

Collegiate Inventors Competition®

Sample Patent/Literature Search

Appendix A

Patent/literature Search

The dolognawmeter is a novel device that shares little with other patented devices. Below, I document three patents that are tangentially related to my device and I systematically review the existing literature that is more germane to the function of the dolognawmeter.

Patent Search:

Although the first two patents below are for devices that quantify pain or the pain threshold, these devices are dissimilar from the dolognawmeter. These first two instruments are used on human subjects and are not useful for indexing pain in animals. These first two devices also do not measure pain associated with oral function as my instrument does. No patents for gnawing assays exist. While significantly different from my instrument, the third patent is listed below for completeness.

(patent #5941833) Heatbeam dolorimeter for pain and sensory evaluation- Used to determine pain tolerance on the skin of human subjects.

- Not used on animals
- Does not work for oral pain
- Does not assay pain during function
- Does not assay chronic pain

(patent #4641661) Electronic Algesimeter- Measures pain threshold on the skin of human subjects.

- Not used on animals
- Does not work for oral pain
- Does not assay pain during function
- Does not assay chronic pain

(patent #6907280) Method and apparatus for objectively measuring pain, pain treatment and other related techniques-

This method recruits a variety of modern brain imaging techniques such as PET, MEG, EEG, fMRI and employs a method to correlate signals in the Central Nervous System with “pain regions” in the brain.

While it is theoretically possible to pursue this technique in animals (the patent specifically mentions animals), it would be extraordinarily expensive to carry out the brain imaging techniques in an iterated fashion for the assessment of chronic pain in groups of laboratory rodents. Moreover, movement of the head during oral function would preclude use of a behavioral assay in a device such as an fMRI in which the animal’s head would be restrained. Lastly, the brain imaging techniques would entail excessive manipulation of the animals and that would preclude normal and consistent oral function.

Literature Search:

Chronic Orofacial Pain Assays In Animals: While assays of stereotyped behaviors (e.g., rubbing and flinching of the head) can be used as an index of acute orofacial pain, assays of stereotyped behavior have not proven useful for objectively measuring chronic pain in animals (Roveroni et al. 2001). More recently, however, Ro (2005) has described a method for the study of inflammatory muscle hyperalgesia (a type of pain). In this study, trained rats achieve lower bite forces with induced muscle (masseter) inflammation. However, a significant effect was demonstrated only for the first three days after induction of inflammation. Beyond day three, significant bite force attenuation was not demonstrated. Thus, this method does not seem amenable to measuring *chronic* pain. Moreover, the oral function of the animal in this study is related to muscle intensity and not duration. Thus, the animal behavior is not immediately analogous to the oral behaviors that elicit pain in patients.

To infer pain in a model of chronic TMJ or masticatory muscle pain, an assay quantifying meal duration, meal size, and inter-meal interval has been developed and termed a “meal specificity” assay. (Harper et al. 2000; Harper et al. 2001; Kerins et al. 2005). Rats with TMJ inflammation exhibit longer meal duration but have decreased food consumption (Harper et al. 2000). Kerins et al., demonstrated that an extended duration (reduced rate) of feeding is indicative of TMJ pain (Kerins et al. 2005). We (Dolan and Schmidt) have used similar computerized feeding assays and found them to be cumbersome because rodents gnaw through more pellets than they consume. To calculate the quantity of food consumed, the mass of partially gnawed pellet debris must be subtracted from the total quantity of food that was dispensed. Determining the exact mass of pellet debris that is dispersed throughout the cage and that mixes with feces and urine is laborious, not easily reproducible, and prone to error.

Meal specificity assays are also limited in their ability to resolve behavioral changes due to orofacial pain versus pain originating elsewhere in the body because rodents with non-trigeminal pain also demonstrate a reduced feeding rate (Kerins et al. 2005). To show a significant difference between orofacial and non-trigeminal nociception (pain), investigators have looked at inter-meal interval (Kerins et al. 2005). However, inter-meal interval is an even more indirect method of demonstrating functional debilitation resulting from pain. In addition, feeding assays are fundamentally prone to error because they are potentially confounded by all variables that affect appetite. Appetite, which will affect the outcome variable, can be altered by analgesics, systemic disease, time of day, duration of the study and reward associated with consumption. Moreover, pain that originates outside of the trigeminal system reduces appetite and affects feeding in humans and rats (Jain et al. 2000; Malick et al. 2001).

Relevant Oral Function Assays for Animals: In an attempt to quantify gnawing function, Ayada et al. (2002) demonstrated that a mouse confined in a narrow tube will gnaw on an object obstructing forward movement. A plastic strip was placed across the end of a tube and a mouse was allowed to gnaw at the strip in an attempt to escape. The mass of the plastic strip was taken before the experiment and then again after the mouse was allowed to gnaw for a *predetermined* quantity of time. The mass of plastic gnawed off

the strip was used as a proxy for gnawing activity. However, since the Ayada experimental setup precluded escape from the confinement tube, the mouse was never rewarded for accomplishing the gnawing task. Subsequently, consistent gnaw baselines are difficult to establish using the Ayada apparatus. Moreover, an observer is required to monitor the experiment and replace the plastic strip if necessary. Extensive animal observation during the experiment is laborious, expensive, and not workable on a large scale. Most importantly, human intervention during the gnawing trial drastically affects the outcome of the experiment by disturbing the animal. The Ayada experimental setup is not patented and is comprised of a tube and a plastic strip that are stationary for the duration of the experiment.

Aspects of the Dolognawmeter Not Available in Other Published or Patented Assays of Chronic Orofacial Pain:

No patented or published animal pain assay parallels the type or duration of oral functions that elicit pain in patients with chronic orofacial pain. Studies on patients with TMJ and masticatory muscle pain demonstrate that both the type and duration of oral function is critical in determining the amount of pain that a patient experiences. To parallel the human condition, I designed the dolognawmeter to measure the duration of gnawing required to complete a discrete task. Animals that are placed into the dolognawmeter perform a masticatory function analogous to the behavior that elicits orofacial pain in patients. Moreover, the animal is required to perform the task over an extended period as might be experienced during the daily oral functioning of a patient. The dolognawmeter is not dependent on appetite, subjective behavioral interpretation, laborious techniques, or extensive animal observation. Moreover, the dolognawmeter is objective and standardized so that the results are directly comparable across laboratories and can be employed by personnel with only basic rodent handling experience.

References

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