# *Creation and validation of the Italian version of the Glasgow Composite Measure Pain Scale-Short Form (ICMPS-SF)*

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**Keywords**
ICMPS-SF,
Dog,
Italian validation,
Pain scale,
Construct validity.

**Summary**
Objective To validate the Italian translation of the Glasgow Composite Measure Pain Scale – Short Form (ICMPS-SF) in order to assess acute pain in dogs. The original English-version of the scale (the Glasgow Composite Measure Pain Scale – Short Form - CMPS-SF) was translated into Italian according to a standard protocol to ensure linguistic and cultural validity. Nine Italian veterinary surgeons then recorded pain scores in dogs undergoing orthopaedic or soft tissue surgery using the ICMPS-SF at 2, 6, and 24 hours post-extubation. Construct validity was demonstrated using hypothesis testing. A total of 95 dogs were recruited into the study. Thirty-seven dogs underwent orthopaedic procedures and 58 dogs underwent soft tissue procedures. Twenty-three, 45, and 27 procedures were classified as mild, moderate, and severe, respectively. Statistically significant differences in the median pain scores were demonstrated between orthopaedic and soft tissue cases as well as among mild, moderate, and severe cases. Median pain scores decreased with time and changes were statistically significant. The ICMPS-SF demonstrated construct validity similar to the original English-language scale, resulting in a valid and reliable instrument for the assessment of acute pain in dogs by Italian veterinarians.

# *Creazione e validazione della versione italiana della* Glasgow Composit Measure Pain Scale-Short Form *(ICMPS-SF)*

**Parole chiave**
ICMPS-SF,
Cane,
Validazione italiana,
Scala del dolore,
Validità di costrutto.

**Riassunto**
Obiettivo di questo studio è stato validare la versione Italiana della *Glasgow Composite Measure Pain Scale – Short Form* (ICMPS-SF), finalizzata alla valutazione del dolore acuto nel cane. La versione originale in lingua Inglese della scala (la *Glasgow Composite Measure Pain Scale – Short Form - CMPS-SF*) è stata tradotta in Italiano secondo un protocollo standard per assicurarne la validità linguistica e culturale. Utilizzando la ICMPS-SF a 2, 6 e 24 ore dall'estubazione, nove veterinari italiani hanno poi registrato i punteggi relativi al dolore in cani sottoposti a chirurgia ortopedica o dei tessuti molli. La validità del costrutto è stata dimostrata usando il test delle ipotesi. Nello studio sono stati reclutati 95 cani, di cui 37 sottoposti a chirurgia ortopedica e 58 ad interventi sui tessuti molli. Degli interventi chirurgici effettuati, 23 sono stati considerati lievi, 45 moderati e 27 severi. Sono state riscontrate differenze statisticamente rilevanti nei punteggi medi tra i casi ortopedici e quelli dei tessuti molli e tra i tre livelli di gravità attribuiti alle chirurgie. La ICMPS-SF ha dimostrato validità di costrutto simile alla scala inglese originale, risultando uno strumento valido e affidabile per la valutazione del dolore acuto nei cani da parte dei veterinari italiani.

## Introduction

Pain is a complex, subjective, and emotional experience that is associated with several medical and surgical conditions. Recognising pain and assessing its intensity is an integral part of effective pain management. If pain is not recognised, it is unlikely to be treated. Moreover, if the intensity of pain is not appreciated, the selection of an appropriately potent analgesic will be hampered, resulting in a lack of pain relief (National Research Council 2009).

At present, there is no 'Gold standard' in assessing pain in animals. However, a presumptive diagnosis, a clinical examination (including the evaluation of psychomotor changes and pain behavioural expressions), the use of validated pain scales, and the response to therapy are all tools which, especially when combined, can help veterinary practitioners to recognise a painful subject and identify an appropriate therapy.

Pain scales are a valuable diagnostic aid, and provide the veterinarian with a ready-to-use tool. Indeed, attributing a score to a painful condition enables veterinarians to identify a therapeutic approach that is proportional to the degree of pain.

Unidimensional pain scales including the Visual Analog Scale (VAS), the Numerical Analogue Scale (NAS), the Numerical Verbal Scale (NVS), and the Simple Descriptive Scale (SDS) have been widely used in the assessment of pain in small animals (Anil *et al.* 2002, Wiese 2015). Unidimensional scales only measure a single parameter associated with pain, namely its intensity, but the contemporary approach to pain assessment emphasises the need to capture the affective component of the pain experience, or 'how it makes you feel', because it is this aspect of pain that causes the associated suffering. Unidimensional scales require the observer to make a subjective judgement of the animal's pain. Inter-observer variability is a problem when these scales are used in a busy practice environment where several observers may be assessing a single animal at different time-points (Holton *et al.* 1998). In order to limit this subjectivity, multidimensional scales have been created. These encourage the observer to evaluate different aspects of the patient's behaviour at rest and during interaction with the observer. A number of multidimensional scales are now available for scoring acute pain in dogs or cats, including the University of Melbourne Pain Scale, the 4AVet scales, the Glasgow Composite Measure Pain Scale – Short Form (CMPS-SF), and the UNESP-Botucatu Multidimensional Composite Pain Scale (UNESP-Botucatu MCPS) (Firth and Haldane 1999, Laboissière 2006, Reid *et al.* 2007, Brondani *et al.* 2011, Brondani *et al.* 2012, Brondani *et al.* 2013a, Brondani *et al.* 2013b).

The Glasgow CMPS-SF was derived from the original Glasgow composite measure pain scale (CMPS), a structured questionnaire completed by an observer following a standard protocol, which includes the assessment of spontaneous and evoked behaviours, interactions with the animal, and clinical observations (Holton *et al.* 2001, Morton *et al.* 2005). The CMPS was designed using psychometric principles, which are well established in human medicine for the measurement of complex and intangible constructs such as intelligence, pain, and quality of life. The psychometric approach to a scale design encompasses an established process of item selection, questionnaire construction, and testing for validity, reliability, and responsiveness, which ensures scientific soundness (Streiner and Norman 2008).

Validity (criterion, content, and construct) is the most fundamental attribute of an instrument because it provides evidence of the ability of the instrument to do the work it was built for (Morton *et al.* 2005, Cook & Beckman 2006, Streiner & Norman 2008).

Criterion validity is the agreement of a new instrument with an existing 'gold standard'. In the case of animal pain, a gold standard does not exist, and other forms of criterion validity must therefore be investigated (Souza & Silva 2005). Content validity focuses on the appropriateness and completeness of the items within the instrument. It is deemed to be present when items cover all the relevant aspects that have to be measured without including any extraneous features (Bullock & Tenebein 2002, Streiner & Norman 2008). Construct validity is demonstrated when hypotheses regarding the attribute(s) in question are upheld by the use of the instrument (Crellin *et al.* 2007).

The usefulness of a clinical instrument is markedly enhanced by having an intervention score as a guideline for analgesic treatment. A scoring system provides the veterinary practitioner with a clinical decision-making tool that can be used as an adjunct to their clinical judgement.

This was the purpose behind creating the CMPS-SF (Reid *et al.* 2007). The scale comprises 6 behavioural categories, with associated descriptive expressions (items): vocalisation (4), attention to wound (5), mobility (5), response to touch (6), demeanour (5), and posture/activity (5). Items are placed in increasing order of pain intensity and numbered accordingly. The observer chooses the item within each category that best describes the dog's behaviour and ranked scores are summed; the maximum pain score is 24, or 20 if mobility is impossible to assess. Consideration of a clinical decision-point for analgesia gave an intervention level for rescue analgesia of 6/24, and 5/20 when section B (mobility assessment) could not be carried

out. Because it was derived from the CMPS, with no new items added, the CMPS-SF scale retained the content validity of the original scale.

Construct validity of the CMPS-SF was initially demonstrated by proving the hypotheses that post-surgical pain decreases with time and that orthopaedic surgery is associated with a greater degree of pain intensity than soft tissue surgery. Subsequently, further evidence of construct validity and responsiveness of the scale was demonstrated in a study of dogs suffering from painful non-surgical as well surgical conditions, where the magnitude of the change in scores before and after the administration of analgesic corresponded to clinicians' interpretations of the change in the pain status (better, unchanged, worse) (Tait *et al.* 2011). Accordingly, the CMPS-SF has been shown to be suitable for the measurement of acute pain per se, and its use is not limited to post-operative pain.

Most healthcare measurement instruments have been developed in English. However, an instrument can be used in the international arena if it addresses the same concepts in all languages (Guillemin *et al.* 1993, Souza & Rojjanasrirat 2011). Accordingly, the original instrument needs to undergo a two-stage process to ensure that the translated version is conceptually equivalent to the original instrument; it is culturally relevant and acceptable to the target population within the target country; and it is psychometrically comparable (Guillemin *et al.* 1993; Beaton *et al.* 2000; Sperber 2004). The process involves a linguistic validation that aims to produce an appropriate translated version that deals with the linguistic and cultural aspects of the target language, followed by a psychometric validation that comprises a statistical evaluation of the properties of the target language version.

Given the absence of validated tools in the Italian language assessing acute pain in dogs, the aim of this study was to validate the Italian version of the CMPS-SF (ICMPS-SF), following the international guidelines proposed for cross-cultural validation (Beaton et al 2000, Streiner & Norman 2008, Souza & Rojjanasrirat 2011).

Three hypotheses were tested to demonstrate construct validity of the ICMPS-SF:

1. Following surgery, pain decreases with time;
2. In a veterinary context, orthopaedic surgery is associated with a higher degree of pain than soft tissue surgery;
3. If surgical procedures are classified as mild, moderate, and severe, intensity of pain will be mild, moderate, and severe, respectively.

## *Materials and methods*

### Linguistic validation

Linguistic validation was based on the standard linguistic validation process undertaken by the MAPI Institute (www.mapi-institute.com) and comprised 3 steps:

1. Forward translation: The original English tool was translated into Italian by 2 independent professional translators who spoke Italian as their mother-tongue. The 2 translated versions were synthesised by a third Italian mother-tongue person to produce a consensus version.
2. Backward translation: The consensus version was back-translated into the source language by 3 independent translators who spoke English as their mother-tongue. A comparison of the source questionnaire with the back-translation was then performed to check the conceptual content of the forward consensus version, in order to assess and control its quality.
3. Pilot Testing: The clarity, intelligibility, and appropriateness of the words (items) used in the translated version of the scale and cultural relevance of the target language version of the scale to the target population were evaluated by 15 Italian veterinarians who offered to participate in the validation process. The aim of this step was to acquire input from people from the representative end-user demographic and to incorporate their feedback.

### Training day

A training day was organised by the developer of the original scale with the 15 aforementioned veterinarians. A formal presentation of the basic principles of scale development and validation, with particular reference to the Glasgow CMPS-SF, was delivered. A focus group discussion followed (Pilot testing). Finally, participants took part in a practical session that included 4 canine surgical cases (1 orthopaedic, 3 soft tissue). The surgeries were carried out the same day in the surgical unit of the Department of Veterinary Clinical Science (University of Milan, Italy), and were selected for pain scoring in particular. All surgeries involved the administration of analgesic according to standard hospital protocol. The scale was applied once the dogs had fully recovered from the sedative effects of the anaesthetic drugs. After an initial demonstration of the examination protocol by JR, each case was individually scored by participants using the Italian Composite Measure Pain Scale – Short Form (ICMPS-SF). Scores were then compared and discussed, and any problems with the use of scale were addressed.

## Psychometric validation

### *Study protocol*

Dogs undergoing either orthopaedic or soft tissue surgery were recruited for the study by 9 veterinary surgeons who had participated in the training day. No restrictions were placed on the age, breed, or sex of recruited dogs. Cases that required local anaesthetic blocks (particularly epidural) were excluded from the study due to the effect on post-recovery mobility and the possibility to score up to the maximum 24.

**Table I.** *ICMPS-SF.*

**SHORT FORM OF THE GLASGOW COMPOSITE PAIN SCALE : Versione Italiana**

**Nome del Cane** _____

**Numero d'identificazione** _____ **Data** ____/____/____ **Ora** ____:_____

**E' stato eseguito un intervento chirurgico ?** SI / NO (barrare la risposta corretta)

**Tipo di intervento chirurgico eseguito** _____

*Per ogni serie di domande cerchiare il punteggio corrispondente alla risposta più appropriata. La somma dei vari punteggi rappresenta il punteggio totale*

**A. Osserva il cane nella gabbia**

Il cane è?

| (I) | | (II) | |
|---|---|---|---|
| Calmo | 0 | Ignora qualsiasi ferita o area dolente | 0 |
| Piange o Uggiola | 1 | Osserva la ferita o l'area dolente | 1 |
| Geme o mugola | 2 | Lecca la ferita o l'area dolente | 2 |
| Urla, grida | 3 | Strofina la ferita o l'area dolente | 3 |
| | | Morde la ferita o l'area dolente | 4 |

In caso di fratture della colonna, della pelvi, in presenza di fattura multiple agli arti, o se è necessaria assistenza per consentire la locomozione non completare la **sezione B**, barrare la seguente casella ☐ e procedere direttamente con la compilazione della **sezione C.**

**B. Mettere il guinzaglio al cane ed incoraggiarlo ad uscire dalla gabbia**

Quando il cane si alza/cammina è ?

| (III) | |
|---|---|
| Normale | 0 |
| Zoppica | 1 |
| Lento o riluttante | 2 |
| Rigido | 3 |
| Rifiuta di muoversi | 4 |

**C. Se ha una ferita o un'area dolente esercitare una lieve pressione attorno a quest'area ad una distanza di circa 1-3 cm.**

Cosa fa il cane ?

| (IV) | |
|---|---|
| Niente | 0 |
| Osserva la ferita o l'area dolente | 1 |
| Si sottrae | 2 |
| Ringhia / protegge l'area | 3 |
| Tenta di mordere | 4 |
| Piange | 5 |

**D. Valutazione Generale**

Il cane è ?

| (V) | |
|---|---|
| Felice e contento o felice e vivace | 0 |
| Calmo/quieto | 1 |
| Indifferente / non reagisce agli stimoli ambientali | 2 |
| Nervoso o ansioso o impaurito | 3 |
| Depresso | 4 |

Il cane è ?

| (VI) | |
|---|---|
| A proprio agio | 0 |
| Infastidito/ turbato | 1 |
| Agitato, non sta fermo | 2 |
| Cifotico o contratto | 3 |
| Rigido | 4 |

**PUNTEGGIO TOTALE** (I+II+III+IV+V+VI)=_____

Otherwise there were no restrictions on surgical procedure. All recruited dogs received anaesthesia and analgesia according to the normal practice of the clinic. All dogs were sufficiently recovered from the effects of anaesthesia to allow full participation in the scale's standard examination protocol.

Demographic and surgical procedural details, anaesthetic and analgesic administration, time of endotracheal extubation, and post-operative analgesic administration were recorded for each dog. Participants recorded pain scores using the ICMPS-SF at 2, 6, and 24 hours post-endotracheal extubation.

### *Statistical analysis*

Surgical procedures were coded according to the type of procedure – soft tissue or orthopaedic – and to the associated surgical severity – mild, moderate, or severe.

Box plots and descriptive statistics were used initially to gain an impression of how the pain scores varied at the different time points for dogs that had undergone orthopaedic surgery compared with dogs that had undergone soft tissue surgery and to compare pain scores when the surgical severity was classified as mild, moderate, or severe. A formal analysis was then applied. This involved fitting a series of repeated measures 2-way ANOVA (random effect) models to explore time, group (surgery type or surgery severity), and interaction effects. Where statistically significant effects were found, follow-up comparisons were performed (using the Wilcoxon Mann Whitney and Wilcoxon signed ranks test). A significance level of 0.05 was selected. All statistical analyses were performed using the software statistical package MINITAB 15.

**Table II.** *List of dog breeds.*

| Dog breeds | Number |
|---|---|
| Labrador | 10 |
| Mixed breed | 30 |
| Bichon Frisee | 1 |
| German Shepherd | 7 |
| Great Dane | 1 |
| Boxer | 5 |
| Italian Greyhound | 1 |
| Dogue de Bordeaux | 1 |
| Jack Russell | 2 |
| Beagle | 1 |
| Schnautzer | 2 |
| Bergamasco Shepherd | 2 |
| Cocker Spaniel | 2 |
| Golden Retriever | 4 |
| Poodle | 3 |
| Dachshund | 4 |
| Basset Hound | 1 |
| Pomeranian | 1 |
| English Bulldog | 1 |
| Rottweiler | 2 |
| Cavalier King Charles Spaniel | 2 |
| Doberman | 2 |
| Pekinese | 1 |
| Miniature Pinscher | 1 |
| Volpino Italiano | 1 |
| Saluki | 1 |
| Pitbull | 2 |
| Springer spaniel | 1 |
| Pointer | 1 |
| Corgi | 1 |

## *Results*

### Linguistic validation

Details of the translation and final consensus version of the ICMPS-SF are shown in Appendix (supplementary materials[1]) and Table I, respectively.

Despite a high level of discussion and engagement during the focus group, no changes to the consensus version of the scale were suggested. This confirmed the clarity, intelligibility, and appropriateness of the words used in the translated version of the scale and the cultural relevance of the target language version to the target population.

### Psychometric validation

#### *Animals & surgical procedures*

A total of 104 dogs were recruited to the study, 52 from university practices and 52 from private clinics. Of these, 9 dogs were excluded from the analysis because of missing information or because the mobility category had not been completed. The mean +/- SD age of the remaining 95 dogs was 7.1 ± 4.4 years (range: 3 months-14 years). Thirty dog breeds were represented, as shown in Table II. Details of the surgical procedures that were carried out are shown in Table III. Of the procedures that were performed, 37 were orthopaedic and 58 were soft tissue. Twenty-three procedures were classified as mild in terms of surgical severity, 45 were moderate, and 27 severe.

Anaesthetic and analgesic protocols were very variable and consequently are not reported in detail. In summary, with the exception of a number of dogs in 1 private practice where no pre-medication was

[1] Appendix (as Supplementary materials) may be requested from the corresponding author.

**Table III.** *List of surgical procedures and their classification.*

| Procedure | Surgery type* | Surgical severity | Number |
|---|---|---|---|
| Pelvic # | O | severe | 2 |
| Thoracoscopy | ST | mild | 1 |
| Pyometra | ST | moderate | 2 |
| TPLO | O | severe | 12 |
| Salivary gland excision | ST | moderate | 1 |
| CCL repair | O | moderate | 5 |
| Amputation limb | O | severe | 1 |
| Mastectomy | ST | moderate | 2 |
| # Elbow | O | severe | 1 |
| Patellar luxation | O | moderate | 2 |
| Excision femoral head | O | moderate | 2 |
| Ulnar ostectomy | O | severe | 1 |
| Herniated T/L disc | O | severe | 1 |
| Splenectomy | ST | moderate | 3 |
| Oral tumour | ST | mild | 1 |
| Bilateral entropion | ST | mild | 1 |
| # maxilla | O | severe | 1 |
| Thoracotomy | ST | severe | 1 |
| # long bone | O | severe | 5 |
| Partial excision pinna | ST | moderate | 1 |
| TECA + bulla osteotomy | ST | severe | 1 |
| Perianal adenectomy + castration | ST | moderate | 2 |
| Tibial crest advancement | O | severe | 1 |
| Splenectomy + arytenoid lateralisation | ST | moderate | 1 |
| Extracapsular tendon repair | ST | moderate | 1 |
| Liver biopsy + mastectomy | ST | moderate | 1 |
| Arytenoid lateralisation | ST | moderate | 1 |
| Perianal gland adenoma | ST | moderate | 1 |
| Maxillectomy | O | severe | 1 |
| Cystotomy | ST | moderate | 4 |
| Punch biopsy granuloma dorsal foot | ST | mild | 1 |
| Cryptorchid castration | ST | moderate | 1 |
| Prolapsed 3rd eyelid | ST | mild | 1 |
| Castration | ST | mild | 5 |
| Castration + FNA prostate | ST | mild | 1 |
| Ablation of small skin tumour | ST | mild | 5 |
| Small mass upper eyelid | ST | mild | 1 |
| Ovariohysterectomy + colposuspension | ST | moderate | 1 |
| Ovariohysterectomy | ST | moderate | 6 |
| Skin biopsy | ST | mild | 1 |
| Aural haematoma drainage | ST | mild | 2 |
| Reconstruction of shearing injury foot | ST | moderate | 1 |
| Gastroscopy + biopsy | ST | mild | 1 |
| Biopsy pad | ST | mild | 1 |
| Exploratory laparotomy + gastrotomy | ST | moderate | 1 |
| Plate removal & ext fixator | O | moderate | 1 |
| Perineal mass removal | ST | mild | 1 |
| Ovariohysterectomy + gastropexy | ST | moderate | 1 |
| Splenectomy + BM biopsy | ST | moderate | 1 |
| Elbow arthroscopy | O | moderate | 1 |
| Enucleation | ST | moderate | 1 |

* O = orthopaedic surgery; ST = soft tissue surgery.

**Table IV.** *Descriptive statistics for the pain scores generated by the ICMPS-SF for orthopaedic (O) and soft tissue (ST) cases at 2, 6 and 24hrs.*

| Time point (hrs) | Surgery type | No of dogs | N* | Median | Range | Q1 | Q3 |
|---|---|---|---|---|---|---|---|
| 2 | O | 31 | 6 | 4 | 0 - 8 | 3 | 5 |
| | ST | 57 | 1 | 3 | 0 - 9 | 1 | 4 |
| 6 | O | 37 | 0 | 3 | 0 - 9 | 2 | 5 |
| | ST | 55 | 3 | 2 | 0 - 7 | 1 | 3 |
| 24 | O | 36 | 1 | 2 | 0 - 10 | 1 | 4 |
| | ST | 53 | 5 | 1 | 0 - 6 | 0 | 3 |

N* denotes number of missing observations. Q1 and Q3 are the lower and upper quartiles of the distribution of pain scores.
O = orthopaedic surgery; ST = soft tissue surgery.

administered, most dogs were pre-medicated with an alpha2-adrenoceptor agonist or acepromazine in combination with an opioid. Induction of anaesthesia was performed with propofol on most occasions and maintained with isoflurane. Combinations of morphine, methadone, fentanyl, sufentanil, lignocaine, and ketamine were commonly administered by continuous rate infusion intra-operatively, especially in those procedures classed as moderate or severe. The use of non steroidal antinflaammatory drugs such as carprofen, firocoxib, and meloxicam was largely restricted to the post-operative period, although on occasion carprofen and meloxicam were administered during an earlier stage. Other analgesics administered for the purpose of post-operative pain relief were opioids such as tramadol.

## Experimental study

### *Orthopaedic (O) vs soft tissue (ST) surgery*

The descriptive statistics for orthopaedic (O) and soft tissue (ST) surgical cases at time points 2, 6, and 24 hours are shown in Table IV. These findings, combined with those in Figure 1, show how the pain score changed over time within these 2 groups.

Using a 2-way ANOVA, the following hypotheses were tested: a) The median pain score is different between O and ST cases; b) The median pain score changes over time; c) There is a statistically significant interaction between time and surgery type. The modelling strategy first fit the full model, including main effects and interactions, and then removed sequentially any terms that were not statistically significant.

After fitting the full model, there was not a statistically significant interaction between time and type of surgery, indicating that the rate of decline in pain score with time was the same for O and ST. This term was therefore removed and the model re-fit. Table V shows the final model.

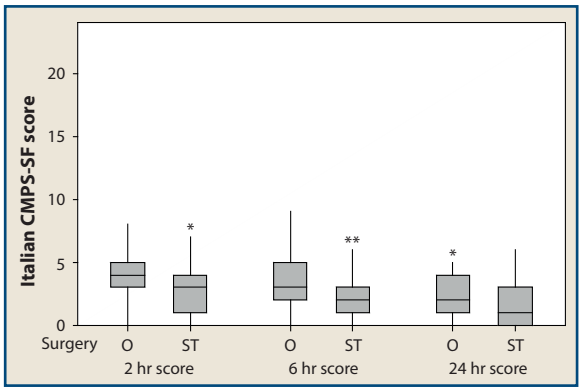


**Figure 1.** *Box and whisker plot of pain scores for orthopaedic (O) (n = 37) and soft tissue (ST) (n = 58) surgical cases at 2, 6 and 24 hrs.* Each box is the interquartile range; the horizontal line within each box is the median. Whiskers represent the range excluding outliers. The asterisk represents an outlier.

**Table V.** *Two-way repeated measures Analysis of Variance for pain score, using Adj(usted) SS for F- tests.*

| Source | DF | Seq SS | Adj SS | Adj MS | F | P-value |
|---|---|---|---|---|---|---|
| surgery type | 1 | 97.062 | 105.937 | 105.937 | 14.87 | 0.000 |
| time (2, 6, 24) | 2 | 72.839 | 78.280 | 39.140 | 25.82 | 0.000 |
| dog ID | 93 | 678.910 | 678.910 | 7.300 | 4.82 | 0.000 |
| Error | 172 | 260.720 | 260.720 | 1.516 | | |
| Total | 268 | 1109.532 | | | | |

DF = degrees of freedom; SS = sum of squares; MS = mean square; F = statistic and p-value.

Statistically significant differences in the median pain score between orthopaedic and soft tissue cases and in the median pain score changes with time were demonstrated (both p-values < 0.001). A series of non-parametric (Wilcoxon Mann Whitney and Wilcoxon signed ranks) follow-up comparisons of the median pain scores (overall 95% confidence intervals) were constructed, in the first case between O and ST at 2, 6, and 24 hours and in the second case, for O and ST separately, between sets of 2 distinct time points.

At 2 hours, the median pain score for ST was highly likely to be between 1 and 2 lower than the median pain score for O cases. At 6 hours, the median pain score for ST was highly likely to be between 1 and 2 lower than the median pain score for O cases. At 24 hours, there was no evidence of a difference in the median pain score, since the 95% confidence interval included 0. Overall, both comparisons at 2 and 6 hours showed that the median pain score for O was higher than for ST, but at 24 hours, there was no evidence of a difference.

Comparing time 6 versus time 2 in ST dogs yielded the following findings: The median pain score at 6 hours was highly likely to be between 0.5 and 1 points lower than at 2 hours; analogously comparing time 24 versus time 2, the median pain score at 24 hours was highly likely to be between 0.5 and 1.5 points lower than at 2 hours. Conversely, there was not a statistically significant difference in the median pain scores between 6 and 24 hours, since the 95 % confidence interval includes the 0 value.

Comparing time 24 versus time 2 and versus time 6 in O dogs yielded the following results: The median pain score at 24 hours was highly likely to be between 1 and 2.5 points lower than at 2 hours and between 0.5 and 1.5 points lower than at 6 hours. There was not a statistically significant difference in the median pain scores between 2 and 6 hours, since the 95% confidence interval includes the 0 value.

Overall, for both procedures, a 95 % confidence interval for the difference in the median pain score at 2 time points was obtained.

### *Mild vs moderate vs severe surgical severity*

The descriptive statistics for cases classified as mild, moderate, and severe at time points 2, 6, and 24 hours are shown in Table VI. When combined with findings from Figure 2, these findings show how the pain score changes over time within the 3 – mild, moderate, and severe – groups.

The repeated measures 2-way ANOVA model tested the following hypotheses: a) The median pain score is different between mild, moderate, and severe cases; b) The median pain score changes over time; c) There is a statistically significant interaction between time and surgical severity. The modelling strategy fit first the full model, including main effects and interactions, and then removed sequentially

**Table VI.** *Descriptive statistics for the pain scores generated by the ICMPS-SF for cases classified as mild, moderate and severe surgical severity at 2, 6 and 24hrs.*

| Time point (hrs) | Surgery type | No of dogs | N* | Median | Range | Q1 | Q3 |
|---|---|---|---|---|---|---|---|
| 2 | mild | 23 | 0 | 1 | 0 - 7 | 1 | 4 |
| | moderate | 40 | 5 | 3 | 0 - 9 | 1 | 4 |
| | severe | 25 | 2 | 5 | 2 - 8 | 3 | 5.5 |
| 6 | mild | 21 | 2 | 1 | 0 - 4 | 0 | 2 |
| | moderate | 44 | 1 | 2 | 0 - 8 | 1 | 4 |
| | severe | 27 | 0 | 4 | 1 - 9 | 2 | 5 |
| 24 | mild | 20 | 3 | 0 | 0 - 3 | 0 | 1.75 |
| | moderate | 43 | 2 | 1 | 0 - 5 | 1 | 3 |
| | severe | 26 | 1 | 3 | 1 - 10 | 1 | 4 |

N* denotes number missing. Q1 and Q3 are the lower and upper quartiles of the distribution of scores

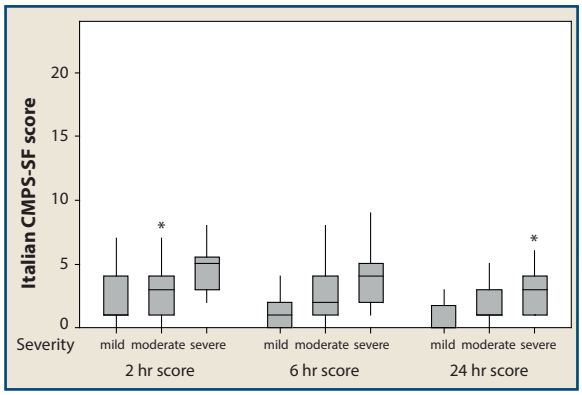


**Figure 2.** *Box and whisker plot of pain scores for cases classified as mild (n = 23), moderate (n = 45) and severe (n = 27) at 2, 6 and 24 hrs.* Each box is the interquartile range; the horizontal line within each box is the median. Whiskers represent the range excluding outliers. The asterisk represents an outlier.

**Table V.** *Two-way repeated measures Analysis of Variance for pain score, using Adj(usted) SS for Tests.*

| Source | DF | Seq SS | Adj SS | Adj MS | F | P-value |
|---|---|---|---|---|---|---|
| severity | 2 | 187.812 | 176.96 | 88.483 | 14.05 | 0.000 |
| time (2, 6, 24) | 2 | 71.339 | 78.280 | 39.140 | 25.82 | 0.000 |
| dog ID | 92 | 589.660 | 589.660 | 6.409 | 4.23 | 0.000 |
| Error | 172 | 260.720 | 260.720 | 1.516 | | |
| Total | 268 | 1109.532 | | | | |

DF = degrees of freedom; SS = sum of squares; MS = mean square; F = statistic and p-value.

any terms that were not statistically significant.

The final model (Table VII) shows that there was a statistically significant difference in the median pain scores between mild, moderate, and severe cases, and that the median pain score changed with time (both p-values < 0.001). There was no statistically significant interaction between time and surgical severity.

Follow-up comparisons using 95% confidence intervals (adjusted for multiple comparisons) for the difference in median pain scores over the severity groups at each time point are reported separately below.

At 2 hours, median pain score for severe cases was highly likely to be between 2 and 4 higher than for mild cases, and between and 1 and 2 higher than for moderate cases. The median pain score for moderate cases was not statistically different to mild cases.

At 6 hours, the median pain score for severe cases was highly likely to be between 1 and 3 higher than for mild cases, but not statistically different to moderate cases, and median pain score for moderate cases was not statistically different to mild cases.

At 24 hours, the median pain score for severe cases was highly likely to be between 1 and 3 higher than for mild cases, and between 0.5 and 1 higher than for moderate cases, but the median pain score for moderate cases was not statistically different to mild cases.

## Discussion and conclusions

This study was performed in order to validate the Italian version of the Glasgow Composite Measure Pain Scale – Short Form (CMPS-SF) and to evaluate acute pain in dogs. The process of translation, cultural adaptation, and psychometric testing were performed according to the rules commonly reported in relevant literature. The results obtained from this analysis confirm linguistic and cultural validation and construct validity of the Italian version of the scale for the evaluation of acute pain in dogs.

The experimental study was conducted under clinical conditions with no restrictions other than the exclusion of dogs where the use of local anesthetic blocks might interfere with post-operative mobility.

The hypotheses tested to assess the construct validity of the scale were 1) the median pain score will change over time as healing takes place; 2) the median pain score will differ between O and ST cases; 3) the median pain score will differ between mild, moderate, and severe cases. These hypotheses have been used in human medicine for the validation of pain scales for pediatric patients (Bullock & Tenenbein 2002, Manworren & Hynan 2003). A similar method has been described in other studies where pain scales for dogs were validated (Morton *et al.* 2005, Murrell *et al.* 2008), and evaluated not only the content and construct validity, but also the responsiveness of the instrument (Baeyer & Spagrud, 2007). In this study the sensitivity to change was confirmed by changes in pain scores obtained during the post-operative period.

There was large variation in pain scores for all dogs within each group (orthopaedic versus soft tissue; mild versus moderate versus severe) and also considerable overlap in pain scores between each group. This is not surprising given the heterogeneous nature of the dogs (ages, breeds), the surgical procedures, and the anaesthetic and analgesic protocols that were employed. Nevertheless, our results confirmed that the ICMPS-SF did perform in accordance with the expected pain profile following surgery when used as a repeat monitoring tool (thus proving hypothesis 1: following surgery, pain decreases with time). Additionally, this study demonstrated a difference between the intensity of pain resulting from orthopaedic and soft tissue procedures, ICMPS-SF scores for the O group being higher than the ST group throughout the evaluation period (thus proving hypothesis 2: orthopaedic surgery is associated with

a higher degree of pain than soft tissue surgery). Similarly results demonstrated a difference between the intensity of pain resulting from surgical procedures classified as mild, moderate, or severe (thus proving hypotheses 3: the intensity of pain decreases with the degree of surgical severity), although follow-up comparisons showed that at some individual time points the difference between groups did not achieve statistical significance. This may in part be due to the hangover effect of the CRI analgesic infusions, which were a feature of the moderate and severe groups, but not of the mild group. Additionally, the allocation of cases into mild, moderate, and severe groups was made on a purely subjective basis based on clinical impression. In conclusion, in the 2 sets of analyses, we have been able to demonstrate construct validity of the ICMPS-SF similar to that demonstrated initially for the original English-language version of the scale. This is sufficient to ensure that the 2 scales will perform in a similar manner in similar circumstances and that the same intervention level of the original English version of 6/24, or 5/20 when section B (mobility assessment) could not be carried out (Reid *et al.* 2007), can be applied.

As a result, Italian veterinarians can be confident in using the ICMPS-SF to assess acute pain of any origin in dogs.

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