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# Low-temperature plasma radiofrequency ablation in phantom limb pain: A case report

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**Abstract:**

Phantom limb pain (PLP) and phantom limb sensations are common complications postamputation. PLP is defined as persistent painful sensations perceived in the missing portion of the amputated limb. Low-temperature plasma radiofrequency ablation (coblation) technology is a relatively new technology that has shown promise in treating neuropathic pain. This report illustrates the use of coblation technology on cervical nerve roots for PLP. Coblation of the cervical nerve root was performed. Three 17G puncture trocars were placed near the C5–C6, C6–C7, and C7–T1 intervertebral foramen with computed tomography (CT) guidance. Then, a coblation needle attached to low-temperature plasma multifunctional operation system was placed near the C8 nerve root through the puncture trocars. To locate the target nerve, single stimulation (lasting for 5 s, at 1 intensity) in "cut" and "coagulation" model was given to serve as a sensory stimulation test. The stimulation induced radiating pain of the stimulated nerve away from the stimulation site to confirm our target nerve. The needle location was redirected based on the reproduction of the patient's symptoms with minimal intensity. A CT-guided cervical nerve root coblation was performed to obtain longer PLP relief. The patient reported pain relief in PLP after the operation. At 1-, 3-, and 6-month postoperative review, PLP relief was achieved. Overall activity was improved and there was necessarily need for pain medications. However, the doses of medicine significantly decreased. The analgesic effect was stable during the 6-month follow-up period. Our report demonstrates that coblation technology is successful treatment for PLP in this case. It will supply us a novel navigation in PLP treatments. Meanwhile, this finding still needs additional study for confirmation.

**Keywords:**

Amputation, coblation, phantom limb pain

## Introduction

Amputation is the removal of a body extremity which is generally caused by severe trauma, circulatory disorders, neoplasm, deformities, and infection of the limb. Historically, phantom limb pain (PLP) and phantom limb sensations are common complications postamputation, and the prevalence of PLP has been reported to be as high as 75%–80%.[1,2] PLP is defined as persistent painful sensations perceived in the missing portion of the amputated limb.[3] Pain mechanisms involved in PLP include formation of neuroma and ectopic discharge. Although the exact etiology and pathophysiology mechanisms of PLP remain unknown, it is often considered as neuropathic pain (NP) because of dysfunctions in the central and peripheral nervous system.[4-8]

Nowadays, managements and treatments for PLP are often difficult and challenging. In the past decades, medication, as the most common analgesic modality,



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is conveniently and extensively utilized for pain management.[9] However, many pharmacological interventions for PLP have shown only limited success, and few of them have evidence-based efficacy and safety.[10-12] Meanwhile, several case reports for the treatment of PLP also present no medical interventions, such as preemptive analgesia, neuromodulation, mirror therapy, graded motor imagery, stump liners, acupuncture, transcranial magnetic stimulation, and cauda equina stimulation.[13-18] However, it is rare that randomized controlled trial (RCT) is designed. Therefore, it is firstly demonstrated that low-temperature plasma radiofrequency ablation (coblation) in phantom upper limb pain was reported as a case report.

## Case Report

A 71-year-old female patient underwent right arm amputation surgery 40 years ago. After operation, the patient soonly recovery without infection. However, she was experienced with PLP sooner. Her past medical history was significant for diabetes and hypertension. Recently, she complained of severe right PLP for 2 years. Pain in the pain clinic was described as a continuous stabbing, burning pain with the initial visual analog scale (VAS) intensity rating of 8/10 (0 is no pain and 10 is the most severe pain imaginable). The principal site of her pain was the right hand, especially five fingers.

After the right arm amputation, the patient reported that he suffered from PLP. Two years earlier, the patient was referred to the pain clinic for the treatment of her severe PLP. Initially, she was treated with medications such as tramadol (37.5 mg) with acetaminophen (325 mg) and gabapentin 900 mg/day. However, it did not provide meaningful paraesthetic coverage or relief of her hand extremity pain. Finally, we recommended a trial of low-temperature plasma radiofrequency ablation on cervical nerve root (C5–C6/C6–C7/C7–T1).

Coblation of the cervical nerve root was performed. Since there was no standardized technique for applying the low-temperature plasma radiofrequency ablation on cervical nerves, we adopted the method of coblation technique used for the intervertebral disk in treating lumbar discogenic pain. Under strict aseptic conditions, 1% lidocaine was used for local anesthesia. Three Gaotong 17G puncture trocars were placed near the C5–C6, C6–C7, and C7–T1 intervertebral foramen with CT guidance. Then, a coblation needle (DXR-G1100-A185; Xi'an Gaotong Medical Technology Company, LTD, Xi'an, China), attached to low-temperature plasma multifunctional operation system (SM-D380D; Xi'an Gaotong Medical Technology Company, LTD, Xi'an, China), was placed near the C8 nerve root through the puncture trocars. To locate the target nerve, single stimulation (lasting for 5 s, at 1 intensity) in "cut" and "coagulation" model was given to serve as a sensory stimulation test. The stimulation induced radiating pain of the stimulated nerve away from the stimulation site to confirm our target nerve. The needle location was redirected based on the reproduction of the patient's symptoms with minimal intensity. Before proceeding with the lesion, considering that the coblation technique is a nociceptive stimulus and may cause severe pain during operation, sufentanil 10 μg and propofol 100 mg were intravenoused. One minute after injection of the general anesthetic, the coblation operation was performed using the following settings: three of intensity for coblation and six of intensity for coagulation (lasting for 30 s, repeat twice). Coagulation mode is applied to thermally seal the lesions after coblation. Coblation and coagulation were performed in sequence. The needle depth was adjusted to completely make sure coverage and coblation of the target nerve. After coblation, 2 ml of phenol glycerin was injected through the needle. The C6 and C7 nerve root was operated as the same way.

After operation, the patient reported PLP went from 8/10-3-4/10 on the VAS; moreover, pain in three fingers in half including finger 1, finger 2, and finger 3, and 1/2 finger 4 have been released. PLP lasted only for 1–2 s each time and 1–3 times a day and could resolve spontaneously. She was visited at 1-week, 1-month, and 3-month postoperation. In the 1st week, PLP was 3–4/10 on VAS. When necessary, her medications were added but decreased, such as gabapentin to 300 mg/day. After 1 month, she reported a significant improved in sleep, in mood, and in daily activities. Moreover, 3 months later, her pain reached 2–3/10, compared with the baseline VAS (8/10), and his overall pain has decreased. No complications were reported during the follow-up period.

## Discussion

PLP refers to the perception of pain in amputated limb or pain following partial or complete deafferentation. PLP is generally difficult to be treated. The treatments include medicine and no medical intervention, while the effects are limited. Therefore, finding a better treatment needs to be focused.

Recently, coblation technology has been demonstrated to have potential for pain management. Coblation is a relatively new technology and has been used in the treatment of NP. It uses radiofrequency energy to excite the electrolytes in a conductive medium such as saline solution, creating energized plasma. This discharge plasma produces chemically active radical species that subsequently interact with organic tissue and possess sufficient energy to break molecular bonds causing

tissue dissolution at a low temperature (approximately 40°C–70°C).[19,20] According to its mechanism, through preventing nociceptive conduction, coblation could suppress dorsal root ganglion activities, thus reducing the erroneous ectopic input to the central nervous system, relieving PLP.

In our PLP case report, the first use of coblation has been successfully reducing pain level, while follow-up visiting is important to evaluate the effects of coblation operations. However, it also needs a number of RCTs further to be designed in PLP coblation. In a word, it supplies a novel navigation in PLP treatments.

## Ethics

This study was approved by the local ethical committee.

## Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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## Conflicts of interest

There are no conflicts of interest.

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