

## Occipital Nerve Stimulation for Refractory Occipital Pain after Occipitocervical Fusion: Expanding Indications

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### Key Words

Occipital nerve stimulation · Neck pain · Cervical fusion · Neurostimulation

### Abstract

**Background:** Occipital nerve stimulation is being used for various pain syndromes. Here, we expand its use for the treatment of refractory occipital pain after occipitocervical fusion. **Case Description:** We describe a case of occipital neuralgia in a 60-year-old man following posterior occipitocervical fusion. The maximum pain intensity was rated 9/10 on the visual analogue scale (VAS). Since pain proved to be refractory to analgetic medication, two quadripolar electrodes (Resume II, Medtronic) were implanted in the occipital region to stimulate the occipital nerve bilaterally. The patient experienced a dramatic response during test stimulation for 10 days with externalized electrodes, and a pacemaker (Synergy, Medtronic) was connected to the electrodes. While on chronic stimulation (bipolar 6 V, 210  $\mu$ s, 130 Hz) improvement of pain was maintained, reflected by a decrease in the VAS score to 1/10 at 12 months of follow-up. **Conclusion:** Occipital nerve stimulation for medical refractory occipital neuralgia after occipitocervical fusion is an effective method expanding the indications for its use.

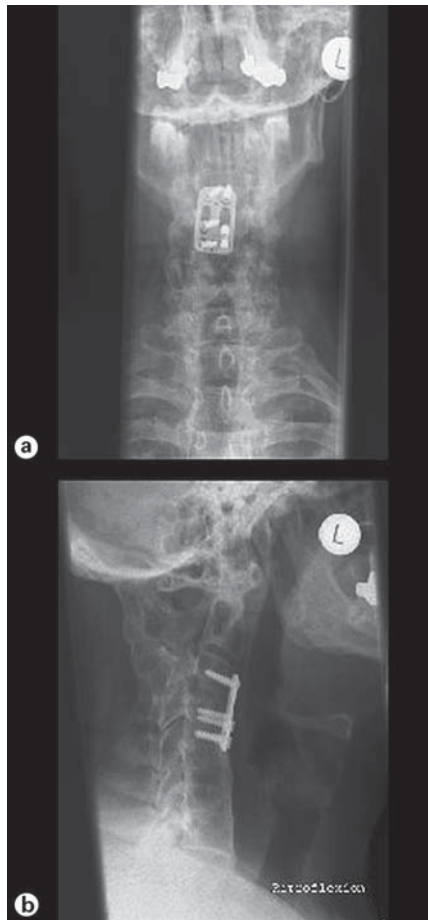
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### Introduction

Occipital neuralgia is characterized by unilateral sharp paroxysmal or constant throbbing, burning, aching pain originating in the suboccipital area and radiating within the distribution of the greater or lesser occipital nerves or both [1]. The etiology of occipital neuralgia is multifactorial and includes arthritis of the C<sub>1</sub>/C<sub>2</sub> segment with irritation of the greater occipital nerve at its origin or entrapment at the entry point of the nerve into the muscles. Other causes may be localized infection, inflammation, tumor, diabetes or gout. Medical treatment includes anti-inflammatory drugs, antidepressants and opioid analgetics. Procedures like thermal or surgical ablation and C<sub>2</sub> ganglionectomy are considered options in patients with pain refractory to medical treatment; however, they yield variable results and morbidity [2].

Occipital nerve stimulation has been shown to be beneficial in medically intractable occipital neuralgia, migraine, cluster headache and trigeminal neuralgia [3–6]. Thus far, it has not been reported in patients suffering from intractable neck pain after occipitocervical fusion to our knowledge. Here, we report our experience with its effect in a patient with severe persistent pain after posterior occipitocervical surgery.

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**Fig. 1a, b.** X-ray of the cervical spine showing occipitocervical fusion with autologous bone from C<sub>0</sub> to C<sub>4</sub> and ventral fusion from C<sub>3</sub> to C<sub>6</sub>.

**Fig. 2.** Postoperative X-ray demonstrates both quadripolar electrodes located in the suboccipital region where the greater and smaller occipital nerves traverse to the occiput.

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## Case Report

### Patient History

A 60-year-old man was admitted to our department for treatment of refractory neck pain.

Nine years earlier, he had undergone posterior fusion from C<sub>0</sub> to C<sub>4</sub> in another hospital for stenosis and instability. In a second procedure 4 years later, ventral fusion was performed in addition (fig. 1a, b).

Over the years, he developed tingling behind both ears and the occipital area in addition to paroxysmal sudden-onset, sharp electric-like pain radiating to the vertex. At the time of admission medication included antiphlogistics, steroids and opiates.

Neurological examination showed tenderness in the occipital region and hypesthesia in the right suboccipital area and the C<sub>6</sub> dermatomes bilaterally. The patient complained about constant burning pain in the upper neck and occiput with intermittent exacerbation for minutes. Preoperatively standardized pain assessments were obtained, which included the visual analogue scale (VAS) score, the SF-36, the Hamilton Depression Scale and the Mini Mental State Examination (MMSE). On the VAS, the patient scored the pain with a maximum of 9/10, a minimum of 7/10 and 8/10 on average in the last 4 weeks before admission.

### Surgical Procedure

Surgery was performed under general anesthesia. In the prone position, a midline posterior cervical incision was made and bilateral quadripolar Resume II electrodes (Medtronic, Minneapolis, Minn., USA) were implanted according to the technique described earlier by Kapural et al. [7] between the subcutis and fascia using an image intensifier to aid positioning (fig. 2). There were no surgical complications. The electrodes were externalized for test stimulation and assessment of pain. Therapeutic testing with different stimulation settings was carried out for 10 days. Paresthesias were induced in the lower occipital region, just above the electrodes but not in the whole area to where the pain radiated preoperatively.

Test stimulation resulted in remarkable improvement of pain with a decrease in the VAS maximum pain from 9/10 to 2/10. During the postoperative test period, stimulation was switched off several times inadvertently due to battery depletion of the external impulse generator. During these periods, pain always recurred. After battery change, there was consistent pain relief, with adequate paresthesia coverage. True placebo trials could not be performed since the patient was well aware of the paresthesias evoked by stimulation. Based on this amelioration, the patient opted to undergo a second surgical procedure, in which a pulse generator (Synergy, Medtronic) was implanted in the right sub-

clavicular region, and the electrodes were connected to the implanted pulse generator.

#### *Postoperative Outcome*

For chronic stimulation, contacts 0 and 4 were used as cathodes, and contacts 3 and 7 as anodes, with an amplitude of 5.5 V, a frequency of 130 Hz and a pulse width of 210  $\mu$ s. Pain was reduced remarkably. Previous medication was tapered off subsequently. The amplitude was slightly increased within prescribed limits by the patient using a patient programmer to 6 V after 3 months.

At the 12-month follow-up, the VAS maximum pain score was reduced from 9/10 to 1/10. Improved quality of life was evident according to changes in the SF-36 subscores.

## **Discussion**

Despite the growing number of controlled trials investigating the efficacy of spinal cord stimulation for the treatment of chronic pain conditions, the number of studies examining the efficacy of peripheral occipital nerve stimulation for the treatment of occipital neuralgia is very limited. Nevertheless, interest in this treatment modality continues to grow and new indications are being evaluated. The most common indications for occipital nerve stimulation are postherpetic neuralgia, idiopathic occipital neuralgia, migraine and cluster headache [2]. Also patients with occipital pain due to cervical spinal degenerative disorders or pain developing after cervical spine surgery including discectomy and ventral fusion have been reported to benefit from occipital nerve stimulation [1, 6].

Our patient is remarkable for several reasons. Most likely, the origin of his pain is neuropathic secondary to partial lesioning of both occipital nerves during stabilization. Although the exact site of its dysfunction remains elusive, it may well be proximal to the site of stimulation. Nevertheless, chronic stimulation provided marked relief.

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Initially, we considered other surgical alternatives such as C<sub>2</sub> block and ganglionectomy which were not feasible, however, due to the altered anatomy after fusion with the implanted autologous bone. Possibly, overgrowth of the implanted bone had an additional impact on the development and maintenance of occipital pain.

We used the technique described by Kapural et al. [7] with two quadripolar plate electrodes placed bilaterally between subcutis and fascia. In contrast to the more common usage of percutaneous leads by other groups, plate electrodes may provide a larger field of paresthesias and thus a better coverage of the painful area.

The physiological mechanism of occipital nerve stimulation remains obscure. The effect has been explained in analogy to the 'gate control' theory [8], that is electrical stimulation of large sensory afferents has an antinociceptive effect, which is likely to be due to suppression of small C fiber and A $\delta$  fiber nociceptive input at the level of the spinal dorsal horn. In addition, its stimulation has been thought to inhibit central nociceptive transmission [1]. PET studies demonstrated that central pain modulating relays involved in affective pain processing such as the cingulate gyrus are activated during stimulation [4, 9].

## **Conclusion**

Occipital nerve stimulation for refractory occipital pain offers several benefits as compared to other methods, including a minimal invasive approach, the option of test stimulation to assess the potential benefit prior to implantation of the pacemaker, and the ability to remove the system making it a reversible procedure. Moreover, when peripheral nerve stimulation results in successful outcome, medication used to treat occipital neuralgia can be reduced and thus drug side effects can be minimized.