Injection pain is perceived in the brain

By Steven G. Goldberg, DDS

The International Association for the Study of Pain defines pain as, “an unpleasant sensory and emotional experience associated with actual or potential tissue damage.” As dentists, it is our great fortune to have acquired the necessary skills to help alleviate the pain of those who are suffering. Isn’t it ironic that the beginning of each dental procedure to alleviate pain begins with a needle injection causing tissue damage resulting in additional pain?

How injections cause pain

- Transduction: A needle injection of local anesthetic becomes a noxious stimulus as it pierces the oral mucosa, causing tissue damage as well as tissue distention and tearing with the submucosal deposition of anesthetic solution. Nociceptors, specialized primary sensory neurons located under the surface of oral tissues, encode this noxious stimuli, converting it into nerve impulses known as action potentials.

- Conduction: The impulses travel along A-delta and C nerve fibers to the spinal cord. It is in the dorsal horn of the spinal cord where it undergoes synaptic transmission and then continues on to the brain. Note: In the case of oro-facial pain, the signal passes through the trigeminal ganglion and then on to the brain.

- Perception: Once in the thalamus, nerve impulses are directed to the somatosensory cortex of the brain. This is where the occurrence of tissue damage is perceived as pain, emotionally processed and acted upon, a process known as nociception.

The Gate Control Theory

Thanks to the work of Drs. Ronald Melzack and Patrick Wall in 1965, we know that there is a “Gating” mechanism located in synapses within the dorsal horn of the spinal cord and similarly in the trigeminal ganglion. This “gate” can either block pain signals or permit them to travel to the brain.

When a counter-stimulation (in this case, vibration) is applied in close proximity during a painful occurrence (e.g., a dental injection), the sensation of vibration reaches the sensory area of the brain first, resulting in a closure of the synaptic pain gate to the sensation of pain — a process known as modulation.

DentalVibe blocks injection pain

I invented the DentalVibe to tap into the merits of the Gate Control Theory by effectively stimulating cutaneous mechanoreceptors, Pacinian and Meissners’ Corpuscles, as a counter-stimulation to injection pain. It is a patented, handheld, cordless device that delivers soothing, pulsed vibrations via a disposable, bifurcated, latex-free comfort tip to the site where an injection is simultaneously administered. This specialized tip is laser calibrated to a specific frequency and amplitude, sending the sensation of vibration to the brain along A-beta nerve fibers, effectively closing the pain gate.

I have personally received the ultimate compliment from Melzack himself, with gracious permission to publish this quote: “Dear Dr. Goldberg, You’ve found an interesting and clinically useful way to diminish pain! Good for you! Best Wishes, Ronald Melzack.”

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About the author

Dr. Steven G. Goldberg, DDS, FADFE, graduated from New York University’s College of Dentistry and has been in private practice for more than two decades. He founded Bing Innovations to bring to market the DentalVibe Injection Comfort System, which is being used by dentists in private practice and in dental schools in the United States and in more than 25 other countries.