



## Short communication

## Monitoring equine head-related pain with the Equine Utrecht University scale for facial assessment of pain (EQUUS-FAP)

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## ARTICLE INFO

## Article history:

Accepted 6 January 2017

## Keywords:

Dental  
Equine  
Facial  
Pain scale  
Pain originating from head

## ABSTRACT

This study validates a recently described pain scale, the Equine Utrecht University scale for facial assessment of pain (EQUUS-FAP), in horses with acute or postoperative pain originating from the head, including dental pain, ocular pain, or trauma to the skull. This cohort study of 23 horses with head-related pain and 23 normal, healthy controls revealed significant differences in EQUUS-FAP scores between control horses and horses with acute or postoperative pain ( $P < 0.001$ ). Moreover, pain scores after surgery decreased significantly over time ( $P < 0.001$ ). The scale showed good inter-observer reliability (intra-class correlation coefficient = 0.92), sensitivity (80%), specificity (78%), and positive (80%) and negative predictive values (78%).

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In the last decade, analgesic and sedative techniques for dental and ocular surgery in horses have been studied intensively (Tremaine, 2007; Marly et al., 2014). The ability to reliably monitor the degree of postoperative pain underpins the improvement of analgesic regimens and consequently, the welfare of these patients. Composite pain scales have been described for several painful conditions in horses (de Grauw and van Loon, 2015; Gleerup and Lindegaard, 2016). Recently, the equine facial action coding system (EquiFACS) has been described (Wathan et al., 2015) and studies have shown the utility of facial expression to assess pain in horses after castration (Dalla Costa et al., 2014) and in horses with experimentally induced pain (Gleerup et al., 2014). Previous studies have described the design and validation of the Equine Utrecht University scale for facial assessment of pain (EQUUS-FAP) to assess pain in horses with acute colic (Van Dierendonck and van Loon, 2016). The aim of the current study was to assess the validity, inter-observer reliability, sensitivity, specificity and positive and negative predictive values of this facial expression-based composite pain scale in horses with acute or postoperative pain originating from the head.

The institutional Ethics Committee on the Care and Use of Experimental Animals approved the study design in compliance with Dutch legislation on animal experimentation. The procedures used in this study consisted only of behavioural observations routinely performed in a clinical setting and did not cause any pain, suffering or distress or lasting harm equivalent to, or higher than, that

caused by the introduction of a needle.<sup>1</sup> Therefore, ethical approval was granted without a formal application. Written owner consent was obtained for all animals participating in this study.

Twenty-three horses admitted to the equine referral center with either acute head-related pain (mandibular or maxillary fractures, acute uveitis;  $n = 9$ ) or with chronic low-grade head-related pain requiring surgery (sinusitis, alveolitis, chronic uveitis;  $n = 14$ ) were included (Table 1). The control group consisted of 23 healthy recipient mares for embryo transfer and horses presented for regular shoeing during the study period. All of the control horses were free from lameness and/or dental problems (Table 1). Horses in the control group were only assessed once, whereas horses with acute and postoperative pain were assessed repeatedly during the hospitalisation period. Eight of the nine horses presented with acute pain underwent surgery and were subsequently also assessed postoperatively.

The EQUUS-FAP has been designed and validated for horses with acute pain due to colic (Van Dierendonck and van Loon, 2016) (Appendix: Supplementary Table S1). Pilot observations demonstrated that pain scoring from video recordings resulted in less detailed observation of facial expression and in lower inter-observer reliability. Therefore, in the present study, live observations were used while leaving the horses as undisturbed as possible. Two independent observers simultaneously obtained pain scores in the morning, before the administration of analgesics to the horses with

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E-mail address: [j.p.a.m.vanloon@uu.nl](mailto:j.p.a.m.vanloon@uu.nl) (J.P.A.M. van Loon).<sup>1</sup> See: Article 1.5f EU directive 2010/63/EU. <http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:276:0033:0079:en:PDF> (accessed 3 January 2017).

**Table 1**Characteristics of horses included in the study ( $n = 46$ ).

	Head-related pain (n)	Control (n)
Total number of horses	23	23
Horses admitted with acute painful condition	9	–
Horses with postoperative pain	22 <sup>a</sup>	–
Warmblood/Thoroughbred	13	19
Other breeds	10	4
Mares	18	16
Geldings	5	7
Mean ( $\pm$ SD) bodyweight (kg)	499.4 ( $\pm$ 105.9)	520.3 (84.6)
Mean ( $\pm$ SD) age (years)	14.8 ( $\pm$ 6.3)	9.7 ( $\pm$ 3.7)

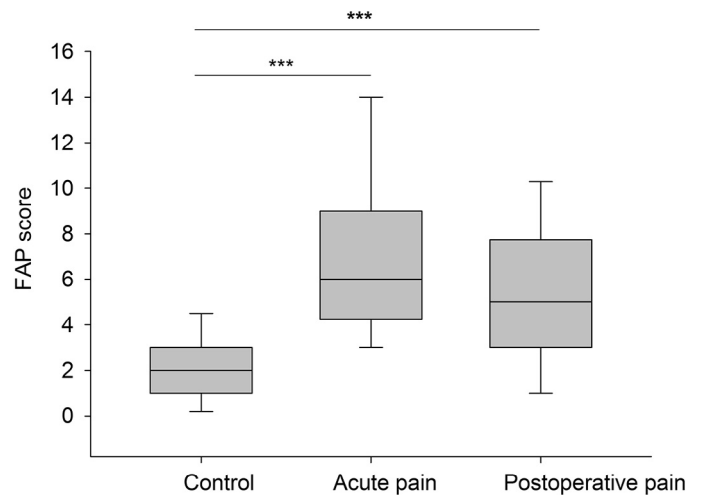
SD, standard deviation.

<sup>a</sup> Eight of the horses with acute pain that underwent surgery were also scored for postoperative pain and were included in this group.

acute or postoperative pain. Pain scores did not influence clinical decision making in the horses included in this study. The observers had not been involved in scale development or in earlier studies and were briefly trained to use the scale prior to the current study.

Median  $\pm$  range pain scores were calculated. Inter-observer reliability was assessed using intra-class correlation coefficients (ICC). Bland–Altman plots were used to evaluate the limits of agreement (average difference  $\pm$  1.96 standard deviation of the difference). The difference in scores between horses with acute or postoperative head-related pain and control horses was determined using the Kruskal–Wallis test, with post-hoc Mann–Whitney  $U$  tests with Bonferroni correction for multiple comparisons. A pilot study (unpublished data) provided a cut-off value for differentiation between horses with and without pain ( $\leq 3$  for control animals,  $>3$  for horses experiencing pain). Sensitivity, specificity, and positive and negative predictive values were determined using this cut-off value. The Friedman test was used to assess the changes in EQUUS-FAP scores over time in horses undergoing surgery. Statistical analyses were performed using SPSS version 20.0 (IBM). Statistical significance was set at  $P < 0.05$ .

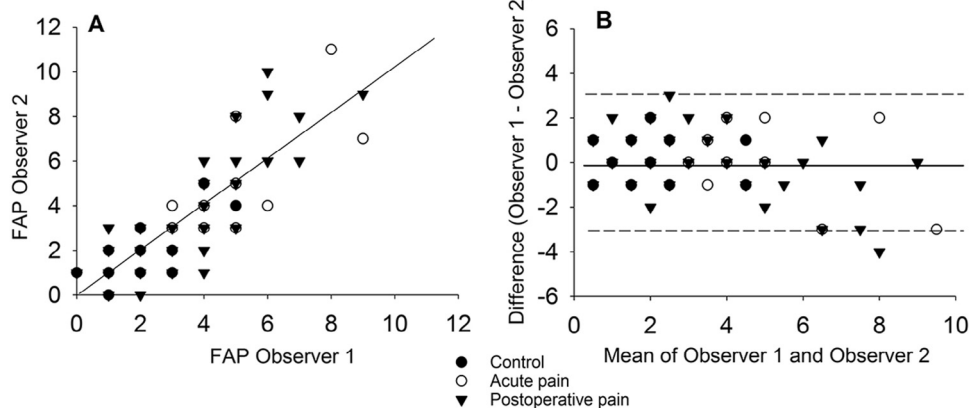
Fig. 1 illustrates the strong and significant correlation ( $ICC = 0.92$ ;  $P < 0.001$ ) and the narrow range of the limits of agreement (between  $-2.8$  and  $+2.8$ ) of pain scores obtained by two independent observers. Significant differences were found between control horses and horses with acute or postoperative pain ( $P < 0.001$ ) and post-hoc tests revealed significant differences between controls and horses with acute pain ( $P < 0.001$ ) and between control horses and horses with postoperative pain ( $P < 0.001$ ). Horses with acute pain and postoperative pain did not show significant differences in FAP scores (Fig. 2;



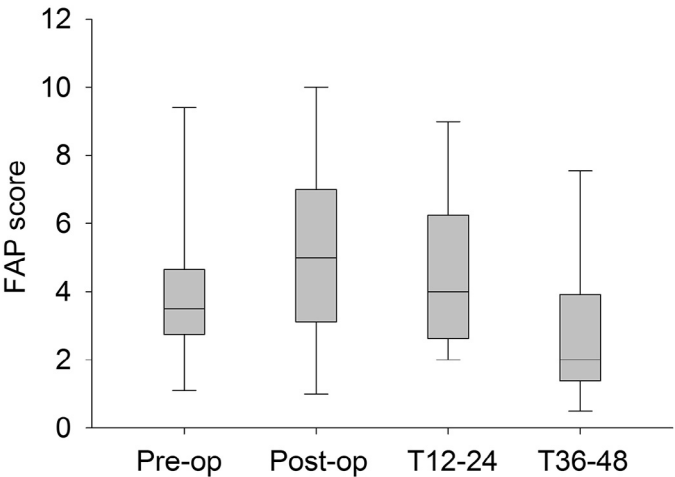
**Fig. 2.** Median Equine University Utrecht scale for facial assessment of pain (EQUUS-FAP) scores for horses in the control group ( $n = 23$ ) and horses with acute or postoperative head-related pain ( $n = 23$ ). The line in the boxes indicates the median score; boxes indicate first and third quartiles, and whiskers indicate ranges. \*\*\* $P < 0.001$ .

$P > 0.05$ ). The postoperative pain group included horses with alveolitis and/or sinusitis that underwent dental extractions or repulsions combined with sinusotomy, horses with end-stage chronic recurrent uveitis and horses with severe ocular trauma necessitating enucleation, horses undergoing removal of the third eyelid because of neoplasia, and horses undergoing mandibular/maxillary fracture repair. Fig. 3 shows EQUUS-FAP scores over time for horses that underwent surgery. These pain scores showed a significant decrease over time ( $P < 0.001$ ). Table 2 shows sensitivity, specificity, and positive and negative predictive values for EQUUS-FAP.

Our study validated EQUUS-FAP, a facial expression pain scale originally developed for the assessment of the severity of pain in horses with acute colic (Van Dierendonck and van Loon, 2016), for pain originating from the head. The EQUUS-FAP effectively distinguished between controls and horses with acute and postoperative head-related pain. This agrees with Hsu et al. (2007), who assessed humans with orofacial pain using various pain scoring systems. They demonstrated that the human facial actions coding system (FACS) provided superior detection of facial expressions of pain compared with a verbal descriptor scale and physiological parameters, in both cognitively intact and cognitively impaired elderly patients.



**Fig. 1.** (A) Scatter plot of Equine University Utrecht scale for facial assessment of pain (EQUUS-FAP) scores simultaneously assessed by two independent observers (80 observations in 46 horses;  $ICC = 0.92$ ,  $P < 0.001$ ). (B) Bland–Altman plots of EQUUS-FAP presenting limits of agreement between  $-2.8$  and  $+2.8$ .



**Fig. 3.** Median Equine University Utrecht scale for facial assessment of pain (EQUUS-FAP) values on admission to the clinic, prior to surgery (Pre-op), 4 h after surgery (Post-op), the first morning after admission (T12–24), and the second morning after admission (T36–48;  $n = 22$ ). The line in the boxes indicates the median score; boxes indicate first and third quartiles, and whiskers indicate ranges.

**Table 2**  
Sensitivity, specificity, and positive and negative predictive values of Equine University Utrecht scale for facial assessment of pain (EQUUS-FAP).

	Sensitivity	Specificity	PPV	NPV
EQUUS-FAP	80.0%	78.0%	80.0%	78.0%

PPV, positive predictive value; NPV, negative predictive value.

In the present study, EQUUS-FAP proved very useful for the assessment of horses with acute and postoperative pain. Furthermore, the scale allowed repeated assessment of pain over time, which could be helpful for evaluating the efficacy of analgesic treatment. Most cases of acute pain in this study involved horses that had undergone trauma (e.g. mandibular fracture) or horses with acute episodes of recurrent uveitis, a condition known to be very painful (Spiess, 2010).

In conclusion, EQUUS-FAP allowed reliable and reproducible assessment of pain in horses with acute and postoperative pain originating from the head.

Conflict of interest statement

This study was partly funded by Boehringer Ingelheim BV, Alkmaar, The Netherlands. The funding source was not involved in the study design, execution, data collection, statistical analysis or interpretation of the data from this study, or in the writing of the manuscript. None of the authors has any other financial or personal relationships that could inappropriately influence or bias the content of the paper.

Acknowledgements

We would like to thank Annemarie Sas, Marlijn van Gendt, Anna-Lot Bos, Daja van Nunen and Aimy Pouw for their help with data collection and René van Weeren for critically reading the manuscript.

Appendix: Supplementary material

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.tvjl.2017.01.006.

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