1st Vienna Pain Day

UNIVERSITY OF VETERINARY MEDICINE VIENNA

Vienna • July 1-2, 2017

Proceeding

SCHMERZBEURTEILUNG BEI KATZEN – EINE ALLGEMEINÜBERSICHT

Sheilah A Robertson
Senior Medical Director
Lap of Love Veterinary Hospice & In-Home Euthanasia

Can we treat pain in cats?

In humans pain is…….

….what the patient says it is

In cats…..

……pain is what *we* say it is

Unidimensional pain scales

Simple Descriptive (SDS)

No pain	0
Mild pain	1
Moderate pain	2
Severe pain	3
Very severe pain	4

Numerical rating (NRS)

0
1
2
3
4
5

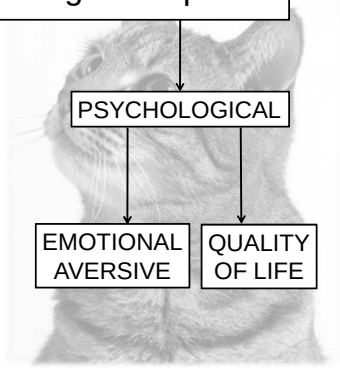
Visual Analogue (VAS)

0 — 100

no pain — worst pain

What is this thing called pain?

- PHYSICAL → SENSORY DISCRIMINATIVE
- PSYCHOLOGICAL → EMOTIONAL AVERSIVE, QUALITY OF LIFE



What is this thing called pain?

- PHYSICAL
  - HOW IT FEELS
    - SENSORY DISCRIMINATIVE
- PSYCHOLOGICAL
  - HOW IT MAKES THEM FEEL
    - EMOTIONAL AVERSIVE
    - QUALITY OF LIFE

If you cannot measure it you cannot improve
Lord Kelvin 1824 -1907

Scientific assessment

The Wine Advocate Rating System

What do cats do when they hurt?

RESEARCH ARTICLE Open Access

Validation of the English version of the UNESP-Botucatu multidimensional composite pain scale for assessing postoperative pain in cats

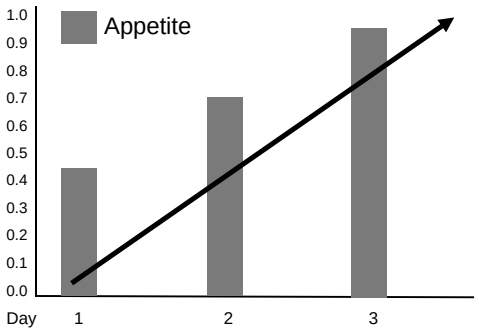
Brondani *et al* 2013

10 assessment domains
Includes
- Blood pressure
- Appetite

Maximum score = 30
Intervention ≥ 7

Appetite

Zeiler *et al* 2014



Definitive Glasgow acute pain scale for cats: validation and intervention level

Reid *et al* 2017

7 Questions
Facial expression
Maximum score is 20
Suggested intervention level is > 5

www.newmetrica.com

Normal behaviors

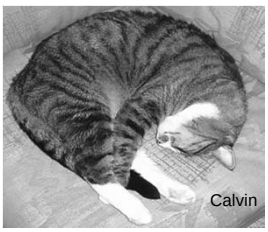
Loss of normal behaviors

Development of new behaviors

Normal Behaviors

Normal behaviors

Question 2 - Posture



Glasgow CMPS - Feline

Question 2 – is it?

Relaxed	0
Licking lips	1
Restless/cowering	2
Tense/crouched	3
Rigid/hunched	4

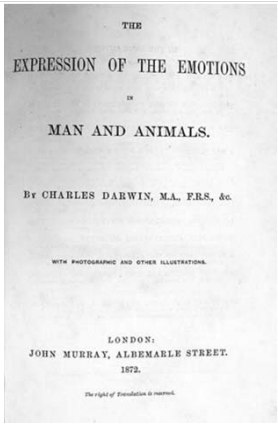
Postures - abdominal surgery

Relaxed	0
Licking lips	1
Restless/cowering	2
Tense/crouched	3
Rigid/hunched	4

Glasgow CMPS

Question 3

Ignoring wound or painful area	0
Attention to wound	1



THE

EXPRESSION OF THE EMOTIONS

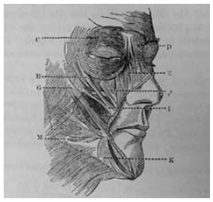
IN

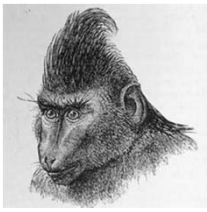
MAN AND ANIMALS.

By CHARLES DARWIN, M.A., F.R.S., &c.

WITH PHOTOGRAPHIC AND OTHER ILLUSTRATIONS.

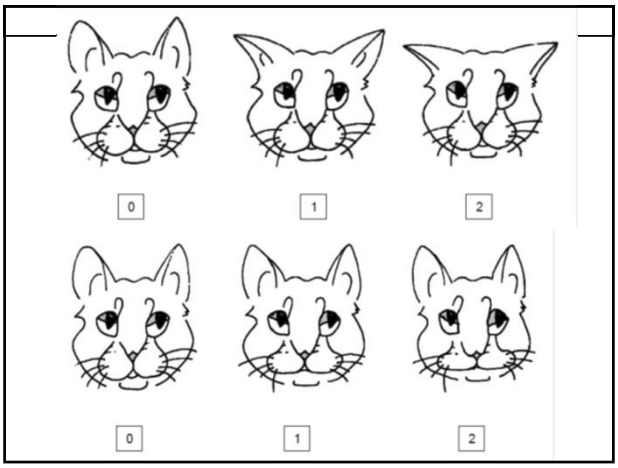
LONDON:
JOHN MURRAY, ALBEMARLE STREET.
1872.

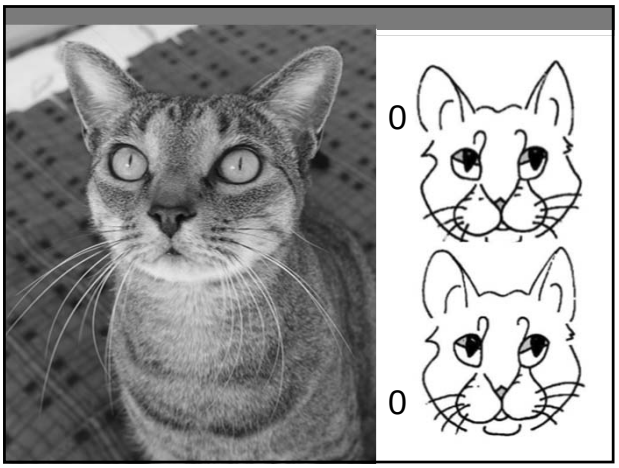




Evaluation of facial expression in acute pain in cats

Holden *et al* 2014


0
1
2
0
1
2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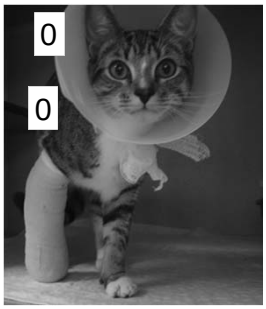
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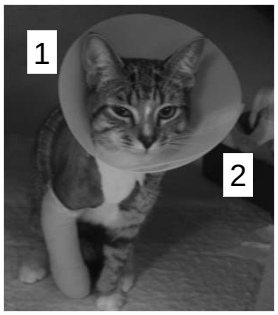

1
2

???

What is being done to this cat?

Glasgow CMPS

Question 5

Approach the cage, call the cat by name and stroke along its back from head to tail.

Does the cat:

Respond to stroking?	0
Is it unresponsive?	1
Is it aggressive?	2

Question 6

If the cat has a wound or painful area, gently apply pressure around the site

Does it:

Do nothing	0
Swish tail or flatten ears	1
Cry/hiss	2
Growl	3
Bite/lash out	4

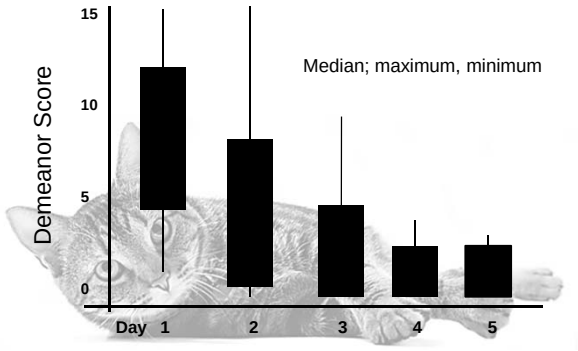
Putting things together

Is it ever straightforward with cats?

Individual temperament and personality
Fear and stress
Anesthetic drugs – ketamine
Upper respiratory tract disease

Temperament and personality

Zeiler GE *et al* 2014



Postoperative analgesia between non-pregnant healthy cats versus pregnant or cats with **upper respiratory tract disease**
Benito & Steagall 2016

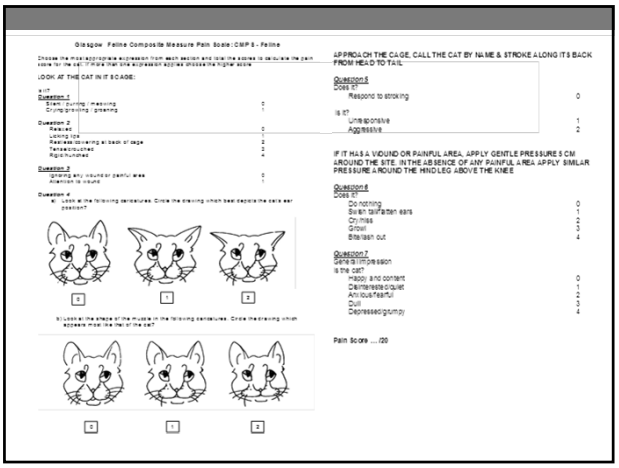
Clinical application

- Not all cats have a score of 0 before surgery
- Fear, anxiety and stress can look like pain
- Trust yourself and not just the number
- Look for changes

QUESTIONS

PRAKTISCHE ÜBUNGEN – GEMEINSAMES BEURTEILEN VON VIDEOS

Sheilah A Robertson BVMS (Hons)
DACVAA, CVA, DACAW, PhD
Senior Medical Director
Lap of Love



Glasgow Feline Composite Measure Pain Scale: CMPS - Feline

Choose the most appropriate expression from each section and total the scores to calculate the pain score for the cat. If more than one expression applies choose the higher score

LOOK AT THE CAT IN IT S CAGE:

is it?

Question 1
Silent / purring / meowing 0
Crying/growling / growling 1

Question 2
Relaxed 0
Looking cute 1
Restless/looking at back of cage 2
Tense/crouched 3
Rigid/hunched 4

Question 3
Licking any wound or painful area 0
Attention to wound 1

Question 4
a) Look at the following caricatures. Circle the drawing which best depicts the cats ear position?

0 1 2

b) Look at the shape of the muzzle in the following caricatures. Circle the drawing which appears most like that of the cat?

0 1 2

APPROACH THE CAGE, CALL THE CAT BY NAME & STROKE ALONG IT S BACK FROM HEAD TO TAIL

Question 5
Does it?
Respond to stroking 0

is it?
Unresponsive 1
Aggressive 2

IF IT HAS A WOUND OR PAINFUL AREA, APPLY GENTLE PRESSURE 5 CM AROUND THE SITE. IN THE ABSENCE OF ANY PAINFUL AREA APPLY SIMILAR PRESSURE AROUND THE HIND LEG ABOVE THE KNEE

Question 6
Does it?
Do nothing 0
Swish/flatten ears 1
Cry/miss 2
Growl 3
Bite/lash out 4

Question 7
Cat's first impression
is the cat?
Happy and content 0
Disinterested/quiet 1
Anxious/fearful 2
Dull 3
Depressed/grumpy 4

Pain Score ...../20

Smokey Joe

Smokey Joe

Crying	1
Rigid	4
Ignoring wound	0
Ears/muzzle	3
Unresponsive to stroking	1
Cries when palpated	2
Depressed	4
Total	15/20

Intervention recommended at > 5

[redacted]

Smokey Joe

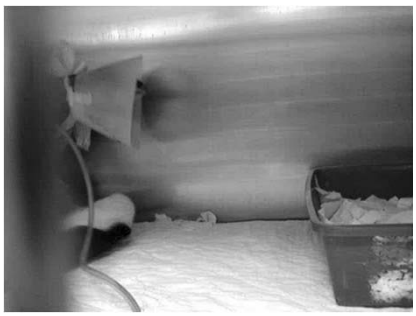
Meowing	0
Licking lips	1
Ignoring wound	0
Ears/muzzle	0
Responds to stroking	0
Palpation – tensed, flattened ears	1
Content	0
Total	2/20

CAT 03b

Cat 01b

BEFORE AND AFTER COMPARISONS

MAX



Cat 02

Neutering Procedures

Who need help?

PAIN ASSESSMENT IN CATS
A GENERAL OVERVIEW

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Senior Medical Director
Lap of Love

Seminar: “Pain assessment in companion animals“
Wienna 1.7.2017

(Chronic) pain assessment tools in dogs, a general overview

Anna Hielm-Björkman, DVM, PhD, Docent, CVA
DOGRISK research group leader
University of Helsinki

Some slides were made together with Dr. Paula Larenza in Helsinki for a talk!

Outline of the talk today

- Pain assessment tools in dogs, a general overview
  - Different types of chronic pain
  - Pain assessment tools for dogs
    - Diagnosing pain
    - Evaluating treatment need
    - Evaluating treatment success
    - Assessing pain in trials (before- after / Test- retest))

Subjective, semi-objective, objective?

  - Validated, reliability tested, psychometrically sound?

Chronic pain in animals

- True incidence unknown
- Specific chronic pain syndromes not as well characterized as in humans
- Pain a common reason for owners to seek veterinary care
- Mild to moderate chronic pain may go unrecognized for long periods
- Undertreated compared to human chronic pain
- Inflammatory / neuropathic / somatic pain

Chronic pain in animals

- Veterinarians should be aware of conditions that may be associated with chronic pain so discussions regarding quality of life can be initiated with owners early in the disease process
- Pain assessment as the 5th vital sign?

New class of chronic pain: post surgery chronic pain

- 22.8 % of chronic pain cases in humans (Crombie et al. 1998)
- Chronic post surgical pain (CPSP) P. Lavand'homme·158 (2017) S50–S54

Table 1

Picture of perioperative pain: evolution of the incidence of preoperative pain, acute postoperative pain, and chronic postsurgical pain in different populations.

	Population	Preoperative pain	Severe acute postoperative pain	CPSP moderate/severe
Crombie et al,[8]	Adult patients in pain clinics			22%
Macrae,[25]	Adult population			10%-50%/4%-10%
Johansen et al, 2012	General adult population			18.3% (6.2% without preoperative pain)
Fletcher et al,[13]	Adult inpatients	35%-60%	30%	11.8%/2.2%
Hoofwijk et al,[18]	Adult outpatients	37.7%	26.7%	15.3%/2.3%
Nikolajsen and Brix[29]	Pediatric population			13% (with NRS > 3)*

* NRS: Numeric rating score on a scale from 0 (no pain) to 10 (worst possible pain).
CPSP, chronic postsurgical pain.

- Prevalence not evaluated in animals yet

Why is pain a diagnostic challange?

- Animals do experience pain in a similar way to that of humans (Morton & Griffiths 1985).
- Animals do not show pain in a similar way
- Species differenses (also between dogs and dogs)
- Different signs between different chronic pains…

- Have to study animals with chronic pain
  - Compare them to healthy / acute pain /…
  - Compare them to ”old”, obese, lazy (?), non-active…
  - Compare before and after pain medication/treatment
  - Compare before and after placebo

Why is pain a diagnostic challange?

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Diagnosing and assessing chronic pain

1. Subjective measures

2. Semi-objective measures

3. Objective measures

Diagnosing and assessing chronic pain

1. Subjective measures:

- The pet's disease history from collegues and owner
- The clinical assessment by the veterinarian
- The owner's thoughts

2. Semi-objective measures

- Visual analogue scales of pain / mobility / quality of life (the owner)
- Non validated pain questionnaires / mobility questionnaires / Quality of life questionnaires / functional tests…
- (Validated owner or veterinary scales)

Veterinary evaluation: - Disease history

- When started? How?
- Old trauma? Old surgery? Rescue animal?
- Clinical signs? Time of day when best/worst?
- Did it start slowly/fast and how has it progressed?
- Usual behaviours (since puppy)? New behaviours? Behaviours falling away? (stretching?)
- Hygiene related behaviours (Grooming, defecating)
- Socialization related behaviours (less/withdrawn/..)
- Eating related behaviours (more/less/how?)
- Sleep related behaviours (more/less, how, where?)

Veterinary evaluation: - Ask about behaviour

- Behaviour
  - Positive ↓
  - Negative ↑
  - Social behaviour ↑ ↓
  - Work, play ↓
  - Mood ↓
  - Vocal or other communication ↑ ↓
  - ”Pain faces” ↑

Veterinary evaluation:
- Stance in hospital / at home?

- **Stance**

  Owner, vet or PT

  - **Sit / up**
  - **Position of the back**
  - **Praying position**

…or maybe this?

- Seen in dogs with abdominal pain (visceral pain)

Veterinary evaluation: - Clinical exam

- Body condition / BW
- ”Normal” clinical exam
  - 3 vital signs
- Skin temperature
- Soft tissue exam
- Orthopeadic exam
- Spine and joint mobility
- Short neurological exam
- Neuropathic exam
- (acupuncture diagnostic points, osteopathy diagnosing, trigger points,

Veterinary evaluation: - Movement

Lameness:

0. Totally normal, no lameness
1. Slightly stiff, not so keen to move, minor lameness
2. Clearly stiff, clearly does not move freely, pacing, slightly lame
3. Clear lameness
4. Totally lame, avoids weight-bearing on affected limb

Jumping:

0. Jumps normally, well
1. A slightly careful jump
2. Jumps with a bit of difficulty, climbs up
3. Jumps or climbs with great difficultly
4. Will not even try because of difficulty/pain

Stairs:

0. Walks stairs normally
1. Slightly careful, uses both paws successively, not so keen to move
2. Sometimes uses both paws at the same time, clearly does not move freely
3. Bunny-hops all the time, walks stairs with great difficulty
4. Will not even try because of difficulty/pain

Veterinary evaluation:
- Movement dysfunction

- Lameness
- Not using the limb
- ”Bunny-hopping”
- Pacing
- Does not jump
- Bad in stairs
- Does not move…

.

3. Objective measures:

- In orthopaedic chronic pain:
  - Force platform and pressure carpet – vertical force from the footfall
  - Static weight bearing

- Activity measures (Accelerometers)
- Validated chronic pain indecies
- Physiological measures (pulse, stresshormones, urine retention, temperature etc.)

Psychometric properties of a scale/assessment method

Validity

VALIDITY is the quality of a scale, its ability to measure what it is supposed to measure. Validity can be divided into four different types: face validity and content validity rely on the internal logic of the measure; criterion validity and construct validity are less subjective and more empirical.

- **Face validity** is the extent to which the scale or index is subjectively viewed by knowledgeable individuals as covering the concept, e.g. that each variable in the questionnaire measures chronic pain in some way.
- **Content validity** is related to face validity, being based on logic and expertise. It asks whether the scale or index covers all of the generally accepted variables of for example, chronic pain, i.e. is it sufficiently comprehensive?.
- **Criterion validity** is used when describing the correlation between a scale and another already validated external measurement of the same phenomenon.
- **Construct validity** has to do with the ability of the scale or index to measure variables that are theoretically related to the variable that the scale purports to measure.

Reliability

RELIABILITY refers to the extent to which the measure yields the same score each time it is administered, all other things being equal. There are four types of reliability. Thus, reliability can be measured in different ways and is always inexact. More tests done, strengthen the index.

- **Internal consistency** or **equivalence** is when the reliability of the instrument is judged by estimating how well the items that reflect the same construct yield similar results or how consistent the results are for the different items for the same construct within the measure and the *Cronbach's coefficient α* (Cronbach 1951) is the best known method for this. (e.g. questions vague or confusingly worded).
- **Repeatability** (also called **stability**, **test-retest, temporal reliability** and **intra-observer/rater reliability**) is when a test is given twice to the same people and thereby evaluated by the test-retest method. When the measure is taken over intervals of time, the scores of the owners should remain consistent. This is often tested using *intra-class correlation* (Streiner & Norman 1995) but also many other tests are possible, e.g. *Cohen's Kappa* (Cohen 1988), *Spearman*- (Siegel 1956) or *Pearson*- (Streiner & Norman 1995) *correlation tests*.

Reliability cont.

- **Inter-rater reliability** (also called **Inter-observer reliability**) is when two observers rate the same phenomenon at the same time, e.g. two veterinarians evaluating the same dog at the same time using the same scale. Same tests as in repeatability.
- **Responsiveness** (also called **sensitivity to change)** of the scale reflects the capability of the instrument to measure changes in levels of pain over time, in particular, in responses to clinical interventions such as analgesics.

- **Cut-off points** on pain scales are points on the scale that differentiate between mild, moderate, and severe pain, between pain being tolerable and intolerable, thus indicating where (additional) analgesics are needed because the dog is experiencing too much pain. Cut-off points must be reliable and valid for each population.

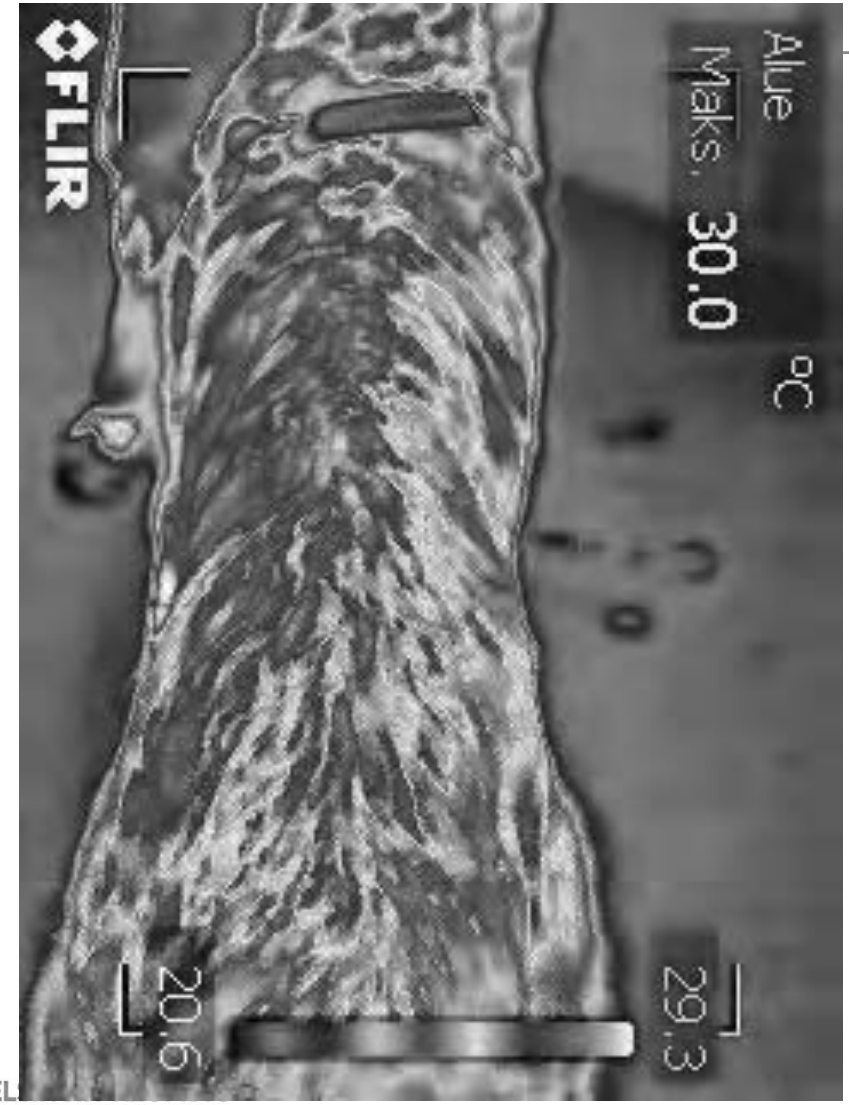
Veterinary evaluation:
- Adding diagnostic tools

?

?

?

Thermal imaging camera (Flir T425)
- used for pain diagnosing and follow-up



M.H. Vainionpää, M.R. Raekallio, E.A.E. Tuhkalainen, H.K. Hänninen, N.E. Alhopuro, M.J. Savolainen, J.J.T. Junnila , **A.K. Hielm-Björkman**, M.P.M. Snellman, O.M. Vainio. Comparison of three thermal cameras with canine hip area thermographic images. J Vet Med Sci. 2012 Jul 9. [Epub ahead of print]

1. Vainionpää MH, Raekallio MR, Junnila JJ, **Hielm-Björkman AK,** Snellman MP, Vainio OM. A comparison of thermographic imaging, physical examination and modified questionnaire as an instrument to assess painful conditions in cats. J Feline Med Surg. 2012 Oct 16. [Epub ahead of print]

Veterinary evaluation: - Provoced pain

Behaviour also directly affects objective measurements

- Dolorimeter
  - Pressure
- Von Frey filament
  - Reaction time
- Steps off ice pack
  - Reaction time

- Scale
- Validated only for humans
- Used also for dogs

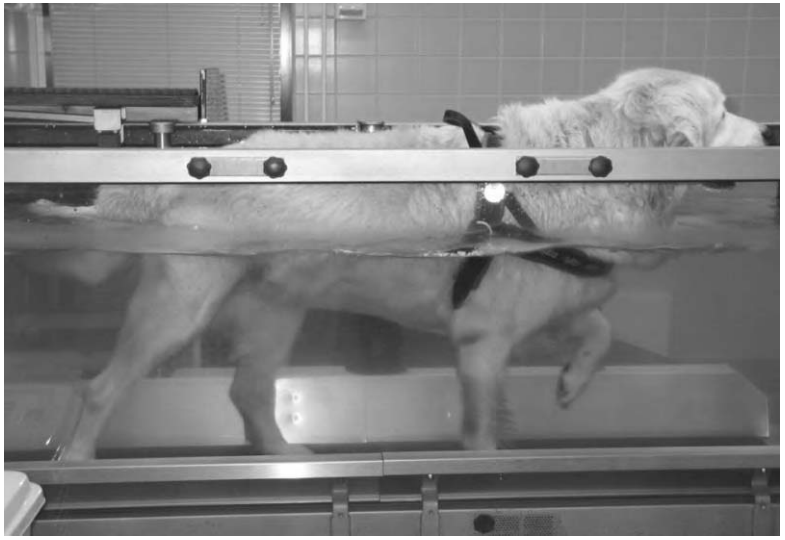
http://www.dogexpert.com/Images/AggressiveDogs/aggressive-dog2.jpg

Accelerometer

- Used for dogs, nocturnal activity

Measuring physical endurance

-We have both a dry and an underwater threadmill at the university in Helsinki



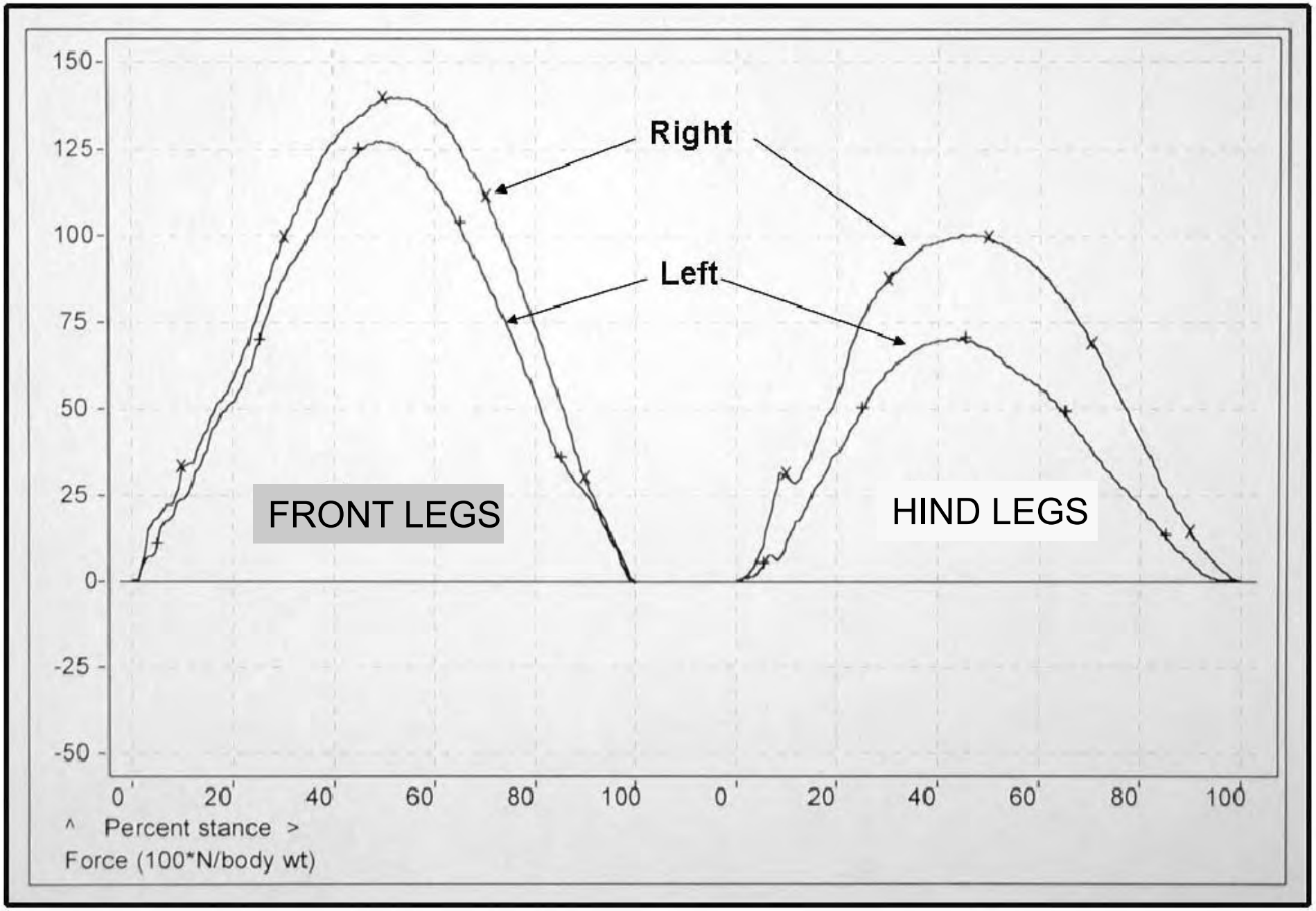
We can all assess chronic pain from faces - hard when ”sneaks” upon the owner or in clinics…

Guesgen MJ, Beausoleil NJ, Leach M, Minot EO, Stewart M, Stafford KJ. Coding and quantification of a facial expression for pain in lambs. Behav Processes. 2016 Nov;132:49-56.

No grimace scale for dogs yet

Force platform (Kistler®)

- Force plate
- Piezoelectric scales
- Validated for dogs


150
125
100
75
50
25
0
-25
-50
Right
Left
FRONT LEGS
HIND LEGS
0
20
40
60
80
100
0
20
40
60
80
100
^ Percent stance >
Force (100*N/body wt)

Pressure Carpet (GAITFour® - USA)

- Not thoroughly validated yet

Chronic pain owner questionnaires

- Helsinki chronic pain index (HCPI),
- Canine Brief Pain Inventory (CBPI),
- Cincinnaty Orthopedic Disability index (CODI),
- Health-Related Quality of life (HRQL), (GUVQuest)
- Liverpool Ostearthritis in Dogs (LOAD),

- Feline Musculoskeletal Pain Index (FMPI).

Questions about:	CHD-dogs (n=40)		Sound dogs (n=24)		
"Positive" behavior	**median**	**min/max**	**median**	**min/max**	**p**
(1) Appetite	0	0-3	0	0-2	0.59
(2) Mood	1	0-3	0	0-1	**$1.2\ 10^{-4}$**
(3) Dog making contact with human family	1	0-2	0	0-2	0.086
(4) Tail wagging	1	0-3	0	0-2	**0.013**
(5) Activity	1.5	0-4	1	0-3	0.052
(6) Play and games	1	0-4	0	0-1	**$7.5\ 10^{-6}$**
"Negative" behavior					
(7) Excessive panting	1	0-4	0	0-2	**$1.4\ 10^{-5}$**
(8) Licking of lips	0	0-4	0	0-3	0.97
(9) Audible complaining	1	0-3	0	0-1	**$4.9\ 10^{-5}$**
(10) Complaining when stretching hind legs caudally	2	0-4	0	0-1	**$1.9\ 10^{-8}$**
(11) Aggressive towards humans	0	0-3	0	0-2	0.88
(12) Aggressive towards other dogs	2	0-3	1	0-3	0.47
(13) Aggressive towards dogs in its own pack	1	0-4	1	0-2	0.09
(14) Subduing in the pack	1.5	0-4	2	0-4	0.27
Locomotion					
(15) Walking	1	0-3	0	0-1	**$6.6\ 10^{-10}$**
(16) Trotting	1.5	0-4	0	0-1	**$2.4\ 10^{-7}$**
(17) Pacing	1	0-4	2	0-4	**$1.6\ 10^{-3}$**
(18) Galloping	1	0-4	0	0-1	**$1.5\ 10^{-4}$**
(19) Jumping	2	0-4	0	0-1	**$7.1\ 10^{-10}$**
(20) Climbing stairs	2	1-4	0	0-1	**$1.1\ 10^{-10}$**
(21) Descending stairs	2	0-4	0	0-2	**$1.3\ 10^{-9}$**
(22) Laying down	2	0-4	0	0-1	**$1.1\ 10^{-11}$**
(23) Getting up	2.5	0-4	0	0-1	**$1.5\ 10^{-11}$**
(24) Difficulties to move post-resting	2	0-4	0	0	**$2.0\ 10^{-10}$**
(25) Difficulties to move after major activity	3	1-4	0	0-1	**$7.7\ 10^{-12}$**
Chronic pain index (2,6,9,15,16,18,19,22,23,24,25)	19	7-35	2	0-5	**$8.8\ 10^{-11}$**

Two extreme groups of dogs; CHD with pain symptoms and healthy. No treatment.

25 ”questions”

In these we could see a significant differen-ce between the painful and the heathy (18).

Difference between a group getting analgesics (carprofen) or not - Responsiveness

	Difference between both groups (P=…)				
MDS questions	**W_{-4}**	**W_0**	**W_4**	**W_8**	**W_{12}**
Mood*	P=0,879	0,319	**0,001**	**<0,001**	0,736
Frequency of tail wagging	1,000	0,803	**0,006**	**0,029**	0,917
Play and games*	0,459	0,184	**0,013**	**0,033**	0,854
Walking*	0,576	0,737	0,071	**0,002**	0,815
Trotting*	0,616	0,108	0,073	**0,035**	0,462
Pacing	0,786	0,770	0,883	0,797	0,977
Galloping*	0,522	0,663	**0,005**	0,170	0,864
Bunny hopping	0,397	0,961	**0,002**	**0,002**	**0,012**
Activity	0,579	0,848	0,428	**0,003**	0,873
Difficulty moving after first major activity and then rest*	0,249	0,434	**<0,001**	**<0,001**	0,266
Jumping*	0,750	0,584	0,053	**0,002**	0,327
Climbing stairs	0,961	0,752	**0,006**	**0,025**	0,301
Descending stairs	0,911	0,615	**0,025**	**0,030**	0,064
Laying down*	0,299	0,705	0,073	**0,005**	0,706
Getting up*	0,799	0,737	**0,035**	**<0,001**	0,414
Excessive panting	0,938	0,583	**0,002**	**<0,001**	0,258
Vocalization (audible complaining)*	0,481	0,452	**0,018**	**0,004**	0,015
Vocalization when stretching leg	0,377	0,208	0,096	**0,002**	0,030
*** Chronic pain index[10]**	0,555	0,546	**<0,001**	**<0,001**	0,432
pain VAS	0,751	0,344	**<0,001**	**<0,001**	0,090
locomotion VAS	0,242	0,376	**<0,001**	**<0,001**	**0,038**

Two groups of dogs, one group got analgesia between week 0 and 8 ($W_0 \rightarrow W_8$) the other group not.

18 ”questions”
In these 16 questions there was a significant difference between groups at W_8.

HCPI =”Helsinki Chronic pain Index” (11 quest.)

-Validated for dogs
-Reliable
-Responsive

Chronic pain evaluation
The Helsinki chronic pain index (HCPI)

AJVR, Vol 70, No. 6, June 2009

Psychometric testing of the Helsinki chronic pain index by completion of a questionnaire in Finnish by owners of dogs with chronic signs of pain caused by osteoarthritis

Anna K. Hielm-Björkman, DVM, PhD; Hannu Rita, PhD; Riitta-Mari Tulamo, DVM, PhD

- Developed by us in Helsinki
- Translated into several languages

HELSINKI OSTEOARTHRITIC CANINE CHRONIC PAIN INDEX

Name of Dog _____ Owner _____ Diagnosis _____

Date _____ Questionnaire no. _____

Tick only one answer – the one that best describes your dog during the preceding week

Points

1. Rate your dog's mood:

Very alert	alert	neither alert, nor indifferent	indifferent	very indifferent	
☒	☐	☐	☐	☐	0

2. Rate your dog's willingness to participate in play:

Very willingly	willingly	reluctantly	very reluctantly	does not at all	
☐	☐	☒	☐	☐	2

3. Rate your dog's vocalization (audible complaining, such as whining or crying out):

Never	hardly ever	sometimes	often	very often	
☐	☐	☐	☐	☐	____

4. Rate your dog's willingness to walk:

Very willingly	willingly	reluctantly	very reluctantly	does not walk at all	
☐	☐	☐	☐	☐	____

5. Rate your dog's willingness to trot:

Very willingly	willingly	reluctantly	very reluctantly	does not trot at all	
☐	☐	☐	☐	☐	____

6 Rate your dog's willingness to gallop:

Very willingly	willingly	reluctantly	very reluctantly	does not gallop at all	
☐	☐	☐	☐	☐	____

29/06/2017

7 Rate your dog's willingness to jump (eg. into car, onto sofa…)

Very willingly	willingly	reluctantly	very reluctantly	does not jump at all

Visual Analogue Scale = VAS

10 cm line:

- Validated for humans
- Pain VAS not possible to give to owners as they do not recognize pain behaviour as pain symptoms
- Mobility and QOL VAS can be used but not entirely validated yet

Conclusions and Clinical Relevance—Although valid and reliable, the pain VAS was a poor tool for untrained owners because of poor face validity (ie, owners could not recognize their dogs' behavior as signs of pain). Only after owners had seen pain diminish and then return (after starting and discontinuing NSAID use) did the VAS have face validity. (*Am J Vet Res* 2011;72:601–607)

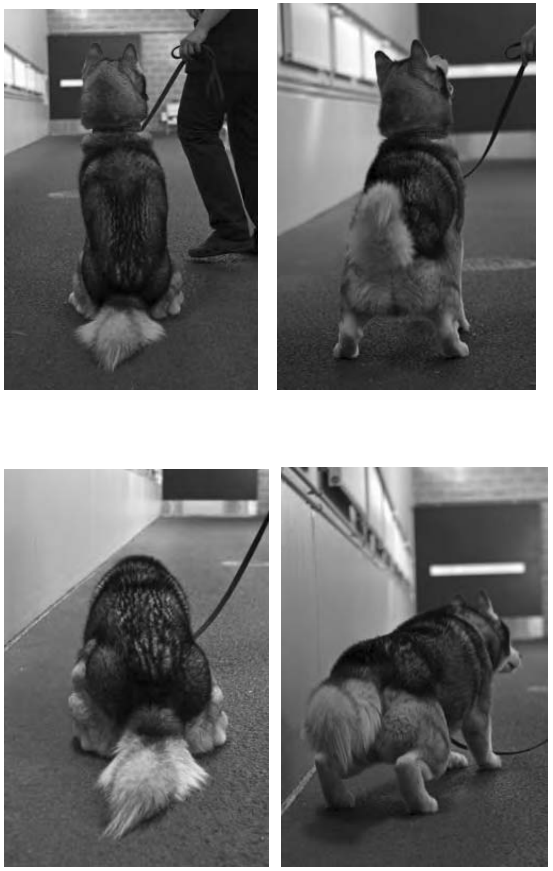
HCPI item	Variable	All dogs†		Carprofen‡					Placebo‡				
		Week –4	Week 0	Week –4	Week 0	Week 4	Week 8	Week 12	Week –4	Week 0	Week 4	Week 8	Week 12
Mood	*r*	0.07	0.13	–0.10	0.31	0.31	0.50	0.78	0.10	–0.16	0.27	0.41	0.49
	P value	0.556	0.310	0.720	0.237	0.330	0.040	< 0.001	0.733	0.531	0.351	0.103	0.053
	No. of dogs	64	67	16	16	12	17	17	15	17	14	17	16
Play	*r*	0.04	0.19	0.01	0.48	0.33	0.35	0.42	0.05	0.09	–0.05	0.22	0.38
	P value	0.777	0.115	0.981	0.060	0.288	0.166	0.091	0.871	0.737	0.854	0.385	0.143
	No. of dogs	64	67	16	16	12	17	17	15	17	14	17	16
Vocalization	*r*	0.31	0.19	0.25	–0.09	0.67§	–0.06	–0.21	0.53	0.33	0.37	0.42	0.03
	P value	0.011	0.121	0.357	0.729	0.018	0.827	0.413	0.041	0.190	0.195	0.096	0.919
	No. of dogs	64	67	16	16	12	17	17	15	17	14	17	16
Walking	*r*	0.32	0.27	0.39	0.24	0.54	0.67§	0.77§	0.41	0.23	–0.12	0.16	0.51
	P value	0.010	0.027	0.138	0.364	0.071	0.004	< 0.001	0.126	0.367	0.686	0.544	0.046
	No. of dogs	64	67	16	16	12	17	17	15	17	14	17	16
Trotting	*r*	0.34	0.42§	0.43	0.49	0.40	0.51	0.79§	0.31	0.12	0.20	0.44	0.62
	P value	0.006	< 0.001	0.097	0.056	0.204	0.035	< 0.001	0.256	0.659	0.483	0.078	0.011
	No. of dogs	64	67	16	16	12	17	17	15	17	14	17	16
Galloping	*r*	0.05	0.12	–0.22	0.35	0.23	0.14	0.67§	–0.15	–0.25	–0.38	–0.07	0.26
	P value	0.712	0.322	0.413	0.190	0.472	0.580	0.004	0.582	0.343	0.186	0.800	0.329
	No. of dogs	64	67	16	16	12	17	17	15	17	14	17	16
Jumping	*r*	0.39§	0.21	0.14	0.02	0.00	–0.04	0.49	0.29	0.09	0.37	0.00	–0.17
	P value	0.001	0.081	0.605	0.953	0.990	0.888	0.044	0.293	0.735	0.199	0.992	0.534
	No. of dogs	64	67	16	16	12	17	17	15	17	14	17	16
Lying down	*r*	0.31	0.31	0.54	0.52	–0.13	0.34	0.66§	0.40	–0.15	0.42	0.25	0.09
	P value	0.013	0.011	0.030	0.041	0.696	0.188	0.004	0.135	0.564	0.133	0.343	0.738
	No. of dogs	64	67	16	16	12	17	17	15	17	14	17	16
Getting up	*r*	0.32	0.32	0.56	0.57	0.18	0.16	0.72§	0.13	–0.12	–0.25	0.17	0.21
	P value	0.011	0.008	0.024	0.021	0.575	0.552	0.001	0.640	0.641	0.387	0.505	0.445
	No. of dogs	64	67	16	16	12	17	17	15	17	14	17	16
Difficulty after rest	*r*	0.36§	0.33	0.18	0.66§	0.02	–0.03	0.64§	0.47	–0.06	–0.25	–0.12	0.26
	P value	0.004	0.007	0.516	0.006	0.942	0.899	0.006	0.079	0.808	0.392	0.642	0.333
	No. of dogs	64	67	16	16	12	17	17	15	17	14	17	16
Difficulty after activity	*r*	0.18	0.17	0.02	–0.08	0.80§	0.66§	0.66§	0.20	0.00	–0.07	0.30	0.14
	P value	0.147	0.175	0.945	0.757	0.002	0.004	0.004	0.479	1.000	0.823	0.237	0.615
	No. of dogs	64	67	16	16	12	17	17	15	17	14	17	16
Total HCPI	*r*	0.45§	0.40§	0.27	0.44	0.44	0.50	0.82§	0.38	–0.13	–0.01	0.37	0.48
	P value	< 0.001	0.001	0.304	0.085	0.149	0.040	< 0.001	0.167	0.631	0.982	0.139	0.059
	No. of dogs	64	67	16	16	12	17	17	15	17	14	17	16

Cannot ask…

”Does your dog/cat have pain?”

Hard to find symptoms that change in same way in all dogs. Index numbers are individual and can be followed per individual

INDEXED TESTING BATTERY MEASURING STIFLE FUNCTIONALITY: THE FINNISH CANINE STIFLE INDEX (F-CSI)



Visual evaluation of 3.-4. functional active range of motion (AROM) and 5.-6. thrust in hind limbs

"Sit (3.) and *sit-to-move (4.)"* The dog was lead over a 20 m distance and asked to sit and sit-to-move 3 times within equal distances. Any functional limitation or compensation of the sitting position, such as external rotation, abduction, limited flexion of the hind limbs, was marked. Observed weakness or asymmetry in thrust in hind limbs from the ground was noted.

"*Lie down (5.)* and *lie-to-move (6.)"* was done using a similar protocol.

Ranking of physiotherapeutic evaluation methods as outcome measures of stifle functionality in dogs. Hyytiäinen HK, Mölsä SH, Junnila JT, Laitinen-Vapaavuori OM, Hielm-Björkman AK. Acta Vet Scand. 2013 Apr 8;55:29. doi: 10.1186/1751-0147-55-29

Diagnosing by drug trial with owner questionnaire

- 1. No drug + HCPI questionnaire for 1 week
- 2. NSAID + HCPI: 1-2 weeks
- 3. No drug + HCPI: 1 week
- → If step 2 helped the dog has inflammatory pain
- → as owners cannot see a slow ameleriosation they often need step 2 + 3

- Gabapentin / Pregabalin: slowly up (+/- NSAID)
- Amantadine
- Amitriptylline
- Selegiline

Assessing drug use can also be used as an outcome measure…

- In trials we can give them all 1 package of e.g. an NSAID, topical cortisone, other analgesics…
- Measure how much it is used in different study groups

Group 1
Group 2
Group 3…

In studies also final questions to assess a pain treatment:

- 1. Please guess if you were in the
  - X treatment group
  - Positive control group / e.g. NSAID
  - Egative control group /Placebo
- 2. Would you recommend this treatment to a friend or someone in the family, for their dog?
- 3. If a new dog of your was diagnosed with the same problem, whould you use this same treatment again?
  - Why? Why not?

Pain parameters in the blood?

HORMONE concentration	CHD group (n=41)		control group (n=23)		p
	mean ± sd	min - max	mean ± sd	min - max	
Epinephrine (nmol/l)	1.37 ± 0.73	0.52-4.40	1.00 ± 0.55	0.30-2.21	**0.0178**
Norepinephrine (nmol/l)	3.42 ± 1.22	1.54-6.36	3.64 ± 1.02	1.70-5.06	0.2388
Beta-endorphin (pg/ml)	85.4 ± 25.8	47-150	125.0 ± 60.0	57-293	**0.0061**
Cortisol (nmol/l)	83.5 ± 55.9	26.6-271.0	46.0 ± 18.4	11.3-93.9	**0.0017**
Vasopressin (pg/ml)	12.45 ± 9.67	3.92-57.35	8.77 ± 6.18	1.72-27.71	**0.0311**

- Statistical differences in 4 hormones but variations in normal are so large that it is not usable as a pain variable.

Inflammatory markers?

- We have been working with intra-articular (=inside the joint) samples and blood (serum, plasma or whole blood) samples

- E.g. IL1-β, IL6, PGE2, Cox 1 and 2, TNF-α, SP
- CRP
- Fatty acids
- Leucogram
- Hormones
- Nutritional profiles
  - Etc.

Testing carprofen, green lipped mussel, zeel and placebo in same trial

	Carprofen (n=15)		GLM (n=15)		HCP (n=14)		Placebo (n=15)	
	Improved %, P=	Improvement Median (range)	Improved %, P=	Improvement Median (range)	Improved %, P=	Improvement Median (range)	Improved %	Improvement Median (range)
Owner: Chronic pain index HCPI	80.0 % 0.028	9 (-9-19) <0.001	80.0 % 0.028	2 (-2-6) 0.102	57.1 % 0.364	2 (-6-9) 0.049	40.0 %	-3 (-25-8)
Owner: Pain VAS	85.7 % 0.001	1.4 (-6-8.4) <0.001	66.7 % 0.011	0.6 (-3.3-3.3) 0.004	57.1 % 0.043	0.2 (-3.5-4.9) 0.020	20.0 %	-1.7 (-7-3.2)
Owner: Loco-motion VAS	85.7 % 0.002	3.1(-1.9-6.2) 0.001	60.0 % 0.070	0.2 (-3.8-3.5) 0.057	57.1 % 0.102	0.7 (-5-4.8) 0.205	26.7 %	-1 (-6.6-5)
Veterinary mobility index	66.7 % 0.031	3 (0-8) 0.001	66.7 % 0.031	1 (-3-7) 0.012	71.4 % 0.018	1.5 (-5-7) 0.015	26.7 %	-3 (-14-3)
Force plate PVF	66.7 % 0.031	3.2 (-8.2-11.8) 0.079	46.7 % 0.264	0.17 (-5.6-12) 0.201 n=14	78.6 % 0.006	2.3 (-3.4-10.2) 0.028	26.7 %	-0.9 (-33.6-10) n=13
Force plate impulse	80.0 % 0.011	0.4 (-0.5-1.3) 0.009	53.3 % 0.277	0.20 (-1-1.54) 0.123 n=14	64.3 % 0.101	0.2 (-1.3-1.3) 0.093	33.3 %	-0.0 (-3.3-0.8) n=13

Animals with suspected Neuropathic pain or NeP

- Intervertebral disc disease
- Chiari-like malformation and Syringomyelia
- Lumbosacral pain
- Any nerve dammage
  - Post-op
  - Trauma
  - Nerve entrappment
  - Chronic skin disease
- Chronic osteoarthritis (all joints, also facet and facial joints)

Neuropathic pain signs

(Cashmore et al. 2009):

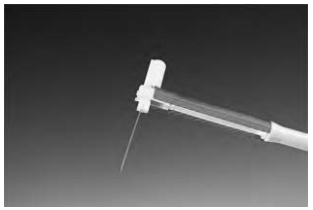
- **Allodynia** (normally not pain provoking)
- **Hyperalgesia** (normally pain provoking, but alot of pain!)
- **Dysaesthesia** (unpleasant abnormal sensations)
  - Looking at its behind, chasing the tail, scratching, attacking…
- **Paraesthesia** (abnormal; not pain/unpleasant)
  - Tickling sensation…
- **Paroxymal** (sudden, quick) **pain episodes**;
  - Shooting, stabbing, burning, throbbing, burning pain in humans

Neuropathic pain signs

(Pickering, 2002)

- **Musculosceletal –** muscle waisting, deformity, osteopenia
- **Trophic changes** – hair loss, skin thickening, callus, ulcers
- **Vasomotor** - Temp. and colour differences
- **Sudomotor** – Hyperhidrosis or dryness

We need different clinical indicators for assessing neuropathic pain:



- Pain from stroking with a pen (von frey filament…)
- Muscle atrophy
- Poor weight bearing
- Proprioception deficiencies, dragging the paw
- Hyperkeratosis of the paw
- Hyperasesthesia
- EMG: Abnormal activity in affected muscles (nerves affected); reduced motor action potential (24-26 → 1-3)
- Self-mutilation of skin

Neuropathic pain symptoms

Ask both about quality and quantity of symptoms:

- Sleep
- Attention span
- Social / withdrawness
- Excessive scratching
- Excessive licking
- Clumsyness
- Resist patting, stroking,…
- History of trauma or surgery
- Treatment history

Diagnosing neuropathic pain

- **Lack of response to NSAIDs or opiates (Tramadol)**

- **The Von Frey filament**

  KuKanich, B., Lascelles, B.D., Papich, M.G. (2005) Use of a von Frey device for evaluation of pharmacokinetics and pharmacodynamics of morphine after intravenous administration as an infusion or multiple doses in dogs. *American Journal of Veterinary Research,* 66, 1968-1974.

- **Sensitivity to cold thermal stimuli has been evaluated in dogs**

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Some things are still hard to assess: Amputee neuropathic pain

Visceral pain

- Often a mixture of inflammatory and neuropathic pain
- May include referred pain
- On the trunc (abdomen / thorax)

- How do we assess that?

Pain? – in distress, ill at ease…

True ethical problem

...and even more difficult – how do these show pain?

RAW FOOD SEMINAR
15-16.9.2017 (Fri-Sat) in Helsinki

Welcome!

E-mail list
on paper outside

Thank you!
Kiitos!
Tack!
Danke!
Merci!

Questions?

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Some of our references

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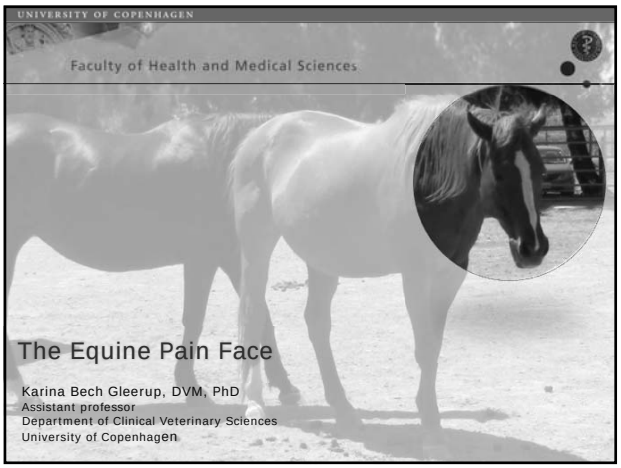
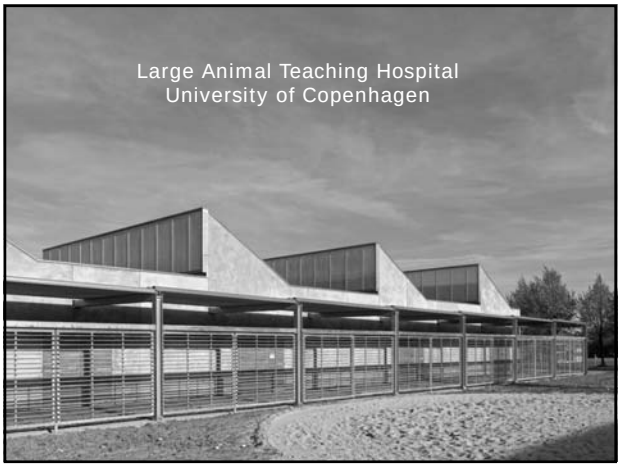
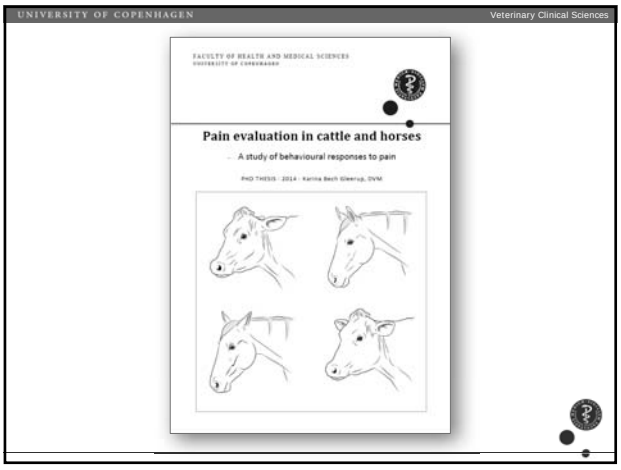
- **Contact: anna.hielm-bjorkman@helsinki.fi**


UNIVERSITY OF COPENHAGEN
Faculty of Health and Medical Sciences
The Equine Pain Face
Karina Bech Gleerup, DVM, PhD
Assistant professor
Department of Clinical Veterinary Sciences
University of Copenhagen


Large Animal Teaching Hospital
University of Copenhagen


UNIVERSITY OF COPENHAGEN
Veterinary Clinical Sciences
Pain evaluation in cattle and horses
A study of behavioural responses to pain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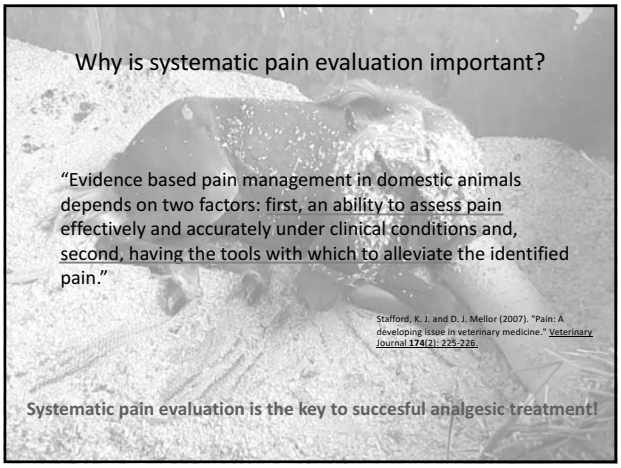
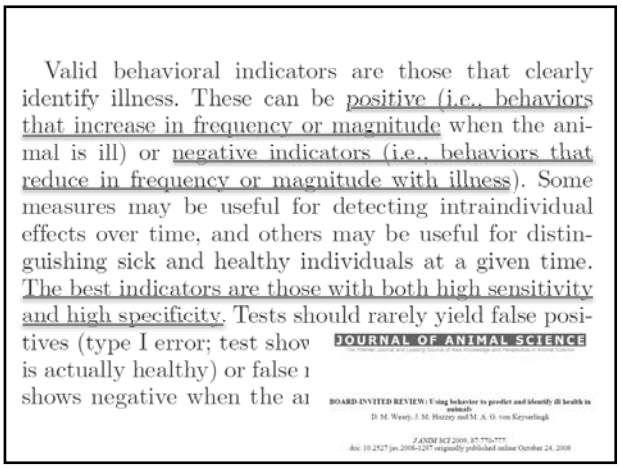
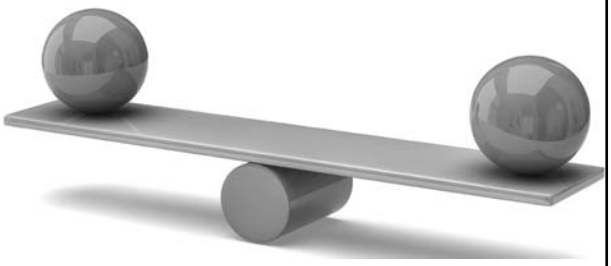
Veterinary Clinical Sciences
Facial Action Coding System
Lie to Me
The science behind the show
Dr. Ekman's Episode Critiques
Season 1
Season 2
Season 3


Why is systematic pain evaluation important?
"Evidence based pain management in domestic animals depends on two factors: first, an ability to assess pain effectively and accurately under clinical conditions and, second, having the tools with which to alleviate the identified pain."
Stafford, K. J. and D. J. Mellor (2007). "Pain: A developing issue in veterinary medicine." Veterinary Journal 174(2): 225-226.
Systematic pain evaluation is the key to succesful analgesic treatment!


Valid behavioral indicators are those that clearly identify illness. These can be positive (i.e., behaviors that increase in frequency or magnitude when the animal is ill) or negative indicators (i.e., behaviors that reduce in frequency or magnitude with illness). Some measures may be useful for detecting intraindividual effects over time, and others may be useful for distinguishing sick and healthy individuals at a given time. The best indicators are those with both high sensitivity and high specificity. Tests should rarely yield false positives (type I error; test shov
is actually healthy) or false
shows negative when the a
JOURNAL OF ANIMAL SCIENCE
BOARD-INVITED REVIEW: Using behavior to predict and identify ill health in animals
D. M. Weary, J. M. Huzzey and M. A. G. von Keyserlingk



ELSEVIER

Applied Animal Behaviour Science 80 (2003) 31–43

APPLIED ANIMAL BEHAVIOUR SCIENCE

www.elsevier.com/locate/applanim

Identification of potential physiological and behavioral indicators of postoperative pain in horses after exploratory celiotomy for colic

Lori C. Pritchett[a], Catherine Ulibarri[b], Malcolm C. Roberts[c], Robert K. Schneider[a], Debra C. Sellon[a,*]

The physiological parameters do not add much information

Veterinary Anaesthesia and Analgesia, 2003, 30, 124–137

Preliminary evaluation of a behaviour-based system for assessment of post-operative pain in horses following arthroscopic surgery

Jill Price BVMS, PhD, MRCVS, Seago Catriona BSc, MSc, Elizabeth M Welsh BVMS, PhD Certificate, VA Certificate, SAS MRCVS & Natalie K Waran BSc, PhD
Department of Veterinary Clinical Studies, Royal (Dick) School of Veterinary Studies, Easter Bush, Roslin, Midlothian EH25 9RG, UK

The subjective factor

Table 2 Definitions of the composite measure pain scale

	Pain score				
Behaviour category	0	1	2	3	4
Gross pain behaviour*	None		Occasional		Continuous
Weight bearing	Normal weight bearing or walking	Foot intermittent off the ground/resting more than other thoracic limb		Continuously taking foot off the ground and trying to replace it Carpus slightly flexed	No weight bearing; Foot totally off the ground or toe just touching the ground.
Head position	Above withers or eating	Level of withers	Below withers		
Location in stall	At door watching environment	Standing in the middle, facing door	Standing in the middle, facing sides	Standing in the middle, facing back or standing in the back	
Response to open door	Moves to door	Looks at door		No response	
Response to approach	Moves to observer, ears forward.	Looks at observer, ears forward	Moves away from observer	Does not move, ears back	
Overall subjective pain score	No apparent pain	Mild discomfort	Slight pain	Moderate pain	Severe orthopaedic pain

*Gross pain behaviour is defined as tooth-grinding, lip-curl, pawing, sweating.

Lindegaard et al 2010

Br. vet. J. (1969), **125**, 150

Some Observations on the Behaviour of the Horse in Pain

By J. A. Fraser, Royal (Dick) School of Veterinary Studies, Easterbush, Roslin, Midlothian

The facial expression is quite characteristic in many cases. There is a fixed stare, the eyes tend to be puckered slightly, the ears held slightly back, nostrils dilated and the animal generally presents a "worried" expression. The head is

Special Article

Guidelines for the recognition and assessment of pain in animals

Prepared by a working party of the Association of Veterinary Teachers and Research Workers

Veterinary Record (1986) **118**, 334-338

Facial expression

This is an important supplement to postural change as a means of communication in some species. The various subtleties of facial expression have not been analysed from this viewpoint for most species. However, people who work with particular species often become aware of such changes without being able to describe them in detail, or to demonstrate any consistent relationship to other means of assessing pain.

Cerebral Cortex January 2007;17:230-237
doi:10.1093/cercor/bhj141
Advance Access publication February 22, 2006

The Compassionate Brain: Humans Detect Intensity of Pain from Another's Face

Understanding another person's experience draws on "mirroring systems," brain circuitries shared by the subject's own actions/feelings and by similar states observed in others. Lately, also the experience of pain has been shown to activate partly the same brain areas in the subjects' own and in the observer's brain. Recent studies show remarkable overlap between brain areas activated when a subject undergoes painful sensory stimulation and when he/she observes others suffering from pain. Using functional magnetic resonance imaging, we show that not only the presence of pain but also the intensity of the observed pain is encoded in the observer's brain—as occurs during the observer's own pain experience. When

Facial expressions of pain

- Innate response reflecting activity within the nociceptive pathways (Kunz et al. 2011)
- Facial expressions of pain are difficult to suppress (Prkachin & Mercer 1989)
- Humans are specialized for decoding faces *(Kadosh et al. (2007)*
- Humans may interpret micro-expressions of < 0.5 seconds (Matsumoto & Hwang 2011)
- Many species use facial cues for social communication (Tate et al. 2006)

UNIVERSITY OF COPENHAGEN Veterinary Clinical Sciences

Veterinary Anaesthesia and Analgesia

Veterinary Anaesthesia and Analgesia, 2015, **42**, 105–114 doi:10.1111/vaa.12212

RESEARCH PAPER

An equine pain face

Karina B Gleerup*, Bjørn Forkman*, Casper Lindegaard† & Pia H Andersen‡
*Department of Large Animal Sciences, University of Copenhagen, Copenhagen, Denmark
†Equine Department, Helsingborg Regional Animal Hospital, Helsingborg, Sweden
‡Department of Clinical Sciences, Swedish University of Agricultural Sciences, Uppsala, Sweden

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Methods

- Semi-randomized controlled cross-over trial with 6 horses
- Observer/no observer
  - Do horses suppress pain in the presence of humans
- Noxious stimulation
  - Blood pressure cuff
  - Capsaicin

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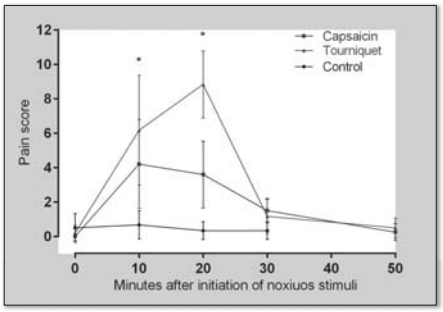
Pain score

- Significantly higher at T10 and T20 during noxious stimulation



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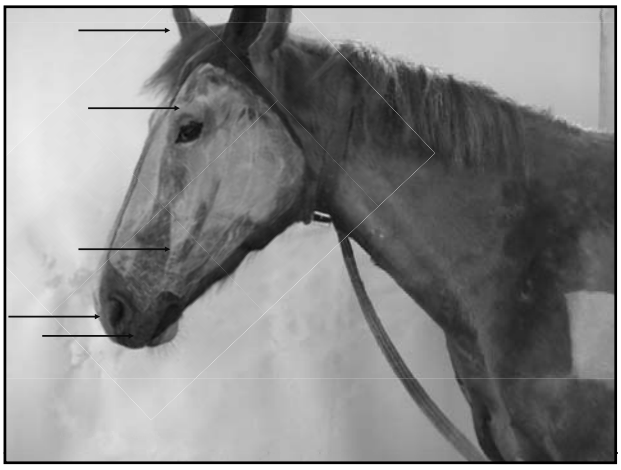
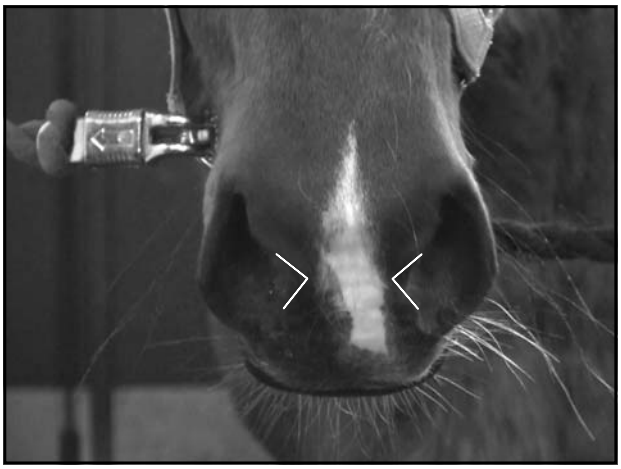
Results

Category	Control (n = 6) (mean ± SD)	Capsaicin (n = 6) (mean ± SD)	p	Control (n = 5) (mean ± SD)	Tourniquet (n = 5) (mean ± SD)	p
Ear movements						
Forward	22 ± 16%	13 ± 11%	0.06	24 ± 15%	13 ± 15%	**0.02**
Attentive	40 ± 10%	11 ± 6%	**0.03**	41 ± 9%	15 ± 11	**0.02**
Asymmetrical/low	23 ± 14%	54 ± 0.5%	**0.03**	21 ± 13%	51 ± 23	**0.02**
Back	16 ± 12%	23 ± 16%	0.2	14 ± 11%	21 ± 16	0.3
Out of frame	2.2 ± 3.4%	11 ± 15%	0.06	2.2 ± 3.4%	25 ± 16%	**0.02**
Contact seeking behaviour	9.1 ± 8.5%	22 ± 14.3%	0. 06	8.8 ± 5.9%	16.4 ± 14.2%	0.06
Eye blinking	0.41 ± 0.15/s	0.44 ± 0.11/s	0.2	0.39 ± 0.14/s	0.46 ± 0.13/s	0.08
Other behaviours						
Chewing	12 ± 8	14 ± 13	0.8	12 ± 9	14 ± 5	1
Yawning	2 ± 4	0.5 ± 0.8	0.8	2 ± 4	3 ± 6	1
Snorting	0 ± 0	0 ± 0	–	0 ± 0	0.6 ± 1.3	1
Head shaking	4 ± 8	5 ± 3	0.4	4 ± 9	4 ± 6	1

Bold values are significant, $p < 0.05$.





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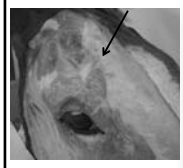
The equine pain face



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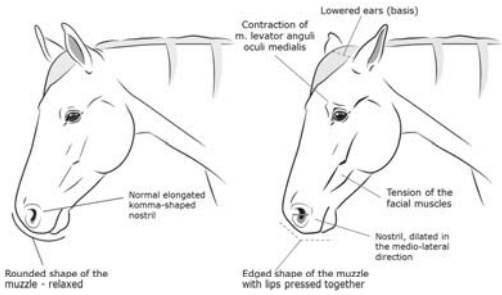
An equine pain face



OPEN ACCESS Freely available online PLOS | ONE

Development of the Ho Assessment Tool in Ho Castration

Emanuela Dalla Costa[1*], Michela Minero[1], Matthew C. Leach[3]

1 Università degli Studi di Milano, Dipartimento di Scienze Veterina
Bielefeld, Germany. 3 Newcastle University, School of Agriculture, Food

The Veterinary Journal 206 (2015) 356–364

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journal homepage: www.elsevier.com/locate/tvj

Monitoring acute equine visceral pain with the Equine Utrecht University Scale for Composite Pain Assessment (EQUUS-COMPASS) and the Equine Utrecht University Scale for Facial Assessment of Pain (EQUUS-FAP): A scale-construction study

Johannes P.A.M. van Loon [a,*], Machteld C. Van Dierendonck [a,b,c]

[a] Department of Equine Sciences, Faculty of Veterinary Medicine, Utrecht University, Yalelaan 114, NL-3584 CM Utrecht, The Netherlands
[b] Veterinary Faculty Ghent University, Salisburylaan 133, 9820 Merelbeke, Ghent, Belgium
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ARTICLE INFO

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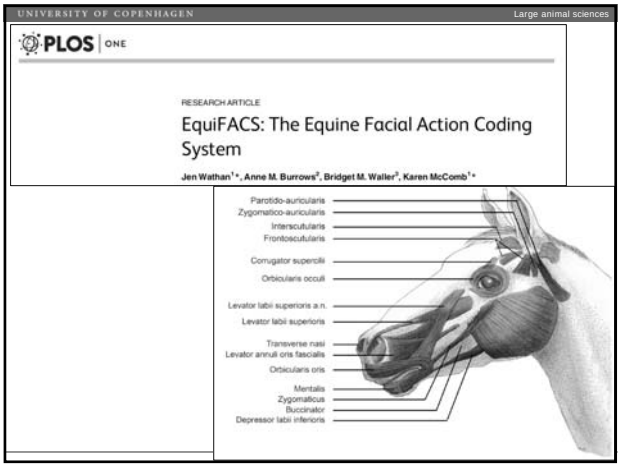
ABSTRACT

Although recognition of equine pain has been studied extensively over the past decades there is still need for improvement in objective identification of pain in horses with acute colic. This study describes scale construction and clinical applicability of the Equine Utrecht University Scale for Composite Pain Assessment (EQUUS-COMPASS) and the Equine Utrecht University Scale for Facial Assessment of Pain (EQUUS-FAP) in horses with acute colic. A cohort follow-up study was performed using 50 adult horses (n = 25 with acute colic, n = 25 controls). Composite pain scores were assessed by direct observations, Visual Analog

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

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 o tightening of eyelids. An edge of the sclera can be seen 50% of the time	1
	Obviously more opened eyes or obvious tightening of eyelids. Sclera can be seen >50% of the time	2
Focus	Focussed on enviroment	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 slightly	1
	Obviously lifted	2
Muscle tone head	No fasciculations	0
	Mild fasciculations	1
	Obvious fasciculations	2
Flehming and/or yawning	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: backwardsno response to sounds	2
Total		.../18



How can we use the equine pain face?

- It should be measuring pain - preferably low-degree pain
- It should be applicable

How can we use the equine pain face?

Owner:

"I will probably use my experience and your research to be more observant of his signals and most of all: no longer interpret his signs and facial expressions as him being lazy or spoilt"

Equine Veterinary Education

EQUINE VETERINARY EDUCATION
Equine vet. Educ. (2016) 28 (1) 47-57
doi: 10.1111/eve.12383

47

Review Article

Recognition and quantification of pain in horses: A tutorial review

K. B. Gleerup[†] and C. Lindegaard[‡]*

UNIVERSITY OF COPENHAGEN

Available online at www.sciencedirect.com

ScienceDirect

RVS

Veterinary Anaesthesia and Analgesia

Formerly the Journal of Veterinary Anaesthesia

Veterinary Anaesthesia and Analgesia, 2010, **37**, 171–185 doi:10.1111/j.1467-2995.2009.00521.x

RESEARCH PAPER

Analgesic efficacy of intra-articular morphine in experimentally induced radiocarpal synovitis in horses

Casper Lindegaard*, Maj H Thomsen*, Stig Larsen† & Pia H Andersen*

Clinical application and reliability of a post abdominal surgery pain assessment scale (PASPAS) in horses

C. Graubner[a,*], V. Gerber[a], M. Doherr[b], C. Spadavecchia[c]

The Equine Pain Scale

Behaviour category	Score 0	1	2	3	4
Pain face	No pain face		Pain face present	Intense pain face	
Gross pain behaviour*	None		Occasional		Continuous
Activity	Exploring, attention towards surroundings or resting	No movement		Restless	Depressed
Location in the stall	At the door watching the environment	Standing in the middle, facing the door	Standing in the middle facing the sides	Standing in the middle facing back or standing in the back	
Posture/ weight bearing	Normal posture and normal weight bearing	Foot intermittent of the ground/occasional weight shift	Pinched (groove between abd. muscles visible)	Continuously taking foot off the ground and trying to replace it.	No weight bearing. Abnormal weight distribution
Head position	Foraging, below withers or high	Level of withers	Below withers		
Attention towards the painful area	Does not pay attention to painful area		Brief attention to painful area (e.g. flank watching)		Biting, nudging or looking at painful area (e.g. flank watching)
Interactive behaviour	Looks at observer or moves to observer when approached	Looks at observer does not move	Does not look at observer or moves away avoids contact	Does not move, not reacting/introverted	
Response to food	Takes food with no hesitation	Looks at food		No response to food	

*Gross pain behaviour includes all readily visible behaviours like, excessive head movements (vertical), fidgeting, kicking, pawing, rolling, tail swishing, mouth playing, repeated stretching etc.

Ref. From Bech Gleerup and Lindegaard 2015. Recognition and quantification of pain in horses - a tutorial review. Equine Veterinary Education. In press. Gleerup et al., An equine pain face. Veterinary Anaesthesia and Analgesia, 2015, 42, 103-114. Illustrator: Andrea Klindtsø.

Before analgesic treatment

The equine Pain Scale

1 0-4 points
2 5-8 points
3 9-15 points
4 16-20 points
5 21-30 points

After analgesic treatment

The equine Pain Scale

1 A. 0-4 points
2 B. 5-8 points
3 C. 9-15 points
4 D. 16-20 points
5 E. 21-30 points

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The Equine Pain Face

- Horses have altered facial expressions when experiencing pain
- The Equine Pain Face is not static and not all changes are necessarily present simultaneously
- The overall impression is important
- Facial expressions of pain may be present even without any gross pain behaviour
- The Equine Pain Face is quick and readily usable, even in the field

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Interspecies Knowledge Transfer for Facial Keypoint Detection

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Abstract

We present a method for localizing facial keypoints on animals by transferring knowledge gained from human faces. Instead of directly finetuning a network trained to detect keypoints on human faces to animal faces (which is sub-optimal since human and animal faces can look quite different), we propose to first adapt the animal images to the pre-trained human detection network by correcting for the differences in animal and human face shape. We first find the nearest human neighbors for each animal image using an unsupervised shape matching method. We use these matches to train a thin plate spline warping network to warp each animal face to look more human-like. The warping network is then jointly finetuned with a pre-trained human facial keypoint detection network using an animal dataset. We demonstrate state-of-the-art results on both horse and sheep facial keypoint detection, and significant improve-

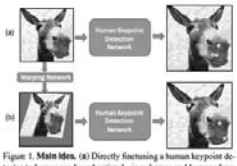
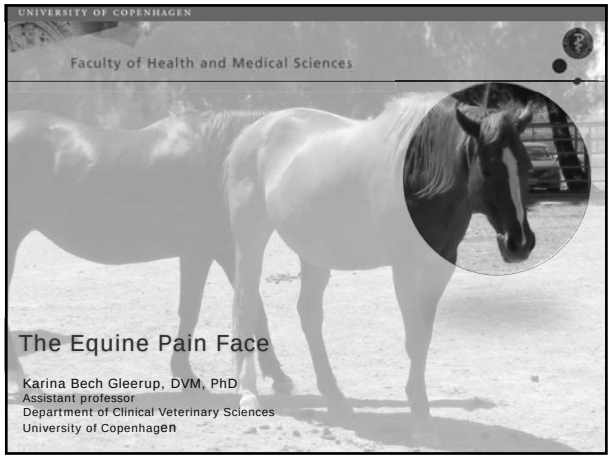


Figure 1. **Main idea.** (a) Directly finetuning a human keypoint detector to horses can be suboptimal, since horses and humans have very different shapes and appearances. (b) By warping a horse to have a more human-like shape, the pre-trained human keypoint detector can more easily adapt to the horse's appearance.

UCDAVIS VETERINARY MEDICINE

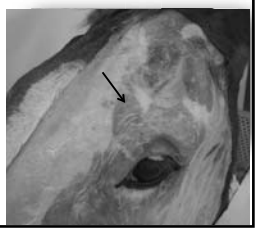
SLU
Sveriges lantbruksuniversitet
Swedish University of Agricultural Sciences


Thank you for your attention



The equine pain face


- Ears
  - Increased distance
  - Opening of the ears facing the sides
  - Both ears moving asymmetrically
- Eyes
  - Tension of the *m. levator anguli oculi medialis*
  - Tense stare – appears withdrawn



The equine pain face

- Ears
  - Increased distance
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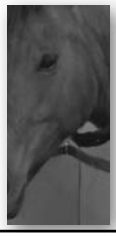
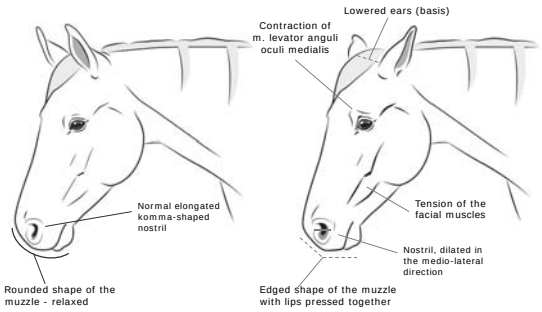
  - Both ears moving asymmetrically
- Eyes
  - Tension of the *m. levator anguli oculi medialis*
  - Tense stare – appears withdrawn
- Facial muscles
  - Tension




The equine pain face

- Ears
  - Increased distance
  - Opening of the ears facing the sides
  - Both ears moving asymmetrically
- Eyes
  - Tension of the *m. levator anguli oculi medialis*
  - Tense stare – appears withdrawn
- Facial muscles
  - Tension
- Nostrils
  - Dilated medio-laterally
- Muzzle
  - Increased tonus of the lips
  - Edged shape of the muzzle

Relaxed horse | Horse in pain



Illustrations Andrea Klintbjer

No pain

Illustration by Andrea Klintbjer

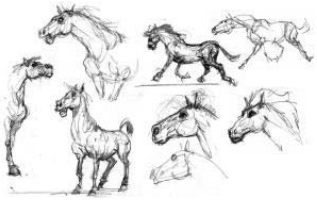
Pain face – asymmetrical ears

Pain face – low ears ('lambs ears')

Quiz


Thank you for your attention
Special thanks to my collaborators:
Pia Haubro Andersen
Casper Lindegaard
Björn Forkman
Andrea Klintbjer
Foreningen Kustos af 1881

Composite Pain Scales in pain assessment in the Horse



Universiteit Utrecht

Dr. Thijs van Loon
DVM, PhD, DipECVAA
Department of Equine Sciences
Faculty of Veterinary Medicine, Utrecht University, the Netherlands

American Pain Society (APS) 1996:

Introduction of "pain as the 5th vital sign"

This initiative emphasizes that pain assessment is as important as assessment of the standard four vital signs (HR, RR, Temp, BP) and that clinicians need to take action when patients report pain.

The Scream, Edvard Munch (1893)

THE VETERINARY CLINICS Equine Practice

Diagnosing and treating pain in the horse Where are we today?

Polly M. Taylor, MAVetMB, PhD[a], Peter J. Pascoe, BVSc[b], Khursheed R. Mama, DVM[c,*]

Pain recognition and management in small animals and people have advanced considerably in the last decade; however, horses have not faired so well. This may in part result from the fact that the range of surgical procedures carried out in horses is much more limited; for instance, thoracotomies and major postcancer surgical reconstruction are not common equine procedures. Nevertheless, horses suffer their share of trauma and diseases causing pain: orthopedic trauma, infected synovial structures, and colic are three obvious examples.

There is remarkably little use of these pain scales and few attempts to develop any in horses. Johnson et al. [31] used an SDS to compare three NSAIDs for postoperative analgesia in horses. Raekallio et al. [71] attempted to develop NRS scoring for postoperative pain assessment in horses.

How do we measure pain in horses?

- VAS (Visual Analog Scale)
- NRS (Numerical Rating Scale)
- SDS (Simple Descriptive Scale)
- TBA (Time budget Analysis)
- CPS (Composite Pain Scale)
- FE (Facial expression)

What is a composite pain scale???

A pain scale that includes multiple variables (behavioural, physiological or both) that are scored individually using well-defined classes by means of Simple Descriptive Scale (SDS), which are then combined to provide an overall CPS score.

Behaviour	Criteria	Score
Pawing on the floor (pointing, hanging limbs)	Quietly standing, no pawing	0
	Occasional pawing (1–2 times/5 min)	1
	Frequent pawing (3–4 times/5 min)	2
	Excessive pawing (>5 times/5 min)	3

Bussières et al. (2008)

pawing on the floor

sweating

weightbearing, shifting weight

lying down, rolling

what makes a pain scale reliable?

- Reproducibility
  - Inter- and intra-observer reliability/variability
- Validity
  - Face validity: does the test look ok?
  - Content validity: do the test items correspond with the symptom content?
  - Concrete validity: is the outcome of the test related to the clinical outcome?
  - Construct validity: is the test really measuring what it claims to be measuring?

⇓

- Sensitivity: true positive rate (colic patients with high pain scores)
- Specificity: true negative rate (controls with low pain scores)
- Response to intervention: painful event or analgesic treatment

what makes a pain scale practically useful?

- Easy
- Understandable
- Short
- Instant results
- …

Composite Pain Scales (CPS)

Bussieres et al. (1998): CPS for acute orthopaedic pain
Lindegaard et al. (2010): CMPS for acute orthopaedic pain
Pritchett et al. (2003): visceral postoperative pain
Graubner et al. (2011): PASPAS for visceral postoperative pain
van loon et al. (2014): CPS for viscerale postoperative pain
Taffarel et al. (2015): UNESP-Botucatu pain scale for postoperative pain
van Loon and van Dierendonck (2015): CPS for acute colic pain

CPS in experimental lameness

ELSEVIER
Available online at www.sciencedirect.com
ScienceDirect
Research in Veterinary Science 85 (2008) 294–306
RVS

Development of a composite orthopaedic pain scale in horses ☆

G. Bussières [b,1], C. Jacques [a,1], O. Lainay [a], G. Beauchamp [b], A. Leblond [a], J.-L. Cadoré [a], L.-M. Desmaizières [a], S.G. Cuvelliez [b], E. Troncy [b,*]

CPS

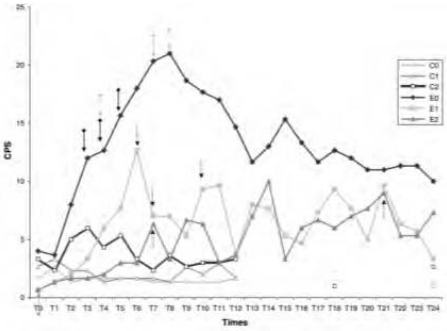
according to Bussières et al. (2008) and van loon et al. (2010 and 2014)

Physiological parameters (4 elements)
(heart frequency, respiratory frequency, rectal temp, borborygmi)

Behavioural parameters (7 elements)
(head movement, sweating, pawing etc.)

Interactive parameters (2 elements)
(reaction to noise and touch)

In total maximally 3 x 13 = 39 points



Synovitis induction:
Amphotericine B in talocrural joint

C = control
E = experimental group

C0 = sedation+epidural sham
C1 = sedation + epidural saline
C2 = sedation + epidural analgesics
E0 = rescue bute + epidural saline
E1 = preemp saline + epidural analgesics
E2 = preemp bute + epidural analgesics

Epidural mixture of:
Ropivacaine (0.15 mg/kg)
Detomidine (0.02 mg/kg)
Morphine (0.05 mg/kg)
Ketamine (0.5 mg/kg)

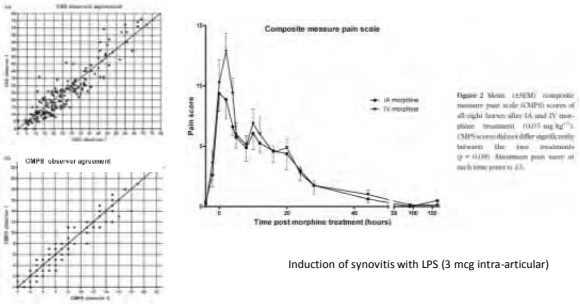
Bussières et al. (2008)

Table 2
Summary of evaluation of reproducibility, specificity and sensitivity for the CPS and individual parameters of the CPS as well as complementary physiological criteria

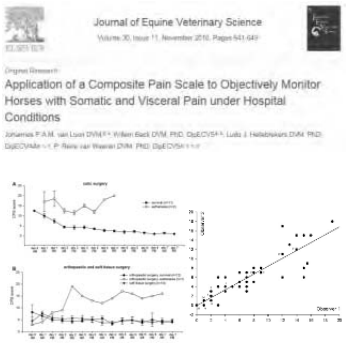
Total CPS	Reproducibility[a]	Specificity[b]	Sensitivity[c]
	Good	Good	Good-to-excellent
Individual parameters			
Physiological parameters			
Heart rate		Moderate	Moderate
Respiratory rate		Moderate	Moderate
Digestive sounds		Good-to-moderate	Null
Rectal temperature		Null	Null to moderate
Behavioural parameters			
Appearance	Good	Null	Moderate
Posture	Good-to-excellent	Excellent-to-good	Excellent
Sweating	Excellent	Good	Null
Head movement	Good-to-excellent	Moderate-to-null	Excellent
Kicking at abdomen	Excellent	Excellent	Excellent[d]
Appetite	Good-to-excellent	Good	Null to moderate
Pawing on the floor	Good	Good-to-moderate	Excellent
Response to care			
Interactive behaviour	Excellent	Excellent-to-good	Null to moderate
Response to palpation of the painful area	Good-to-excellent	Excellent	Excellent
Complementary physiological criteria			
Mean systemic arterial blood pressure		Good	Excellent
Blood glucose		Null	Null
Blood cortisol		Good	Moderate

Bussières et al. (2008)

CMPS Lindegaard et al. (2010)



Induction of synovitis with LPS (3 mcg intra-articular)



CPS in individual patients

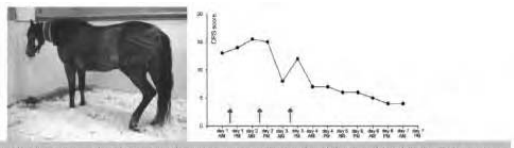


Figure 3. Horse that was admitted with severe soft-tissue trauma at the head and front and hind limbs (left panel). Right panel shows individual CPS scores of this patient that received multimodal analgesic treatment, including epidural morphine (red marks) and systemic NSAIDs.

van Loon et al. (2010)

CPS in individual patients

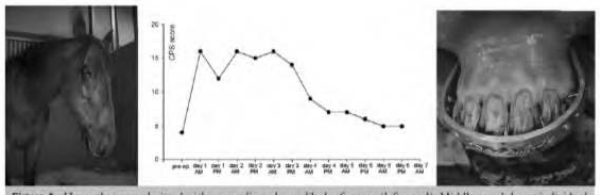
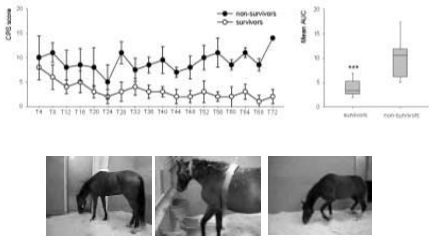


Figure 4. Horse that was admitted with a complicated mandibular fracture (left panel). Middle panel shows individual CPS scores of this patient that received mandibular nerve blocks with lidocaine + bupivacaine preoperatively and systemic NSAIDs for 7 days. Right panel shows external fixation of the mandible.

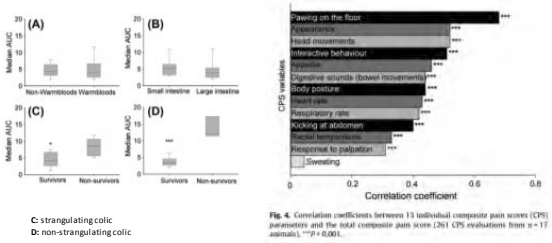
van Loon et al. (2010)

CPS in postoperative colic patients



van Loon et al. (2014)

CPS in postoperative colic patients



C: strangulating colic
D: non-strangulating colic

Fig. 4. Correlation coefficients between 13 individual composite pain scores (CPS) parameters and the total composite pain score (261 CPS evaluations from n = 17 animals). ***P < 0.001.

van Loon et al. (2014)

The Veterinary Journal 188 (2011) 176–181

Contents lists available at ScienceDirect

The Veterinary Journal

journal homepage: www.elsevier.com/locate/tvj

Clinical application and reliability of a post abdominal surgery pain assessment scale (PASPAS) in horses

C. Graubner [a,*], V. Gerber [d], M. Doherr [b], C. Spadavecchia [c]

- based on clinical experience and published literature (Pritchett et al. 2003)
- Physiological and behavioural parameters, including general subjective behavioural pain category
- interobserver variability of PASPAS was low (CV 0.3 ± 0.1)

Heart rate was moderately correlated with the total pain index ($r^2 = 0.57$; $P < 0.001$)

Respiratory rate was poorly correlated with the total pain index ($r^2 = 0.36$; $P < 0.001$)

Taffarel et al. BMC Veterinary Research (2015) 11:69
DOI 10.1186/s12917-015-0395-4

BMC Veterinary Research

RESEARCH ARTICLE Open Access

Refinement and partial validation of the UNESP-Botucatu multidimensional composite pain scale for assessing postoperative pain in horses

Marlêda Orghero Taffarel[1*], Stelio Pacca Loureiro Luna[2*], Flavia Augusta de Oliveira[1], Guilherme Schiess Cardoso[1], Juliana de Moraes Monteiro[1], Jose Carlos Pantoja[1], Juliana Tabatelli Brondani[1], Emma Love[3], Polly Taylor[4], Kate White[4] and Joanna C. Murrell[4]

Table 3 Median (minimal and maximal value) pain scores in horses undergoing castration or anaesthesia only

Treatment / Moment	GA	GAA	GC	GCA
TC	3 (0–11)	2 (0–11)	4 (0–11)^{C}	4 (0–10)^{B}
T4	5 (1–14)^{BC}	5 (2–14)^{C}	14 (7–25)^{AA}	11 (3–16)^{AA}
T6	4 (1–6)^{BC}	4 (1–7)^{C}	10.5 (5–16)^{AB}	6.5 (1–19)^{AB,AB}
T24	3 (0–8)^{BC}	2 (0–7)^{B}	8 (1–14)^{AC}	6.5 (2–13)^{AB}

GA: general anaesthesia
GAA: + analgesia
GC: castration + postop analgesia
GCA: preemp analgesia + castration

Refinement and partial validation of the UNESP-Botucatu multidimensional composite pain scale for assessing postoperative pain in horses

Table 2 Relevance, specificity and item-total correlation of each item and categories of the scale in horses submitted to castration or only anaesthesia *(Continued)*

Variable	Criteria	Specificity (%)[1]	Item-total correlation[2]
Looking at the flank	The horse does not look at the flank	84.6	0.4
	The horse looks at the flank	15.4	
Kicking at the abdomen	The horse does not kick the abdomen	95.8	0.3
	The horse kicks at the abdomen	2.5	
Lifting hind limbs	No lifting of hind limbs	74.6	0.6
	Lifting hind limbs	22.0	
	Lifting one of the hind limbs and extending the head	3.4	
Head movement	Head straight ahead most of the time	87.1	0.4
	Lateral and/or vertical occasional head movements	12.1	
	Lateral and/or vertical continuous head movements	0.9	
Pawing on the floor (fore limbs)	Quietly standing, no pawing	89.7	0.4
	Pawing	9.4	

EQUUS COMPASS (van Loon and van Dierendonck 2015, 2016):
Equine Utrecht University Scale for *Composite Pain Assessment*

Assessment of whole horse, based on 14 criteria:

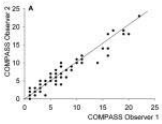
Physiological:
Breathing, heart frequency, temperature, borborygmi

Behavioural:
posture
Lying down, rolling
Sweating
Tail flicking
Kicking at abdomen
Pawing at floor
Head movements
Pain sounds

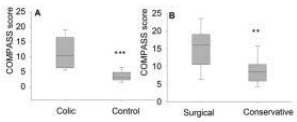
Interaction:
Overall appearance: reaction to observer
Reaction to palpation

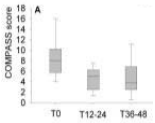
Minimal total score: 0
Maximal total score: 42

EQUUS COMPASS in acute colic: scale construction study



n = 72
r^2 = 0.94
ICC = 0.98
$P < 0.001$





van Loon and van Dierendonck (2015)

Table 5
Sensitivity, specificity and weighting factors for individual parameters of the Equine Utrecht University Scale for Composite Pain Assessment (EQUUS-COMPASS) and the Equine Utrecht University Scale for Facial Assessment of Pain (EQUUS-FAP).

	Colic vs control			CT vs STE		
	Sensitivity	Specificity	Weighting factor*	Sensitivity	Specificity	Weighting factor*
	[%]			[%]		
EQUUS-COMPASS						
Heart frequency	46	54	1	100	40	1
Breathing frequency	42	54	1	86	67	2
Rectal temperature	08	100	0	–	–	
Borborygmi	92	96	3	80	36	1
Posture	88	72	2	44	75	1
Laying down, rolling	29	100	1	60	50	1
Sweating	54	100	2	38	100	1
Tail flicking	58	08	0	–		
Kicking at abdomen	29	100	1	40	50	1
Pawing at floor	63	48	1	86	38	1
Head movements	17	80	0	–	–	
Pain sounds	38	72	1	0	50	0
Reaction to observer	58	80	2	100	44	1
Reaction to palpation	54	80	2	50	83	2

CT, conservatively treated animals; STE, surgically treated or euthanased animals.
* Where sensitivity or specificity is ≤25%, the weighting factor = 0; 25–50%, weighting factor = 1; 50%–75%, weighting factor = 2; ≥75%, weighting factor = 3.

van Loon and van Dierendonck (2015)

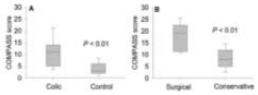
EQUUS COMPASS in acute colic: validation study

Table 2
Sensitivity, specificity, positive and negative predictive value of EQUUS-COMPASS and EQUUS-FAP (unweighted values).

	Sensitivity	Specificity	Positive predictive value	Negative predictive value
Colic ($n = 23$) vs. control ($n = 23$)				
EQUUS-COMPASS	87%	71%	77%	83%
CT ($n = 17$) vs. STE ($n = 6$)				
EQUUS-COMPASS	100%	76%	56%	93%

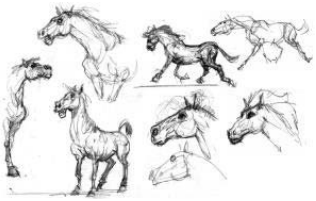
EQUUS-COMPASS, Equine University Utrecht Scale for Composite Pain Assessment

CT, conservatively treated horses; STE, surgically treated or euthanased horses.



van Dierendonck and van Loon (2016)

Composite Pain Scales in case reports
with non-validated scales



Case Report

Managing severe hoof pain in a horse using multimodal analgesia and a modified composite pain score

EQUINE VETERINARY EDUCATION
Equine vet. Educ. (2009) **21** 37-43
doi: 10.2746/095777308X382669

D. W. Duffon, K. J. Lashnits and K. Wegner†*
Pacific Crest Equine, 2500 Eisel Myer Avenue, Dexter, California 95221; and †Veterinary Anesthesia and Pain Management, 91 E. Thomas Court, Kennett Square, Pennsylvania 19348, USA

Treatment 3. Days 5–19
Lidocaine[a] (2.0 mg/kg bwt i.v. bolus, then 4.0 mg/kg bwt i.v. in 250 ml saline over 2 h Days 5–11 and Day 14)
Gabapentin (3.3 mg/kg bwt per os q. 6 h Days 5–17)
Flunixin meglumine[b] (1.1 mg/kg bwt i.v. q. 24 h Days 5–7)
Aspirin (4 mg/kg bwt per os q. 24 h Days 8–16)
Perineural bupivacaine[c] lateral palmar digital nerve (3 ml of 0.5% q. 12 h Days 6–12)
Acepromazine[d] (0.03 mg/kg bwt i.v. to facilitate ice bath q. 24 h Days 4–12)
Detomidine[d] (0.002 mg/kg bwt i.v. to facilitate ice bath q. 24 h Days 4–12)
Ice bath 1.5 h (both front feet submerged in ice water up to knees q. 24 h Day 4–12)
Chlorhexidine hydrogen peroxide soak of right leg 20 min (following ice bath) q. 24 h Day 4–6)

Treatment 4. Days 11–16
Potassium penicillin[e] (22,000 u/kg bwt i.v. q. 6 h Days 11–16)
Gentamicin sulphate[f] (8.6 mg/kg bwt i.v. q. 24 h Days 13–16)
Metronidazole[g] (15 mg/kg bwt per os q. 8 h Days 11–16)
Flunixin meglumine[b] (1.1 mg/kg bwt i.v. q. 12 h Days 14–15; phenylbutazone discontinued)
Methadone (0.15 mg/kg bwt per os q. 24 h Days 14–15, and q. 12 h Days 16–17)
Regional limb perfusion (RLP): Ampicillin[e] (1 g i.v., lateral or medial palmar vein Days 11–14) replaced by Ceftiofur[h] (1 g i.v., lateral or medial palmar vein Days 15–17).

Dynamic score: Obel laminitis pain scale

Grade	Descriptor
1	Frequent shifting of weight between the feet with no discernible lameness of the walk.
2	Does not resist having a foreleg lifted; is not reluctant to walk, but does show lameness of the walk.
3	Resists having a foreleg lifted and is reluctant to walk.
4	Walks only if forced.

Static score: Modified from Glasgow composite scale

Score	Descriptor
1	No pain or distress: normal behaviour.
2	Mild pain: irritable, restless, decreased appetite.
3	Mild pain: 2 plus resists handling.
4	Mild-moderate pain: 3 plus standing in back of stall or with back to stall door.
5	Moderate pain: 4 plus camped-out legs, increased digital pulses.
6	Moderate-severe pain: 5 plus frequent recumbency, HR >44 beats/min, and/or RR >24 breaths/min.
7	Moderate-severe pain: 6 plus sweating, muscle fasciculation, head-tossing.
8	Severe pain: 7 plus unwilling to move.
9	Severe-extreme pain: 8 plus non-weightbearing when standing.
10	Extreme pain: 9 or entirely recumbent, bordering on agonal.

Maximum possible score: 14

Dutton et al. (2009)

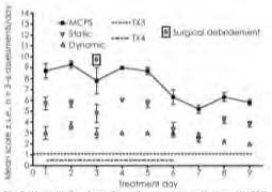


Fig 2: Mean static, dynamic and composite pain score (MCPS). Days 11–19 and treatment (TX).

Case Report

A preventive multimodal analgesic strategy for bilateral rostral mandibulectomy in a horse

EQUINE VETERINARY EDUCATION
Equine vet. Educ. (2014) **26** (2) 66-71
doi: 10.1111/eve.12076

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School of Veterinary Medicine, College of Medical, Veterinary and Life Sciences, University of Glasgow, UK.
**Corresponding author email: e.minghella.1@research.gla.ac.uk*

Fig 1: Purulent mass of rostral mandible - biopsy results confirmed ameloblastoma.

Fig 4: Wound soaker catheter placed at the surgical site.

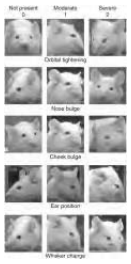
Minghella en Auckburally (2014)

TABLE 2: Results of pain score in the early post operative period

Indicator	Preoperative score	Post operative score (hours after surgery)																			
		0	1	2	3	4	5	6	7	8	9	10	11	13	14	15	17	19	20	21	23	25
Appetite	1	-	3	0	0	0	0	0	0	0	0	0	0	0		2	2	2		0	0	0
Drinking	1	-	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0		0	0	0
Demeanour	1	2	1	0	0	0	0	0	0	0	0	0	0	0		0	0	0		0	0	0
Headshaking	2	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0		0	0	0
Approach head to front	3	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0		0	0	0
Palpation (light)	3	0	0	0	0	0	0	0	0	0	0	0	1	0		0	0	0		0	0	1
Palpation (firm)	3	0	0	1	1	2	2	1	0	1	1	2	3	0		1	2	2		1	1	2
Total pain score	**14**	**2**	**4**	**1**	**1**	**2**	**2**	**1**	**0**	**1**	**1**	**2**	**4**	**0**		**3**	**4**	**4**		**1**	**1**	**3**
Drug received		B		M				B	F	M			B		M			B	M	F		B

B = Bupivacaine using wound soaker catheter – 10 ml of 0.5% solution; M = Morphine (0.1 mg/kg bwt i.m.); F = Flunixin meglumine (1.0 mg/kg bwt i.m.).

Composite pain scales in Facial Expression of Pain



Horse Grimace Scale (HGS)

DallaCosta et al. (2015, 2016, 2017)

Equine Pain Face (EPF)

Gleerup et al. (2014)

Gleerup and Lindegaard (2016)

Facial Assessment of Pain (FAP)

van Loon and van Dierendonck (2015, 2017)

van Dierendonck and van Loon (2016)

Facial Expressions in ridden horses (FEReq)

Mullard et al. (2017)

Dyson et al. (2017)

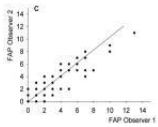
EQUUS FAP (van Loon and van Dierendonck 2015, 2016):
Equine Utrecht University Scale for *Facial assessment of Pain*

Assessment of head of horse on 9 criteria:

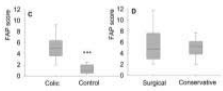
Head
Focus
Lips and corners mouth
Ears
Flehming and/or yawning
Teeth grinding and/or moaning
Eyelids
Nostrills
Muscular tone

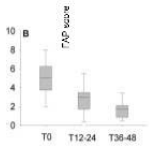
min. total score: 0 – max. total score: 18

EQUUS FAP in acute colic



n = 72
r^2 = 0.84
ICC = 0.93
$P < 0.001$





van Loon and van Dierendonck (2015)

EQUUS FAP in pain originating from the head

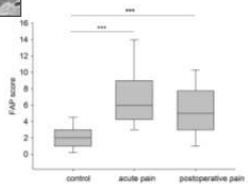
14-year old KWPN gelding
- Alveolitis 107
- premolar extraction under sedation and local blocks, finally dental root repulsion under GA

Day 1 postop before tramadol: FAP score = 9
Day 1 post-op 1 hour after tramadol: FAP score = 1

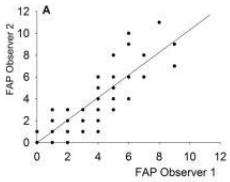
before tramadol

after tramadol (5 mg/kg PO)

EQUUS FAP in pain originating from the head



control (n = 23) versus acute or postoperative facial pain (n = 23)
*** = $P < 0.001$



n = 80
ICC = 0.92
$P < 0.001$

van Loon and van Dierendonck (submitted data)


questions???

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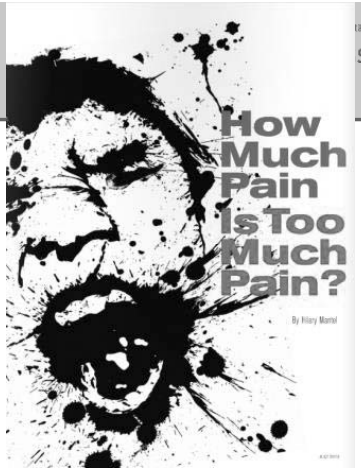
Measurement of nociception in experimental studies

1st Vienna Pain Day, 1-2 July 2017

Prof. C. Spadavecchia

Anaesthesiology and Pain Therapy Section
Department of Clinical Veterinary Medicine
Vetsuisse Faculty, University of Bern



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Issues in Veterinary Pain Research

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Pain Assessment in research settings

- Physiological parameters
  - HR, HRV, BP, cortisol, b-endorphines
- Behavioural based scoring systems
  - Facial pain scales, DIVAS, HCPI
- Nociceptive thresholds determination
  - Quantitative Sensory Testing methods

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Pain Assessment in research settings

- Physiological parameters
  - HR, HRV, BP, cortisol, b-endorphines
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  - Facial pain scales, DIVAS, HCPI
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  - Quantitative Sensory Testing methods

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Pain Assessment in research settings

Nociceptive thresholds

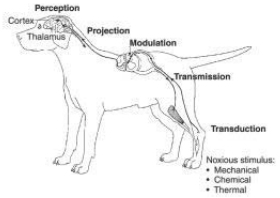
Nociception

from the Latin "nocere" (to harm)

"The neural process of encoding noxious stimuli"

Note: Consequences of encoding may be autonomic (e. g. elevated blood pressure) or behavioral (motor withdrawal reflex or more complex nocifensive behavior).
Pain sensation is not necessarily implied.

Nociception has an important warning function



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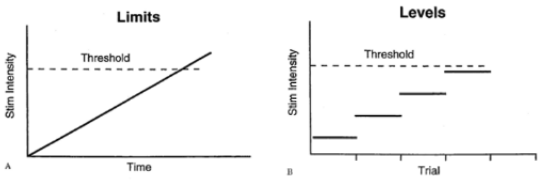
Animal Models of Nociception

DANIEL LE BARS,[1] MANUELA GOZARIU, AND SAMUEL W. CADDEN
INSERM U-161, Paris, France (D.L.B.); Laboratoires UPSA Bristol-Myers-Squibb, La Grande Arche Nord, Paris La Défense, France (M.G.); and The Dental School, University of Dundee, Dundee, Scotland (S.W.C.)

2001

«Nociceptive» Threshold Determination



Shy et al. 2003

«Quantitative Sensory Testing»

Quantitative Sensory Testing (QST)

- Assessment of peripheral nociceptive sensory function
- Central sensitization and integration
- Multimodal/multi-tissue approach

- Basic mechanistic studies in healthy subjects
- Clinical studies for diagnostic and monitoring purposes
- Pharmacological studies to evaluate analgesic efficacy

Arendt-Nielsen et al. 2009

Quantitative Sensory Testing (QST)

Psychophysical testing
- Sensory stimulus is an objective physical event
- Response is the subjective conscious report/reaction

Neurophysiological testing
- Sensory stimulus is an objective physical event
- Response is the evoked neurophysiological response

Quantitative Sensory Testing (QST)

Static
- Threshold determination

Dynamic
- Stimulus-response curve
- Spatial summation
- Temporal summation
- Diffuse noxious inhibitory control (DNIC)

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Psychophysical QST

- Outcome is a (nocifensive) behavioural reaction
- The reaction has to be interpreted
- Thresholds/reaction times are measured
- Pharmacological threshold changes are detected
- Low threshold mechano- and thermoreceptors are activated
- Influenced by drugs altering behaviour
- Learning effect can occur

2014

2015

2016

2017

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Psychophysical QST: thermal threshold

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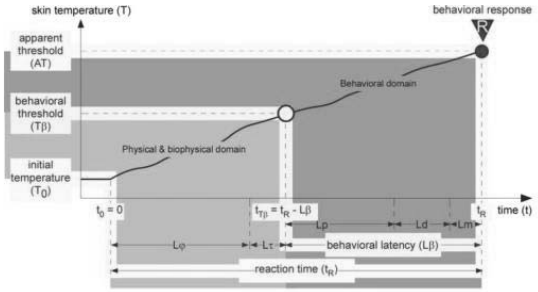
Psychophysical QST: thermal threshold

- Threshold determination: heat and cold
- Methods: thermode, Peltier cell, radiant heat, immersion
- Skin properties and contact surface
- Thermal stimulation is always progressive: reaction time

- Heating slope
  - 1° C/s: C fibers
  - 6.5° C/s: Aδ fibers

- Cut off values

Behavioural response to heating: determinants



Benoist et al. 2008

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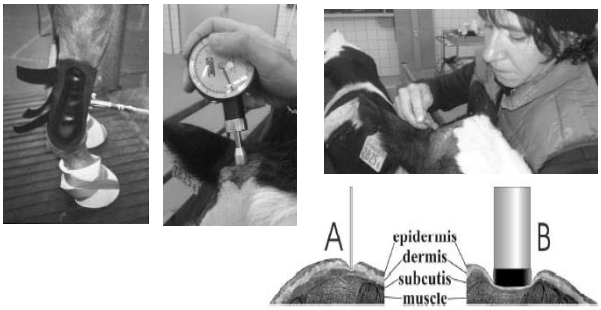
Psychophysical QST: mechanical threshold



Psychophysical QST: mechanical threshold

- Threshold determination
  - Von Frey filaments
  - Algometry
- Methods
  - hand-held or fixed actuator
  - manual or computer-recorded
- Rate of force increase
- Stimulating surface

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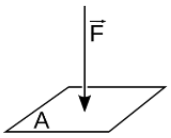
Psychophysical QST: mechanical threshold

- Stimulation of nociceptors is elicited by pressure
- p= F/A



- Pressure depends on the stimulation surface
- Force is independent from the stimulation surface

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Psychophysical QST: electrical threshold

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Psychophysical QST: electrical threshold

- Direct versus alternating current
- Constant current/voltage stimulation
- Electrodes impedance/resistance
- Ohm's law: I=V/R

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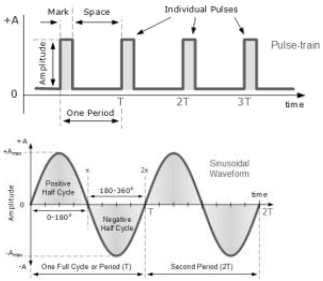
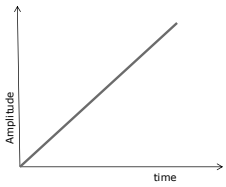
Psychophysical QST: electrical threshold

- Electrical waveforms





Veterinary Anaesthesia and Analgesia, 2009, **36**, 9–17 doi:10.1111/j.1467-2995.2008.00420.x

RESEARCH PAPER

Determination of the minimum alveolar concentration of isoflurane in Shetland ponies using constant current or constant voltage electrical stimulation

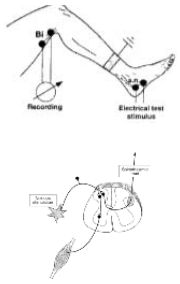
Olivier L Levionnois* DVM, Dr Med Vet, Diplomate ECVAA, Claudia Spadavecchia* DVM, Dr Med Vet, PhD, Diplomate ECVAA, Peter W Kronen† DVM, Dr Med Vet, Diplomate ECVAA & Urs Schatzmann* Dr Med Vet, Diplomate ECVAA

Constant current surface electrode stimulations were the most repeatable and gave clearer resposes.

Neurophysiological QST

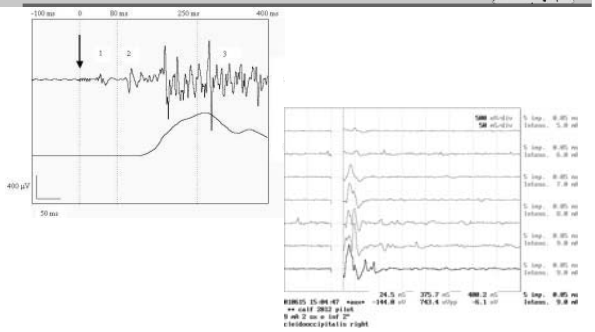
- Outcome is a recorded evoked reaction
- The reaction can be quantified
- Thresholds and stimulus-response curves can be determined
- Pharmacological modulation can be detected
- Less influenced by drugs altering behaviour
- Low threshold mechano- and thermoreceptors are not activated if electrical stimulation is used

Neurophysiological QST

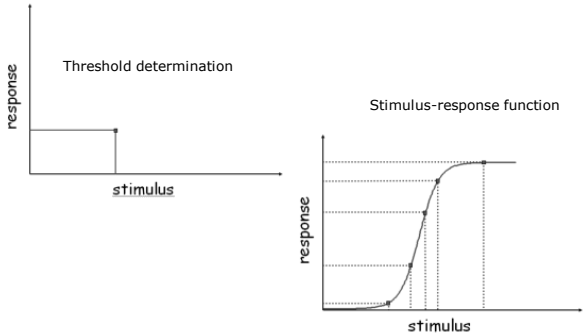


Nociceptive Withdrawal Reflex (NWR)
Trigemino-Cervical Reflex (TCR)

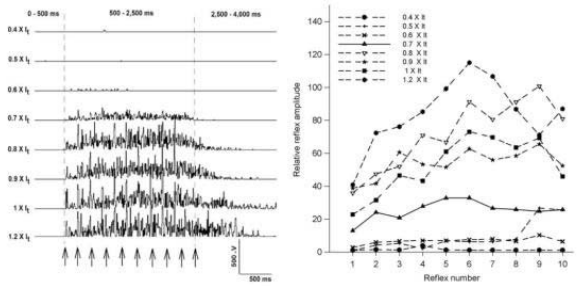
The NWR: Nociceptive Withdrawal Reflex



The NWR: Nociceptive Withdrawal Reflex



The NWR: Nociceptive Withdrawal Reflex



Temporal summation: biomarker for neurogenic pain

The Veterinary Journal 191 (2012) 101–107
Contents lists available at ScienceDirect
The Veterinary Journal
journal homepage: www.elsevier.com/locate/tvjl

Nociceptive trigeminal reflexes in non-sedated horses

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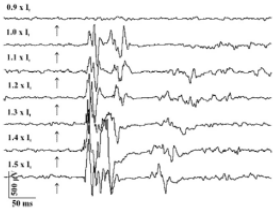
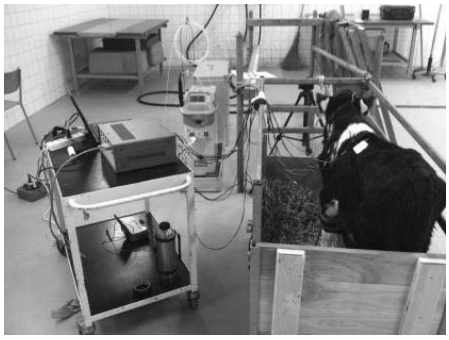
[b] Interuniversity Centre for Pain Neurophysiology, University of Genova, Via Dodecaneso 35, 16132 Genova, Italy



Neurophysiological QST



Conditioned Pain Modulation (CPM)

Extent of threshold change during application of a conditioninig noxious stimulus

QST in pre- and para-clinical drug testing

- Species-specific approach
- Focus on antinociceptive activity
- New and existing drugs
- Insight into mechanisms of action
- Investigation of several doses and infusion rates
- Support from/for clinical studies

Aim= Optimization of clinical veterinary practice

QST in clinical pain syndromes

- Characterization of spontaneously occurring pain syndromes
- Understanding of involved processing mechanisms
- Diagnosis of peripheral (and central) sensitization
- Mechanisms-based approach to therapy
- Treatment follow up

Aim= complemetary tool for a through understanding of cllinical pain conditions

Future development

- Improve quality and standardization of QST methods for nociceptive threshold determination
- Explore mechanisms of nociceptive processing involved in threshold determination methods to increase specificity
- Develop multi-tissue nociceptive markers and experimental sensitization methods