- Records data as ‘movies’



Tekscan Force Platform - cont.

Advantages

- Size
  - Multiple readings in a single pass
  - Consecutive, contralateral and simultaneous foot-strikes recorded
  - Ability to easily calculate limb speeds
  - Patients of extreme size can be evaluated
- Pressure distribution throughout the foot
- Mobile

Disadvantages

- Cost
- Current software needs improvements
  - Time needed to extract data can be prolonged
  - Inability to measure Fx and Fy

Hypothesis

- That peak vertical force and vertical impulse measurements would be similar between the AMTI model OR6-5 force platform and the Tekscan pressure walkway at a similar velocity and acceleration

Materials and Methods

- Dogs - 8 healthy adult Greyhounds (27.3 to 36.6kg; 4SF, 3M, 1NM)
- 4 experienced handlers
- Force Platforms - AMTI model OR6-5, Tekscan (I-scan pressure measurement system) pressure walkway
- Photoelectric cells/Triggered timer system

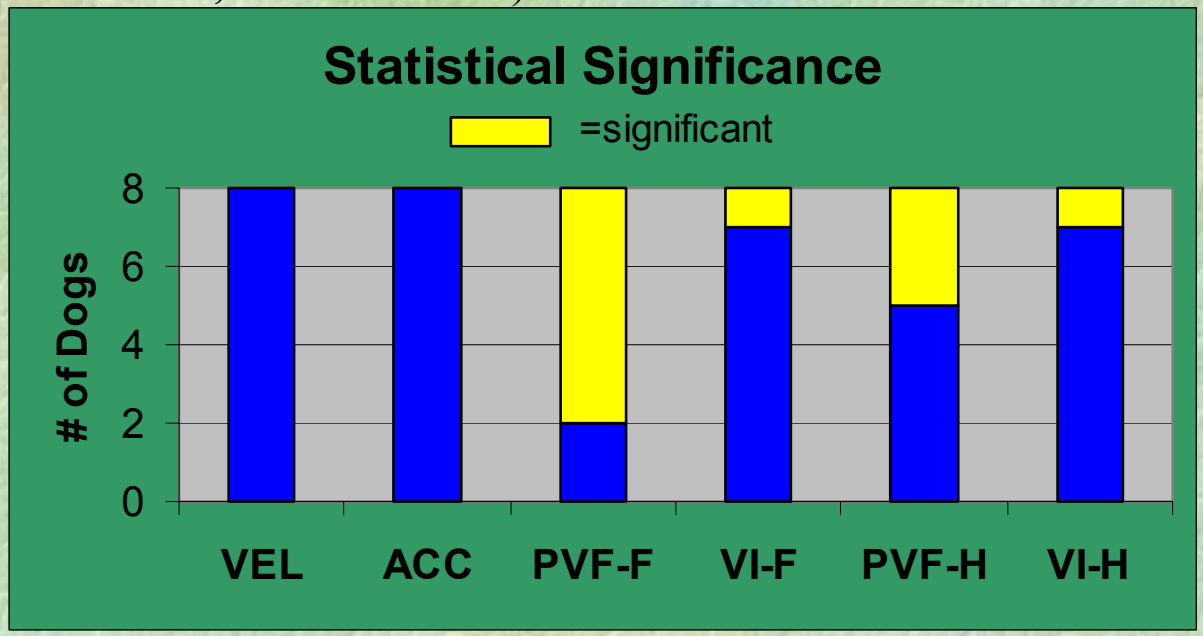
Data Collection

- Dogs were randomly assigned to 1 of 2 groups
- Acclimation to force plate area
- Velocity (0.9 - 1.1 m/s) and acceleration (± 0.1 m/s^2)
- Valid trials (1st 20 acceptable trials)

Tekscan vs. AMTI

Results

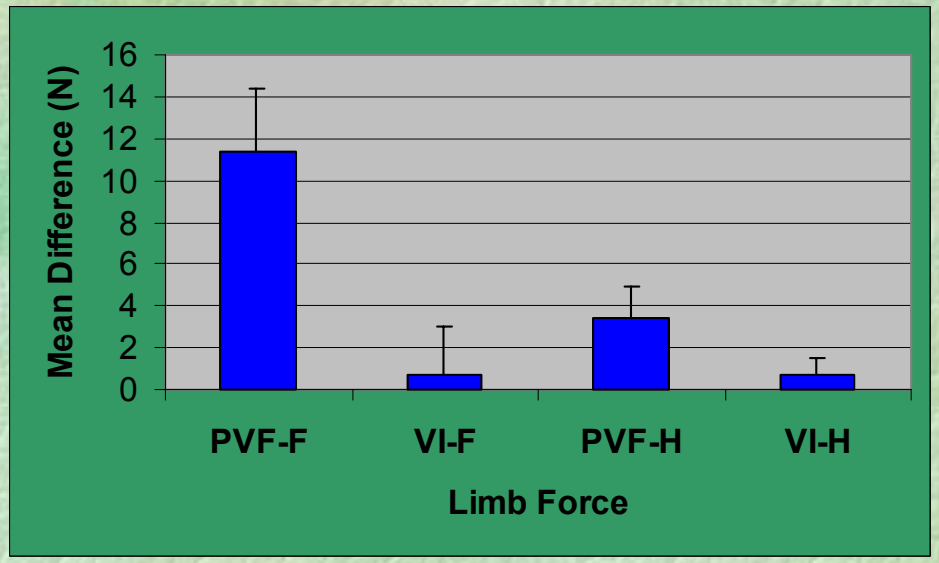
- Intra-dog - Comparison of individual dogs
  - (*t-test*, $p < 0.05$)
  - Velocity and Acceleration measurements are statistically similar
  - Statistically significant differences noted in PVF in 9 of 16 dogs (6/8 forelimb, 3/8 hind-limb)
  - Statistically significant differences noted in VI in 2 of 16 dogs (1/8 forelimb, 1/8 hind- limb)

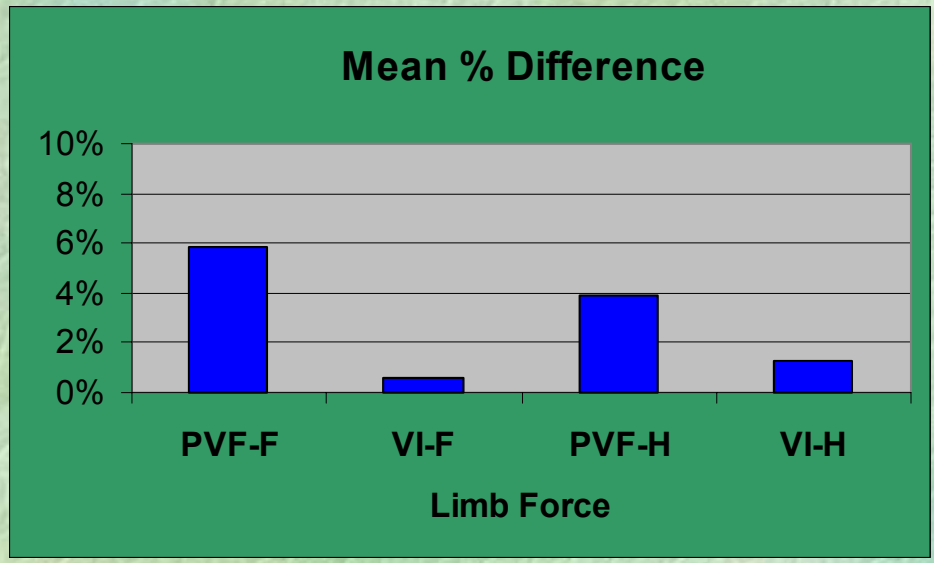


Tekscan vs. AMTI

Results

- Inter-dog comparison
  - ANOVA ($p < 0.05$)
  - Statistical significance in only PVF for the front limbs

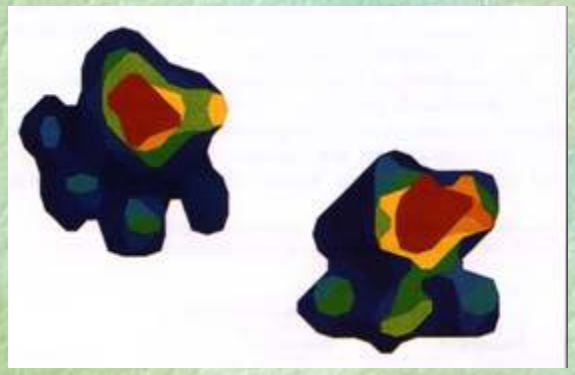




Tekscan vs. AMTI

- Vertical impulse measurements recorded by the Tekscan pressure walkway system provide for a reliable comparison to those measured by the AMTI force plate
- Differences in PVF are likely attributed to calibration technique
- The Tekscan system is a viable alternative, especially for outpatient clinical evaluations (eg. dogs with difficulty in ambulation, mobile platform), to the AMTI force platform for the generation of VI data, however PVF numbers are less reliable and need to be evaluated further
- Improvements to the I-scan software, allowing the reading of velocity and acceleration parameters along with craniocaudal and mediolateral forces, would give this system the potential to be superior to traditional forceplates

Potential uses of the Tekscan Platform



- Comparison of pressure differences throughout the foot pads
- Comparison of torso velocity to limb velocity, and evaluation of associated vertical forces
- Pain studies
- Animal models of human disease