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OBJECTIVE LAMENESS ASSESSMENT IN HORSES USED FOR EQUINE-ASSISTED THERAPY IN RIO GRANDE DO SUL STATE

TRABALHO DE CONCLUSÃO DE RESIDÊNCIA

PATRICIA MAURER TASCHETTO

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PREVALÊNCIA DE CLAUDICAÇÃO EM CAVALOS DE EQUOTERAPIA NO RIO GRANDE DO SUL

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Objective lameness assessment in horses used for equine-assisted therapy in Rio Grande do Sul State

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Abstract

Equine-assisted therapy is a method used since ancient times to rehabilitate individuals. The biomechanics provided by horses and the friction between their back and riders' saddle generate impulses that are transmitted to riders' central nervous system; thus, these horses must be healthy enough to enable the desired therapeutic effect. The aim of the current study is to investigate lameness prevalence and intensity in equine-assisted therapy horses in Rio Grande do Sul State. The adopted methodology consisted in the objective evaluation of lameness based on Lameness Locator® wireless inertial sensors, which were placed in the 21 horses assessed in six equestrian centers in Rio Grande do Sul State. Results have shown that 90.1% of the assessed horses presented lameness in the hind (54.2%) and forelimbs (45.8%), as well as that 72% of them presented mild lameness intensity. This outcome has evidenced the need, and significance, of assessing these horses' locomotor system. Besides, it is essential hiring veterinary doctors to monitor these animals in order to treat and prevent different diseases. Even subtle lameness can influence the generated stimuli; thus, it is an important factor to be taken into consideration at the time to select equine-assisted therapy horses.

INDEXING TERMS: Horse riding, Inertial Sensors, Lameness Locator.

1. Introduction

Equine-assisted therapy is a technique that uses horses in an interdisciplinary approach to the health, education and horse-riding fields. It enables the rehabilitation of patients with special needs or disabilities, as well as of elderly individuals, among others, since it brings physical and mental benefits to them [1,2]. The technique, which was used in Europe and in the United States, was introduced in Brazil in 1989. It enables individuals to interact with horses since their first contact, as well as to ride and handle them. Besides enabling new socialization forms, this activity helps individuals to improve their self-confidence and self-esteem. Activities held on horseback allow the treatment of overall body muscles in a natural manner, since they enable modulating and improving individuals' muscle tone, posture, rhythm, balance and coordination. In addition, stretching exercises help improving social integration and make individuals more independent to perform daily tasks [3].

Horses present three natural gait types, namely: walk, trot and gallop. Equine-assisted therapy sessions adopt the walk gait, since trot and gallop are jumpy and require individuals to have greater balance [4].

The movement produced by horses' walk gait generates stimuli that boost the central nervous system of individuals with impaired balance, motor coordination and muscle tone. The three-dimensional movement generated by the connection between the animals' back and the riders' saddle is fundamental for equine-assisted therapy, since it stimulates individuals' central nervous system [5]. The longer the stride length, the greater the horse's back movement, which enables better muscle use due to wide movement oscillation [6].

According to Araújo [7], horse selection for equine-assisted therapy is based on several features, with emphasis on animal conformation. Animals presenting conformation defects are more likely to have lameness; therefore, their locomotion dynamics is often compromised [8]. Assumingly, lameness can affect animals' strides; consequently, it can affect the stimulus they generate in individuals.

The aim of the current study was to objectively evaluate lameness prevalence and intensity in horses used for equine-assisted therapy in different equestrian centers in Rio Grande do Sul State.

2. Materials and Methods

The study was approved by the Ethics Committee on Animal Use (CEUA - Comitê de Ética no Uso de Animais) of Federal University of Pampa (UNIPAMPA), under protocol n. 020/2019.

2.1 Animals

The present study assessed 21 crossbred horses, 11 mares and 10 castrated males (mean weight of 415 kg ± 35.8 kg and mean age of 16.5 years ± 4 years). Most animals resulted from crossbreeding with Crioulo breed; they came from six equestrian centers in Rio Grande do Sul State, in the following counties: São Gabriel - four animals (Group A); Santa Maria - animals from two different equestrian centers, the first center provided four animals (Group B) and the second one provided two animals (Group F); Santo Ângelo - four animals (Group C); São Luiz Gonzaga - four animals (Group D); and Itaqui - three animals (Group E).

Data collection was initially based on general clinical examination, which comprised assessing animals’ heart and respiratory rates, mucosal color, capillary refill time and body temperature. The second data collection started after any change in baseline parameters was ruled out; it was carried out through specific examination of animals’ locomotor system and through the objective lameness assessment based on the wireless inertial sensor system (Lameness Locator®).

2.2 Objective lameness assessment

After the conduction of the first part of the specific examination of the locomotor system, which comprised anamnesis, inspection and palpation, animals were equipped with inertial wireless sensors (Lameness Locator®) to enable the in-movement examination and the flexion tests. Animals’ instrumentation, as well as data collection and analysis, were carried out as recommended by Keegan et al. [9] Each horse had an accelerometer attached to the dorsal aspect of their heads, in the midline between their ears, and another one attached to their sacral tuberosities. Next, a gyroscope was placed on the dorsal aspect of the animals’ right forelimb quarter.

Data collection was carried out while animals were pulled by the halter in a straight line at trot gait for 25-30 meters (round trip) in order to enable at least 25 steps. This procedure was the baseline assessment used to identify the presence, or absence, of lameness, as well as its intensity. The floor type (asphalt / concrete / solid ground / sand) has changed according to the availability in the equine therapy centers.

Next, animals were subjected to pre-flexion evaluation (from 8 to 12 steps). Subsequently, their forelimbs were subjected to distal flexion test for 30 seconds, whereas their hindlimbs were subjected to total flexion test for 60 seconds. The tests always started in the fore or hindlimb that did not present lameness; the same individual ran all flexion tests. After the flexion tests were over, animals were subjected to a new baseline assessment, which was similar to the previously described one.

Collected data were analyzed at real time in a specific software [9]. The analysis was based on the following measurements: HDmax of forelimbs (mean and standard deviation) - difference between the highest point of animals' head after the right forelimb support and the highest point of their head after left forelimb support; HDmin of forelimbs (mean and standard deviation) - difference between the lowest point of animals' head during right forelimb support and the lowest point of their head during left forelimb support. HDmax and HDmin were used to calculate the vector sum (VS), which measures lameness intensity, based on the formula below:

$$VS = \sqrt{Mean\ HDmin^2 + Mean\ HDmax^2}$$

The lameness observed in the forelimbs corresponded to assessment results showing VS greater than 8.5 mm and at least one HDmax value or one HDmin value above 6 mm and their respective standard deviation was lower than their mean.

The assessment of hindlimbs consisted in calculating the following variables: PDmax of hindlimbs (mean and standard deviation) - difference between the highest point of the animals' pelvis after the right hindlimb support and the highest point of their pelvis after the left hindlimb support; PDmin of hindlimbs (mean and standard deviation) - difference between the lowest point of the animals' pelvis during right hindlimb support and the lowest point of their pelvis during left hindlimb support. The lameness observed in the hindlimbs corresponded to assessment results showing at least one PDmax value or one PDmin value above 3 mm and their respective standard deviation lower than their mean.

Lameness intensity (mild, moderate or severe) and type (push-off or impact) were measured based on information generated in the assessment software.

The comparison among means recorded for variables VS, HDmax, HDmin, PDmax and PDmim, which were measured by the inertial sensors in initial and post-flexion baseline assessments, was carried out through Wilcoxon statistical test ($p < 0.05$) for non-parametric data analysis.

3. Results

Animals who did not present abnormal results in the overall clinical examination were subjected to objective lameness assessment. Table 1 shows data of all 21 assessed animals.

The objective lameness assessment of equine-assisted therapy horses has shown that 90.1% (19/21) of animals presented some lameness level - lameness was more prevalent in the hindlimbs than in the forelimbs (Figure 1). Most animals (61.9%) were assessed on hard floor (concrete or asphalt), whereas the remaining ones were assessed on soft floor (sand or grass). All equine-assisted therapy centers presented animals with lameness; only centers C and F had one animal who did not have lameness.

Mild lameness intensity was mostly prevalent in animals' hind and forelimbs (Figure 2). Pushoff lameness was observed in 71.4% of the assessed animals, impact lameness was observed in 66.7% of them, whereas 38.1% of animals presented pushoff and impact lameness.

Lameness in the Left Hindlimb (LHL) was observed in 14.3% (3/21) of horses; two animals had impact lameness and one had push-off lameness. On the other hand, lameness in the Right Forelimb (RFL) was observed in 38.1% (8/21) of the assessed horses; four animals had push-off lameness and four had impact lameness (Figure 3). Lameness in the Left Hindlimb (LHL) was observed in 57.1% (12/21) of the horses; five animals had push-off lameness, three had impact lameness and four had impact and push-off lameness. On the other hand, lameness in the Right Forelimb (RFL) was observed in 9.5% (2/21) of the horses; one animal had impact lameness and one had impact and push-off lameness (Figure 4).

Variables such as VS, HDmax, PDmax and PDmim did not show significant difference between initial and post-flexion baseline assessments (Figure 5).

4. Discussion

Studies focused on investigating lameness prevalence in equine-assisted therapy animals remain scarce in the literature. The current research is the first study based on the objective lameness assessment of these horses.

The objective lameness assessment method has gained importance in recent years. Studies have shown that the subjective assessment of mild lameness is unreliable, since evaluators are vulnerable to a range of biases capable of negatively affecting lameness identification and accurate location, with emphasis on the experience level of each observer [10].

The current study recorded high lameness prevalence, since more than 90% of assessed animals have shown some lameness intensity level. Although the present study did not perform lesion diagnosis, the very incidence of lameness was a strong indication that the assessed animals presented some change in the skeletal muscle system, since lameness is nothing more than a clinical sign or manifestation of structural or functional changes in one, or more, horse limbs [8]. Silva et al. [11] have evaluated the clinical records of 17 animals used for equine-assisted therapy in Uruguaiana County and found that 23.4% of them had locomotor system-related issues; this percentage was much lower than the one observed in the current study.

According to Baxter [8], lameness is more often found in the forelimbs than in the hindlimbs, since 60% to 65% of animals' body weight is supported by their forelimbs. The current study showed a larger number of animals with lameness in the hindlimbs; this outcome corroborates the study by Abreu [12], who found 59.2% (118/201) of the assessed Crioulo breed animals with lameness in the hindlimb. The high lameness prevalence observed in the hindlimbs may be associated with animals' breed and use prior to the equine-assisted therapy, since most animals used for this therapy belonged to Crioulo breed and were donated by previous owners. In other words, these animals may have been previously used for field work or even for sports; therefore, they presented some degree of locomotor system impairment at pelvic level.

It is essential selecting the right location to perform the examination, since some lameness types can be exacerbated, or weakened, depending on the floor type. The animals should be preferably examined on a flat, smooth and non-slippery surface, since slippery floors can make them take short strides and lead to misinterpretation of lameness data [8,13]. The main importance of selecting the ideal floor type lies on the exacerbation of some lameness types that are linked to the floor type where animals are examined on. Hard floors can lead to maximum concussion, which may exacerbate subtle lameness and predispose animals to present impact injuries, mainly in the osteoarticular structures [13]. However, Azevedo et al.[14] have used inertial sensors to assess horses and they did not find difference in variables such as maximum and minimum height of head and pelvis in animals examined on three different floor types (concrete, sand and grass), or difference between floor type (hard versus soft) and lameness type (impact versus push-off). Thus, analyses were performed by taking into consideration floor availability in each equestrian center.

The current study recorded higher prevalence of push-off lameness (71.4%), which is often seen when the limb is suspended. Moreover, push-off lameness may indicate changes in muscles, tendons, tendon sheaths and bursae. Impact lameness was the second most prevalent (66.7%) type. It often happens when the limb touches the ground or when it supports the animals' body weight; it may be associated with injuries in bones, joints and other support structures [8].

Pain in one limb can lead to uneven weight distribution in another limb or limbs; this process can generate lameness in a previously healthy limb - it is called compensatory lameness [8]. Compensatory lameness develops in the forelimb located at the same side of the hindlimb presenting primary lameness; it may have happened in horses 2, 5, 14 and 19. If the forelimb is the primary issue, compensatory lameness often develops in the contralateral hindlimb - it may have happened in horse 4. Anesthetic nerve blocks can be performed to confirm these suspicions, since by blocking the primary cause it is possible to decrease or even eliminate compensatory lameness [8].

More than 90.1% of horses assessed in the current study presented some lameness level, and it justifies the need of evaluating the locomotor system of horses used for equine-assisted therapy. However, since equine-assisted therapy sessions are based on walk gait and the assessment performed in the current study was based on trot gait, it is essential conducting further research on this subject in order to investigate the association between lameness incidence in equine-assisted therapy horses and the evolution of patients under this therapy. Assumingly, the subtle lameness intensity observed at trot gait may not be enough to cause changes in walk gait; consequently, it does not impair impulse transmission to therapy patients.

5. Conclusion

The objective lameness assessment based on wireless inertial sensors (Lameness Locator®) has shown high lameness prevalence in 90.1% of the assessed animals; mild lameness was the most prevalent type of it (72% of the assessed animals). The current study emphasized the importance of examining animals' locomotor system, as well as of hiring a veterinary doctor to monitor these animals in order to assure their wellbeing and the quality of the equine-assisted therapy.

Future studies focused on evaluating the possible correlation between lameness improvement and patients' clinical evolution should be conducted to provide relevant information about the equine-assisted therapy scenario.

Conflicts of Interest

The authors declare no conflict of interest.

Acknowledgment

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Table 1: Lameness data generated in the Lameness Locator, site and animals' features - Rio Grande do Sul State, Brazil.

Animal/Sex/Origin	Forelimb		Hindlimb		Floor type	Group
	Left	Right	Left	Right		
1 / F / Donation	_	_	Mild push-off lameness	Mild impact lameness	Sand	A
2 / M / Donation	Mild push-off lameness	_	Mild impact lameness	_	Sand	A
3 / F / Donation	_	_	Mild push-off lameness	_	Sand	A
4 / F / Donation	_	Mild push-off lameness	Mild push-off lameness	_	Sand	A
5 / F / Donation	Mild impact lameness	_	Mild push-off and impact lameness	_	Grass	B
6 / M / Born at the center	_	_	Moderate push-off lameness	_	Grass	B
7 / F / Born at the center	_	Mild push-off lameness	_	_	Grass	B
8 / F / Donation	_	_	Moderate push-off and impact lameness	_	Grass	B

9 / M / Donation	_	_	_	_	Asphalt	C
10 / F / Donation	_	_	Moderate push-off and impact lameness	_	Asphalt	C
11 / M / Donation	_	_	Mild impact lameness	_	Asphalt	C
12 / M / Donation	_	Mild impact lameness	_	_	Asphalt	C
13 / F / Donation	_	Moderate impact lameness	_	_	Concrete	D
14 / M / Donation	_	Moderate impact lameness	_	Moderate push-off and impact lameness	Concrete	D
15 / F / Donation	_	Mild push-off lameness	_	_	Concrete	D
16 / F / Donation	_	Mild push-off lameness	_	_	Concrete	D
17 / M / Donation	_	_	Mild push-off and impact lameness	_	Concrete	E
18 / F / Donation	_	_	Mild impact lameness	_	Concrete	E

19 / M / Donation	Moderate impact lameness	_	Mild push-off lameness	_	Concrete	E
20 / F / Donation	_	Mild impact lameness	_	_	Asphalt	F*
21 / M/ Donation	_	_	_	_	Asphalt	F*

A= São Gabriel; B= Santa Maria; C= Santo Ângelo; D= São Luiz Gonzaga; E= Itaqui, F*= Santa Maria; F= female; M= male. Source: prepared by the author, 2019.

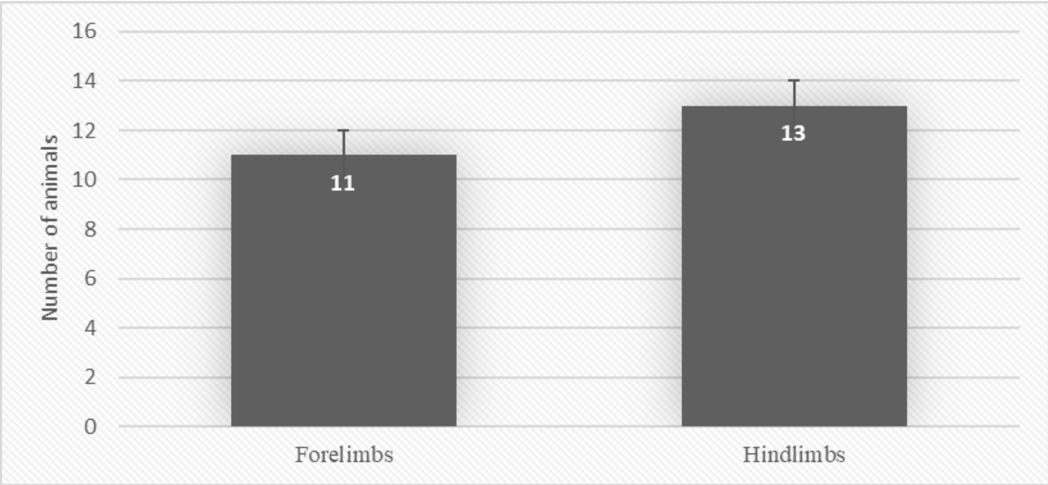

Figure 1: Number of animals presenting lameness in the fore or hindlimbs among the 21 male and female equine-assisted therapy horses assessed with Lameness Locator in Rio Grande do Sul State. Source: prepared by the author, 2019.

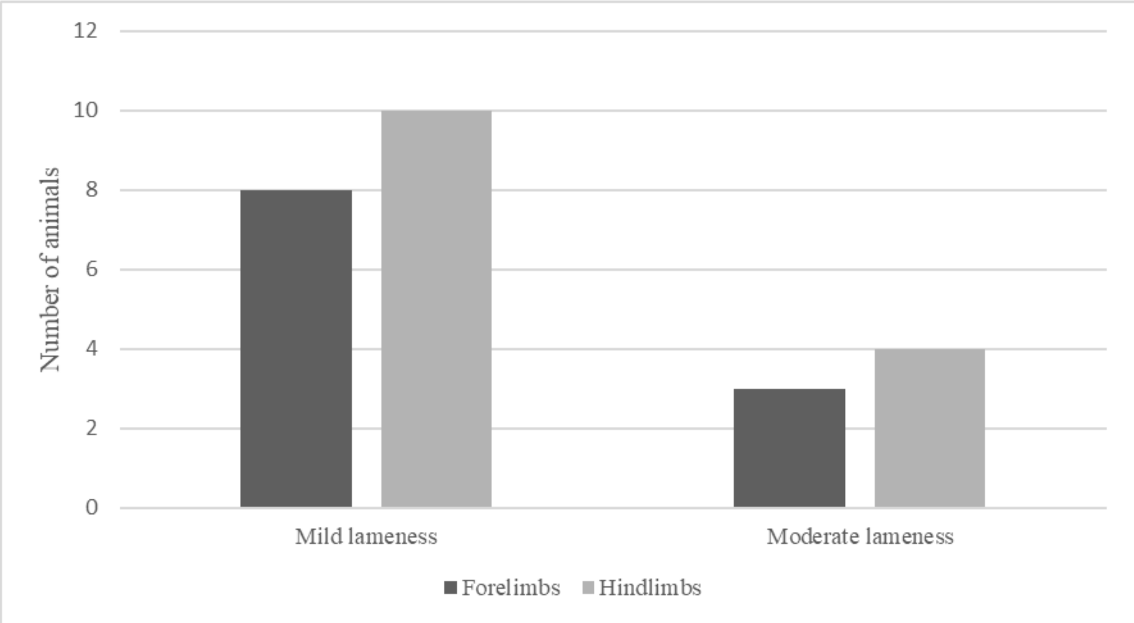

Figure 2: Lameness intensity observed in the fore or hindlimbs of the 21 male and female equine-assisted therapy horses assessed with Lameness Locator in Rio Grande do Sul State. Source: prepared by the author, 2019.

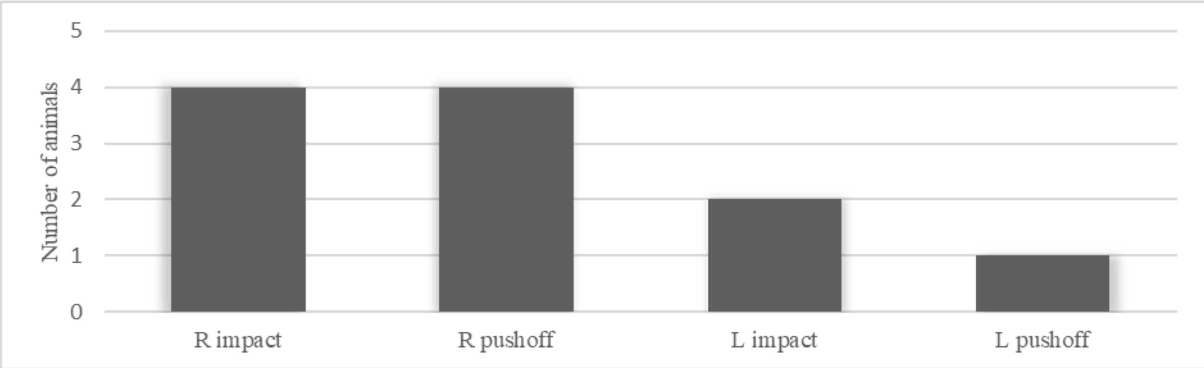

Figure 3: Lameness type observed in the forelimbs of the 21 male and female equine-assisted therapy horses assessed with Lameness Locator in Rio Grande do Sul State. R = right; L = left. Source: prepared by the author, 2019.

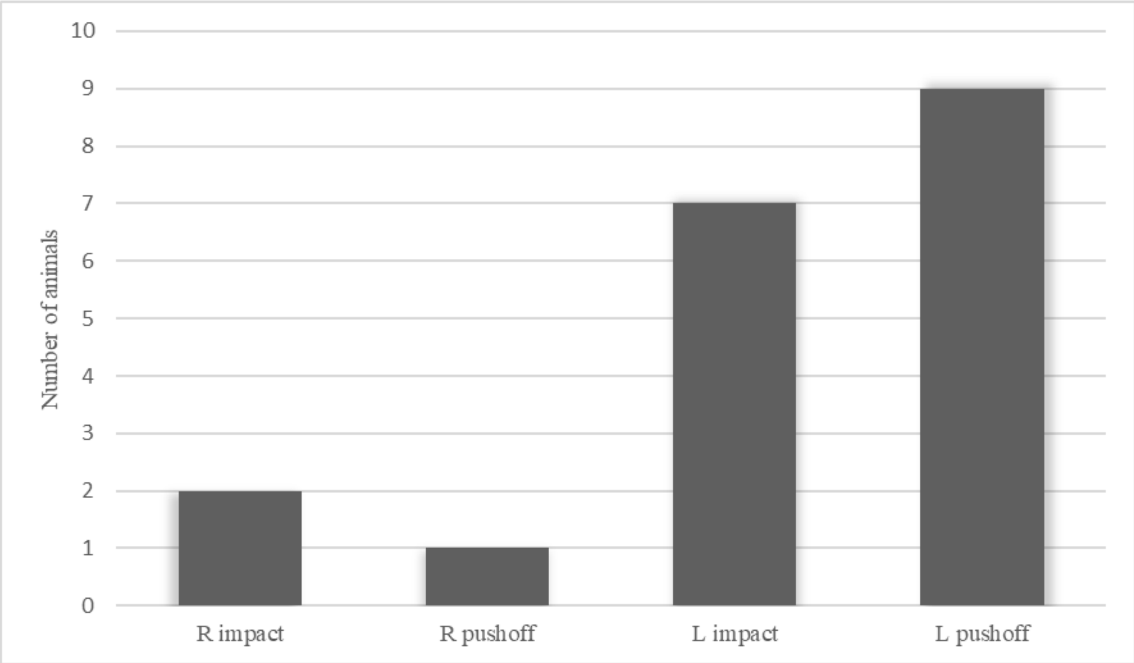

Figure 4: Lameness type observed in the hindlimbs of the 21 male and female equine-assisted therapy horses assessed with Lameness Locator in Rio Grande do Sul State. R = right; L = left. Source: prepared by the author, 2019.

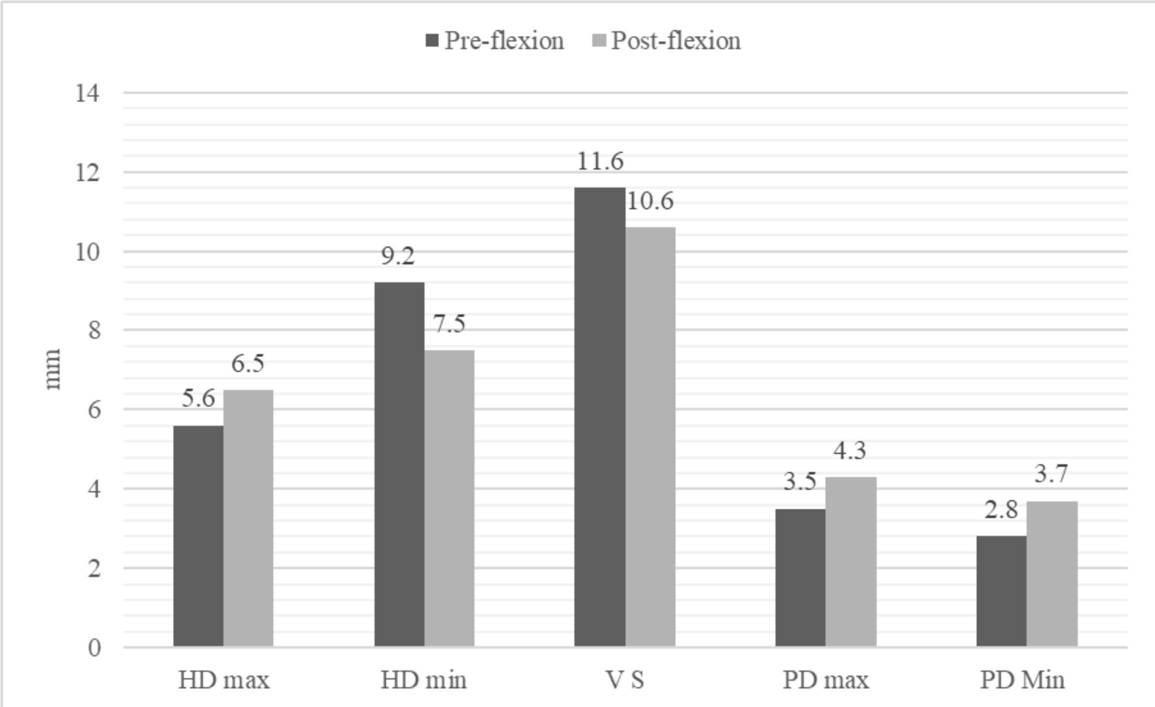

Figure 5: HDmax, HDmin, VS, PDmax and PDmin values recorded in the pre- and post-flexion baseline assessment of the 21 male and female equine-assisted therapy horses, based on Lameness Locator, in Rio Grande do Sul State. Source: prepared by the author, 2019.