Temporospatial and kinetic characteristics of sheep walking on a pressure sensing walkway

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Abstract

The walking gait of sheep was analyzed in terms of temporospatial and kinetic parameters and weight distribution among the 4 limbs. Eighteen mature female Suffolk-mix sheep walked comfortably with a halter-guide over a 1.5-m pressure sensing walkway. Six valid trials were acquired for each sheep without any previous selection or habituation. Stance phases of the forelimb and hind limb were 66.3% and 68.9%, respectively, of total gait cycle, and limb velocity was 1.06 m/s in both forelimbs and hind limbs while walking. The mean peak vertical force (PVF) and vertical impulse (VI) as percentage of body weight in the forelimbs were 52.5% and 19.9%, respectively, and those of the hind limbs were 38.5% and 14.9%, respectively. More body weight was loaded on the forelimbs than the hind limbs, at 59% and 41% of body weight, respectively. The walking gait of sheep measured with the pressure sensing (PS) walkway was similar to that reported in dogs and horses. The PS walkway enabled collection of temporospatial and kinetic data, and simplified the process of data collection.

Résumé

La démarche de moutons a été analysée afin d'en déterminer des paramètres temporo-spatiaux et cinétiques de même que de mesurer la distribution du poids sur les quatre membres. Dix-huit brebis Suffolk croisées ont été marchées à l'aide d'un licou sur une plaque de pression de 1,5 m. Six essais valides, sans sélection antérieure ou accoutumance, ont été obtenus pour chaque animal. Les phases d'appui du membre antérieur et du membre postérieur étaient respectivement 66,3 % et 68,9 % du cycle total de la démarche, et la vélocité du membre était de 1,06 m/s pour les deux membres antérieurs et les deux membres postérieurs lors de la marche. Les moyennes de la force du pic vertical (PVF) et de l'impulsion verticale (VI), exprimées en pourcentage du poids corporel, étaient respectivement 52,5 % et 19,9 % pour les membres antérieurs, et pour les membres postérieurs étaient 38,5 % et 14,9 %. Plus de poids corporel étaient mis sur les membres antérieurs que sur les membres postérieurs avec, respectivement, 59 % et 41 % du poids corporel. Les données de l'allure à la marche de moutons mesurées à l'aide d'une plaque de pression (PS) étaient similaires à celles rapportées pour les chiens et les chevaux. La PS a permis la prise de données temporo-spatiales et cinétiques, et a simplifié le processus d'acquisition de données.

(Traduit par Docteur Serge Messier)

Introduction

Animal models have been used to learn more about biological systems and diseases that afflict humans or other animals. They provide an understanding of the natural history of disease, allow the development of new and improved surgical techniques, and can predict the effect of a given treatment or surgical procedure (1). Although animals provide whole, complex living systems that can react to stimuli as humans do, the results from experimental animal studies must be extrapolated because animals are not identical to humans. In order to acquire valid information from animal studies; therefore, it is essential to recognize the characteristics of animal models and select an appropriate animal model.

Sheep are often used as animal models in orthopedic research. Domestic sheep are placid and have a body weight (BW) similar to humans. Their size is also adequate for serial sampling and multiple experimental procedures (2). Sheep have been used to study numerous musculoskeletal pathologic conditions, such as repair of fractures and articular ligaments, limb lengthening, treatment of osteoarthrosis and osteoporosis, muscular disorders, osteomyelitis, spinal diseases, and biomaterial evaluation (2). However, basic physiological and functional information on sheep is limited, certainly in comparison with dogs, the large animal in vivo model most commonly used in orthopedic research.

Gait is a fundamental function of animals and engages all behaviors, such as active foraging for food sources or pursuit of prey, movement to avoid a stressful environment, and finding a mate (3). Gait analysis of animal models, therefore, can be an accurate, quantitative, and objective method by which to document limb function during normal activities or to analyze changes that are related with disease. Since this method is noninvasive, and yields objective information without any influence on the conditions of the experiment, gait measurement has been shown to be an important biomechanical tool in research and clinical applications, as an outcome indicator to guide the course of treatment (4), and to compare the efficacies of alternative therapies (5).

A pressure sensing system was developed recently and has been used for the evaluation of a variety of foot pathologies in humans (6–8) and description of limb function in animals (4,9–12). The pressure sensing (PS) walkway is a thin, long plastic sensing pad

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with grid-fashion sensors that record changes of resistance, shown as color pixels of pressure, on a computer screen. The PS walkway system saves gait data as a real-time movie of serial footprints and allows data analysis of each acquired frame. The PS walkway has been presented as a viable alternative of traditional force platform and in animal studies has an advantage for its capability to record multiple foot strikes in a single passage (9).

Sheep have been used as animal models to study various conditions, but there is still lack of basic and detailed information on gait and on standardized methods to use for the objective evaluation of limb function. The purpose of this study is to describe the walking gait of sheep and develop a basic database of sheep gait parameters using a PS walkway.

Materials and methods

Eighteen mature, female Suffolk-mix sheep, ranging from 69.3 to 103.5 kg, were used in this study. Each sheep was examined for any gait abnormalities before the start of the study. Sheep were only included in the final data analysis if 6 valid trials could be obtained. This study was approved by the Purdue Animal Care and Use Committee.

A 1.5-m × 0.5-m pressure sensing walkway (Walkway™; Tekscan, South Boston, Massachusetts, USA), composed of individual sensors with a density of 3.9 sensors/cm^2 was mounted on the floor in the center of a 10-m long walkway. The sensors of PS walkway were calibrated according to the manufacturer's specifications. A wooden partition, 4.8-m long and 0.65-m high, was placed along the right side of the PS walkway to guide the sheep. A digital video camera was positioned alongside the PS walkway and used to record limb strike and gait. The sampling rate of the PS walkway was 30 Hz, and the video camera recorded at least 120 frames (4 s) during each trial.

Before data collection, each sheep was weighed on an electronic scale and walked across the walkway 3 to 5 times to become accustomed to the PS walkway, handler, and halter. During each trial, sheep walked over the walkway at a comfortable speed, led by a handler using a halter. The handler walked behind the wooden partition, being careful not to pull the halter. Data were acquired in at least 10 trials for each sheep; 3 or more trials with the sheep placing the left forelimb first on the PS walkway, and 3 or more trials with the sheep placing the right forelimb first. The direction of walking relative to the camera (left to right and right to left) was also balanced in order to remove the possibility of leaning toward the wooden partition and the handler. A trial was considered valid if a sheep walked comfortably in a straight line without overt head movement or pulling of the halter. In addition, at least 1 of the 4 limbs had to fully contact the walkway twice (1 gait cycle of that limb) during a sheep's passage. The data from the first 6 valid trials (3 left and 3 right forelimb starts) were taken for each sheep and were analyzed using designated software (I-Scan version 5.23; Tekscan, South Boston, Massachusetts, USA) by reviewing every frame of the trial. If 6 valid trials could not be obtained, that sheep was excluded from the study.

All data collection recordings were saved as movies with an "fsx" file extension and force data at each frame were exported as ASCII files. All kinematic and kinetic data were recorded in a spreadsheet program (Excel 2002; Microsoft Corporation, Redmond, Washington, USA) for further analysis. The frame under peak mode, a composite frame displaying the maximum pressure value each sensor reached during the recording, as well as its sensor and calibration information, was printed for record keeping.

For data analysis, every frame of the movie of a trial was reviewed to analyze the sequence of placing the 4 limbs on the PS walkway and the corresponding number of frames of each step. Next, all steps on the PS walkway displayed at peak mode were encased with a color-coded box (20 × 20 sensors). If any overlapping of forelimb and hind limb occurred, a copy of the movie was generated and edited as separate movies for forelimb and hind limb.

The kinematic parameters determined for each limb included gait cycle duration, stance phase duration, swing phase duration, stride length, and limb velocity. Gait cycle duration, measured in second(s) was defined as the interval between the 1st frame of the 1st step of 1 of the forelimbs on the PS walkway and the 1st frame of the consecutive step of the same forelimb. Stance phase duration (s) of each limb was calculated as the numbers of frames that displayed any force data of each limb multiplied by the sampling rate (30 Hz). The stance phase duration was also represented as fraction of the gait cycle duration [duty factor, β (13); β = stance phase duration/gait cycle duration]. Swing phase duration (s) was calculated as the stance phase duration subtracted from the gait cycle duration. Swing phase as a percentage of gait cycle (% gait cycle) was calculated [(swing phase duration/gait cycle duration) × 100]. Stride length (m) was measured as the distance in millimeters from the most caudal pixel of 1st contact of the foot on the PS walkway to the most caudal pixel of the next contact of the same foot. Limb velocity (m/s) was calculated as the stride length divided by the corresponding duration of gait cycle. The kinematic parameters were only measured from limbs with complete gait cycles on the PS walkway and, depending on the location of the1st step on the PS walkway, 1 or 2 gait cycles were completed in a single trial.

Unlike kinematic parameters, the kinetic variables were measured from all steps placed on the PS walkway regardless of their contribution to the complete gait cycle. The kinetic parameters of every step on the PS walkway were presented as a color-coded force-time curve of each step and numeric form in the peak frame of each trial by the software. The peak vertical force (PVF) was measured in both Newtons (N) and kilograms (kg). The vertical impulse (VI), the area under the vertical force curve, was also measured in N/s and kg/s. For comparison, PVF and VI were normalized to the sheep's body weight and represented as force and impulse per unit BW (N per kg BW and N × s/kg) and percentage of sheep's body weight (% BW and % BW × s). The PVF was also used to calculate the percentage of body weight distribution among the 4 limbs using the following calculation:

(PVF of the limb/total PVF of the 4 limbs in 1 gait cycle)

×100 (14)

All gait parameters from right and left sides of forelimbs and hind limbs were compared using a paired *t*-test to identify any influence of walking direction and wooden partition. The gait parameters

Table I. Kinematic gait parameters of sheep during walking

	Forelimb				Hind limb			
	Mean (SD)	Range	Median	CV[a] range[b]	Mean (SD)	Range	Median	CV range
Gait cycle (s)	0.82 (0.13)	0.63–1.27	0.80	6.52–22.78	0.82 (0.16)	0.44–1.17	0.80	9.70–30.83
Stance phase (s)	0.55 (0.12)	0.27–0.93	0.53	9.56–24.65	0.57 (0.15)	0.26–1.30	0.54	10.45–32.62
Stance phase (% gait cycle)	66.31 (3.41)	59.36–74.49	66.33	2.44–5.02	68.89 (4.03)	55.56–79.06	69.26	3.02–7.78
Swing phase (s)	0.27 (0.04)	0.20–0.38	0.27	8.95–17.30	0.25 (0.07)	0.14–0.47	0.24	10.74–32.74
Swing phase (% gait cycle)	33.69 (3.41)	25.51–40.64	33.67	5.02–12.12	31.11 (4.03)	20.94–44.44	30.74	6.25–15.33
Stride length (m)	0.85 (0.07)	0.70–1.01	0.85	3.17–7.07	0.84 (0.06)	0.70–1.00	0.84	4.00–7.04
Limb velocity (m/s)	1.06 (0.19)	0.57–1.49	1.07	7.24–22.58	1.06 (0.22)	0.57–1.76	1.08	6.82–27.60

[a] Coefficient of Variation = (standard deviation/mean) × 100.
[b] Range of individual sheep's CV (n = 7).

Table II. Kinetic gait parameters of sheep during walking

	Forelimb				Hind limb			
	Mean (SD)	Range	Median	CV[a] range[b]	Mean (SD)	Range	Median	CV range
Peak vertical force (N)	454.85 (95.71)	207.64–741.51	461.26	16.25–21.04	309.67 (72.32)	178.38–544.29	303.55	14.74–28.57
Peak vertical force (N/kg)	5.15 (0.96)	2.61–7.70	5.21	16.25–20.56	3.38 (0.68)	1.81–6.01	3.30	14.74–20.59
Peak vertical force (% BW)	52.52 (9.84)	26.58–78.51	53.13	16.25–20.56	38.52 (9.08)	18.46–77.13	37.72	15.94–28.56
Vertical impulse (N × s)	173.24 (56.21)	61.70–378.29	166.25	19.21–32.94	120.81 (38.98)	50.80–246.05	113.21	17.49–33.35
Vertical impulse (N × s/kg)	1.85 (0.61)	0.75–3.71	1.83	17.49–31.85	1.36 (0.38)	0.58–2.38	1.29	17.49–34.84
Vertical impulse (% BW × s)	19.89 (5.85)	8.92–37.88	19.26	19.21–32.93	14.85 (4.78)	5.88–35.41	14.08	17.47–34.85

[a] Coefficient of Variation = (standard deviation/mean) × 100.
[b] Range of individual sheep's CV (n = 7).

of left and right limbs were pooled and mean, standard deviation, median, and ranges of data were calculated for forelimbs and hind limbs. Coefficients of variation (CV) were calculated to determine intra-sheep and inter-sheep variability. Coefficients of correlation between all analyzed variables of both forelimb and hind limb were calculated using software for statistical analysis (SPSS 12.0; SPSS, Chicago, Illinois, USA). A P-value of < 0.05 was taken as a significant difference for all tests.

Results

Only 7 of the 18 sheep fulfilled the inclusion criteria and were used for the final data analysis. This data set consisted of 288 individual steps and 61 complete gait cycles. The average body weight of the 7 sheep used for the final data analysis was 88.5 kg (69.3 to 103.5 kg).

Any data from the 11 sheep that failed to do 6 valid trials were not used for the final data analysis due to either inconsistent force generation during walking, or inability to take temporospatial measurements. Struggling with the halter, obvious deviation from the path during walking, or running instead of walking on the walkway, could change the velocity or acceleration, thus affecting the ground reaction force of a limb. It was impossible to measure the temporospatial parameters for a complete stride if sheep put only 1 step or part of a foot of 1 or more limbs on the PS walkway.

The kinematic gait parameters of forelimbs and hind limbs were identical, except for the mean stance and mean swing phase duration. The mean gait cycle duration of both forelimbs and hind limbs was 0.82 s. Although not statistically significant, the mean stance phase duration of forelimbs (0.55 s) was shorter than that of hind limbs (0.57 s). The mean swing phase duration was the opposite: forelimbs had a longer swing phase duration than hind limbs (0.27 s and 0.25 s, respectively). The mean limb velocity of forelimb and hind limb in

Table III. Weight distribution among limbs during walking

Sheep number	Weight (kg)	Weight distribution (%)[a] Left forelimb	Right forelimb	Left hind limb	Right hind limb
1	69.3	30.1	27.0	22.0	21.0
2	79.6	31.1	30.1	19.7	19.0
3	84.6	27.9	31.0	20.7	20.6
4	86.8	32.5	26.3	20.5	19.1
5	97.2	27.5	32.4	21.1	18.9
6	98.5	27.4	30.9	21.2	20.5
7	103.5	27.9	31.2	21.0	19.9
Mean (SD)	88.5 (12.0)	29.2 (2.1)	29.8 (2.3)	20.9 (0.7)	19.9 (0.8)

[a] Mean values of 6 trials of each limb.

this study was 1.06 m/s. The mean duty factors of forelimb and hind limb were 0.66 and 0.69, respectively. All kinematic results, including statistical analysis are listed in Table I.

During walking, more forces were loaded on the forelimbs than on the hind limbs (Table II). Mean PVF and VI in the forelimbs were 5.15 N/kg and 1.85 N × s/kg, respectively, and those of the hind limbs were 3.38 N/kg and 1.36 N × s/kg, respectively. Mean PVF and VI as a percentage of body weight in the forelimbs were 52.5% and 19.9% respectively, and in the hind limbs 38.5% and 14.9%, respectively. Although the stance phase duration of the hind limbs was slightly longer, the vertical impulse of the hind limbs was smaller due to the smaller vertical forces loaded on the hind limbs. Mean weight distribution during walking was 29.2% and 29.8% for the left and right forelimbs, respectively, and 20.9% and 19.9% for the left and right hind limbs, respectively (Table III).

There was no significant difference between the gait parameters of the left and right limbs: gait cycle duration ($P = 0.164$), stance phase duration ($P = 0.966$) and swing phase duration ($P = 0.788$), stride length ($P = 0.105$) and limb velocity ($P = 0.576$). Kinematic data of forelimbs and hind limbs were significantly correlated: gait cycle duration ($r = 0.944$, $P = 0.001$), stance phase duration ($r = 0.920$, $P = 0.003$) and swing phase duration ($r = 0.760$, $P = 0.047$), stride length ($r = 0.987$, $P < 0.001$) and limb velocity ($r = 0.849$, $P = 0.016$). Significant correlation between body weight and the other parameters (r, range: 0.098 to 0.522, P, range: 0.229 to 0.834) were not identified.

Discussion

The kinematic and kinetic gait parameters and weight distribution of each limb were determined for sheep as they were walked along a PS walkway. This is the 1st study to determine kinematic and kinetic parameters in sheep using a PS walkway.

It is difficult to compare the kinematic data from the present study to similar data from other quadrupeds because of differences in limb length, body weight, body and foot conformation, and gait speed. Considering the body size, and the linear relation between velocity and stride length, and the negative relation between velocity and duration of stance phase, the kinematic data of sheep would be expected to be between those of dogs and horses. In general, the kinematic and kinetic data from sheep were similar to or a scaled dimension of data reported for horses, dogs, and cats. During walking of a normal horse (1.2 m/s to 1.8 m/s), the reported stride length was 1.5 m to 1.9 m and limb stance phase duration was 65% to 75% of the gait cycle duration (15). In healthy, large-breed dogs walking at a speed of 1 m/s, reported stride lengths of forelimb and hind limb were 0.80 m and 0.81 m, respectively, and stance phase durations of forelimb and hind limb were 0.53 s and 0.51 s, respectively (16). Sheep in this study had a slightly longer stride length even with longer stance phase than these dogs when walking at similar velocity, most likely because of their larger body dimensions.

Reported kinetic parameters in dogs and the kinetic parameters in this study are similar. The mean PVF of forelimb and hind limb in greyhounds, measured using a PS walkway, were 58% and 42% BW, respectively, with a walking speed of 0.9 m/s to 1.1 m/s (9). The mean VI of forelimbs and hind limbs of greyhounds were 26% and 18%, respectively. The mean PVF for the forelimbs and hind limbs of 13 adult domestic cats were 56% and 50% body weight, respectively, and the mean VI of forelimbs and hind limbs were 19% and 15%, respectively (12). The PVF and VI were also obtained using a PS walkway, but cats had a slower walking speed (0.69 m/s) than dogs and sheep. Sheep in the present study, similar to dogs, had more disparity between forelimb and hind limb parameters than cats, but the importance of this species differences is not known. The distribution of body weight on each limb during walking in sheep was identical as that reported in dogs (17) and horses (14): approximately, 30% to each forelimb and 20% to each hind limb.

Although there is no reported range of walking speed for sheep, the limb velocity of sheep in this study was thought to be within the walking speed range for the following reasons: 1) all the measured limb velocities of the valid trials, except for 1 (1.76 m/s) were slower than the typical trotting speed (> 1.5 m/s) of dogs (5,18), which have a smaller body conformation and a smaller stride length than sheep; and 2) although the transition between walking and trotting in sheep is less distinct than, for example, that in dogs, the duty factors of forelimbs (0.66) and hind limbs (0.69) in the sheep were indicative of walking. Generally, a duty factor of 0.50 is considered as the transition between walking ($\beta > 0.50$) and trotting ($\beta < 0.50$) in quadrupeds (19). Walking gait was chosen in this study because it is the most relevant gait for studies where gait is used as a measure of functional outcome. At walking speed, lame animals are willing to use the affected limb rather than carry it as in a trot. In addition, at a walking gait, animals place more steps per pass on the walkway than at a faster gait, thus facilitating data collection.

A significant correlation between body weight and PVF reported in sheep (4) and other quadrupeds (17,20) was not identified. In dogs, PVF measured using a force platform inversely correlated with physical size; the larger the dog, the lower the PVF exerted by each limb (17). Other workers using a pressure sensitive platform reported a significant positive correlation between PVF and body weight in 16 sheep (4). Both studies were performed with animals at walking velocity similar to that found in the present study. It is believed that the lack of significant correlation in the data set herein may be caused by data variability or by the limited number of sheep in the final data analysis.

In our experience, sheep are not particularly suitable for use in gait analysis. Even though sheep were domesticated a long time ago, flocking instinct of sheep as a protective mechanism is still present. As soon as a sheep is isolated from the flock for gait analysis, it is under stress, and becomes restless. In addition, since their "flight zone", the space around a sheep in which it reacts to a perceived threat (21), is penetrated by a handler during walking with halter, they become nervous and more difficult to handle. Training and acclimation will reduce the flight zone and flocking behavior, but may not abolish them completely.

In the present study, data were obtained on sheep gait by attempting to walk sheep at a comfortable speed without leading and controlling the sheep at a certain speed during data collection. Although this excluded data from 11 sheep, it is believed that the walking gait is more natural without these external influences. The excluded sheep struggled with their halters, and tried to run away regardless of the number or duration of the practice trials. In dogs, selection and habituation will improve precision of data and possibly reduce the number of subjects or repetition of trials (22). However, selection of subjects is not always feasible when obtaining experimental animals, and habituation is labor intensive with the effectiveness often being questionable. Furthermore, in clinical studies evaluating abnormal limb function, it may be impossible to habituate animals at that time, just to record data.

The coefficients of variation for hind limb PVF and VI were higher in the present study than in previous studies on other species (23,24). In dogs and horses, variability of gait data was introduced from the velocity and acceleration of the subject (25–28), trial repetition (23), limb symmetry (29), handlers (23), selection and habituation of the subject (22), and individual morphometrics (17,23). In the present study, variability from stance phase duration and speed of walking influenced the consistency of data. These variables are inversely correlated in quadrupeds; as speed of gait increases the duration of stance phase decreases (30,31). Stance phase duration and speed are also related to other variables such as gait cycle duration, PVF, and VI. However, since there was no limit of stance phase duration as exclusion criterion, all values of stance phase duration were used for the final data analysis, as long as the trial data were obtained at a comfortable walking speed.

Although there was a significant difference in body weight among sheep included in the final data analysis, the magnitude of variability of gait parameters was not related to body dimension, and was random among sheep in this study. This could be explained by the fact that only 1 breed of sheep was used in this study; therefore, the conformation and gait pattern might be consistent among these sheep. In addition, it is possible that variations stemming from the wide range in comfortable walking speeds as a major inclusion criterion might mask the variations among individual sheep.

The PS walkway used in this study has several advantages compared with traditional force platforms. First, the 1.5-m length of this PS walkway made it possible to record multiple readings and simultaneous, consecutive, and contralateral foot-strikes with a single pass over the walkway and to correlate these parameters over time. This allowed the measurement of a spatial parameter such as stride length and the calculation of gait cycle duration, stance phase duration, and limb velocity. However, in order to record spatial parameters at a faster gait using a 1.5-m PS walkway, the PS walkway needs to be longer or the size of animals needs be smaller than those used in this study. The length of the PS walkway also enhances the efficacy of taking PVF measurements, by acquiring multiple readings per trial instead of 1, as with traditional force platforms. Second, the PS walkway allows direct estimation of limb speed. In most animal studies that use force platforms, the animal's average velocity and acceleration are measured as indicators of limb velocity. This, however, may be an inaccurate representation of actual limb velocity, because of the disparity between the animal's average body velocity and limb velocity. Limb velocity is a function of the physical size of the animal; smaller animals with shorter stride length need to generate a greater limb speed to achieve the same body velocity as larger animals (9). Thus, use of limb velocity is particularly important when comparing and evaluating animals of different size.

The animal's average velocity may also be determined by using photoelectric cells positioned specific distances apart, and measuring the time interval between the interruptions of the light beams caused by the animal. Any part of an animal's or handler's body may interrupt the light beam; however, possibly creating an inaccurate measurement of the animal's average velocity. Accurate limb-specific velocity can be calculated using the PS walkway, because stride length and gait cycle duration can be determined.

The PS walkway, however, also has limitations compared with traditional force platforms. First, the sampling rate used in the present study was 30 Hz, and the maximum sampling frequency in this system is able to generate is 60 Hz. This is much smaller than the 1000 Hz of most commercial force platforms used for gait analysis. Theoretically, the lower sampling rate of the PS walkway system could lead to missed data points during the stance phase, possibly resulting in a lower value of PVF of gait. However, in a dog study that compared the PVF obtained using both a PS walkway and a force platform, a statistically significant difference was noted only in forelimb PVF values, and their clinical relevance appeared to be negligible (9). Second, the PS Walkway system can only measure the vertical component of ground reaction forces. This may be significant in gait analysis in patients with neurological impairment, whereby the longitudinal and horizontal forces may be changed by the increased sway of body's center of mass.

Gait analysis is a noninvasive method for quantitative assessment of functional movement without undue influences on the experimental conditions. However, analysis in experimental animal models may be difficult because of an animal's temperament, and lack of comparable data and standardized methodology. In this sheep study, gait analysis using a PS walkway allowed the collection of spatial and temporal parameters, as well as kinetic data on the walking gait of sheep without excessive effort for selection and habituation of animals. Data obtained with the PS walkway in this study may be helpful in planning or analyzing future biomechanical studies that evaluate the limb function in sheep.

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