DOI: 10.1111/papr.13254

CASE REPORT

# Cryoneurolysis of alveolar nerves for chronic dental pain: A new technique and a case series

**Matthieu Cachemaille MD, FIPP, CIPS**[1,2] | **Sébastien Geering MD, DDS**[3] | **Martin Broome MD, DDS**[3]

[1]Pain Clinic, Hôpital de la Tour, Meyrin, Switzerland

[2]Department of Anaesthesiology, Lausanne University Hospital, University of Lausanne, Lausanne, Switzerland

[3]Division of Oral and Maxillofacial Surgery, Lausanne University Hospital, University of Lausanne, Lausanne, Switzerland

**Correspondence**
Matthieu Cachemaille, Pain Clinic, Hôpital de la Tour, Av. J.-D.-Maillard 3, 1217 Meyrin, Switzerland.
Email: matthieu.cachemaille@latour.ch

## Abstract

**Background:** Chronic neuropathic dental pain has a poor prognosis with a low chance of significant spontaneous improvement. Local or oral therapies may be efficient, however short in terms of duration with potential side effects. Cryoneurolysis has been described to prevent acute postoperative pain or to treat some chronic pain conditions; however, application to dental orofacial pain has not been reported so far.

**Case Series:** Following a positive diagnostic block on the corresponding alveolar nerve, neuroablation was performed using a cryoprobe on three patients suffering from persistent pain after a dental extraction and 1 after multiple tooth surgeries. The effect of treatment was assessed using a Pain Numeric Rating Scale (NRS) and determined by changes in medication dosage and quality of life at day 7 and 3 months. Two patients experienced more than 50% of pain relief at 3 months, 2 by 50%. One patient was able to wean off pregabalin medication, one decreased amitriptyline by 50%, and one decreased tapentadol by 50%. No direct complications were reported. All of them mentioned improvement in sleep and quality of life.

**Conclusion:** Cryoneurolysis on alveolar nerves is a safe and easy-to-use technique allowing prolonged neuropathic pain relief after dental surgery.

**KEYWORDS**
cryoneurolysis, orofacial pain, persistent postoperative pain

## INTRODUCTION

Chronic neuropathic orofacial pain after dental surgery occurs in 3%–7% of cases[1] and has a poor prognosis with a significant spontaneous improvement in only 10%–20% of patients.[2,3] Local or topical treatment may be efficient, however short in terms of duration.[4,5] Oral treatment consisting of antiepileptic (carbamazepine, oxcarbazepine, pregabalin, and gabapentin) or antidepressant (amitriptylin, venlafaxin, and duloxetin) medication has shown some efficiency but with frequent side effects related.[6–8]

Cryoanalgesia is a technique that was first described by Hippocrates in ancient Greece with applications of ice on wounds for pain relief. More recent use was described by Lloyd et al.[9] for pain management by targeting nerves with very low temperatures. Then, different devices have been developed as cryoprobes used percutaneously and applied to neural structures in order to create a Wallerian degeneration starting at −70°C.[10,11] With that technique, the endoneurium and the myelin sheath remain intact, preventing cryoablated nerves from neuroma formation.[12]

Indications of cryoneurolysis have been recognized in a preoperative setting to prevent acute postsurgical pain[13–15] as well as used postoperatively for chronic neuropathic pain conditions.[16] However, to our knowledge, no studies have described in the literature the effect of cryoneurolysis in chronic neuropathic dental pain.

In this study, we demonstrate that cryoneurolysis performed on distal alveolar nerves and nasopalatine nerves may produce a prolonged orofacial pain relief with an improvement in quality of life.

## CASE SERIES

Written informed consents for the patients' information to be published were provided by the patients. Characteristics of the four patients are summarized in Table 1. Three patients reported pain between 3 months and 8 years after a dental extraction in the context of infection, and one patient complained of 6 years of persistent pain after a dental breakage followed by three consecutive surgeries. All of them benefited from different oral medications including antiepileptic, antidepressant, and opioid treatments without a clear improvement. Other causes of chronic pain including infection (sinusitis), mechanical compression (vessels, tumor), or trauma were excluded with a CT scan.

All the four cases reported localized pain in the corresponding dental area that may radiate in the trigeminal nerve dermatoma. Before enrolling them for cryoneurolysis, they all underwent one positive diagnostic injection of bupivacain 0.5% (0.2 mL) in the alveolar mucosa of the corresponding tooth targeting the alveolar nerve branches (case N°1–4) and the nasopalatine nerve (case N°3). A decrease of 80% of pain during the first 6 h was expected.

On the day of the procedure, basal pain scores were evaluated using a Numeric Rating Scale (NRS) from 0 to 10 (Figure 1). Patients were lying supine with the mouth opened and the head extended (Figure 2A,B). Alveolar mucosa was cleared using an alcohol-free chlorhexidine 2% solution and bupivacain 0.5% 0.2 mL was injected. A 2 cm length cryoprobe from Metrum Cryoflex® was then used until getting a bony contact. Cryoneurolysis at −80°C was performed for 90 s (2 times) with a 40-s break in between. Saline at ambient temperature was applied locally during neuroablation in order to prevent potential mucosal damage. Patients were then observed for 30 min and then discharged from hospital.

The effect of treatment was assessed using the NRS score (from 0 to 10) and quality of life was reflected using the Global Perceived Effect (GPE) scale, from −5 to +5, at 7 days and 3 months.

Pain was still reduced by more than 50% (cases N°1 and N°2) and by 50% (cases N°3 and N°4) at 3 months (Figure 1). All patients mentioned improvement in sleep and quality of life with GPE scale scores measured between +2 and +5 during the follow-up (Figure 3).

Case N°1 was able to wean off her pregabalin medication (75 mg twice daily) after 7 days. Case N°2 decreased her medication of amitriptyline from 50 mg twice daily to 25 mg twice daily after 7 days. Case N°4 decreased her medication of tapentadol from 100 mg 4×/day to 2×/day after 2 weeks.

## DISCUSSION

Chronic orofacial pain originating from a dental pathology is part of the chronic secondary pain from the new International Classifications of Diseases (ICD-11).[17] Causative factors may be caries, trauma to the tooth or to the surrounding tissue including gum, pulp, or periodontium. Teeth innervation is supplied by the maxillary division (V2) of the trigeminal nerve as the superior alveolar nerves and by the mandibular division (V3) as the inferior alveolar nerves.[18] Incisors including the surrounding mucosa specifically get innervation from the nasopalatine nerve.[19] Persistent pain after peripheral nerve injuries may arise after oral tissue damage resulting in chronic inflammation and neural structures hypersensitization.[20] Neurogenic inflammation may render nerve fibers more resistant to local anesthetics injected locally or administered topically for chronic pain conditions.[21] Thereby, we hypothesized that cryoneurolysis application on these nerves, previously anesthetized positively, may interrupt the pain signal for a longer duration.

Oral cryotherapy to prevent oral mucositis in cancer patients has been reviewed in the literature with positive effects on inflammation and pain.[22] Cryotherapy applied in endodontic acts on tissues with vascular, neurologic, and tissue metabolism effects.[23] Cold, by a vasoconstriction process, reduces permeability, tissue edema, and swelling. This reduces blood flow and cell metabolism, resulting in a decrease of free radical production and inflammatory markers.[24] Furthermore, velocity of nerve conduction is decreased and intrinsic endorphins are released.[25] When axonal injury after dental extraction or after chronic inflammation initiates ectopic activity

**TABLE 1** Demographic characteristics of the patients.

| Case | Sex | Age | Comorbidities | Pain duration | Pain origin | Targeted nerves |
|---|---|---|---|---|---|---|
| 1 | F | 66 | Parkinson disease | 3 months | Tooth N°38 | Inferior alveolar nerve |
| 2 | F | 41 | Nihil | 8 years | Tooth N°17 | Postero-superior alveolar nerve |
| 3 | F | 36 | Active smoker + alcohol | 6 years | Tooth N°21 | Antéro-superior alveolar nerve + nasopalatine nerve |
| 4 | F | 51 | Hypertension | 4 years | Tooth N°47 | Inferior alveolar nerve |

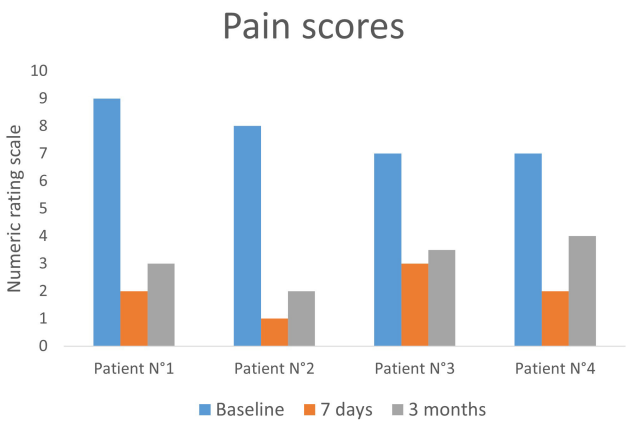


**FIGURE 1** Pain scores at baseline, 7 days, and 3 months.

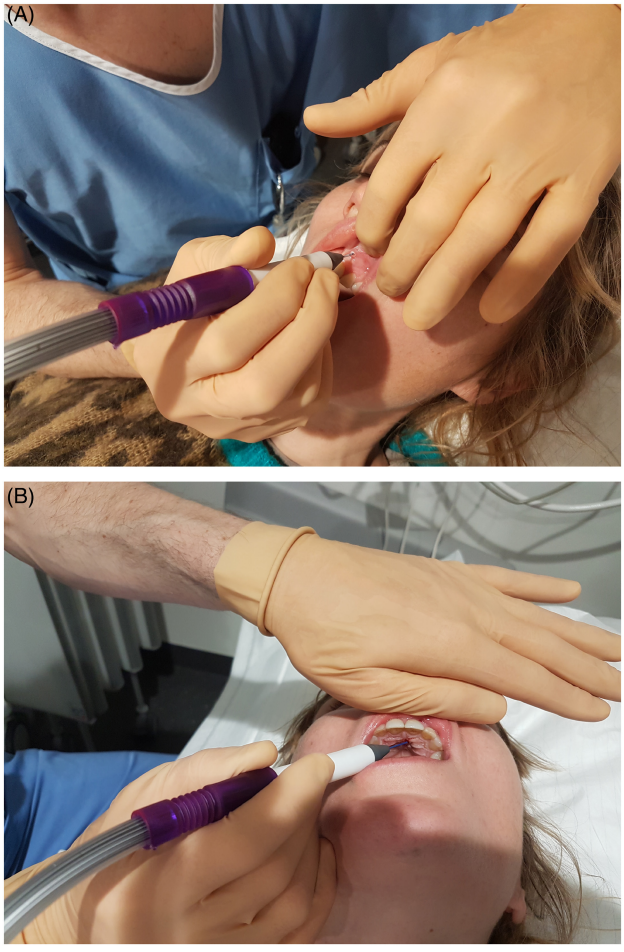


**FIGURE 2** (A) Cryoneurolysis of the anterior superior alveolar nerve. (B) Cryoneurolysis of the nasopalatine nerve.

from damage primary afferent nerve fibers, this may create a central sensitization in secondary neurons in the trigeminal sensory nucleus creating atypical trigeminal neuralgia.[26,27] In our patients, all of them experienced localized pain with some radiation in the trigeminal (V2 or V3) dermatoma. By creating, after cryoneurolysis, an axonotmesis with a Wallerian degeneration to the

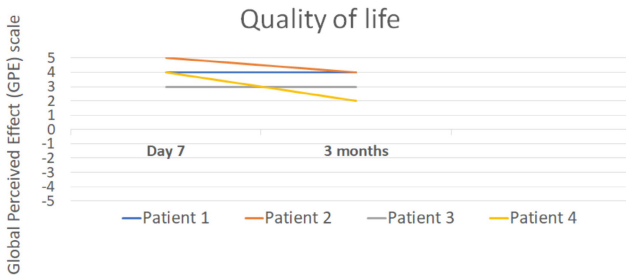


**FIGURE 3** Global Perceived Effect scale reflecting quality of life at 7 days and 3 months.

peripheral nerve, neuronal ectopic activity would be possibly interrupted, resulting in a decrease of the central sensitization.

All four cases described in this study responded to the therapy with a pain decrease after one session of cryoneurolysis, lasting up to 3 months, correlated with an improvement in their quality of life and a drop in their pain medication dosages.

Several limitations deserve to be mentioned in our study. First, it is a small sample of patients and our findings should be confirmed with a large randomized controlled study. All the cases were aware of the treatment. All of them were female; no male at this time suffering from dental pain was referred to our clinic. For organizational reasons, pain assessment was conducted up to 3 months after treatment; axon regeneration after cryoneurolysis is supposed to grow at a rate of 1–1.5 mm per week in humans[28] or even 1–3 mm per day in animal studies,[29] and analgesia duration is proportional to the nerve length denervated, which is proportional to the "ice ball" size generated at the tip of the probe. Most of the current clinical studies on cryoneurolysis referred to analgesic effects between 2 and 4 months, so pain assessment beyond 3 months would be necessary to monitor as part of a larger study. Finally, we chose the GPE scale to reflect quality of life, which is a short subjective outcome. An elaborated questionnaire such as the McGill Quality of Life Questionnaire, expanded by Cohen et al.,[30] could take into account the social and the psychological aspects of improvement after pain relief. Moreover, measurement of pressure pain threshold or pressure pain tolerance locally could offer objective outcomes to the therapy.[31]

To conclude, this study describes a safe and easy-to-use technique on alveolar and nasopalatine nerves that seems efficient to allow prolonged neuropathic pain relief in patients after dental surgery. A larger randomized controlled study would therefore be necessary to demonstrate the real benefit of cryoneurolysis for this pathology.

## ACKNOWLEDGMENTS

Open access funding provided by Universite de Lausanne.

## CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflict of interest to declare.

## DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request. The data are not publicly available due to privacy or ethical restrictions.

## ORCID

*Matthieu Cachemaille* https://orcid.org/0000-0001-7897-1286

## REFERENCES


1. Khan J, Zusman T, Wang Q, Eliav E. Acute and chronic pain in orofacial trauma patients. Dent Traumatol. 2019;35:348–57.
2. Pigg M, Svensson P, Drangsholt M, List T. Seven-year follow-up of patients diagnosed with atypical odontalgia: a prospective study. J Orofac Pain. 2013;27:151–64.
3. Pogrel MA, Jergensen R, Burgon E, Hulme D. Long-term outcome of trigeminal nerve injuries related to dental treatment. J Oral Maxillofac Surg. 2011;69:2284–8.
4. Casale R, Symeonidou Z, Bartolo M. Topical treatments for localized neuropathic pain. Curr Pain Headache Rep. 2017;21:15.
5. Heir G, Karolchek S, Kalladka M, Vishwanath A, Gomes J, Khatri R, et al. Use of topical medication in orofacial neuropathic pain: a retrospective study. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2008;105:466–9.
6. Wiffen PJ, Derry S, Bell RF, Rice AS, Tölle TR, Phillips T, et al. Gabapentin for chronic neuropathic pain in adults. Cochrane Database Syst Rev. 2017;(6):CD007938.
7. Finnerup NB, Attal N, Haroutounian S, McNicol E, Baron R, Dworkin RH, et al. Pharmacotherapy for neuropathic pain in adults: a systematic review and meta-analysis. Lancet Neurol. 2015;14:162–73.
8. Baltenberger EP, Buterbaugh WM, Martin BS, Thomas CJ. Review of antidepressants in the treatment of neuropathic pain. Ment Health Clin. 2015;5:123–33.
9. Lloyd JW, Barnard JD, Glynn CJ. Cryoanalgesia. A new approach to pain relief. Lancet. 1976;2:932–4.
10. Trescot AM. Cryoanalgesia in interventional pain management. Pain Physician. 2003;6:345–60.
11. Ilfeld BM, Preciado J, Trescot AM. Novel cryoneurolysis device for the treatment of sensory and motor peripheral nerves. Expert Rev Med Devices. 2016;13:713–25.
12. Myers RR, Powell HC, Heckman HM, Costello ML, Katz J. Biophysical and pathological effects of cryogenic nerve lesion. Ann Neurol. 1981;10:478–85.
13. Ilfeld BM, Finneran JJ, Swisher MW, Said ET, Gabriel RA, Sztain JF, et al. Preoperative ultrasound-guided percutaneous cryoneurolysis for the treatment of pain after mastectomy: a randomized, participant- and observer-masked, sham-controlled study. Anesthesiology. 2022;137:529–42.
14. Gabriel RA, Finneran JJ, Swisher MW, Said ET, Sztain JF, Khatibi B, et al. Ultrasound-guided percutaneous intercostal cryoanalgesia for multiple weeks of analgesia following mastectomy: a case series. Korean J Anesthesiol. 2020;73:163–8.
15. Dasa V, Lensing G, Parsons M, Harris J, Volaufova J, Bliss R. Percutaneous freezing of sensory nerves prior to total knee arthroplasty. Knee. 2016;23:523–8.
16. Fanelli RD, DiSiena MR, Lui FY, Gersin KS. Cryoanalgesic ablation for the treatment of chronic postherniorrhaphy neuropathic pain. Surg Endosc. 2003;17:196–200.
17. Benoliel R, Svensson P, Evers S, Wang SJ, Barke A, Korwisi B, et al. The IASP classification of chronic pain for ICD-11: chronic secondary headache or orofacial pain. Pain. 2019;160:60–8.
18. Nair PN. Neural elements in dental pulp and dentin. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 1995;80:710–9.
19. Fitzpatrick TH, Downs BW. Anatomy, head and neck, nasopalatine nerve. Treasure Island, FL: StatPearls Publishing; 2022.
20. Fristad I. Dental innervation: functions and plasticity after peripheral injury. Acta Odontol Scand. 1997;55:236–54.
21. Jeske AH. Local anesthetics: special considerations in endodontics. J Tenn Dent Assoc. 2003;83:14–8.
22. Correa MEP, Cheng KKF, Chiang K, Kandwal A, Loprinzi CL, Mori T, et al. Systematic review of oral cryotherapy for the management of oral mucositis in cancer patients and clinical practice guidelines. Support Care Cancer. 2020;28:2449–56.
23. Fayyad DM, Abdelsalam N, Hashem N. Cryotherapy: a new paradigm of treatment in endodontics. J Endod. 2020;46:936–42.
24. Malanga GA, Yan N, Stark J. Mechanisms and efficacy of heat and cold therapies for musculoskeletal injury. Postgrad Med. 2015;127:57–65.
25. Fields HL, Basbaum AI. Brainstem control of spinal pain-transmission neurons. Annu Rev Physiol. 1978;40:217–48.
26. Costigan M, Scholz J, Woolf CJ. Neuropathic pain: a maladaptive response of the nervous system to damage. Annu Rev Neurosci. 2009;32:1–32.
27. Tinastepe N, Oral K. Neuropathic pain after dental treatment. Ağrı. 2013;25:1–6.
28. Sunderland S. A classification of peripheral nerve injuries producing loss of function. Brain. 1951;74:491–516.
29. Gaster RN, Davidson TM, Rand RW, Fonkalsrud EW. Comparison of nerve regeneration rates following controlled freezing or crushing. Arch Surg. 1971;103:378–83.
30. Cohen SR, Russell LB, Leis A, Shahidi J, Porterfield P, Kuhl DR, et al. More comprehensively measuring quality of life in life-threatening illness: the McGill quality of life questionnaire – expanded. BMC Palliat Care. 2019;18:92.
31. Kim D-K, Ahn C-H, Hwang M-J, Lee YH, Kang SK, Auh QS, et al. Comparison between the subjective evaluation and the objective evaluation of the effect of pain control in the masticatory muscle pain. J Oral Med Pain. 2016;41:61–71.


**How to cite this article:** Cachemaille M, Geering S, Broome M. Cryoneurolysis of alveolar nerves for chronic dental pain: A new technique and a case series. Pain Pract. 2023;23:851–854. https://doi.org/10.1111/papr.13254