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1 **An Exploration of Visual Gait Assessment of Horses by Physiotherapists**

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5

6 Abstract: Beyond lameness grades, the qualitative features assessed physiotherapists during
7 observation of equine gait assessment are unknown. Similarly, the methods used during
8 observation of the gait assessment process have only documented in textbooks. A qualitative
9 methodology was used with eight members of the Association of Chartered Physiotherapists in
10 Animal Therapy being interviewed using a semi structured approach. The interviews consisted
11 of the assessment of six equine gait videos (part A) and a series of exploratory questions (part
12 B). The data were transcribed, with part A data catalogued and part B data analysed using
13 thematic analysis. Features identified during gait assessment were catalogued according to
14 each gait and viewing aspect, with consistent key features tabulated. Six themes were identified
15 as representative of the gait assessment process used by participants, relating to the purpose of
16 gait assessment, initial and routine methods used, progression thereof and communication and
17 collaboration with the equine interdisciplinary team. These data highlight various factors that
18 influence and limit the gait assessment process when used as an outcome measure. Visual
19 assessment of equine gait is standard practice and was found to be individualized and therefore
20 specific to the horse and owner, with physiotherapists using evidence informed practice.
21 Physiotherapists aim to continually work within scope of practice and communicate gait
22 assessment findings with veterinarians and interdisciplinary team members. In identifying key
23 features assessed and methods used by physiotherapists during equine gait assessment, study
24 findings can inform practice and education and set the initial exploratory basis for potential
25 future quantitative research in this area.

26 Keywords: Horse; gait assessment; physiotherapy; outcome measures; qualitative analysis.

27 Highlights

- 28 • Equine gait assessment by physiotherapists is similar to veterinary examination where
29 visual evaluation appears to be standard practice.
- 30 • The visual assessment of equine gait by physiotherapists is not limited to a lameness
31 score and includes evaluation of head, trunk and pelvis movement.

32 • Physiotherapists use evidence-informed practice during gait assessment. particularly in
33 the progression of assessing for lameness and selection of additional movement assessments
34 such as canter, lunging and ridden evaluation.

35 • Gait assessment for rehabilitation should include assessment of quality of movement
36 and function

37 1. Introduction

38 Gait assessment and analysis is an inherent component of human physiotherapy practice,
39 particularly in the management of patients with movement disorders [1]. Gait analysis identifies
40 markers of pathology, informs diagnosis, monitors disease progression and evaluates efficacy
41 of interventions [2]. The type of gait assessment used by a physiotherapist is largely dependent
42 on their training, underlying knowledge of gait, experience and the resources available in the
43 clinical setting [3]. Instrumented gait assessment has been available for several decades
44 providing gold standard, quantitative three-dimensional kinematic and kinetic measures in
45 human physiotherapy, yet is restricted by the expensive laboratory-based setting and the high
46 level of experience and interpretation skills required [4].

47 More recently technology has been developing at a fast pace and wearable sensor-based
48 systems along with the use of markerless video analysis using artificial intelligence is
49 transforming the ease at which data can be collected in clinical practice [5]. Whilst overcoming
50 the challenges of needing complex laboratory-based gait analysis systems being portable and
51 providing user-friendly data analysis, there is further development in their use as outcome
52 measures and validation studies needed for patient populations [6]. Therefore, observational
53 gait assessment, using the naked eye or video images, continues to be preferred in routine
54 clinical practice as it requires less time and equipment, making it cheaper and more accessible
55 to physiotherapists [7].

56 Physiotherapists, trained in assessment and treatment of humans, can clinically reason and
57 selectively apply appropriate biomechanical and pathological knowledge and skills to the
58 assessment, treatment and rehabilitation of horses with neuromuscular and musculoskeletal
59 conditions [8]. Like human practice, equine physiotherapists complete an evaluation of gait as
60 part of a thorough equine physiotherapy assessment [9] with development of this clinical skill
61 forming part of their postgraduate qualification. This dynamic movement assessment is an
62 essential adjunct to the static observation of conformation and posture, allowing a
63 physiotherapist to identify a horse's willingness to move and to observe and report on

64 movement patterns, symmetry and muscle balance [10]. The evaluation of equine gait
65 importantly allows for comparisons within a horse over time and monitors the effects of
66 treatment [11]. In addition to the assessment of function of the neuromusculoskeletal system,
67 physiotherapists observe for lameness during a gait assessment [12]. Currently, clinical
68 observations and visual evaluation continue to be standard practice and the primary method of
69 equine gait assessment by veterinarians [13]. However, the visual evaluation of equine gait by
70 veterinarians is reported to have low repeatability, especially for mild lameness [14].
71 Considering mild lameness (e.g. subtle movement asymmetries) is the most likely level of
72 lameness presented in horses undergoing rehabilitation [15], veterinarians and physiotherapists
73 could benefit from a validated equine gait assessment process of whole-body movement
74 quality, that has acceptable interrater agreement, in addition to a numerical lameness scale.
75 This system could inform the documentation and reporting of equine gait and further support
76 communication between the physiotherapist and veterinarian.

77 At present, the identification of features during equine gait assessment and the evaluation of
78 lameness have been confined to research within the veterinary profession; however, the current
79 practice of equine gait assessment by physiotherapists has not been explored [12]. A greater
80 understanding of the key features assessed, and methods used by physiotherapists could
81 inform further veterinary research as well as support the reliability and consistency of equine
82 gait assessment by physiotherapists.

83 The aims of this study were to explore the process of assessment of equine gait via visual
84 observation performed by physiotherapists and to identify the key terms, features assessed,
85 and methods used.

86

87 2. Materials and Methods

88 Ethical approval to undertake the study was gained, in accordance with Hartpury University
89 Ethics Panel guidelines (Number: ETHICS2020-50-LR), prior to the commencement of the study.

90 A qualitative approach was chosen, and purposive sampling used to recruit participants for the
91 study [16,17]. Given that the sample needed to be sufficient to capture the potential themes
92 [18], the proposed sample size for this study was eight participants, comparable to a recent,
93 similar exploratory qualitative study [19]. Primary recruitment was achieved by sending an
94 invitational email to all members of the Association of Chartered Physiotherapists in Animal
95 Therapy (ACPAT).

96 The inclusion criteria were participants qualified as human physiotherapists who have
97 subsequently been practising for a minimum of two years in animal practice. This level of
98 experience deemed adequate based on the two-year clinical experience timeframe that is set
99 for clinical educators within the Master of Science (MSc) in Veterinary Physiotherapy
100 programme at Hartpury University [20]. Additionally, participants were required to be assessing
101 and treating horses in their daily practice either in the UK or internationally.

102 Following recruitment, eight participants who met the inclusion criteria agreed to take part in
103 the study, with the timeframe of working as an equine physiotherapist ranging from three years,
104 eight months to 14 years, nine months. Interviews durations ranged from 44 - 93 minutes.

105 A pilot study was carried out to trial the interview questions and recording procedures, as well
106 as the post interview transcribing process. One interview was undertaken with a physiotherapist
107 who met the participant inclusion criteria and followed the exact format as the semi-structured
108 interview planned for the study. The pilot interview allowed the primary, but novice qualitative,
109 researcher to refine questions, identify potential biases and practice their interview skills, whilst
110 assessing the feasibility of the methods and thus their confidence in the interview techniques.

111 Completion of the pilot interview confirmed the interview protocol was appropriate to the study
112 aims, and feedback from the participant identified that questions were clear. Accordingly, no
113 questions were added or withdrawn, and the corresponding data set was included in the final
114 data analysis. As the primary researcher felt that they may demonstrate some bias in aligning
115 the physiotherapist's answers through their own experiences, neutral prompts were added to
116 ensure that the researcher did not impose their own beliefs onto participants. The semi
117 structured interviews with participants were carried out via an online audio and web
118 conferencing platform (Zoom Video Communications Inc., 2021) and an additional recording
119 was made using the Otter Voice Meeting Notes app (AI Sense Inc., Version 2.1.4) on an iPhone
120 (iPhone Pro, China).

121 An interview guide was created for the study (Supplementary File 1) and after an introductory
122 brief, the interview comprised of two sections: Part A six equine gait videos to identify the main
123 terms used and features of gait assessed by participants and Part B a series of exploratory
124 questions to examine the equine gait assessment process and methods used by participants.
125 The gait videos were sourced from equine gait assessment teaching materials used within the
126 Veterinary Physiotherapy programme at Hartpury University and included viewing a horse
127 moving in hand in a straight line from three different aspects (caudal, cranial and lateral viewing
128 aspects) at both the walk and the trot.

129 2.1. Data analysis

130 Data were transcribed and reviewed, checking for accuracy in tandem with the audio recording.
131 The respective data from each part of the interview were analysed separately. Participant
132 responses from the equine gait assessment videos in part A were catalogued according to
133 features assessed during each gait and viewing aspect (Supplementary File 2), with frequent
134 and consistent features drawn together and tabulated.

135 All data were anonymised and imported into NVivo (QSR International, 2021), software for
136 qualitative research data analysis. Codes were created and assigned to sentences, phrases or
137 paragraphs, then compared across the whole data set to establish similarities, variations,
138 patterns and relationships [21]. After reviewing, renaming or discarding, using an iterative
139 process, codes were grouped together based on connections and themes (broad patterns that
140 capture important elements of data) and subthemes (specific aspects of the themes) were
141 generated [22].

142 3 . Results and Discussion

143 3.1. Features identified by physiotherapists during equine gait assessment

144 During the observation of walk and trot from the caudal and cranial viewing aspects,
145 participants completed the gait assessment using a consistent and structured method, with
146 seven participants evaluating features in a proximal to distal direction. During the observation of
147 walk and trot from the lateral viewing aspect, four participants completed the gait assessment
148 in a distal to proximal direction, with one of those participants additionally assessing in a cranial
149 to caudal direction and four participants not identifying features in a particular direction or
150 order. The physiotherapists reported viewing each section of the body and limb, presumably to
151 ensure a thorough assessment, however whether this improves reliability between assessments
152 or between practitioners is not known. During the assessment of trot, all participants
153 consistently reported on the need to assess for lameness as a core purpose of equine gait
154 assessment (Table 1).

155 All participants mentioned the identification of symmetry versus asymmetry as the underlying
156 basis of equine gait assessment. Characteristics additional to gait were identified by five
157 participants, including facial expressions and demeanour of the horse, horse behaviour, body
158 condition, conformation and willingness to move. acknowledging specific research, thus
159 supporting the premise that physiotherapy is an evidence-based profession [8]. However, an
160 example of a challenge to the consistent application of research, is where participants

161 referenced the Ridden Horse Pain Ethogram (RHpE) developed by Dyson et al. [23]. Considering
162 the evaluation of gait within a veterinary and physiotherapy assessment typically involves
163 observation of an unriden horse, a modified ethogram may be appropriate to be validated for
164 the unriden horse in motion.

165 Participants followed a similar process and identified consistent features when assessing a
166 horse during in hand walk and trot on a straight line, comparable to the gait assessment
167 features advocated by Goff [9]. In an overview of lameness evaluation by veterinarians;
168 movements of the poll, the tuber coxae and tuber sacrale, and fetlock extension are highlighted
169 as key features [13]. Therefore, it appears physiotherapists use features evaluated by
170 veterinarians and adapt them to the practice of physiotherapy gait assessment, including
171 reporting on subjective features such as spinal mobility providing a dynamic context to the
172 manual spinal assessment that usually follows gait assessment [9].

173 In comparing certain features from walk to trot, some participants reported differences in
174 trunk/ribcage movement and spinal mobility, particularly highlighting increased rigidity and
175 reduced mobility as the horse moves in trot. These observed differences correlate with greater
176 ranges of motion for the thoracolumbar spinal segments at the walk compared to the trot
177 [25,26] with larger inertial effects and ground reaction forces in the trot requiring increased
178 stabilisation of the equine trunk [27]. During trot, increased recruitment of axial musculature
179 [28,29] reduces lateral bending at the intervertebral joints [30] and increases spinal rigidity,
180 providing dynamic trunk stability and a rigid platform from which the limbs can articulate [28]. In
181 differentiating features expected in different gaits, participants appear to be implementing
182 evidence from research, informing their information gathering to take forward through the
183 assessment to clinically reason treatment interventions.

184 Table 1. Key features identified by participants during equine gait assessment.

Walk (in-hand, straight line):		
<p>Caudal viewing aspect</p> <ul style="list-style-type: none"> • Head carriage/movement • Pelvic symmetry and movement • Muscle symmetry/balance and tone • Tail position/movement • Trunk/ribcage movement/swing • Hindlimb movement pattern (swing phase) • Hock and fetlock range of motion • Hoof landing and balance • Limb placement and tracking • Timing of limb contact with ground (visual and audible) • Limb loading and stability (stance phase) 	<p>Cranial viewing aspect</p> <ul style="list-style-type: none"> • Facial expressions • Head carriage/movement • Trunk/ribcage movement/swing • Pelvic/hindquarters symmetry • Forelimb movement pattern (swing phase) • Shoulder, carpus and fetlock range of motion • Hoof landing and balance • Limb placement and tracking • Timing of limb contact with ground (visual and audible) • Limb loading and stability (stance phase) 	<p>Lateral viewing aspect</p> <ul style="list-style-type: none"> • Facial expressions • Head carriage/movement • Spinal posture, curvature and movement/mobility • Pelvic position/movement • Tail carriage/movement • Limb range of motion: protraction/retraction • Limb movement pattern (swing phase) • Hoof landing and balance • Limb placement and tracking • Timing of limb contact with ground (visual and audible) • Limb loading and stability (stance phase) • Muscle symmetry/balance and tone • Hindlimb/abdominal engagement • General mobility of fascia • Quality of gait and stride length
Trot (in-hand, straight line): in addition to above-mentioned		
<p>Caudal viewing aspect</p> <ul style="list-style-type: none"> • Quality of gait and transitions 	<p>Cranial viewing aspect</p> <ul style="list-style-type: none"> • Quality of gait and transitions 	<p>Lateral viewing aspect</p> <ul style="list-style-type: none"> • Quality of gait, transitions and stride length

185

186 3.2. Themes

187 Using reflexive thematic analysis [22,31], six main themes and subthemes (Table 2) were
188 generated from data collected in the interviews (part B).

189 3.2.1. Theme 1: Gait assessment is a core component of equine physiotherapy assessment and
190 informs practice

191 Participants described the gait assessment process as an essential component of equine
192 physiotherapy assessment and, similar to Goff [10], detailed how initial static observation,
193 where the physiotherapist evaluates conformation, posture, condition and demeanour of the
194 horse, progresses to an assessment of movement. Gait assessment establishes a baseline for
195 each horse, enabling comparison and review of changes over time. Routine evaluation of equine
196 gait can identify early locomotor inadequacies prior to musculoskeletal injury, ultimately

197 promoting positive equine welfare [32] by informing physiotherapy treatment and guide
198 rehabilitation programmes.

199 *“I couldn’t assess a horse without looking at it move because they can’t talk and half the time, if I’m being
200 honest, the owner doesn’t know if their horse is lame or not.” [Participant 8]*

201 *“We’re looking for dysfunctional movement and homing in on the problem from there to try and then
202 correct it to make it a normal functional movement pattern.” [Participant 1]*

203 *“You’ve got those markers or that description that you have, and you can see whether that’s changed, so
204 you can assess progress or regression if you haven’t gone in the right direction with them.” [Participant 6]*

205 *“It feeds us into clues as to where the issue is and directs our exercise rehabilitation programme.”
206 [Participant 3]*

207 Holistic observation during gait assessment provides additional information, including the
208 overall condition and demeanour of the horse, rather than a dichotomous lame or not lame.
209 Adaptation of locomotion as a sign of musculoskeletal injury in horses and gait modifications to
210 reduce musculoskeletal pain during movement [33,34], highlights how gait assessment gives
211 valuable insight into these adaptations and responses, supporting the clinical reasoning
212 process used by physiotherapists.

213 The multiple purposes of gait assessment were mentioned implicitly and explicitly by all
214 participants, like those advocated in human [2] and equine practice [9]. In identifying
215 asymmetries and dysfunctional movement patterns, physiotherapists aim to further
216 differentiate between conformational issues and postural or movement issues to determine
217 which areas they can address within their scope of practice.

218 *“It gives you a lot of information, not just about lameness, but about general demeanour, behaviour,
219 general condition.” [Participant 4]*

220 *“I suppose it gives you an extra piece of the puzzle to say, ‘well okay, so why does it look like that, but it
221 feels like this’, and so your clinical reasoning process can move through from there.” [Participant 6]*

222 3.2.2. Theme 2: Gait assessment is a structured process that is individualised and therefore
223 specific

224 The gait assessment process used by participants followed similar formats and includes the
225 visual evaluation of the horse during walk and trot. All participants reported initial assessment
226 of the horse in hand in a straight line on a flat hard surface, with lunging on a soft surface
227 occasionally included. The process used and surfaces incorporated were specific to the horse,

228 their function and the assessment findings. The inclusion of specific surfaces and additional
229 movement assessments was highly tailored to the horse and handler/rider.

230 *“I always try and trot up a horse on the hard first. So routinely I always trot the horse away from me,
231 towards me and sometimes obviously from the side. Depending on what the horse’s performance is and
232 what their job is then obviously the surfaces are really important. Depending on what I see on the hard, I
233 would then lunge the horse or not.” [Participant 5]*

234 *“It’s being consistent; each assessment is fairly similar to the assessment I’ve done previously.”
235 [Participant 3]*

236 A polarising topic was the inclusion of lunging on a hard surface, using this specific component
237 to confirm lameness or whether this was outside the remit of physiotherapy. Beyond the initial
238 in hand gait assessment process, participants made consistent reference to the additional
239 movements, such as canter on the lunge or ridden assessment, particularly if gait patterns
240 appear normal and no dysfunctional movement patterns are detected [10]. Although mentioned
241 to a lesser extent, participants use a gradual slope to assess deceleration and loading changes,
242 particularly through the forelimbs during descent [35]. Again, the use of these assessments
243 appeared to be individualised and therefore specific to each horse.

244 *“If it’s a new case I usually do see them on the lunge. [for a horse I know] I won’t always put them on the
245 lunge, but I might put them on the lunge every two or three sessions after I’ve seen them.” [Participant 3]*

246 *“Not routinely [assessed on the lunge]. If it’s my first time meeting them, unless it’s a problem that is very
247 specific to canter, I wouldn’t routinely assess the canter on the very first visit, on meeting a new client.”
248 [Participant 7]*

249 *“I wouldn’t routinely see it ridden on an initial assessment.” [Participant 4]*

250 *“I always do very tight circles to the left and right and I always do a rein back as well. It’s just looking at
251 how the body moves with tight circles and the rein back that adds to your gait analysis.” [Participant 5]*

252 Whilst quantitative gait analysis tools are available, none of the participants in this study made
253 use of them due to the belief that these are expensive and time-consuming, echoing similar
254 feedback from a group of Irish equine industry stakeholders [36]. The process of evaluating and
255 monitoring the effectiveness of treatment is currently limited due to a dearth of validated and
256 reliable outcome measures in equine physiotherapy practice [37]. Some utilise videos and
257 review footage in applications on their phones, while others have preference for real-time
258 observation in the field; two participants reported the occasional use of markers on the horse.
259 The interviews were conducted before the availability of markerless, AI based, validated

260 objective gait assessment became available to veterinary surgeons and musculoskeletal
261 therapists [38]. Future review of techniques used 'in the field' to see if access to these forms of
262 technology has changed physiotherapists' practice will test if assessment strategies are now
263 different.

264 *"At least with a video you can keep going back and referencing and reviewing something, so you've kind of*
265 *got something to compare against."* [Participant 7]

266 A validated framework for the equine gait assessment process, and one iterative based on
267 specific findings could enable reporting of the effect of a physiotherapy intervention beyond
268 anecdote would be advantageous for research purposes and improve the evidence base for the
269 profession [39].

270 3.2.3. Theme 3: Progression within gait assessment is guided by findings and knowledge of
271 equine biomechanics research

272 All participants reasoned progression within gait assessment as case specific and guided by
273 findings. Some participants referred to equine biomechanics research when commenting on
274 the selective use of additional components within their gait assessment process. Their actions
275 were underpinned by knowledge of equine biomechanics research, often correlating specific
276 pathologies and injuries with changes on soft and hard surfaces. Participants often incorporate
277 lunging into a gait assessment when needing to further assess particular limbs and dynamic
278 control on a circle. One participant made reference to differentiating between inside and
279 outside limbs when assessing gait on a circle, correlating with research [39]. Assessment of
280 canter was highlighted by participants to assess trot-canter-trot transitions and hindlimb
281 engagement on both reins, often attributing the need to assess these features based on
282 recommendations made by Dyson [40]. Sacroiliac joint region pain and lumbosacral
283 dysfunction were identified as particular areas of concern that could be assessed during
284 unridden canter due to the relationship between gait changes in canter and sacroiliac pain [41];
285 examples of evidence-informed practice by physiotherapists

286 *"On the circle, they put more pressure or more weight through the outside limb according to the research*
287 *and I suppose then that might for me confirm or help to confirm which limb I think that is an issue."*
288 *[Participant 8]*

289 *"You can see a correlation between the two surfaces and your different paces as well on the surfaces.*
290 *You'd be thinking that's a bit more joint, a bit more osseous with the harder surface. And then you might be*
291 *thinking more soft tissue type origin on your softer surfaces."* [Participant 7]

292 *“If you can't see something in walk or in straight line trot, then very often you will start to bring it out on the*
293 *lunge. You're just stressing the horse a little bit more, stressing the joints, stressing the movement more,*
294 *loading differently. So that's where I would then come on to circles walk, trot, canter.” [Participant 1]*

295 *“Canter shows up a variety of problems, particularly if they've got suspected lumbosacral or sacroiliac*
296 *dysfunction, then canter is the gait that shows it more. I tend to see a lot of horses with that type of*
297 *problem, so I would need to see the canter. It shows up different spinal movement as well. And research*
298 *has shown that they're going to be shearing forces through the sacroiliac joint and hence why that*
299 *predisposes it in the canter.” [Participant 3]*

300 Participants described ridden assessment to assess the rider-saddle-horse-interaction and the
301 overall function, as a progression from the unridden gait assessment, often being sport specific
302 and guided by findings only present in the ridden scenario, rather than routinely used. Additional
303 demands are placed on the ridden horse, including athletic demands [42], the skill and weight
304 distribution of the rider [43], and influences by the bit [44], restrictive noseband [45], rein
305 contact [43] and saddle [46]. Considering these potential variables, the ridden horse ethogram
306 such as the RHpE [24] valuably supports ridden assessment and aids recognition of features
307 that may be potential indicators of musculoskeletal pain. The use of behavioural evaluation
308 alongside kinematic assessment is suggested as imperative as part of a thorough gait
309 assessment.

310 *“If there's a specific ridden problem then I think it's really important to see it ridden. So, when you're*
311 *putting the weight of the rider on, you're increasing the forces through all of the limbs. But you're also*
312 *assessing the quality of the rider.” [Participant 3]*

313 3.2.4. Theme 4: Assessing for lameness is a core purpose of gait assessment and ensures
314 physiotherapists work within scope of practice

315 Participants strongly reported on the evaluation of lameness as a primary method to recognise
316 when to refer for veterinary input. The lameness grading methods used by participants varied,
317 with some participants opting for basic categories (e.g. mild, moderate, severe) instead of a
318 NRS as local veterinarians all used different scales. Participants confirmed the use of
319 supplementary descriptors in addition to their chosen method of lameness evaluation, with a
320 focus on describing quality of movement and features of gait. Establishing that physiotherapists
321 within this study use a similar method to the one recommended by Dyson [11], suggests that
322 the use of descriptors as an adjunct to an NRS gives a more complete and accurate
323 representation of the lameness.

324 By establishing appropriateness for physiotherapy intervention and ensuring they only practice
325 in the areas in which they are safe and competent to do so, it was clear that participants
326 continually work within their scope of practice, adhering to the legal, regulatory and
327 professional frameworks that underpin both the veterinary field [47] and the physiotherapy
328 profession [48,49].

329 *“I’m primarily looking at how sound the horse is. Is it too lame for me and needs a veterinary work up?”*
330 *[Participant 3]*

331 *“Because I have too many vets who are doing different things, I have stopped grading lameness. In that*
332 *way I go with very subtle, mild, moderate, severe, partial weightbearing or non-weightbearing.” [Participant*
333 *2]*

334 *“My vets locally will always use the 0 -10 scale as well, so it’s always quite nice to use the same one as the*
335 *local vets and then at least you’re on the same sort of wavelength with them.” [Participant 5]*

336 *“I’ll use more descriptors and all the other features, the main things that I’m looking at. It’s sometimes*
337 *also a way for me to justify what I think I’m seeing properly.” [Participant 2]*

338 3.2.5. Theme 5: Gait assessment findings support communication and collaboration with the
339 equine interdisciplinary team

340 Gait assessment findings appear to be regularly used by participants when communicating and
341 collaborating with other equine professionals, namely veterinarians, farriers and saddle fitters,
342 thus contributing to the continuum of care of the equine patient. Participants strongly reiterated
343 the role of the veterinarian in providing a diagnosis, with lameness evaluation highlighted as a
344 particular area for veterinary input [50]. As lameness is one of the main reasons for veterinary
345 intervention [51-53] and a symptom indicative of pain or injury of the locomotor apparatus [54],
346 prevention and early identification are crucial [55]. Considering pain management is dependent
347 on the quality of the pain evaluation, improved pain recognition can improve equine patient
348 outcomes and enhance current veterinary and equine welfare practices [56].

349 *“It’s good to find out if there’s anything subtle and I think that’s then a veterinary rather than a*
350 *physiotherapy area.” [Participant 5]*

351 *“It [gait assessment] gives you something to discuss with other professionals if you need to feedback to*
352 *anyone. And I suppose it’s easier to talk to the vet about that than it is to talk to them about a particular*
353 *muscle. Depends on the vet, some of them are very rehab oriented but some are not.” [Participant 6]*

354 *“You can then feedback [the findings] to the farrier as well, so that can be valuable.” [Participant 1]*

355 3.2.6. Theme 6: Gait assessment is influenced and/or limited by various factors

356 The most frequently mentioned limitations were those hindering the observer when visually
357 assessing equine gait, included limited resolution of the human eye [57], perception of
358 asymmetry [58] and memorisation [13]. Some participants highlighted research evidence when
359 discussing these limitations. It is recognised that veterinarian lameness detection increases in
360 accuracy with experience [59-61], suggesting that inexperienced practitioners require time to
361 develop this skill. This can lead to potential variability and bias and, relevantly, subtle variations
362 in the features identified and the methods used by participants during the equine gait
363 assessment process were found, emphasising the benefit of a standardised gait assessment
364 system.

365 The effect the handler may have on the horse's behaviour [62], as well as their handling skill
366 competency, were identified as influencing factors. An additional factor to consider is whether
367 owners can notice signs of illness or injury in their horses, which may impact the subjective
368 feedback they provide. Greve and Dyson [63] indicated that riders fail to recognise the presence
369 of pain related gait abnormalities and similarly, Müller-Quirin et al. [54] found a high occurrence
370 of mild to moderate lameness scores in owner sound horses, highlighting that an owner's
371 perception was often incongruent with veterinary exams. Therefore, educating owners about
372 equine pain-related behaviours could allow earlier identification of lameness, improving equine
373 welfare through accurate diagnosis and timely treatment.

374 *"The human eye can only see so much. You may not remember everything; you may not process
375 everything."* [Participant 7]

376 *"It's so subjective, even if you take videos, it's still really subjective. That would be my number one
377 limitation."* [Participant 4]

378 *"It also can be very time consuming if you're both having to trot it up, put it on the lunge, want it ridden.
379 Yeah, realistically, it can be time consuming. That's a limitation."* [Participant 4]

380 *"The handler and their handling skill competency can influence the gait assessment process.*

381 *So definitely limited within what the handler can do, if they can lunge or not."* [Participant 4]

382 *"Depending on how good the client is as a rider. Some of the riders are picking up very subtle things under
383 saddle rather than on the lunge. So, it depends on the experience of the rider."* [Participant 5]

384 Practically, the gait assessment process is often directly linked to the surfaces and facilities
385 available and other factors, such as weather. Participants strongly reported on the importance
386 of safety and the need to consider this factor for both the horse and handler. It appeared that
387 safety considerations and risk assessment was integrated into all aspects of the physiotherapy

388 assessment, including the gait assessment process. With a high risk of occupational injury
 389 within equine practice for veterinary surgeons and physiotherapists attention must be paid to
 390 the environment, species-specific equine behaviour and the intervention being undertaken with
 391 the horse [64-66].

392 *“The limitations are definitely with the surface that you're trotting on, if you've not got the right
 393 environment to trot them up in. Definitely the outside environment, whether it be weather, or the facilities
 394 is huge.” [Participant 8]*

395 *“First of all, safety is your paramount. Is the ground safe for the horse to trot on? Is the handler safe for the
 396 horse to trot on?” [Participant 3]*

397 Table 2. Identified themes and subthemes.

Theme	Subtheme
Gait assessment is a core component of equine, physiotherapy assessment and informs practice	Gait assessment is essential and feeds into other parts of physiotherapy assessment Gait assessment identifies areas that physiotherapy can address Gait assessment provides a baseline and allows evaluation of change Gait assessment findings inform physiotherapy treatment and guide rehabilitation Gait assessment provides additional information Gait assessment supports clinical reasoning Gait assessment supports owner education and understanding
Gait assessment is a structured process that is individualised	Initial gait assessment is standard in structure but individualised to the horse and owner Physiotherapists follow a routine to maintain consistency Inclusion of additional movement assessments may vary and are individualised to the horse and owner Use of additional tools or measures may vary Reassessment of gait is intermittently used
Progression within gait assessment is guided by knowledge of equine biomechanics research	Progression is case-specific and may vary dependent on findings Physiotherapists purposefully utilise different surfaces Lunging allows further gait analysis Canter is purposefully assessed and identifies additional features Ridden assessment is case-specific and further assesses horse-rider interaction
Assessing for lameness is a core purpose of gait assessment and ensures physiotherapists work within scope of practice	Physiotherapists assess for lameness to establish appropriateness for physiotherapy Physiotherapists work within scope of practice Physiotherapists use different lameness grading scales and approaches Rationale for use of a particular lameness scale and approach vary Supplementary descriptors are used in lameness evaluation
Gait assessment findings support communication, and collaboration with the equine interdisciplinary team	Veterinarian is responsible for lameness evaluation and diagnosis Communication with veterinarian and other equine professionals is recommended Collaboration with equine interdisciplinary team members is essential
Gait assessment is influenced and/or limited by various factors	Limitations exist within the visual assessment of equine gait Time constraints can be a limiting factor Gait assessment can be influenced by the handler and their handling skills Owners and riders have varying levels of knowledge and awareness Many factors, such as horse behaviour and facilities, influence the gait assessment process and progression Risk assessment is continually performed as safety is paramount

398

399 **4. Limitations**

400 In qualitative research, the influence of the researcher’s experiences and beliefs should be
 401 acknowledged [64], as researchers cannot avoid introducing subjectivity into the research
 402 process, just as readers will have their own perspectives [66]. Sample size calculation is a
 403 debatable issue, particularly in qualitative studies [67]. Within thematic analysis, six participant
 404 interviews are suggested for meaningful pattern detection within the data [68], which this study
 405 met with a sample size of eight. Purposive sampling was used, which could be a potential
 406 source of bias and limits generalisation of the study [69]. However, participants were
 407 deliberately selected to capture a range of specified group characteristics due to the nature of
 408 the research question [70].

409 In this study, gait was assessed via video recordings and no clinical history or information
410 regarding the horses were included. The gaits assessed were presented on a straight line and
411 did not show canter or ridden assessment despite these forms of assessment being mentioned
412 by the participants. Future studies could explore the features considered relevant to
413 physiotherapists in these differing dynamic scenarios. It can be argued that the use of videos
414 does not accurately replicate a clinical setting. Video assessment method has been
415 successfully utilised in studies evaluating equine gait [70,71], however whilst consistent gait
416 assessment features were reported by participants, it remains to be determined whether similar
417 results could be achieved in real-time, highlighting an area for further research.

418 The study utilised the semi structured interview to gather data, based on several qualitative
419 human physiotherapy studies [72,73] and veterinary studies [74], which have successfully used
420 this approach, including a recent qualitative study used this interview approach with a group of
421 six equine physiotherapists exploring clinical reasoning [19]. It is important to recognise, as a
422 limitation, that data collected from interviews is a combination of thoughts from both the
423 interviewer and interviewee [75]. Whilst the interviewer aimed to remain impartial by continually
424 considering potential bias and impact during the interviews, participants intermittently required
425 prompts to complete, affirm or clarify their answers.

426 5. Conclusions

427 This study is the first to explore equine gait assessment by physiotherapists whereby, like
428 veterinarians, visual evaluation appears to be standard practice. The themes identified show
429 the main methods used by physiotherapists during gait assessment, a process highly
430 individualised and therefore specific to the horse and owner. It is evident that physiotherapists
431 use evidence-informed practice during gait assessment, particularly in the progression of
432 assessing for lameness and selection of additional movement assessments such as canter,
433 lunging and ridden. There are various factors that influence, and limit equine gait assessment
434 and this qualitative analysis sets the initial exploratory basis for potential future quantitative
435 research in this area. The physiotherapists interviewed work within scope of practice, using the
436 findings from gait assessment to support communication and collaboration with the
437 veterinarian and other professionals in the equine interdisciplinary team.

438 Supplementary Materials: Interview Guide; Supplementary File

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440 Institutional Review Board Statement: Ethical approval to undertake the study was gained, in
441 accordance with Hartpury University Ethics Panel guidelines (Number: ETHICS202050LR), prior
442 to the commencement of the study.

443 Informed Consent Statement: Informed consent was obtained from all subjects involved in the
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