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Pain assessment in horses after orthopaedic surgery and with orthopaedic trauma

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ABSTRACT

Objective pain assessment is important to guide and tailor therapy in clinical practice. This study describes the clinical applicability and validity of two pain scales, the Composite Pain Scale (CPS) and the Equine Utrecht University Scale for Facial Assessment of Pain (EQUUS-FAP) in horses with orthopaedic trauma or after orthopaedic surgery. A cohort follow-up study was performed using 77 adult horses ($n = 43$ with orthopaedic trauma or injury; $n = 34$ controls). Composite and facial expression-based pain scores were assessed by direct observations of pairs of two independent observers. All horses were assessed at arrival, and on the first and second day after arrival or after surgery.

Both CPS and EQUUS-FAP scores demonstrated high inter-observer reliability (Crohnbach's alpha = 0.97 for CPS; Crohnbach's alpha = 0.93 for EQUUS-FAP; $P < 0.001$), with low bias (0.07 and −0.08 respectively) and limits of agreement of −1.9 to 1.9 for CPS and −1.9 to 1.9 for EQUUS-FAP. Both CPS and EQUUS-FAP scores showed significant differences between control horses and orthopaedic cases ($P < 0.001$). Trauma cases had significantly higher pain scores compared to postoperative cases for both CPS ($P < 0.05$) and for EQUUS-FAP ($P < 0.01$) and both pain scores significantly decreased after nonsteroidal anti-inflammatory drug (NSAID) administration. In accordance with the findings in other types of equine pain, the CPS and FAP proved useful and valid for objective and repeatable assessment of pain in horses with orthopaedic trauma or after orthopaedic surgery. This can further aid treatment of horses in clinical practice and might improve equine welfare.

Introduction

Over the last decade, pain and its impact on equine welfare are becoming increasingly important fields of research and numerous studies on objective (acute) pain assessment in horses have appeared during this time. The reviews by Gleerup and Lindegaard (2016) and de Grauw and van Loon (2016) provide an in-depth overview of studies of pain scoring in horses until that time. Objective and reliable recognition of pain is essential so that analgesic protocols can be tailored according to the needs of individual horses (Daglish and Mama, 2016; Guedes, 2017). Apart from species differences, pain expression is also dependent on the type and origin of pain. For instance, somatic and visceral pain are different phenomena that manifest differently and need to be treated accordingly (Robertson, 2006). They also need to be measured by means of specifically designed reliable and validated pain scales that can be used in clinical cases with real-time pain scores.

The most promising instruments seem to be the composite pain scales (CPS) and facial expression-based pain scales. Both types of pain scales are based on several simple descriptive scale (SDS) elements, that are combined to account for various manifestations of pain. These include behavioural, physiological and interaction parameters for CPS and different aspects of facial expression, including positioning of ears, nostrils etc., for facial expression-based pain scales. CPS have been described for different types of pain in horses, including acute orthopaedic pain (Bussières et al., 2008; Lindegaard et al., 2010) and pain after colic surgery (Pritchett et al., 2003; Graubner et al., 2011; van Loon et al., 2014). Recently, a CPS for horses with acute colic pain was designed and validated (van Loon and van Dierendonck, 2015; van Dierendonck and van Loon, 2016). Taffarel et al. (2015) described the UNESP-Botucatu multidimensional CPS for horses after surgical castration.

Facial expression-based pain scales for horses have been described by Dalla Costa et al. (2014), who described the Horse Grimace Scale in horses after surgical castration and in horses with

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acute laminitis (Dalla Costa et al., 2016). The Equine Pain Face by Gleerup et al. (2015) describes facial expression in horses with acute experimentally induced pain. Recently, a facial expression-based pain scale was described in horses with acute colic pain (van Loon and van Dierendonck, 2015; van Dierendonck and van Loon, 2016) and in horses with head-related pain (Van Loon and van Dierendonck, 2017). Facial expression of pain was also investigated by Mullard et al. (2017) and Dyson et al. (2017, 2018) in ridden lame and sound horses.

Although these various studies demonstrate that different types of pain can be validly assessed by means of different types of pain scales in horses, there is a clear need for objective pain assessment in clinical cases with orthopaedic pain, e.g. after orthopaedic surgery, or in horses with traumatic orthopaedic pain. The studies by Lindegaard et al. (2010) and Bussières et al. (2008) describe pain from experimentally induced synovitis pain. This type of pain relates to acute joint pain in horses, but also has its limitations for extrapolation to other types of clinical orthopaedic pain. The study by Taffarel et al. (2015) describes postoperative pain assessment by means of a CPS, but that study investigated pain after surgical castration. In a pilot study by van Loon et al. (2010), the CPS by Bussières et al. (2008) was used to assess pain in a limited number of horses (n = 13) after orthopaedic pain. These latter findings indicated that the CPS by Bussières et al. (2008) could be useful to assess horses after orthopaedic surgery, but the number of horses studied in this subgroup was too small for statistical analysis.

The aim of this study was to assess the validity and clinical applicability of the CPS and the Equine Utrecht University Scale for Facial Assessment of Pain (EQUUS-FAP) in horses with acute orthopaedic trauma and in horses after orthopaedic surgery. This latter pain scale is entirely based on facial characteristics and therefore takes limited time, which could facilitate clinical implementation. The hypotheses were that the CPS would have better inter-observer reliability compared to the EQUUS-FAP, and that both pain scales would be clinically applicable and could differentiate between control horses and horses with orthopaedic pain.

Materials and methods

Animals

The study design was approved by the institutional Ethics Committee on the Care and Use of Experimental Animals in compliance with Dutch legislation on animal experimentation. Because the procedures used in this study contain only behavioural observations and physiological assessments (heart rate, breathing rate, borborygmi, rectal temperature) and therefore are not likely to cause pain, suffering or distress or lasting harm equivalent to, or higher than, that caused by the introduction of a needle *(article 1.5f EU directive 2010/63/EU)*, ethical approval was obtained without an official approval number. Furthermore, owner consent was obtained for all horses and ponies participating in this study.

30 animals (29 horses and 1 Shetland pony) that had been admitted to the equine referral centre with orthopaedic trauma or were referred for orthopaedic surgery were included; 13 Shetland ponies that underwent orthopaedic surgery for research purposes (ethical permission under license number AVD 108002015307) were also included (Table 1). Twenty-five control horses (healthy mares that were used as recipients for embryo transfer and healthy horses from the Police Department) and nine healthy control Shetland ponies were also included (Table 1). All control horses and ponies were free from lameness and/or other clinical problems.

Table 1
Data from horses that were included in the study (n = 77).

	Surgical	Trauma	Control
Number of horses	18	11	25
Number of Shetland ponies	13	1	9
Warmblood	17	11	25
Other breeds	14	1	9
Mean (±SD) weight (kg) horses	555.1 (107.2)	497.2 (112.3)	575.1 (54.8)
Mean (±SD) weight (kg) ponies	178.9 (13.7)	–	183.6 (12.9)
Mean (±SD) age (years)	7.5 (4.2)	8.9 (5.1)	9.6 (4.1)

SD, Standard deviation.

The total study population consisted of 49 mares, 27 geldings and one stallion. Foals and mares with foals were excluded from the study, because of the potential for mare-foal interaction to interfere with the assessment of pain scores. Breeds included Warmbloods (n = 49), Friesians (n = 2), Icelandic horses (n = 2), Trotter (n = 1), Pony (n = 1) and Shetland ponies (n = 22). Analgesic treatment and clinical management occurred at the discretion of the attending veterinarian and was independent of pain scores. Observers were not involved with day-to-day care of the horses and were unaware of any analgesic treatment protocols at the time of pain assessment. Horses that required alpha2-agonists were excluded from the study because of possible interference with pain scores.

Composite Pain Scale

The CPS is described by Bussières et al. (2008) and validated for acute orthopaedic pain by means of an amphotericin-B induced synovitis model. The CPS is a multifactorial simple descriptive scale (SDS) based on 13 parameters scored for 5 min. It includes physiologic parameters, responses to stimuli, and spontaneous behavioural parameters (Table 2). Each of the 13 parameters can be scored from 0 to 3, resulting in a total pain score ranging from 0 (no signs of pain) to 39 (maximal pain score).

Equine Utrecht University Scale for Facial Assessment of Pain (EQUUS-FAP)

The EQUUS-FAP is a multifactorial SDS based on nine parameters scored for 2 min, describing different elements of facial expression, such as the appearance of the eyelids, nostrils and muscle tone (Table 3). Each of the nine parameters can be scored from 0 to 2, resulting in a total pain score ranging from 0 (no signs of pain) to 18 (maximal pain score). The EQUUS-FAP has been designed and validated for the assessment of horses with acute colic (van Loon and van Dierendonck, 2015; van Dierendonck and van Loon, 2016) and has been described in horses with acute head-related pain (Van Loon and van Dierendonck, 2017).

Experimental design

Observations were performed by two independent observers (four veterinary students in pairs; each pair observed half the horses) who performed their observations simultaneously. The observers did not discuss their findings. Prior to commencement of the study, all observers had the chance to familiarise themselves with the parameters assessed in the CPS and EQUUS-FAP using horses assumed to be pain-free (not included in the study). The observers were not masked to the clinical diagnosis. Horses that had undergone trauma were evaluated as soon as possible after admission to the university hospital (T0) and were followed for 2–3 days after admission. After acclimatisation to their new surroundings, elective orthopaedic surgical cases were assessed before surgery (T-2 and T-1 i.e. 2 days and 1 day before surgery), on the day of surgery from 6 h after recovery from anaesthesia (T0) and also for 1–3 days after surgery three times daily (T1.1-1.2-1.3, T2.1-2.2-2.3, T3.1-3.2-3.3). Mean anaesthesia time (±standard deviation, SD) was 75 (±33.4) min; no postoperative opioids were administered to the surgical cases. Pain scoring was performed at similar times before the administration of analgesics (meloxicam 0.6 mg/kg PO, T1.1-2.1-3.1, 7.00am), after morning medication (T1.2-2.2-3.2, 12.00am) and in the afternoon (T1.3-2.3-3.3, 5.00pm). Control horses were assessed once only. Each observation period comprised 10 min. Scoring was performed with each horse in their own box.

Data processing and statistical analysis

All data are expressed as medians and quartiles. Inter-observer reliability was assessed using intra-class correlation analysis with Crohnbach's alpha. Bland-Altman plots were used to visually evaluate correlations and determine bias and limits of agreement (average difference ± 1.96 SD of the difference; Bland and Altman, 1986; Myles, 2007). Differences in scores between experimental ponies and surgical cases and between control horses and control ponies were analysed using the Mann Whitney U test (P > 0.05). Thereafter, surgical cases and Shetland ponies were pooled (surgical cases) and control horses and ponies were pooled (control horses). Differences between control horses, surgical cases and trauma cases were analysed using Kruskall Wallis tests with post-hoc Mann Whitney U tests (using Bonferroni correction) to compare the three groups. The effects of nonsteroidal anti-inflammatory drug (NSAID) treatment on pain scores were assessed using Mann Whitney U tests for both surgical and trauma cases. Statistical analysis was performed using SPSS version 20.0 (IBM). Statistical significance was accepted at P < 0.05.

Results

Inter-observer reliability

Fig. 1 presents the results of correlation analysis between the pain scores from two independent observers. There was a strong and significant correlation (Crohnbach's alpha = 0.97, P < 0.001 for

Table 2
Score sheet for the Composite Pain Scale (CPS), scored for 5 min (by Bussières et al. (2008) – physiological data slightly adapted).

Data	Categories	Score
Physiological data	24–44 beats/min	0
	45–52 beats/min	1
Heart rate	53–60 beats/min	2
	>60 beats/min	3
Respiratory rate	8–13 breaths/min	0
	14–16 breaths/min	1
	17–18 breaths/min	2
	>18 breaths/min	3
Rectal temperature	36.9 °C–38.5 °C	0
	36.4 °C–36.9 °C or 38.5 °C–39.0 °C	1
	35.9 °C–36.4 °C or 39.0 °C–39.5 °C	2
	35.4 °C–35.9 °C or 39.5 °C–40.0 °C	3
Digestive sounds	Normal motility	0
	Decreased motility	1
	No motility	2
	Hypermotility or steelband	3
Behaviour Posture (weight distribution, comfort)	Stands quietly, normal walk	0
	Occasional weight shift, slight muscle tremors	1
	Non-weight bearing, abnormal weight distribution	2
	Analgesic posture (attempts to urinate), prostration, muscle tremors	3
Appetite	Eats hay readily	0
	Hesitates to eat hay	1
	Shows little interest in hay, eats very little hay in mouth but does not chew or swallow	2
	Neither shows interest in nor eats hay	3
Sweating	No signs of sweating	0
	Warm or damp to touch, no sweat or wet spots visible	1
	Wet spots visible, no droplets or streams	2
	Excessive sweating, may include streams or droplets	3
Kicking at abdomen	Quietly standing, no kicking	0
	Occasional kicking at abdomen (1–2 times/5 min)	1
	Frequent kicking at abdomen (3–4 times/5 min)	2
	Excessive kicking at abdomen (>5 times/5 min), intermittent attempts to lie down and roll	3
Pawing at floor (pointing, hanging limbs)	Quietly standing, does not paw at floor	0
	Occasional pawing at floor (1–2 times/5 min)	1
	Frequent pawing at floor (3–4 times/5 min)	2
	Excessive pawing at floor (>5 times/5 min)	3
Head movements	No evidence of discomfort, head straight ahead for the most part	0
	Intermittent head movements laterally/vertically, occasional looking at flank (1–2/5 min), lip curling (1–2 times/5 min)	1
	Intermittent and rapid head movements laterally/vertically, frequent looking at flank (3–4/5 min), lip curling (3–4 times/5 min)	2
	Continuous head movements, excessively looking at flank (>5 times/5 min), lip curling (>5 times/5 min)	3
Appearance (reluctance to move, restlessness, agitation and anxiety)	Bright, no reluctance to move	0
	Bright and alert, occasional head movements, no reluctance to move	1
	Restlessness, pricked up ears, abnormal facial expressions, dilated pupils	2
	Excited, continuous body movements, abnormal facial expression	3
Response to treatment Interactive behaviour	Pays attention to people	0
	Exaggerated response to auditory stimulus	1
	Excessive-to-aggressive response to auditory stimulus	2
	Stupor, prostration, no response to auditory stimulus	3
Response to palpation of the painful area	No reaction to palpation	0
	Mild reaction to palpation	1
	Resistance to palpation	2
	Violent reaction to palpation	3
Total		. . . /39

CPS scores, Crohnbach's alpha = 0.93, $P < 0.001$ for EQUUS-FAP scores) for both the CPS and EQUUS-FAP scores. Bland Altman analysis yielded a bias of 0.07 and limits of agreement of −1.9 to 1.9 for CPS and a bias of −0.08 and limits of agreement of −1.9 to 1.9 for EQUUS-FAP (Fig. 1).

Differences between control horses, horses with acute trauma and surgical cases

There were significant differences between control horses and trauma cases ($P < 0.001$) and between control horses and postoperative cases ($P < 0.001$) for both CPS and EQUUS-FAP scores. Trauma cases had significantly higher pain scores compared to postoperative cases for both CPS ($P < 0.05$) and EQUUS-FAP ($P < 0.01$; Fig. 2).

Response to NSAID treatment in acute trauma and postoperative pain

There were significant decreases in both CPS and EQUUS-FAP pain scores after NSAID treatment, both for surgical cases (Fig. 3A and C; $P < 0.001$ and $P < 0.01$, respectively), and for trauma cases (Fig. 3B and D; $P < 0.01$ and $P < 0.05$, respectively).

Table 3
Score sheet for the Equine Utrecht University Scale for Facial Assessment of Pain (EQUUS-FAP), scored for 2 min.

Data	Categories	Score
Head	Normal head movement/Interested in environment	0
	Less movement	1
	No Movement	2
Eyelids	Opened, sclera can be seen in case of eye/head movement	0
	More opened eyes or tightening of eyelids. An edge of the sclera can be seen for 50% of the time	1
	Obviously more opened eyes or obvious tightening of eyelids. Sclera can be seen more than 50% of the time	2
Focus	Focussed on environment	0
	Less focussed on environment	1
	Not focussed on environment	2
Nostrils	Relaxed	0
	A bit more opened	1
	Obviously more opened, nostril flaring and possibly audible breathing	2
Corners mouth/Lips	Relaxed	0
	Lifted a bit	1
	Obviously lifted	2
Muscle tone head	No fasciculation's	0
	Mild fasciculation's	1
	Obvious fasciculation's	2
Flehming and/or Yawn	Not seen	0
	Seen	2
Teeth grinding and/or moaning	Not heard	0
	Heard	2
Ears	Position: Orientation towards sound/clear response with both ears or ear closest to source	0
	Delayed/reduced response to sounds	1
	Position: backwards/no response to sounds	2
Total		. . . /18

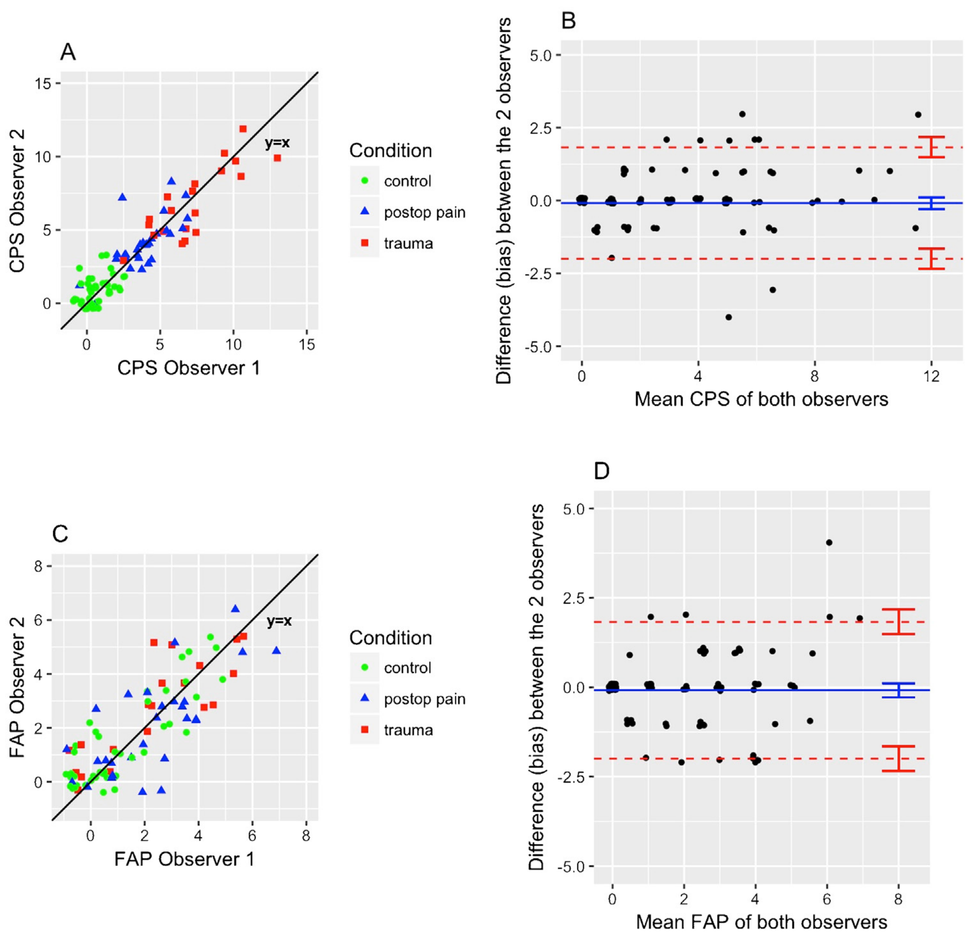

Fig. 1. Inter-observer reliability.
A + B: CPS: Crohnbach's alpha = 0.97 ($P < 0.001$), bias = −0.07 and limits of agreement of −1.9 to 1.9 ($n = 94$; NB. many points overlap).
C + D: Facial Assessment of Pain (FAP): Crohnbach's alpha = 0.93 ($P < 0.001$); bias = −0.08 and limits of agreement of −1.9 to 1.9 ($n = 94$; NB many points overlap).

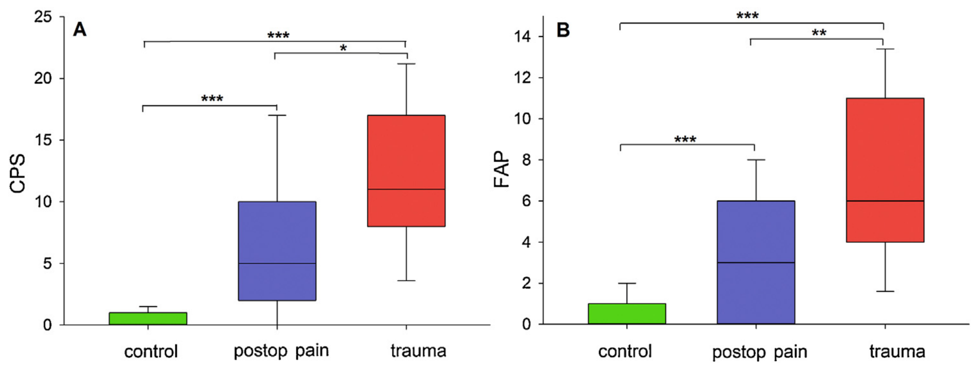

Fig. 2. Composite Pain Scale (CPS) and Facial Assessment of Pain (FAP) scores in acute trauma and postoperative pain. A) CPS and B) FAP in Control ($n = 34$), surgical cases ($n = 31$), and trauma cases ($n = 12$). Lines in boxes show median scores; boxes show 25–75th percentiles; error bars show 5–95th percentiles. * = $P < 0.05$, ** = $P < 0.01$, *** = $P < 0.001$.

Effects over time in horses admitted with trauma and admitted for orthopaedic surgery

Fig. 4 presents CPS and EQUUS-FAP scores over time in surgical cases (Fig. 4A, CPS; Fig. 4C EQUUS-FAP) and in trauma cases (Fig. 4B, CPS; Fig. 4D, EQUUS-FAP).

Discussion

This study demonstrated that both the CPS and the EQUUS-FAP are reliable and reproducible scales for the assessment of pain in horses after orthopaedic surgery and in horses with orthopaedic trauma. Both pain scales were used to assess pain in horses while being stabled in their box. In the trauma cases, pain scores were high at admission and gradually decreased over time. In the horses that underwent orthopaedic surgery, pain scores at admission were relatively low, because of their low-grade pathology and lameness. After surgery, pain scores increased, and gradually decreased over time. In both types of cases, pain scores decreased significantly after administration of NSAIDs, supporting our hypothesis that the scores truly reflect pain. Based on our findings and those of previous studies, we consider that CPS scores of 5–8 indicate mild pain, CPS scores of 8–10 indicate moderate pain and CPS scores >10 indicate severe pain. For the EQUUS-FAP, pain is considered mild at scores of 3–5, moderate for scores between 5 and 8 and severe for pain scores >8.

Inter-observer reliability was assessed in our study by means of intra class correlation analysis (Crohnbach's alpha) and Bland Altman analysis. For both the CPS and the FAP, strong and significant correlations were found when results from two independent observers were compared. Bland Altman analysis demonstrated that, in relation to the range in pain scores that were

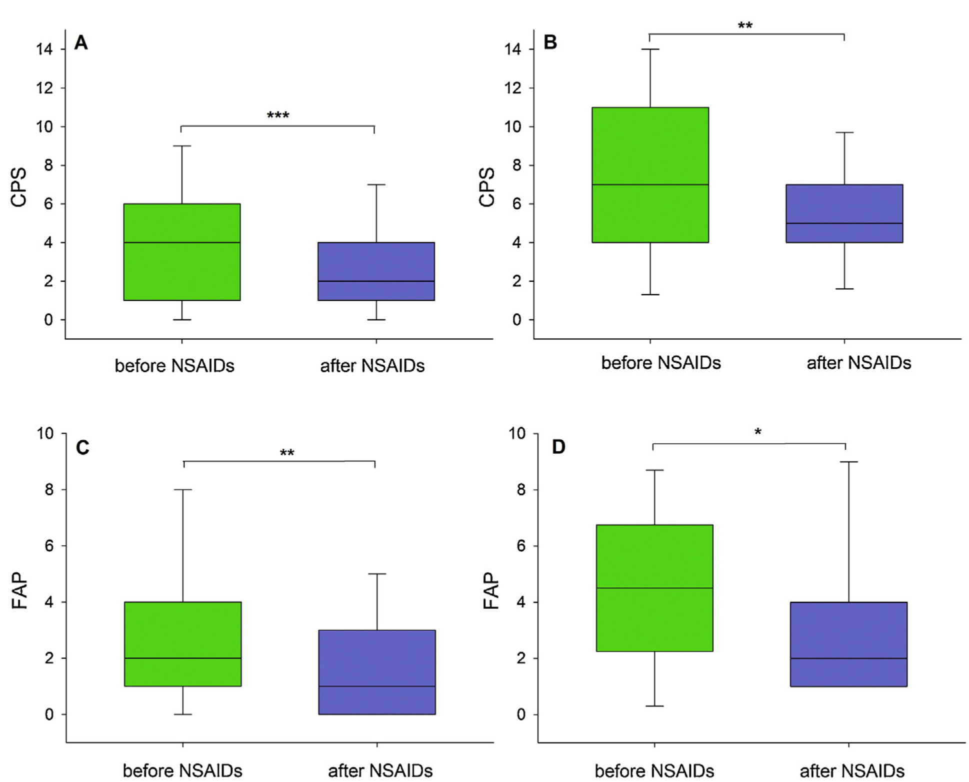

Fig. 3. Response to nonsteroidal anti-inflammatory drug (NSAID) treatment in acute trauma and postoperative pain. A) Composite Pain Scale (CPS) postoperative pain ($n = 31$); B) CPS trauma pain ($n = 12$); C) Facial Assessment of Pain (FAP) postoperative pain ($n = 31$); D) FAP trauma pain ($n = 12$). Lines in boxes show median scores; boxes show 25–75th percentiles; error bars show 5–95th percentiles * = $P < 0.05$, ** = $P < 0.01$, *** = $P < 0.001$.

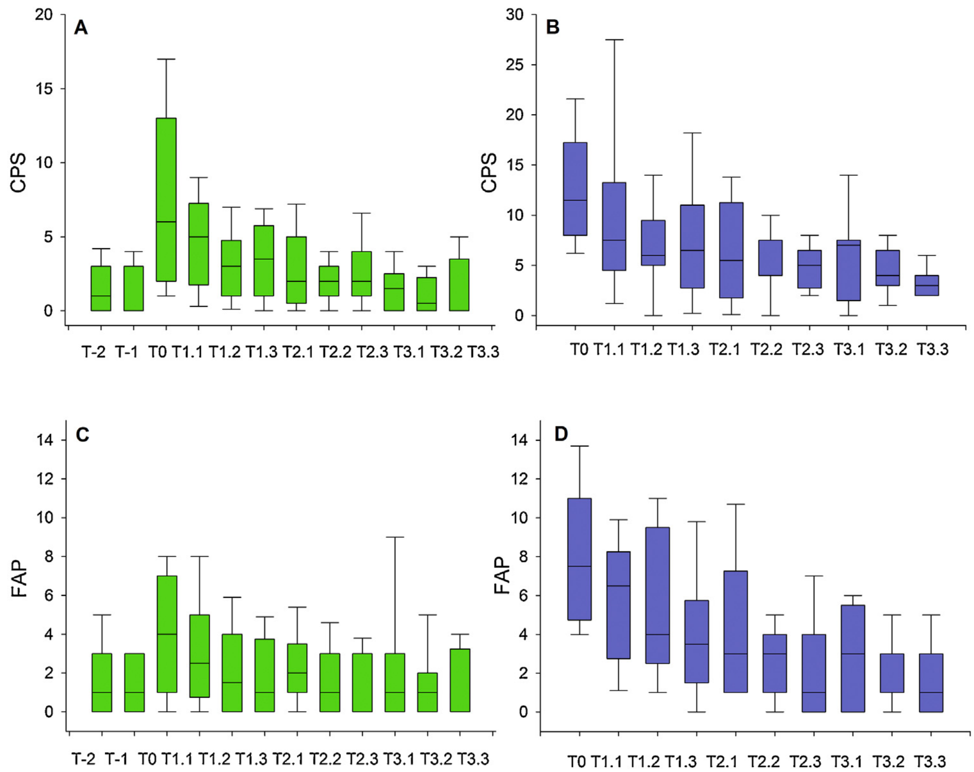

Fig. 4. Time effects of Composite Pain Scale (CPS) and Facial Assessment of Pain (FAP) in acute trauma and postoperative pain. A) CPS postoperative pain (n = 31); B) CPS trauma pain (n = 12); C) FAP postoperative pain (n = 31); D) FAP trauma pain (n = 12).
T −2 = two days before surgery; T −1 = day before surgery; T 0 = 6 h after completion of recovery from general anaesthesia for surgery (surgical pain) or at admission (trauma pain).
T1.1-2.1-3.1: pain scores at first, second and third day after surgery at 7.00am (before morning medication); T1.2-2.2-3.2: pain scores at first, second and third day after surgery at 12 AM (after morning medication with meloxicam 0.6 mg/kg orally administered); T1.3-2.3-3.3: pain scores at first, second and third day after surgery at 5.00p.m. (afternoon). Lines in boxes show median scores; boxes show 25–75th percentiles; error bars show 5–95th percentiles.

found in the patients, the CPS showed lowest limits of agreement. This agreed with the original study that described CPS in horses with induced acute orthopaedic pain (Bussières et al. 2008), and also reported good inter-observer reliability (K-coefficient 0.8–1.0). Earlier studies with FAP and an adapted CPS for horses with acute colic (EQUUS-COMPASS) also reported high inter-observer reliability; CPS had superior correlation in this study. The study reported no differences in FAP and CPS scores when mares and geldings were compared (Van Loon and van Dierendonck, 2015).

We assessed Warmblood horses and Shetland ponies in our study. There were no differences in pain scores from Warmblood horses and Shetland ponies, and no differences were found in healthy pain-free animals when the two breeds were compared, demonstrating that CPS and FAP scales provide a means of assessing pain that is independent of breed. This observation confirms the findings of an earlier study that used a CPS designed for horses with acute colic and the same FAP scale that was used in this study (Van Loon and van Dierendonck, 2015). In this study, horses were categorised as warmblood horses or coldblood horses (including Friesian and Quarter horses, Irish cobs, Fjorden, Icelandic and Haflinger horses) and there were no differences in pain scores between FAP and the EQUUS-COMPASS scores (the latter being a CPS based on the CPS by Bussières et al. 2008, constructed for horses with acute colic). In the study by Wathan et al. (2015), the concept of EquiFACS, describing the equine facial action coding systems, has been published. Facial expressions are described by means of the underlying facial musculature and underlying muscle movement. These action coding systems are very similar for various breeds of horses. This suggests that horses of different breeds show similar patterns in facial expression when they are in pain. The original FACS was described for humans by Ekman and Friesen (1976). FACS has also been described for chimpanzees (Vick et al. 2007) and macaques (Parr et al. 2010), showing clear similarities between these species. This is not surprising, since Charles Darwin described similarities between man and animals in his book "The expression of the emotions in man and animals" (Darwin, 1872). Descovich et al. (2017) described similarities and differences in facial expressions between different species, indicating that facial expression of emotions such as pain overrides species differences. Although there are several differences between the facial action coding systems in man and horses, many similar parameters are described in EquiFACS,

The major limitations of our study were that direct and unmasked observations were performed by the observers. However, pain scoring did not influence clinical treatment decisions. To date, this approach is most often chosen when clinical studies with horses are conducted and pain behaviour is assessed. Since the observers were aware of the presenting condition of each horse, pain scoring could have been affected by expectation bias (Tuyttens et al., 2014). However, any observational study inherently contains some degree of subjectivity. In all EQUUS pain score studies, high inter-observer reliability suggests that this potential bias works in the same direction for all observers. To date, the accuracy and reliability of pain scoring based on photos or videos of horses experiencing pain has not been proven. This deficiency in our understanding could be addressed by pain scoring studies using videos and masked observers or by automated facial recognition techniques successfully adapted for horses. Another limitation in our study was that horses were only assessed while being stabled and no assessments were performed during locomotion. Most horses that have undergone orthopaedic surgery or that are referred with orthopaedic trauma need to box rest after admission. Therefore, it was not possible to assess pain behaviour during locomotion in the current study. Another limitation was that control horses had not undergone anaesthesia, as had case horses. However, from anaesthetic recovery to the first assessment in surgical cases was at least 6 h. This protocol was developed in accordance with previous studies performed by our group (van Loon et al., 2010). In those studies, there were no discernible effects of general anaesthesia in horses that had undergone anaesthesia for nonsurgical reasons at 4 h after anaesthetic recovery. In a recent study by Abass et al. (2018), stallions were assessed at 4 and 8 h after general anaesthesia for surgical castration, and increased CPS and FEP-based pain scores were reported, especially in the group that did not receive intra-testicular local anaesthesia.

Mullard et al. (2017) and Dyson et al. (2017, 2018) investigated pain observations in ridden horses. In these studies, both whole body and facial expressions of pain were described and assessed in horses while they were being ridden. Differences between healthy control horses and lame horses were reported, based on still photography and video footage taken during locomotion. Our research group also plans to assess pain scoring during locomotion in sound and lame horses to facilitate pain assessment during training and competition. This could improve training regimens for competitive horse sports and also benefit equine welfare.

Conclusions

Both the CPS and the EQUUS-FAP were reliable and valid for the assessment of pain in horses after orthopaedic surgery and in horses with acute orthopaedic trauma. Both scales demonstrated good inter-observer reliability, could differentiate between healthy pain-free horses and horses with orthopaedic pain. NSAIDs led to decreases in pain scores for both pain scales. These findings support the clinical application of pain scales in horses with orthopaedic pain.

Conflict of interest statement

None of the authors of this paper has a financial or personal relationship with other people or organisations that could inappropriately influence or bias the content of the paper.

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