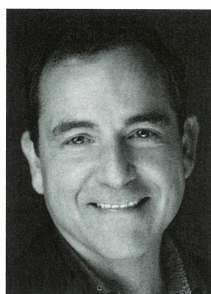


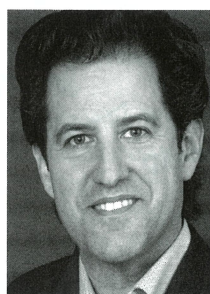
# High-Frequency Neuromodulation with the Dental Pain Eraser for Nonpharmacologic Pain Relief in Orthodontic Practice

COSMO HARALAMBIDIS, DMD  
JONATHAN NICOZISIS, DMD, MS

**T**he application of an electrical stimulus to modify nerve function—known as high-frequency neuromodulation—has been used since the 1960s for the management of craniofacial pain. Today, it has become a common treatment for chronic pain conditions and other neurological disorders.<sup>1</sup>



Dr. Haralambidis



Dr. Nicozisis

Dr. Haralambidis is President and CEO of Synapse Dental, LLC, and in the private practice of orthodontics at Cranston Orthodontics, 59 Phenix Ave., Cranston, RI 02920; e-mail: info@drcosmo.com. Dr. Nicozisis is a member of the Clinical Advisory Council of the *Journal of Clinical Orthodontics*, an international lecturer, and in the private practice of orthodontics in Princeton and West Windsor, NJ. He is on the Synapse Clinical Advisory Board.

## KRAVITZ KEYS

- The Dental Pain Eraser\* is a portable, pen-shaped neuromodulation device for pain relief.
- Electrodes from the device cause a reversible conduction block.
- The required time of application averages around 30 seconds, but varies depending on the need.
- On average, relief occurs within 20 seconds of application to a single tooth or within two minutes of application to a broader area.

Synapse Dental recently introduced a device that uses high-frequency neuromodulation to manage the pain response in the oral cavity, which commands a considerable share of the brain's neural function.<sup>2</sup> The Dental Pain Eraser, a portable, pen-shaped tool, delivers a nonpharmacologic, noninvasive, and medically validated means of controlling oral discomfort. The device has received FDA regulatory clearance (510k) for clinical and prescription home use.

This article outlines the science behind neuromodulation and describes the procedure for using the Dental Pain Eraser to relieve patient pain during orthodontic procedures.

\*Synapse Dental, LLC, Cranston, RI; [www.dentalpaineraser.com](http://www.dentalpaineraser.com).

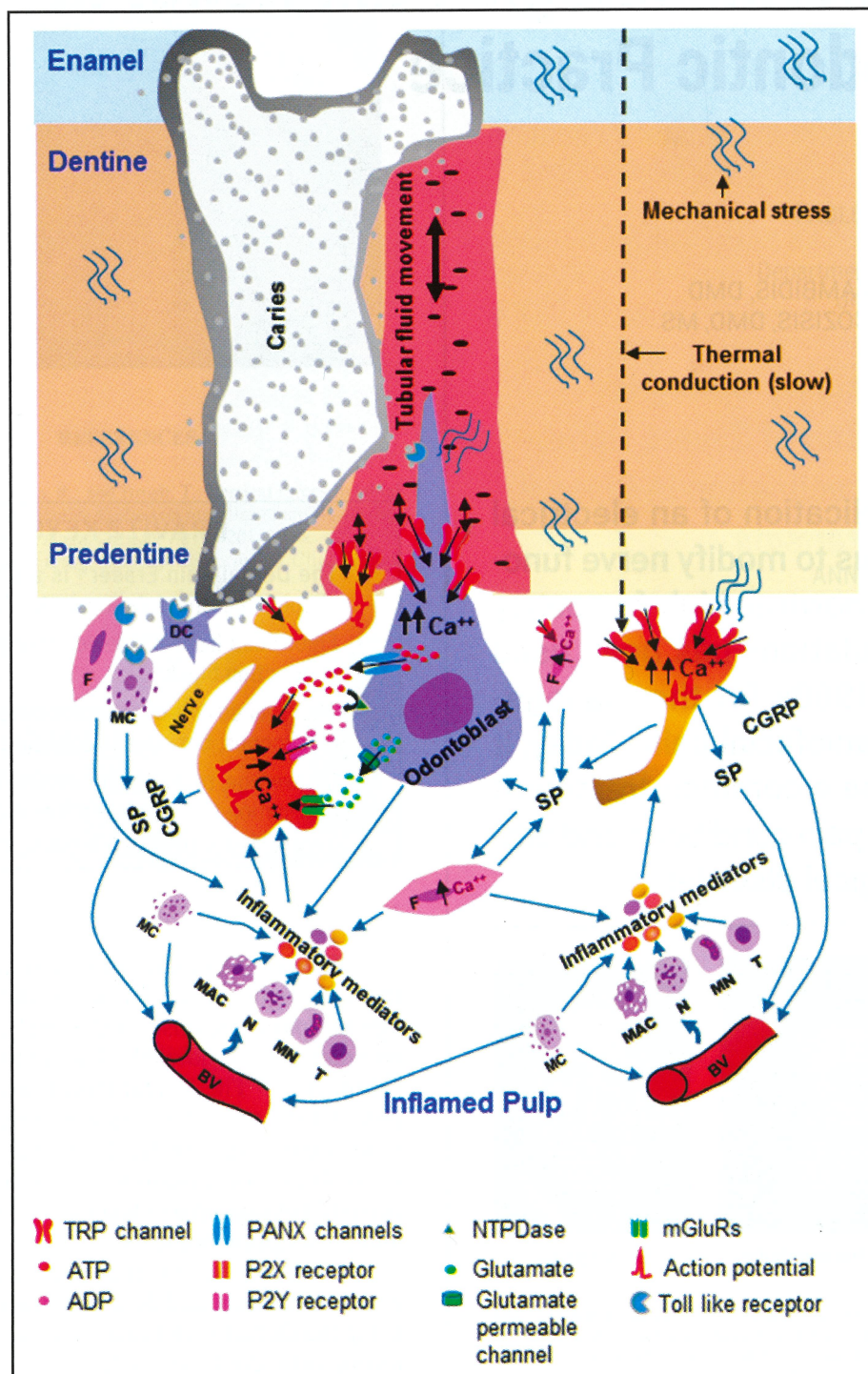


Fig. 1 Mechanisms by which transient receptor potential (TRP) channels transduce dental pain and trigger inflammation (blue arrows = release of inflammatory mediators). (Reprinted from Hossain and colleagues.<sup>3</sup>)



## High-Frequency Neuromodulation for Dental Pain

A groundbreaking 1992 study<sup>4</sup> demonstrated the role of central nervous system (CNS) processing in the pain response.<sup>5</sup> In this study, capsaicin was injected at a specific site, and a mechanical stimulus was then applied to an area near the point of injection. Subjects interpreted the stimulus as painful,<sup>4</sup> suggesting that the injection had caused a change in the processing of sensory input to the surrounding tissue, temporarily altering both the response threshold and the perception of the stimulus.

Neuromodulation has both a direct effect on the peripheral nervous system and an indirect effect on CNS processing of stimuli, influencing direct and indirect sensory responses even at points more than 1cm away from the actual site of the painful stimulus. When electrodes are placed along the nerves, high-frequency biphasic stimulation (HFS) at an intensity below the sensory threshold causes a rapid, reversible conduction block.<sup>6</sup> In the densely innervated oral cavity,<sup>2</sup> this block can take effect within 20 seconds.<sup>7</sup> The particularly rapid onset in the periodontal complex is attributable to the high concentration of A-beta, A-delta, and C nerve fibers, which are situated near the start of the pathway relaying painful sensations from the primary afferent neurons to the CNS. Electrical stimulation not only produces an immediate inhibition of nerve impulses, but also has a lasting effect on the neuropeptide cascade that would otherwise initiate a positive feedback loop, leading to increased pain.

Odontoblasts in the pulp are essential to pain sensation in the teeth. When HFS is applied to the surface of the enamel or dentin, it blocks transient receptor potential channels in the odontoblasts, restricting the concentration of calcium ions within the cells and thus preventing the calcium-signaling cascade that transduces dental pain (Fig. 1).<sup>3</sup> The electrical stimulus can be applied directly to the exposed dentinal tubules or indirectly to the root surface covered by the attached gingiva and mucosa, where it communicates with the odontoblasts through the lateral canals and periodontal ligament.

High-frequency neuromodulation with the Dental Pain Eraser has been shown to successfully relieve dental pain. In a previous study, we examined the effect of a single 30-second application of a prototype 10kHz device on the pain response after orthodontic wire activation or adjustment.<sup>7</sup> This application blocked the immediate pain response, and a statistically significant reduction in pain was still observed after 24 hours and 48 hours. The reduction was correlated with a decreased chemical response in the peripheral tissue, which would otherwise lead to inflammation and hypersensitivity to occlusal pressure.

Further studies have replicated these results.<sup>8</sup> In a recent randomized, blinded study conducted in a pediatric dental population, the Dental Pain Eraser was used before injecting local anesthesia for dental procedures.<sup>9</sup> The application led to a significant reduction in signs of pain and anxiety, with lower pulse rates, higher oxygen saturation levels, and higher salivary pH found in the experimental group. These results suggest that the sensory- and pain-fiber block affected CNS output in the patients.

## Procedure

The Dental Pain Eraser is applied to the root surface or the mucosa of the periodontal complex with a slow, gentle "erasing" motion (Fig. 2). While the two-probe tip is appropriate for the majority of applications, the four-probe tip can be used for complex procedures or when a larger surface area must be covered. Table 1 lists the recommended application times for various indications. These recommendations can be modified as the clinician gains experience with the device and a better understanding of the factors that can influence patient response times. Among these variables are an infection near the area of application, the surrounding tissue type, and the patient's individual psychological pain response. Application times may also need to be adjusted if large restorations will impede delivery of the electrical stimulus.

For common clinical orthodontic situations such as wire adjustments, detailing, or the initial





**Fig. 2 Common indications for Dental Pain Eraser.\* A. General tooth pain. B. Aphthous ulcers. C. Interproximal reduction. D. Temporary anchorage device placement. E. Frenectomy. F. Trauma.**

insertion of fixed appliances or aligners, an application of 10-20 seconds is recommended. The Dental Pain Eraser can also be used chairside to reduce discomfort while removing adhesive during debonding appointments. When treating an impacted tooth, the device should be applied for at least 45 seconds adjacent to the site of traction. A three-minute application is advised before and after temporary anchorage device (TAD) placement or removal (before the administration of local anesthesia). In patients with TMJ-related intraoral muscle or ligament pain, patients may experience relief after a five-minute application to the sore area; treatment can continue until the joint's range of motion improves, facilitating subsequent procedures.

For basic pediatric applications without anesthesia, the recommended procedure follows the "Synapse rule of threes": apply the device to the hard tissue for one minute on the buccal root sur-

face, one minute on the lingual root surface, and one minute on the clinical crown. A constant application of the probe tip can be used during polishing in severely hypersensitive patients or during interproximal reduction. For difficult pediatric or adult restorations, the Dental Pain Eraser can be used in combination with local anesthesia to produce a synergistic anesthetic effect.<sup>10</sup>

In most cases, saliva alone can conduct the high-frequency PulseWave.\* If the device does not provide the expected response, however, a thin layer of a conductive medium such as mouthwash can be applied to either the hard or soft tissue to improve efficacy.

## Conclusion

Identifying the factors that influence patients' decisions about whether to seek care is essential to optimizing patient satisfaction and practice



**TABLE 1**  
**APPLICATION TIMES AND LOCATIONS FOR SPECIFIC DENTAL INDICATIONS\*\***

Indication	Time	Location
Initial discomfort from orthodontic treatment	10-20 seconds per tooth	Facial root surface
Aphthous ulcer	30 seconds	Around sore (applied in circular motion)
After separator placement	20-30 seconds	Facially and lingually (applied to each surface for half of total time)
Interproximal reduction	30-45 seconds	Root and tooth surfaces (applied evenly)
Impacted tooth	45 seconds to 2 minutes	Adjacent to traction site
Before TAD placement	3 minutes (two or four probes)	Placement site
Debonding	3-4 minutes before procedure	Root and tooth surfaces (pre-dose by patient)
	10 seconds	Tooth surface (applied by clinician); direct constant current may be needed in cases of recession with hypersensitivity
TMJ or muscle pain	5 minutes (minimum)	Intraoral trigger point and adjacent muscle ligament
General tooth or hyperocclusal pain	45 seconds to 2 minutes (titrate to pain score)	Root and tooth surfaces (applied evenly)
Trauma	4-5 minutes (titrate to pain score)	Adjacent to site of soft- and hard-tissue trauma
After surgery (frenectomy, periodontal surgery, extraction)	2-4 minutes (titrate to pain score)	Adjacent to surgical site (applied by clinician or patient)
Teething	2 minutes (titrate to pain score)	Directly to teething site, or adjacent to or encircling torn tissue

success. Pain is a primary concern among patients and parents considering orthodontic treatment.<sup>11</sup> Because the Dental Pain Eraser provides a non-pharmacological means of relieving discomfort almost instantaneously, it can help manage this concern while avoiding the side effects and risks of pharmaceuticals. Empathetically addressing the fear of discomfort and providing a means of relieving it can also improve perceptions of the quality of care. Patients can even be taught how to use the

device outside the office to control their own pain management, thus enhancing the overall orthodontic or dental experience.

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\*\*Video examples of these uses can be found at [dentalpaineraser.com/ortho](http://dentalpaineraser.com/ortho).

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