Full Report

Investigating the impact of working dog trials obstacles on kinetics and kinematics of dogs

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Outputs:

- Williams, E., Carter, A. and Boyd. J. 2021. The impact of scale height on landing force in working trial dogs. Presentation to Canine Science Forum, virtual Conference 2021.
- Carter, A., Williams, E. and Boyd. J. Under Review. Understanding the impact of scale height on the kinetics and kinematics of dogs in working trials. Frontiers in Veterinary Science
- Williams, E., Carter, A. and Boyd. J. Under Review. Kinetics and kinematics of working trial dogs: the impact of long jump length on peak vertical landing force and joint angulation. Animals

Report

Study background

Working trials is a competitive canine discipline based on work originating from military and police dog work. Working trials competitions include dogs clearing a 9ft long jump and a 6ft scale. Jumping over hurdle jumps or long jumps has the potential to cause injuries to the front limbs of dogs, and different jump heights can cause changes to landing forces and angle of joints on landing. Little is known about the impact of the 6ft scale or the 9ft long jump on landing force and joint angles in dogs, despite a wealth of literature on the impact of agility obstacles on peak vertical landing forces (PVF) and joint angulation in dogs. Evidence-based approaches to canine working trials are important to ensure minimum impacts on physical health and welfare of participating dogs, in terms of risk of injury in both competition and training.

Aim

The aim of this research was to determine whether altering the length of the long jump impacted dogs' landing forces or joint angles in order to make recommendations which will help to ensure the health of dogs training and competing in this discipline.

Methodology

Study Population

Dogs were recruited opportunistically from the population of handlers and dogs regularly competing in working trials in the UK. All dogs had competed in working trials for at least 12 months to minimise the effect of naive or inexperienced dogs. Dogs were therefore experienced in clearing both the scale and the long jump obstacles at the maximum competitive height/length.

21 dogs (15 male, 6 female) were recruited to the study from five breeds/types (identified by handlers): border collie/working sheep dog (10), golden retriever (1), German shepherd/malinois (4), Labrador retriever (5), spaniel cross Labrador (1). Demographic details of the study population are provided in Table 1. All dogs were declared as physically fit enough to undertake this study by their handlers. Signed consent was given for their participation in the study.

Table 1. Demographic details of study populations and number of successful clearances of the obstacles tested during this research

Dog	Gender	Breed	Age	Height to withers	Weight	Number of successful clearances					
						Scale			Long jump		
						5ft	5.5ft	6ft	7ft	8ft	9ft
1	M	Working sheep dog	8	59.0	23.7	3	3	3	3	3	3
2	M	Border collie	4	49.5	21.7	3	4	3	3	3	3
3	M	Labrador retriever	5	57.0	27.7	4	3	3	5	3	4
4	F	Labrador retriever	3	51.0	21.0	3	3	4	3	3	5
5	M	Working sheep dog	3	56.5	24.1	7	3	3	4	4	3
6	M	Border collie	7	56.5	23.3	5	3	3	4	0	1
7	M	Working sheep dog	8	53.0	17.8	3	3	3	3	3	3
8	M	German shepherd	6	65.0	40.0	1	0	0	3	3	6

9	F	Labrador retriever	5	55.0	24.6	4	4	4	4	4	5
10	F	Border collie	2	48.3	17.2	3	3	3	3	5	3
11	M	Labrador retriever	5	57.0	31.3	3	3	3	5	4	6
12	M	Labrador retriever	4	57.0	25.8	4	3	3	4	4	4
13	M	Spaniel/ Labrador retriever cross	6	47.0	23.2	3	3	3	3	0	2
14	M	Border collie	3	56.0	25.2	4	3	3	9	0	0
15	F	German shepherd	5	No data **	30.2	3	3	3	4	2	1
16	F	Working sheep dog	3	52.0	18.6	3	3	3	4	4	3
17	M	Border collie	2	55.0	21.3	3	6	6	3	6	5
18	F	German shepherd	3	56.5	26.3	3	6	4	5	4	3
19	M	Malinois	No data**	54.0	26.6	3	3	3	4	3	5
20	M	Working sheep dog	7	52.0	21.7	3	3	3	3	3	3
21	M	Working golden retriever	4	57	29.8	4	3	3	5	3	4

*Dogs traversed the obstacles until they were considered to have landed successfully on the pressure mat three times (visual assessment from the project team). Continued traversing of the obstacles to achieve three successful landings on the pressure mat was at the discretion of the handler.

**Where no data was collected, this was due to omission or due to difficulty in measuring height.

Experimental setup

The study was carried out in a fenced outdoor equestrian arena with a fibre sand surface. The handlers prepared their dogs, as they would in training or competition. This also allowed the dogs to acclimatise to the research environment and equipment. Dogs were directed by their handler throughout the study. Dogs traversed the obstacles as they would do in normal training or competition and were asked to complete each exercise three times per height/length. The order of the three heights/lengths was randomised. No time limit was put on completion of the obstacles; therefore, the owner could take breaks between attempts. If a dog failed to complete the obstacle, they were given one further attempt at that height/length, following a second failed attempt, the dog was withdrawn from the study. Dogs were withdrawn from the study at the owner's discretion.

Dogs were filmed during the landing phase of their traversing of the scale using high-definition video cameras (JVC-GC PX10 HD, 300fps) with lateral placement to the obstacle with a one metre ground marker for reference (Figure 1 & 2).

Obstacles

The study examined dogs traversing the scale at three different heights. 6ft (1.83m) (the current maximum KC height in competition for dogs exceeding 15" (38.1cm) at the shoulder), 5.5ft (1.71m) and 5ft (1.52m). This was the equivalent to removing one plank from the scale each time.

Figure 1. Scale study setup showing positioning of pressure sensing mat on landing side. The participating dog was traversing the scale at 5ft.

The study examined dogs traversing the long jump at three different lengths. 9ft (2.74m) (the current maximum KC length in competition), 8ft (2.44m) and 7ft (2.13m).

Figure 2. Long jump study setup showing positioning of pressure sensing mat on landing side.

Peak vertical landing force

A Tekscan walkway gait analysis system 3150 pressure (sensing area of 0.87m x 0.37m) (Tekscan) was placed at the landing point (Figure 1 & 2), covered by a thin rubber mat to standardise the landing surface. This was used to measure peak vertical force (PVF) on landing. Peak vertical force on landing across both front feet was measured using Matscan XL (Figure 3). If only one foot landed on the mat this replicate was discarded. Where dogs did not land fully on the pressure sensing equipment, they were requested to repeat the height/length to achieve three successful landings on the mat. The number of times each dog traversed the obstacle is included in Table 1.

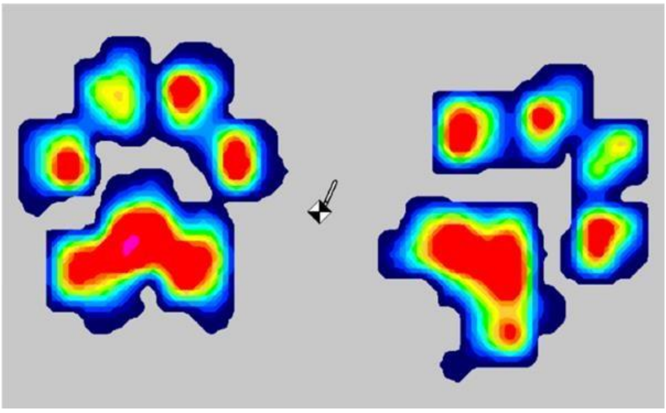

Figure 3. Tekscan 'heatmat' visualisation of landing force. Colours provide a visual representation of measured forces from low (blue) to high (red). The black and white symbol indicates centre of gravity at the point of measurement.

Apparent joint angles and duration of landing

Apparent carpus and shoulder angles on landing were measured using Kinovea Version 0.9.3. Apparent angles of the carpus and the shoulder of dogs on landing (Figure 4 and 5) were measured on each video frame (30 fps) during the landing from the time the first front foot touched the floor to the time the first rear foot hit the floor. The frame at which the dog had the minimum carpus angle was taken to be the lowest phase of the landing.

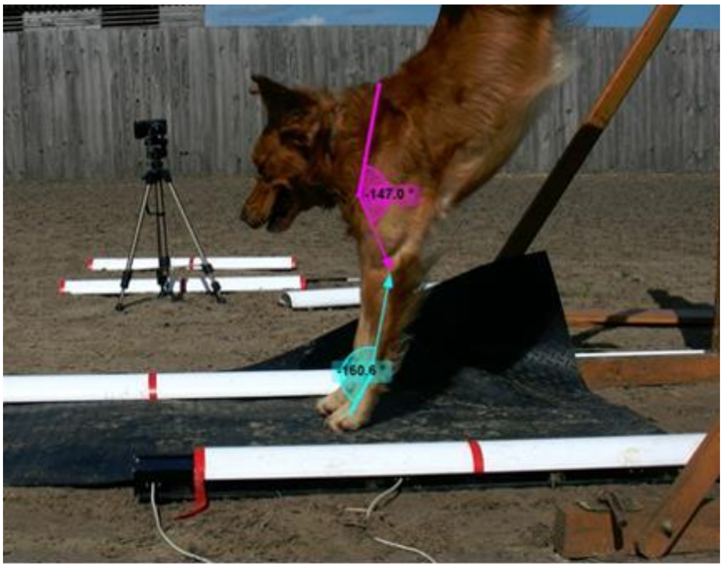

Figure 4. Apparent angles of the carpus and shoulder of dogs on landing after completing the scale obstacle, measured using Kinovea Version 0.9.3.

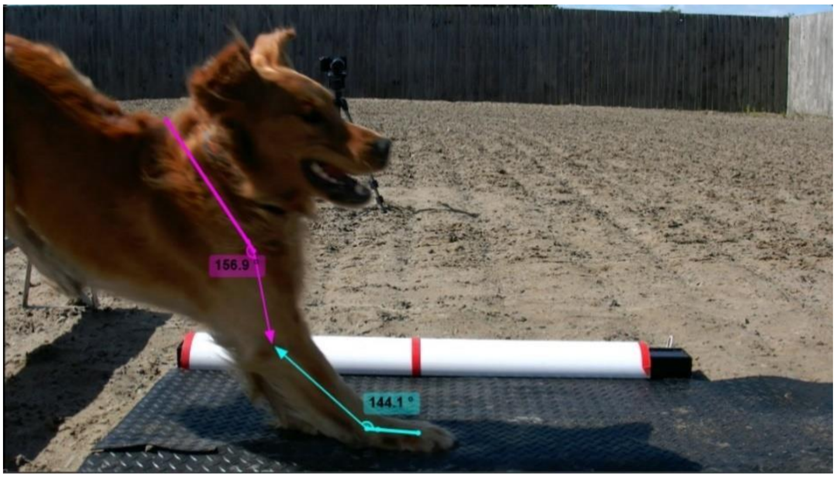

Figure 5. Apparent angles of the carpus and shoulder of dogs on landing after clearing the long jump, measured using Kinovea Version 0.9.3.

Data analysis

General linear mixed models, with Tukey corrected post-hoc tests where appropriate, were used to investigate the impact of scale height (5ft, 5.5ft, 6ft) length of the long jump (7ft, 8ft, 9ft) and dog weight (<25kg, >25kg), on PVF and minimum carpus and shoulder angles on landing. To prevent erroneous identification of PVF, individual jumps were only included in analysis if values were present for both front feet, to enable identification of the PVF across both feet. Peak vertical landing force and joint angles on landing were fitted as response variables. Scale height/long jump length and dog weight were fitted as fixed effects. To control for replicates, dog was included as a random effect in each model. Data analysis was undertaken in R Studio

(Version 4.0.3) (R Core Team, 2020) using packages ‘lme4’ (Bates et al., 2015) and ‘emmeans’ (Lenth, 2021). Variance in PVF and apparent angles on landing between dogs <25kg and >25kg at the three scale heights (5ft, 5.5ft, 6ft) was assessed using a Levene’s test using package ‘car’.

Graphs were produced using package ‘ggplot2’.

Results

Scale obstacle

Peak vertical landing force was greater in dogs >25kg at 6ft than at the lowest height (5ft) (Figure 6). For dogs >25kg there was no difference in PVF between 5.5ft and 6ft. For dogs <25kg there was no impact of scale height on PVF. PVF was more variable in dogs <25kg than >25kg, with dogs >25kg showing more consistency in their PVF at all obstacle heights.

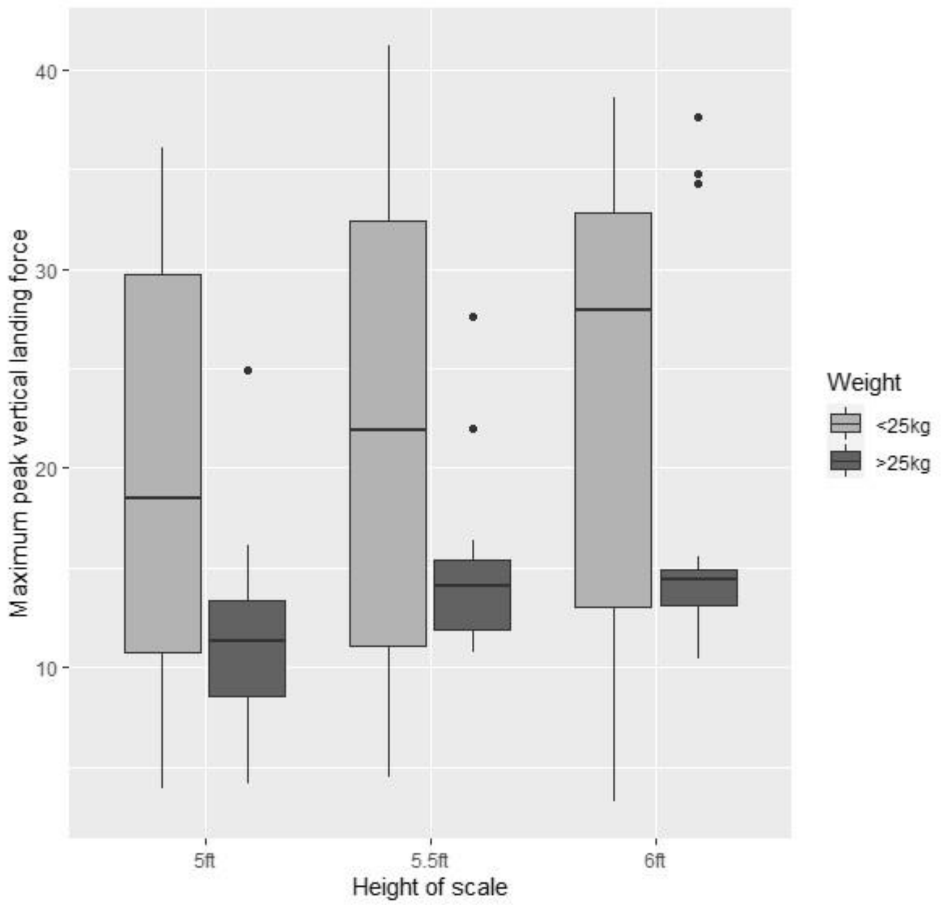

Figure 6. Maximum peak vertical landing force for the study dogs (n=20) at the three scale heights (5ft, 5.5ft and 6ft)

Apparent carpus angle on landing was smaller at 6ft than 5ft and 5.5ft for dogs <25kg. This indicated greater compression at the carpal joint on landing for dogs <25kg at 6ft than at the 5ft and 5.5ft heights. There was no difference in apparent carpus angle on landing at any height for dogs >25kg, although median carpus angle on landing was smallest at this height, again indicating greater compression at this height than at 5ft and 5.5ft.

Long jump

There was no difference in PVF for any of the dogs, however there was a trend towards dog of <25kg showing greater variation in their landing forces (Figure 7). Dogs >25kg showed more variation at the 9ft length and were more consistent at 7ft and 8ft lengths.

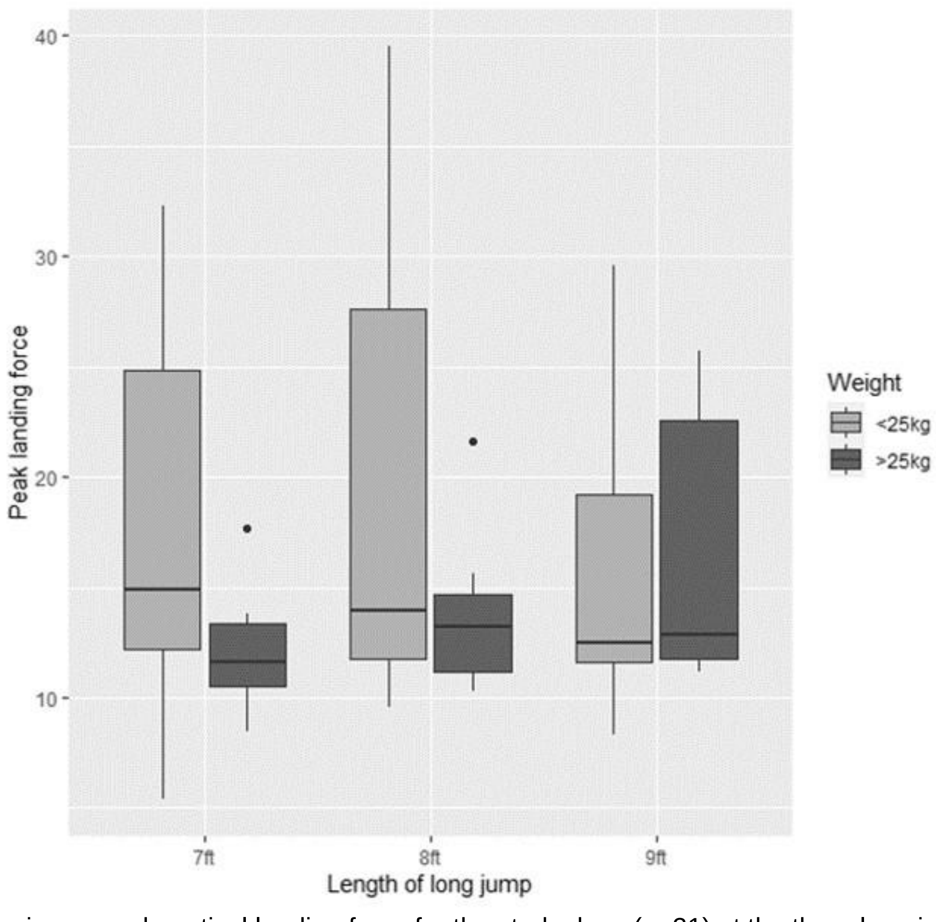

Figure 7. Maximum peak vertical landing force for the study dogs (n=21) at the three long jump lengths (7ft, 8ft, 9ft)

Dogs that were <25kg had smaller minimum carpal angles on landing than dogs >25kg, however there was no relationship between this and length of the jump. Dogs that were >25kg had smaller minimum shoulder angles on landing than dogs <25kg, however there was no relationship between this and the length of the jump. Dogs showed considerable variation in this obstacle and greatest compression in the joints was observed at the longest distance (9ft).

Main recommendations:

- From the findings, it is recommended that the scale is lowered from 6ft to 5.5ft. Whilst lowering to 5ft may further reduce the impact on joints and landing force, this in turn encourages the dogs to 'jump' rather than 'scale', changing the nature of the obstacle.

- There is evidence to suggest that shortening the length of the long jump would be of benefit to the dogs. Whilst not formally measured as part of the study, the capacity of the dogs to avoid overjumping the shorter distances suggests a sudden reduction of the long jump distance does not appear to impact dogs experienced in jumping a 9ft long jump.

Areas for future research and considerations:

- The large amount of individual variability in landing force and joint angles, particularly within dogs under 25kg suggest that further research surrounding the scale and long jump in relation to dog size would be beneficial. As with agility, obstacle height/length could be considered according to dog size.
- Dogs participating in the study were actively competing in working trials. Owners reported that dogs often retired due to an inability to clear the 9ft long jump. Therefore, it is worth investigating causes of and age of retirement from working trials competition, whether due to obvious injury or willingness to continue to compete over the obstacles. 'Senior' categories of lower heights and shorter distances could be offered for older or indeed young, inexperienced dogs in competition.
- Anecdotally, the capacity for dogs to clear obstacles of different heights/distances suggests that the need to train at full height/distance may not be necessary for all training sessions.