ORIGINAL RESEARCH PEER REVIEWED

Comparison of blunt versus functional claw trimming effects on sow gait

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Summary

Objective: To determine the effect of functional claw trimming versus blunt claw trimming on the gait of sows.

Materials and methods: Nineteen sows (PIC C29) were transported to the research center and claws were trimmed 3 times over an 8-day period. Dewclaws were trimmed even with the coronary band of the hoof on day 1. Claws were blunt trimmed on day 4 and functional trimming occurred on day 8. The gait of each sow was recorded prior to each trimming to compare the effect of the previous trimming. A final gait recording was taken on day 12. The gait data collected from the sows was compared across days to determine if any changes occurred.

Results: Positive improvements in gait data were noted after dewclaw trimming. Changes were seen in velocity ($P = .03$), stride length ($P = .02$), stride duration ($P = .04$), stance ($P = .04$), and rear percent stance ($P = .03$). Blunt trimming offset the improvement gained by trimming dewclaws, seen in the changes to rear percent stance ($P = .02$) and front swing ($P = .04$). Functional trimming increased the improvement observed by trimming dewclaws. Changes were seen in the stance ($P < .001$), percent stance ($P < .001$), stride duration ($P = .003$), stride length ($P = .008$), and velocity ($P = .003$).

Implications: Trimming dewclaws and functionally trimming claws improved the sow's gait. Blunt trimming did not provide the same benefits observed by trimming dewclaws or functionally trimming the claws.

Keywords: swine, gait analysis, claw trimming, blunt trimming, functional trimming

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Resumen - Comparación de los efectos de recorte de pezuña sin detalle versus funcional en la marcha de la cerda

Objetivo: Determinar el efecto del recorte funcional de la pezuña versus el recorte sin detalle de la pezuña en la marcha de las cerdas.

Materiales y métodos: Diecinueve cerdas (PIC C29) fueron transportadas al centro de investigación y las pezuñas fueron recortadas 3 veces durante un período de 8 días. Se cortaron los espolones incluso con la banda coronaria de la pezuña el día 1. Las pezuñas se recortaron sin detalle el día 4 y el corte funcional se hizo el día 8. La marcha de cada cerda se grabó antes de cada corte para comparar el efecto del corte anterior. La marcha final se grabó el día 12. Los datos de la marcha recolectados de las cerdas se compararon a lo largo de los días para determinar si se produjeron cambios.

Resultados: Se observaron mejoras positivas en la información recolectada de la marcha después del corte de pezuña. Se observaron cambios en la velocidad ($P = .03$), la longitud del paso ($P = .02$), la duración del paso ($P = .04$), la postura ($P = .04$), y la posición del paso trasero ($P = .03$). El recorte sin detalle disipó la mejora obtenida al recortar los espolones, observado en los cambios en la posición del paso trasero ($P = .02$) y la oscilación frontal ($P = .04$). El recorte funcional aumentó la mejora observada por el corte de espolones. Se observaron cambios en la postura ($P < .001$), el porcentaje de postura ($P < .001$), la duración del paso ($P = .003$), la longitud de la zancada ($P = .008$), y la velocidad ($P = .003$).

Implicaciones: El corte de los espolones y el corte funcional de las pezuñas mejoraron la marcha de la cerda. El corte sin detalle no proporcionó los mismos beneficios observados al recortar los espolones o al cortar funcionalmente las pezuñas.

Résumé - Comparaison des effets d'une coupe fonctionnelle versus une coupe émoussée des onglons sur la posture des truies

Objectif: Déterminer les effets d'une coupe fonctionnelle des onglons versus une coupe émoussée des onglons sur la posture des truies.

Matériels et méthodes: Dix-neuf truies (PIC C29) furent transportées au centre de recherche et les onglons furent taillés trois fois sur une période de 8 jours. Les ergots furent taillés à égalité avec la bande coronaire du sabot au jour 1. Une coupe émoussée des onglons fut effectuée au jour 4 et une coupe fonctionnelle réalisée au jour 8. La posture de chaque

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truie fut enregistrée avant chaque coupe pour comparer les effets de la coupe précédente. Un enregistrement final de la posture fut fait au jour 12. Les données amassées sur la posture des truies furent comparées en fonction des différents jours afin de déterminer si des changements étaient survenus.

Résultats: Des améliorations positives dans les données de la posture furent notées après la taille des ergots. Des changements furent notés dans la vélocité ($P = .03$), la longueur de l'enjambée ($P = .02$), la durée de l'enjambée ($P = .04$), la posture ($P = .04$) et le pourcentage de posture arrière ($P = .03$). La coupe émoussée annula les améliorations apportées par la taille des ergots, tel que vu dans les changements au pourcentage de posture arrière ($P = .02$) et le balancement avant ($P = .04$). La coupe fonctionnelle augmenta les améliorations observées lors de la taille des ergots. Les changements furent observés dans la posture ($P < .001$), le pourcentage de posture ($P < .001$), la durée de l'enjambée ($P = .003$), la longueur de l'enjambée ($P = .008$) et la vélocité ($P = .003$).

Implications: La taille des ergots et la coupe fonctionnelle des onglons améliora la posture des truies. La coupe émoussée n'apporta pas les mêmes bénéfices que ceux observés lors de la taille des ergots et la coupe fonctionnelle des onglons.

Lameness is a major issue in the swine industry caused by factors including limb malformation, infected skin lesions, osteochondritis disease, skeletal design, and joint swelling.[1-4] Within a sow herd, 9% to 15.2% of removals are due to lameness or foot lesions.[2,4-6] One of the possible preventative treatments for lameness is claw trimming.[7] While, claw trimming is standard practice in the dairy cattle industry, it is not as common in the swine industry. In cattle, there are multiple methods of trimming that focus on improving the pressure distribution across both claws. The swine industry has adapted and patterned functional trimming in dairy cows as a method to trim swine claws.[7-10] Functional trimming is the correction of claw horn overgrowth and re-establishing even weight distribution across the claw.[7,11,12] The functional trimming method, sometimes referred as the Dutch trimming method, comes from a cattle trimming technique composed of five steps originally developed in the Netherlands.[13,14]

Different than functional trimming, blunt trimming only takes length off the claw by cutting the toe of the claw off without balancing and shaping any other part of the claw. It also includes trimming dewclaws even with the claw coronary band without causing bleeding. This method is faster and cheaper than functional trimming due to the ability to trim the claw toe while the pig is in a crate or lying down, therefore no chutes or special equipment are needed. This method also does not require the extensive training that is necessary for functional trimming, which allows anyone on the staff to trim the claw with minimum risk of injury to the pig or the handler. Unfortunately, blunt trimming does not change the height or angle of the claw. Leaving the toe square instead of rounding it increases the chance of the sow hitting its front claw toe on the ground as it walks, potentially injuring the claw.

Computer-assisted gait analysis is a widely accepted tool that is more accurate in assessing gait deviation than visual gait analysis.[15] Such analysis can be used to assess changes to the sow's gait in response to claw trimming. Gait analysis can be used to detect abnormalities in swine that are not visually observable.[16,17] Programs used for gait analysis illustrate the differences in gait characteristics of lame sows.[18] This helps to provide a basis on which to compare subclinical gait changes in response to lameness or treatment.

The objective of this study was to determine the effect of functional claw trimming versus blunt trimming on the gait of visibly sound sows with overgrown claws. It was hypothesized that blunt trimming will not improve the gait of the sow compared to functional trimming due to blunt trimming not addressing all issues related to long claws.

Materials and methods

Experimental protocols were approved by the University of Georgia Institutional Animal Care and Use Committee A2016 01-010-R2. In this study, 19 PIC C29 (Pig Improvement Corporation) sows from the University of Georgia research herd were used. Prior to the study, sows were housed in a group housing setting on cast iron floors. Sows were transported from the farm to the on-campus animal facility. Sows were multiparous, non-pregnant and had a body condition score of 2.5 to 3.5 on a scale of 1 to 5. None of the sows were visually lame, but all sows presented with overgrowth of claws. When using the Feet First Lesion Scoring System (Zinpro Corporation) for lesion identification, claws for all sows were moderately overgrown with the length of the rear claw midline being over 7 cm. Using the same system, dewclaws were categorized as mild although they were not measured for exact length. Due to the short time frame of this study, sows were not trained to trot on the track, however all sows were used to being handled. Over the duration of the study, sows were allowed access to ad libitum water provided by nipple waterers and 2 kg of standard gestational diet, which met 2012 NRC requirements.[19] Sows were maintained in small groups of 2 to 3 sows on a solid concrete floor within the University of Georgia Large Animal Research Unit. At the end of the study, sows were transported back to the University of Georgia swine farm.

Gait recording

Sow gaits were recorded immediately prior to dewclaw trimming, blunt trimming, functional trimming and 4 days post functional trimming (Figure 1). All sows were used as their own control and were compared to their original gait.[7] Sows were trotted through a commercial, hog-panel walled, dog-bone track, with a 7.5-m GAITFour electronic walkway (GAITRite). A shaker paddle was used to encourage sows to cross the mat and treats were provided as a reward. The GAITFour electronic walkway contained 10 sensor pads (each 48 sensors wide × 48 sensors long; sensors were 12.7 cm off-center) encapsulated in a roll-out carpet to produce an active area 60.96 cm wide and 609.6 cm long. In this arrangement the active area is a grid, 48 sensors wide × 480 sensors long, totaling 23,040 sensors (Figure 2). The pressure mat was covered with a layer of PIG Grippy Absorbent mat (Mat 32100, New Pig) to protect the pressure mat from moisture and to provide a non-slip walking surface for the sows. Sows were trotted through the gait track until 6 usable repetitions were recorded or a maximum of 20 minutes had passed. Usable repetitions were defined as recordings where at least 16 consecutive steps were captured at a trot. All pigs in this study provided the minimal repetitions collected at each time point and were in the walkway for less than 20 minutes.

Recordings from the mat were collected in the GAIT4Dog software program (GAITRite). This program provides a digital copy of the pig's footfalls as they land on the mat. The footfalls are then processed so that each one is numbered in the order they land. Once all feet are assigned a number, the program designates the foot that the footfall belongs to depending on direction of travel and pattern

Figure 1: Study timeline for gait scoring and claw trimming.

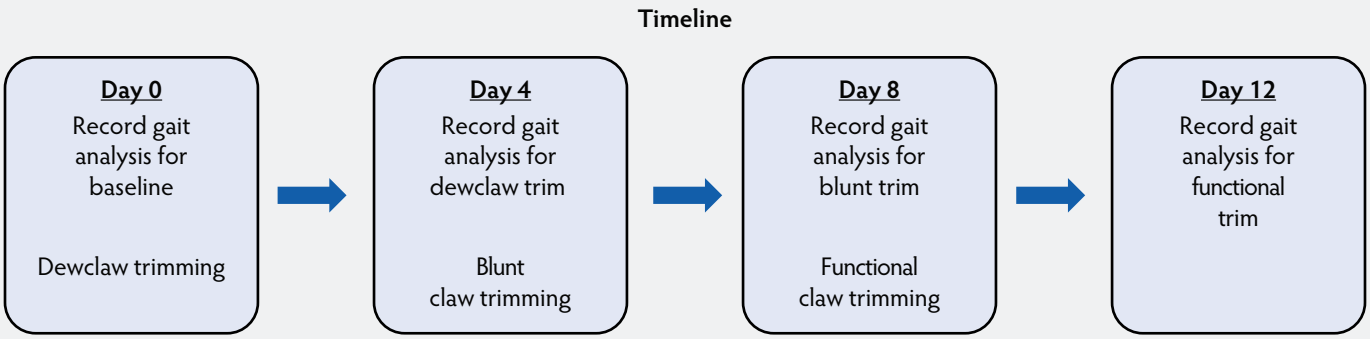
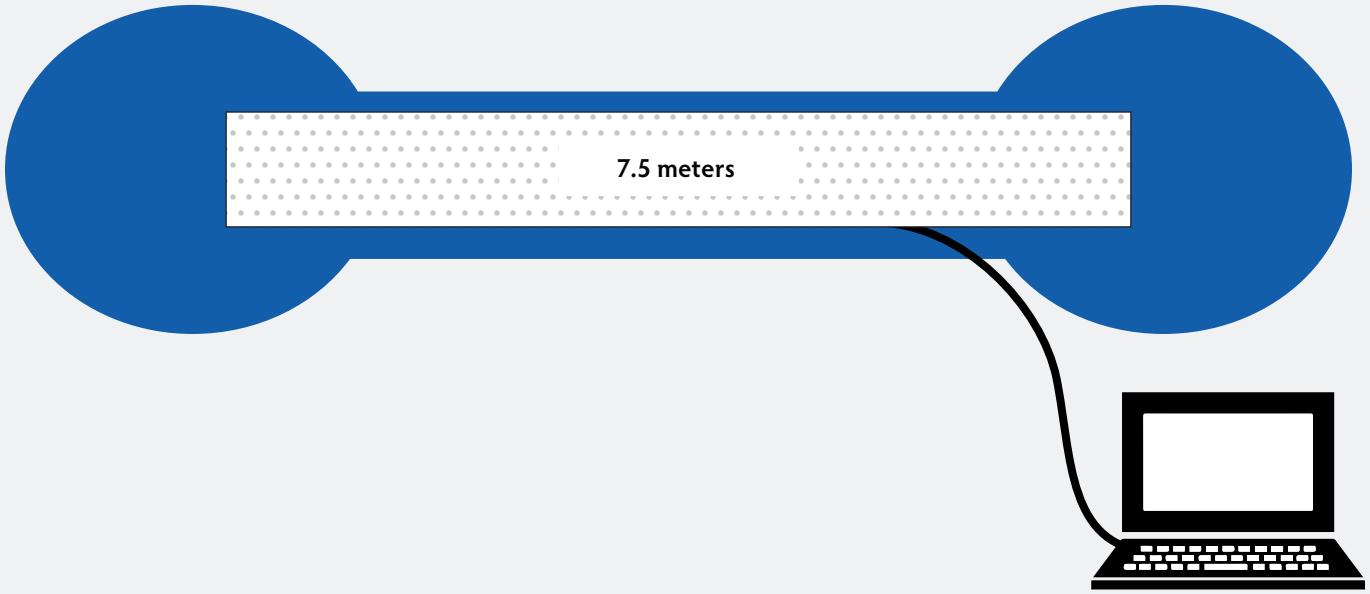


Figure 2: Set up and sensor arrangement of GAITFour electric walkway in the middle of the dog-bone track.



of movement so that each foot is categorized as right front, left front, right rear, or left rear. Any erroneous assignments of number or foot assignment can be corrected by the user before the run is analyzed for gait parameters. Velocity, stance time, swing time, stride duration, stride length, and percent stance of stride duration were calculated by the computer software for each recording.[7] Velocity is defined as displacement of the object with respect to time. Stance time is the length of time in which the claw initially contacts the ground until contact is broken. Swing time is the length of time in which the limb breaks contact with the ground until it touches again. Stride duration is the total time for the limb to move through a stride cycle of stance and swing time. Stride length is the distance between sequential footfalls of the same claw. Percent stance is defined as the ratio of the stance time to the stride duration. Following recording, sows were moved to another room for trimming. Each day of data recording followed this pattern.

Claw trimming

Following gait recordings, sows were loaded into a Feet First (Zinpro Corporation) chute equipped with a padded center support allowing for ventral cushioning of the sow. The front and rear chute gates were secured, and the chute was raised to allow trimmers easy access to the claws. Most sows did not require additional restraint and remained calm in the chute. If sows were fractious, hobbles with Velcro were used as a non-invasive method of restraint on the front feet.[7]

On day 1, sows had all 8 of their dewclaws trimmed even with the coronary band using loppers. The unbranded loppers had a heavy-duty Teflon-coated, high carbon-steel guillotine style blade with extendable handles. While not commercially available, they were similar to Kew Gardens Loppers (Spear and Jackson). On day 4, sows' claws were blunt trimmed to 6.5 cm from the coronary band using the loppers. Blunt trimming claws any shorter would increase the chance of exposing blood vessels to the environment, which would be detrimental to the health of the claw. Claws were closely trimmed straight across using a line drawn perpendicular to the claw end as a guide. The bottom of the foot was not leveled, and the side walls were not corrected. Blunt trimming of all four claws occurred within 5 minutes. On day 8, claws were functionally trimmed using a DeWalt heavy-duty 11.5 cm (model D28402W) electric power grinder with

20.34-cm, 60-grain grinding pads. Following Zinpro's Feet First: Functional Sow Claw Trimming protocol, each claw was marked at 5.5 cm, but no less than 5.0 cm, from the coronary bands, with dewclaws marked even with the coronary band. Claws were then carefully shaped so that each claw would not interfere with its partner and would maintain a rounded edge, decreasing bluntness and providing a smooth, level sole. Each claw was carefully inspected visually and tactilely for evenness to ensure that pressure applied to the foot would be distributed evenly across both claws and heel. Functional trimming of all four claws was performed within 15 minutes. Following each trimming, sows were given 3 days to adjust to the trimming.

Data analysis

Data were analyzed in SAS (version 9.4; SAS Institute Inc) using the mixed linear regression (PROC MIXED procedure) to evaluate the differences of the front and rear paired limbs at the four time points as repeated measures. Descriptive statistics, such as means and standard deviations, for variables were obtained. Each pig was its own unit with the average of the two paired limbs being taken. Runs were used as replications for each of the time points. Gait parameters were analyzed separately from each other. Each parameter was analyzed using the appropriate units. Time, distance, and length were the dependent variables of interest. Statistical significance was considered at $P < .05$ for all parameters measured, and the PDIFF command was used to separate means where necessary.

Results

There was an improvement in gait and movement down the length of the mat when trimming dewclaws to the coronary band of the hoof. This improvement is observed in the increased velocity ($P = .03$; Figure 3A) and stride length (front $P = .01$; rear $P = .02$; Figure 3B). The improvement can also be observed in the decrease in stride duration (front $P = .04$; rear $P = .03$; Figure 3C), stance (front $P = .04$; rear $P = .02$; Figure 3D), and rear percent stance ($P = .03$; Figure 3E) when comparing trimmed dewclaws to the sows' control data. Looking at blunt trimming, the only changes observed were a decrease in rear percent stance ($P = .02$; Figure 3E) when comparing blunt trimming to the control data. There was also an increase ($P = .04$; Figure 3F) in front swing when comparing blunt trimming to dewclaw trimming.

Functional claw trimming had the greatest improvement compared to the other trimming methods. Functional trimming data, when compared to the control data, exhibited that sows were able to move forward more efficiently as demonstrated by the smaller stance ($P < .001$; Figure 3D), percent stance ($P < .001$; Figure 3E), and stride duration (front $P = .003$; rear $P = .001$; Figure 3C). Stride length (front $P = .003$; rear $P = .008$; Figure 3B) and velocity ($P = .003$; Figure 3A) increased, suggesting that the sows were more comfortable moving across the mat after corrective trimming compared to the shorter, slower strides that were observed in the control data.

The only measurements that were significantly different between the data collected after dewclaw trimming and the data collected after functional trimming was an increase in front swing ($P = .01$; Figure 3F) and decrease in percent stance (front $P = .001$; rear $P = .02$; Figure 3E). These two measurements revealed that functional trimming had a greater benefit to the pigs than the dewclaw trimming as the sows were more willing to move their limbs through the air instead of having them on the ground during the stride duration.

When comparing blunt trimming versus functional trimming, functional trimming improved sow gait. Pigs became more efficient moving across the mat after functional trimming as observed in the decrease in stance (front $P = .004$; rear $P = .005$; Figure 3D), stride duration (front $P = .03$; rear $P = .02$; Figure 3C), and percent stance (front $P < .001$; rear $P = .002$; Figure 3E). The increase in stride length (front $P = .035$; rear $P = .04$; Figure 3B) and velocity ($P = .009$; Figure 3A), in conjunction with the decrease in the previously mentioned values, demonstrated that the pigs stood less during the stride duration and that they moved a greater distance in a shorter amount of time. Swing did not change (front $P = .57$; rear $P = .89$; Figure 3F), revealing that the improvement in stride duration value was only due to the pigs being more comfortable having their feet off the ground.

Discussion

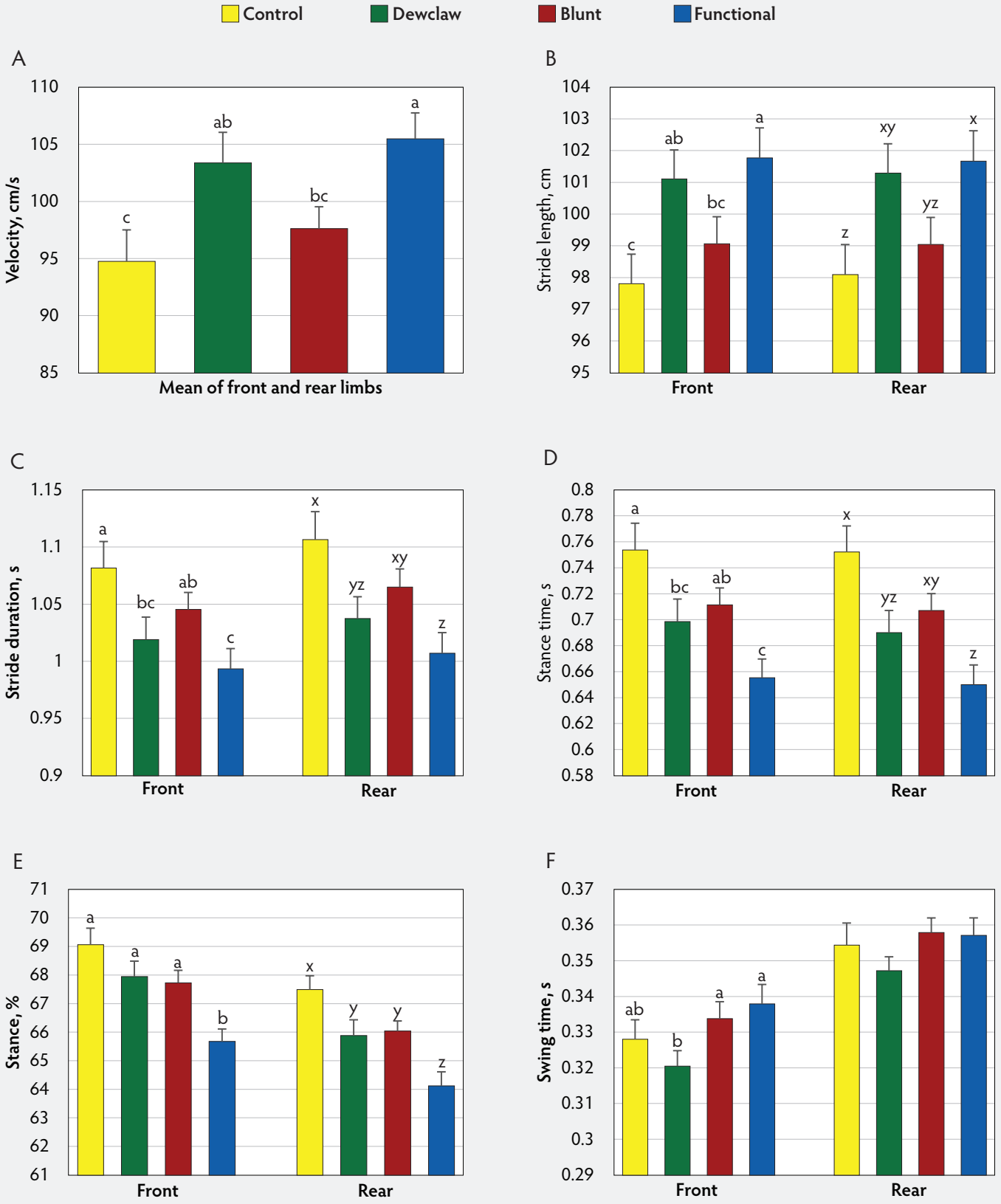
Sows are quadrupeds, and like all quadrupeds there is a set pattern to footfall for each gait. Throughout the study, sows were maintained at a two-beat, symmetrical gait, with diagonal pairs that moved in sync with each other and diagonal support phases.[20] This gait is preferred in horses for lameness detection and evaluation because the symmetry allows for detection of asymmetries in the animal's movement.[20] During this gait, the swing time is longer than the stance time, making stance time less than 50% of the total stride duration.

In this study, sows were not trained prior to the beginning of data collection. Due to the short amount of time that sows were present on the mat and the amount of time between sessions, training was not deemed necessary for comparisons to be made across the days.[7] Studies on swine memory indicate that swine have a long habituation period for learning tasks, [21,22] which was longer than the total time the pigs were exposed to the track. The sample size and lack of visible lameness in this study prevents these results from being universally used. Future studies need to be performed on a larger scale to separate each treatment into its own group to perform comparisons over a longer period.

While dewclaw trimming was done as a precautionary measure to decrease interference while assessing gait changes between the two trimming methods, it had a significant impact on the gait isolated from either of the trimming methods. By decreasing the length of the dewclaws, the heel can make contact with the floor faster because the dewclaws are not interfering with the heel contact. This decrease in time until contact makes the stride faster, which is seen in the increased velocity and decreased stride duration. Dewclaw trimming does not require the sow to be put in the chute and can be done in the farrowing crate, taking just a few seconds per foot. Dewclaw trimming reduces the chances of the dewclaw being caught, torn, or broken. This has the potential of reducing the culling rate in the herd.

The change in gait parameters after blunt trimming illustrate that blunt trimming did not have the benefits that were expected. Shortening the toe without balancing the sole negated the positive effects that were seen after dewclaw trimming. The lack of benefit from blunt trimming is most likely due to the trimming reducing only the claw

Figure 3: Mean gait measurements (with standard error) by type of trimming for front and rear limbs: A) Velocity, B) Stride length, C) Stride duration, D) Stance time, E) Percent stance, and F) Swing time. Means with different letters differ ($P < .05$; PROC MIXED).



length, while ignoring claw height and any wall shape abnormalities. By ignoring these issues, blunt trimming does not balance the hoof so that it resembles the natural hoof shape. In cattle, it has been observed that not balancing the weight bearing surface of the claw causes further claw disease and dysfunction.[10] Blunt trimming also leaves the hoof with a square toe, which increases the chances of the sow to stub the front claw toes, potentially causing more damage than if the front claw was rounded.

Functional trimming regained the positive effect that was seen after dewclaw trimming. When comparing blunt trimming to functional trimming, functional trimming provided a better result in gait quality. In cattle, this newfound comfort in gait after functional trimming is reflected by increased milk yield from lame cows.[14] By trimming the full claw and balancing the sole, the sow was able to move more efficiently across the mat. The differences between the 2 trimming methods is important in determining necessary guidelines for producers to achieve the same results.[8] While blunt trimming is economically preferable to a producer due to less labor inputs, training, and special equipment needed, the results were not able to match that of functional trimming.

Trimming is an important method to help prevent and treat lameness. In this study, functional trimming was the best method of trimming due to its improvement in gait parameters. If the farm is unable to perform functional trimming, trimming dewclaws provided a greater benefit than blunt trimming the claws. These results are only applicable when the correct method of functional or dewclaw trimming is used as trimming too short and drawing blood would negate the benefits.

Implications

Under the conditions of this study:

- Functional trimming improved locomotion compared to blunt trimming.
- Dewclaw trimming was a quick and easy method to improve locomotion.
- Blunt trimming did not provide a benefit to the sow's locomotion.

Acknowledgments

Conflict of interest

None reported.

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