Peripheral Neurostimulation for Treatment of Intractable Occipital Neuralgia

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OBJECTIVE: Medically intractable pain caused by occipital neuralgia (ON) can be very difficult to control with traditional pain management. Peripheral nerve stimulation (PNS) may serve as a good alternative to destructive surgical manipulations used currently for the treatment of severe ON.

METHODS: We analyzed records of 14 consecutive patients (9 women and 5 men; mean age, 43.3 yr) with intractable ON treated with PNS during the period from April 2002 to November 2004. Five patients had unilateral and nine had bilateral PNS electrodes inserted for trial, which was considered successful if patient reported at least 50% decrease of pain on the visual analogue scale. Ten patients proceeded with system internalization, and their long-term results were analyzed.

RESULTS: At the time of the last follow-up examination (3–32 mo; mean 22 mo), seven patients (70%) with implanted PNS systems continue to experience beneficial effects of stimulation, including adequate pain control, continuous employment, and decrease in oral pain medications intake. Two patients had their systems explanted because of loss of stimulation effect or significant improvement of pain, and one patient had part of his hardware removed because of infection.

CONCLUSION: Overall, the beneficial effect from chronic stimulation in our series persisted in more than half of the patients for whom procedure was considered and in 80% of those who significantly improved during the trial and proceeded with internalization. Thus, chronic PNS may be a safe and relatively effective method for long-term treatment of chronic pain syndrome in patients with medically intractable ON.

KEY WORDS: Neurostimulation, Occipital neuralgia, Pain, Peripheral nerve stimulation

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Occipital neuralgia (ON) is a rare neurological disorder characterized by severe episodes of lancinating pain within the distribution of the greater and lesser occipital nerves (18). ON attacks are comparable with those of trigeminal or glossopharyngeal neuralgias, except that in case of ON, pain mostly involves occipital and periauricular areas with possible retro-orbital radiation and can be often bilateral (16, 17). In rare occasions, pain may radiate also to the side of the head or to the frontal region (11). Similar to other neuropathic pain syndromes, ON attacks can be provoked by palpating a trigger point, which in most cases identified as the occipital notch (5). Trauma of the C2 root during normal or excessive movements (e.g., whiplash injury) of the head or by arthritic changes of the atlantoaxial joint is thought to be the main cause of ON (25, 30). Sustained contraction or spasm of the posterior neck muscles have also been implicated as a cause of ON (32). However, very often, the offending agent (previous trauma, cervical spondylosis, or ligamentous hypertrophy) cannot be easily identified, and for these patients, the etiology of ON remains unknown (18). Therefore, neuropathic changes in greater or lesser occipital nerve in these cases are considered idiopathic.

Various therapies have been tried in the management of intractable ON. These range from noninvasive, drug based therapies, such as different combinations of oral and topical analgesics, anticonvulsant, antidepressant, and even antiviral agents, to minimally inva-

sion techniques, such as trigger point injections with the mixture of local anesthetic and steroid (which may be both diagnostic and therapeutic), transcutaneous electrical nerve stimulation, and different nerve blocks, to highly invasive, surgery-based therapies, such as neurolysis of the greater or lesser occipital nerve, intradural rhizotomy of the C2 root, selective partial posterior rhizotomy of C1 to C3 roots, C2 ganglionectomy, or C2 root decompression (4, 4, 7, 9, 13, 15, 16, 20, 22, 24, 29, 31, 38). Even acupuncture techniques and repeated injections of botulinum toxin type A have been tried with a variable rate of success (8, 19, 37, 40). Despite all efforts, none of these treatment options provides complete long-term relief of symptoms without causing significant side effects (22). With time, the attacks of ON can become very severe and intractable to above-mentioned treatment modalities, which can significantly impair a patient's quality of life, disrupting normal daily activities.

Chronic occipital nerve stimulation (ONS) is another modality for treatment of chronic occipital headache (39). It may provide good long-term relief from painful attacks of ON without virtually any significant side effects. The idea of pain inhibition by chronic nerve stimulation originated from the gate-control theory of pain, which was introduced by Melzack and Wall (25) almost 50 years ago, although some specific assumptions of this original hypothesis were not confirmed by subsequent investigations (26, 34, 36). The current understanding of possible neuromodulation mechanism with chronic electrical stimulation is based on the fact that the electrical current applied during stimulation can directly block cell membrane depolarization and axonal conduction in afferent states, so the patient experiences light tingling sensation instead of pain in areas innervated by stimulated nerves (14). In the past, repetitive electrical stimulation of human peripheral nerves was shown to produce excitation failure in C fibers, which are responsible for propagation of painful stimuli (35). Alternatively, it was postulated that electrical stimulation of a peripheral nerve may block more distal nociceptive input by inhibitory action at the dorsal horn, brain stem, or thalamus (6, 10, 24). However, the pathophysiological mechanism of pain relief with peripheral nerve stimulation (PNS) in patients with medically intractable ON still remains unclear because factual experimental or clinical data available in the literature on this subject are very limited. In this article, we present our experience with ONS in 14 patients with chronic ON treated in the University of Illinois at Chicago Medical Center for the period from April 2002 to November 2004.

PATIENTS AND METHODS

Patient Demographics

We conducted a retrospective study of 14 patients treated with chronic ONS and operated on by our team from April 2002 to November 2004 for intractable ON (*Table 1*). Original preoperative and postoperative clinic notes, operative reports, hospital charts, and direct patient follow-up during regular

TABLE 1. Patients' representation and their occipital nerve stimulation system status*

Patient no.	Age (yr)/ sex	Etiology	Stimulated nerve(s)	Trial	Neurostimulation system status
1	29/F	Idiopathic	RON	Failed	No implant
2	43/F	Chiari malformation	LON	Passed	System removed after 12 months because of chronic infection
3	53/F	Idiopathic (previously diagnosed with severe migraine)	RON + RN	Passed	In place
4	64/M	Cervical spine surgery, fibromyalgia	RON + LON	Failed	No implant
5	43/F	Idiopathic	RON + LON	Passed	Explanted at 21 months because of improvement of pain and no need for stimulation
6	48/M	Chiari malformation	RON + LON	Passed	In place
7	29/F	Idiopathic	RON + LON	Passed	In place
8	53/M	Chiari malformation	RON + LON	Passed	In place
9	45/M	Cervical spine surgery	RON + LON	Failed	No implant
10	52/F	Idiopathic	RON + LON	Passed	Explanted at 15 months because of loss of stimulation effect
11	41/M	Neck trauma	LON + LSN	Passed	In place
12	32/F	Idiopathic	RON	Passed	In place
13	51/F	Cervical spine surgery	RON + LON	Passed	In place
14	36/F	Idiopathic	RON + RSN	Failed	No implant

* RON, right occipital nerve; LON, left occipital nerve; RN, right rhizotomy; LSN, left supraorbital nerve; RSN, right supraorbital nerve.

clinic visits were used. All patients in this study were diagnosed with chronic, intractable ON according to guidelines of the International Headache Society (12). They all presented at their initial visit to our clinic with complaints of severe sharp stabbing pain in occipital area with or without radiation to other parts of the head, neck, or shoulder. The duration of pain attacks varied from several minutes to several days, and the frequency from several times per month to several times per day. Palpation of the occipital area or upper neck on the affected side usually revealed muscle tenderness and in most cases precipitated the pain attack. All patients positively responded to occipital nerve blocks with temporary relief of their pain, which was one of the most important factors in patient selection for ONS.

The age of the patients ranged between 22 to 63 years with a median age of 44 years. The patient population consisted of nine (64%) women and five (36%) men. The majority of patients presented with bilateral symptoms (64%, 9 of 14 patients). The remaining five (36%) patients were suffering from unilateral ON: three on the right and two on the left side.

In 8 of 14 (57%) patients, the possible underlying etiological factors have been identified. Three patients underwent surgical interventions for Arnold-Chiari malformation before the first episode of ON; three patients had history of cervical diskectomy with fusion (one of whom also was diagnosed with fibromyalgia); one patient had previous neck trauma; and one patient was previously diagnosed with severe symptomatic migraine, involving right side of the head. In the remaining six (43%) patients without any history of related or underlying pathology, ON was considered as idiopathic.

Medical therapy was unsuccessful or caused severe side effects that outweighed the therapeutic benefits in all patients. In addition, each patient routinely underwent neuropsychological evaluation to rule out underlying depression, addiction, psychiatric disorder, or any other conditions known as predictors for an unsatisfactory outcome. In eight (57%) patients, we performed diagnostic nerve blocks before the stimulation procedure, which were positive in all cases in bringing temporary relief of pain after injection of the local anesthetic. All other patients had similar blocks performed before referral to our institution.

The mean total follow-up of the series was 22 months, ranging from 5 to 32 months. The results of the treatment were assessed according to three criteria: 1) degree of pain on a visual analogue scale before surgery, during the trial, and at first and last follow-up examinations after internalization of the stimulator; 2) consumption of analgesics before surgery and at consecutive follow-up examinations; and 3) the degree of patient satisfaction with pain relief.

Operative Technique: A Two-Stage Procedure

The first stage of the procedure (the trial) was performed under mild sedation and local anesthesia to monitor patient's feedback and ensure the most optimal coverage of the painful areas by the stimulation. After placing the patient on the operating table in a prone position, a curved needle was inserted at the upper lateral end of the neck and advanced toward the midline of craniovertebral junction along the contour of the C1 vertebral arch under fluoroscopic guidance, crossing over the anatomic course of the greater or lesser occipital nerves. When positioning of the needle was considered as satisfying, standard four-contact electrode (Quad PISCES, Medtronic Neurological Inc., Minneapolis, MN; or Quattrode, Advanced Neuromodulation Systems Inc., Plano, TX) was advanced through the needle, and the tip of the electrode, containing four discrete contacts, was placed in close proximity of the greater or lesser occipital nerve. Correct position of the electrode(s) was verified by intraoperative test stimulation of the awake patient and fluoroscopically (Figs. 1 and 2). Position was considered adequate if low to middle amplitude stimulation and small pulse width were enough to cover all painful areas. Once adequate coverage was achieved, the electrode was sutured in place with nonabsorbable nylon sutures using two plastic anchors provided by the manufacturer to minimize the possibility of movement. In addition to the suturing, the electrode was taped to the skin and connected to the external stimulation device. After final verification of the electrode position by fluoroscopy and test stimulation, the patient was transferred to the recovery room and then discharged home the same day.

The polarity of electrode contacts and the stimulator settings were individually adjusted in every patient to optimally cover all painful areas. The parameters of stimulation varied widely from patient to patient and were as follows: the pulse width ranged from 90 to 360 ms, the frequency ranged from 30 to 90 Hz, and the amplitude ranged from 1.0 to 4.0 V. All patients went through a stimulation trial at home for 5 to 7 days where they were able to use the stimulator during their

FIGURE 1. Intraoperative fluoroscopic image of paired occipital nerve stimulation electrodes. Both electrodes were inserted in direction from right to left. Insertion point for the left electrode was at the midline at the level of C2 spinous process, advanced toward the left mastoid tip. The right electrode was inserted 1 cm posterior to the right mastoid tip, aiming toward the midline.

FIGURE 2. *Unilateral occipital nerve stimulation electrode. The four contacts of the electrode overlay the course of the greater and lesser occipital nerves.*

normal daily activities. They were allowed to adjust certain stimulation parameters, such as amplitude, frequency, and pulse width, within specified preset marginal values (usually within the range of ±15% from the optimal coverage values defined in the hospital) to adjust the stimulation coverage and intensity depending on their needs.

In case of successful trial defined as more than 50% of pain reduction, the patient had the second part of surgical procedure performed under general anesthesia because of painful subcutaneous wire tunneling and creation of the pocket for the implantable pulse generator (IPG). The first incision was made along the retroauricular area in a vertical direction. The soft tissues were dissected down to the fascia, and a small pocket was created above the fascia. The temporary electrode was removed, and the standard four contact electrode was then positioned into the same anatomic location, which was confirmed by rough approximation of the baseline and subsequent fluoroscopic images. Once the electrode was positioned in the right plane, the needle was removed, and the electrode was anchored to the occipital fascia with nonabsorbable sutures using a manufacturer provided plastic anchor.

Then, a subcutaneous pocket was created below the clavicle on the same side to accommodate the IPG. Extension cables were advanced through a subcutaneous tunnel, establishing connection between the electrode(s) and IPG. At the end, all incisions were closed, cleaned, and covered with sterile dressings, and the patient was transferred to the recovery room after waking up from general anesthesia and discharged home on the same or next day. Before discharge, the ONS system was turned on, and the settings of the stimulation were individually adjusted in every patient. All patients were given the opportunity to adjust certain settings of the stimulation at home based on their needs within preset values, which in most cases were similar to those used during the trial. At the first clinical follow up visit 1 to 2 weeks after the discharge, patients reported their overall satisfaction with the degree of pain relief and if it was necessary, the stimulator settings were once again adjusted to better fit each patient's individual needs.

RESULTS

All patients with permanently implanted ONSs were seen in the outpatient clinic on regular basis for the follow up period averaging 22 months (5–32 mo). Overall, 28 occipital nerves were stimulated in 14 patients. Seventeen (74%) trials in 10 (71.5%) patients were considered successful, and these patients proceeded to permanent internalization of the stimulator (*Table 1*). From these patients, the stimulation remained beneficial at least for 6 months after internalization in 100% (*Table 2*).

The intensity of the pain during the trial remained unchanged or only minimally improved in four (28.5%) patients. This happened despite intraoperative verification of the correct electrode placement confirmed by test stimulation. These patients did not proceed to internalization because their benefit from stimulation was insufficient to justify permanent implantation of the PNS system.

From those who proceeded with internalization, at the time of last follow up, two (20%) patients had their systems partially or totally explanted because of complications. One patient, who continuously experienced proper relief by stimulation, had part of the hardware removed because of infection. The second patient initially lost the effect of stimulation in early postoperative period because of migration of the electrode and underwent an additional surgical procedure for repositioning of the electrode. She regained reasonable stimulation after repositioning and had satisfactory control of her pain for over a year. However, later on, she lost the effect of stimulation once again. In addition, the patient developed tightness and spasms in the neck and right side of the body and requested for removal of the device. Another patient (10%) had her system explanted 21 months after the internalization of IPG because of complete improvement of pain and loss of need in stimulation.

The first two patients had their pain return shortly after their systems were explanted. The pain was similar in distribution and intensity to preestimulation levels, and they required a combination of several analgesic drugs for pain relief, whereas the last patient was completely pain free. The remaining seven (70%) patients with the implanted PNS system continued to have beneficial effects from chronic ONS ranging from 60 to 90% in pain relief during their last follow-up. This resulted in a decreased amount of pain medications they have been taking for their pain control and the ability to return to normal daily activities and, for some, to gainful employment.

Overall, the beneficial effect of chronic ONS in our series persisted in more than half of the patients for whom procedure was considered and in 80% of those who significantly improved during the trial and proceeded with permanent device implantation (*Table 2*). We had no intraoperative or

TABLE 2. Pain relief outcomes in patients who proceeded with occipital nerve stimulation system internalization after successful trial[a]

Patient no.	Pain relief outcomes at 1 week follow-up after system internalization[b]	Total follow-up (mo)	Pain relief outcomes at the last follow-up[b]
2	Complete	47	ONS system is removed, required mild opioids for pain control
3	Satisfactory	30	Significant improvement of pain with stimulation; occasionally used nonopioid analgesic medications for additional pain control
5	Complete	27	Pain free without stimulation, ONS system is removed
6	Complete	25	Significant improvement of pain with stimulation, no analgesic medications used
7	Satisfactory	24	Required mild nonopioid analgesics with stimulation for adequate pain control
8	Complete	24	Pain free with stimulation
10	Satisfactory	22	ONS system is removed; required strong nonopioid analgesics for pain control
11	Complete	21	Pain free with stimulation
12	Complete	19	Pain free with stimulation
13	Complete	5	Pain free with stimulation

[a] ONS, occipital nerve stimulation.
[b] Derived based on patient's overall rating of pain control.

postoperative complications that would lead to any type of significant morbidity or mortality. Two (20%) systems had to be removed because of infection or loss of stimulation effect, and one (10%) system was removed because of significant improvement of pain and no need in stimulation. The remaining ONS systems continue to stay in place and provide adequate pain relief to seven (70%) patients.

DISCUSSION

ON is one of several so-called cervicogenic headache syndromes with many etiologies and multiple treatment options (28). Pathological conditions most often implicated in the origin of ON are trauma, arthritic changes of the atlantoaxial joint, cervical cord tumors, Chiari malformation, as well as ligamentous hypertrophy and sustained neck muscle contractions (7, 18, 30). A number of various treatments, both conservative and surgical, have been used to help people suffering from ON, and the medical management, obviously, is the most commonly used approach (5, 22). Chronic use of opioids and chemical neuromodulators, including antiepileptic drugs and antidepressants in different combinations, alleviates pain in more than half of the patients with idiopathic ON (29). However, approximately one third of all patients with ON, particularly those who have traumatic or arthritic etiology, become less sensitive to medications over time and require significant increase in oral drug intake, which may cause undesirable side effects, making it difficult to maintain the beneficial effect of the therapy. Recently, multiple injections of botulinum toxin into neck muscles, which reduce muscle hyperactivity, have been proposed as a safe and somewhat effective method for treatment of ON (8, 19). Occipital nerve blocks are even more effective and can provide immediate pain relief in almost every patient with ON, but the effect of botulinum toxin injections and nerve blocks is temporary, and pain usually returns once the drug effect wears off (23, 38). However, nerve blocks are considered as a generally accepted standard tool for confirming the diagnosis of any peripheral neuralgia because the probability for the patient to have psychogenic pain syndrome increases significantly after failed nerve block trial (28). We used nerve blocks as an important tool to prove that the pain syndrome has its roots in the greater or lesser occipital nerve, and thus a successful nerve block was one of our prerequisites before considering the patient to be a candidate for stimulation trial.

Most destructive procedures, such as neurolysis or gangliectomy, are very effective in the treatment of different medically intractable pain syndromes (3, 9, 20, 31). However, the use of this modality for treatment of intractable ON is very controversial. Once an anatomic structure is destroyed, it cannot be easily recovered, and with any destructive procedure, there is always a risk of development of painful neuroma or causalgia, conditions that may be even harder to control than the original neuropathic pain. As opposed to the destructive procedures, neuromodulation with chronic nerve stimulation is completely reversible. If the patient decides not to use this treatment modality in the future, the system can be easily turned off or even removed without any consequences, and the patient will stand exactly at the same point where he was before implantation, open to any other treatment option. The ONS is based on the same principles as the more commonly used technique of spinal cord stimulation (39).

Although chronic peripheral neurostimulation was described almost 40 years ago for the treatment of neuropathic

pain syndromes (33), it seems that there are many variables that may contribute to the success of this treatment modality. One of the difficulties in delivering stimulation to the area of face and back of the head has been the issue of electrode placement. The anatomic environment has to make it possible to place the electrode in the right location. Scar formation from previous surgical interventions or trauma could prevent the surgeon from advancing the electrode to the desired location. In addition, the stimulated nerve must be intact so the stimulation signal passes through the nerve and is not blocked by deafferentation or discontinuity along the nerve trunk. This is why performing the initial step of electrode insertion under local anesthesia may be important because it assures adequate positive feedback from the patient during the procedure and helps to maximally cover all painful areas with stimulation. Intraoperative test stimulation and direct feedback from the patient allowed us to get adequate paresthesia coverage in all patients from our series. Moreover, because the placement of the electrode for trial stimulation by itself was not a very complicated surgical procedure and did not require keeping the patient under general anesthesia, it has been performed on an outpatient basis, which in turn minimized the hospital stay time for these patients and, consequently, reduced the overall cost of the treatment.

We found that an important prerequisite for successful treatment of ON with peripheral neurostimulation is careful patient selection. Similar to spinal cord stimulation, certain neuropsychological and social findings could be very accurate in predicting an undesirable outcome. For example, presence of depression, drug addiction, unrealistic expectations, a long history of different procedures and approaches in the past, or social economical benefits may all be reasons for inadequate pain relief in such patients. In addition, a 1-week (5–7 d) trial period is usually given to every patient before internalization of the permanent device, which makes it possible for the patient to extensively test the stimulation and adjust the settings to his daily needs, assuring that stimulation provides adequate pain relief and proves beneficial for long-term use.

Another important prerequisite for considering any patient with ON for stimulation trial should be alleviation of the pain with occipital nerve block. The effect of any nerve block is always transitory. However, it is interesting that after the occipital nerve block, the pain may drastically reduce in other areas of the head as well that are not correlated anatomically to anesthetized areas (28). This phenomenon can explain the beneficial effect of chronic ONS in migraine patients. The stimulation of greater occipital nerve in these patients relieves the pain not only in the occipital region but also in the frontotemporal area (23). It has been shown in an experimental animal model that the stimulation of the greater occipital nerve increases metabolic activity in both typically nociceptive regions of the spinal cord and in the trigeminal nucleus caudalis through the so-called trigeminocervical complex, which consists of functional connections between meningeal inputs and greater occipital nerve afferents (2, 10). This functional coupling between nociceptive meningeal afferents and cervical afferents in the greater occipital nerve occurs at the second-order neuron level in the upper spinal cord (1, 27). Another positron emission tomographic study of eight patients with migraine who have had a marked response to chronic occipital stimulation showed significant changes in regional cerebral blood flow during the stimulation in the anterior cingulate cortex, cuneus, and left pulvinar nucleus, which directly correlated with paresthesia scores and inversely correlated with pain scores (23).

Although most of these studies were performed in patients with chronic migraine or in experimental headache animal models, the proposed mechanism may be also responsible for pain relief in patients with ON and secondary generalized headaches. The small size of our series does not allow us to confirm or disprove this hypothesis.

All four patients from our series who did not proceed with internalization reported insufficient pain relief during the trial period, although in all cases, the correct placement of the electrode has been confirmed with intraoperative patient feedback and adequate coverage of painful areas by stimulation. Moreover, we did not find any particular difference between responders and nonresponders related to parameters of stimulation used, and diagnostic nerve blocks resulted in adequate temporary alleviation of the pain in all four patients. Thus, our experience shows that the stimulation trial remains an important step for appropriate patient selection because the patients who failed the trial did not differ from those who passed it, even with thorough physiological testing and neuropsychological evaluation.

Because we had a relatively small series (only 14 subjects) and a very large variation between patients in regard to the etiology of their ON, we were not able to find any particular correlation between etiology of ON and the outcome of stimulation. A long-term prospective clinical study with a bigger series of patients is needed to define such a correlation.

In our current series of 14 patients, 10 successfully passed the trial and proceeded with internalization of the PNS system. From those, only two (20%) patients had hardware-related complications that required their systems to be explanted after at least 12 months of continuous use, which corresponds to an 80% overall success rate of long-term ONS.

One (10%) patient requested her system to be removed 21 months after the implantation because of significant improvement of pain and no need for stimulation for over 6 months (*Table 2*). She was completely pain free at the time of her last follow-up (3 mo after the system was explanted). The remaining seven PNS systems continue to provide satisfying pain relief in seven (70%) patients.

Thus, we believe that PNS may be an effective and very promising method for long-term treatment of intractable ON. With the increasing number of procedures, the surgical technique will further improve, which in turn will lower the overall rate of minor complications we encountered. In addition, because neuromodulation systems have become more flexible currently, the effects of a minor shifting of the electrode or increase in electrical impedance caused by scar for

mation, for example, may be easily corrected by changing the active contacts on the electrode or by adjusting the pulse width and voltage of the electrical current. The remote control allows one to turn the stimulator on and off, increase or decrease certain settings within given ranges, opening for patients the possibility to adjust stimulator settings to their daily activities, thus providing better pain control over time, which in turn results in improvement of psychological well-being in most patients.

CONCLUSION

The approach, technique, and results described in this paper demonstrate that chronic peripheral neurostimulation may be a safe and effective treatment for intractable ON and that the long term benefit derived from chronic ONS appears to be durable. Although this is limited experience from a single center and needs to be expanded further, our results suggest that chronic peripheral neuromodulation is a promising surgical treatment modality for patients with medically intractable ON.

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An earlier version of this paper with preliminary results was presented at the 2004 Annual Meeting of American Association of Neurological Surgeons in Orlando, Florida and received the best poster award in the Section on Pain.

COMMENTS

This study of eleven patients with a mean follow-up of almost two years examines the efficacy of occipital neurostimulation in the treatment of occipital neuralgia. Out of the initial eleven patients entered into the study, three failed to obtain measurable benefit even early in their treatment and were not fully implanted. In addition, three patients had their devices explanted because of either loss of benefit or infection. Of the remaining six patients, five appear to be either pain free or significantly improved on last follow-up. Therefore, five of the eleven patients studied appear to be enjoying significant relief of their pain an average of almost two years following stimulation. Despite the small number of patients in this study, these results are promising. The technique described is exceptionally easy to perform, and appears to hold significant promise in a very refractory group of patients.

Although this study supports the use of neurostimulation for the treatment of occipital neuralgia, it is limited by the rather loose way in which it was conducted. For example, the entry criteria for occipital neurostimulation in this group were based mainly on the results of a diagnostic block and the patients are otherwise a rather diverse group with a number of other pain conditions. Significant "noise" is therefore introduced into the system which may well affect the outcome of such a small study. In addition, the outcome measures appear a bit loose. The authors state that pain relief ranges from 60-80% in the five successful patients, and that these patients enjoyed a reduction in pain medicine intake as well as a return to normal activities and work. Unfortunately, since this is a retrospective study, one cannot gain insight into more objective measures of success (functional scales, measures of analgesic use, etc.). Still, despite these limitations, this study does support the results of other anecdotal reports of this technique and should stimulate a more rigorously controlled, prospective study.

There are currently a growing number of neurosurgeons and anesthesiologists using occipital neurostimulation in the treatment of occipital pain syndromes, based upon the description of the technique by Weiner (1). The literature documenting occipital stimulation is still largely anecdotal however (e.g., 2). The current study by Slavin et al. is therefore a welcome addition to the literature. Although it is still a retrospective analysis of a relatively small group of patients (and therefore considered Class III data), this study does document the results of occipital neurostimulation in a more explicit way than has been done previously. I am hopeful that Dr. Slavin will follow up this pilot data with a prospective trial that will help delineate the uses and limitations of this technique.

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1. Weiner RL: Peripheral nerve neurostimulation. Neurosurg Clin N Am 14:401–408, 2003.
2. Kapural L, Mekhail N, Hayek SM, Stanton-Hicks M, Malak O: Occipital nerve electrical stimulation via the midline approach and subcutaneous surgical leads for treatment of severe occipital neuralgia: a pilot study. Anesth Analg 101:171–174, 2005.

In this paper, the authors present a retrospective case series of subcutaneous electrical stimulation for occipital nerve pain. A total of 14 patients, all of whom responded to local anesthetic blockade of the occipital nerves, were included in the study. Each underwent percutaneous placement of a trial electrode. A total of 10 patients experienced greater than 50% relief of pain for five to seven days and proceeded to implantation of the pulse generator. All of these patients experienced relief for six months after implantation, and eight experienced ongoing 50% improvement of symptoms. Three devices of the 10 total were removed: one due to complete resolution of pain, one due to loss of benefit, and another due to infection.

This case series provides some insight into the potential benefits of peripheral stimulation for occipital nerve pain. The patients are carefully selected, with each having resolution of pain with local anesthetic nerve blockade. It is interesting to note that although just over half of the patients with diagnostic nerve blockade went on to long-term benefit from electrical stimulation, all but one patient with a successful stimulation trial benefited from therapy. These results are encouraging, particularly as nerve stimulation likely poses lower risk to patients than traditional ablative approaches. Remaining questions involve the relationship of pain etiology to potential benefit and the factors that predict and differentiate treatment responses from treatment failures. To answer these important questions a larger patient population and prospective study is required.

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Neuromodulation therapies for chronic pain are increasingly growing and new indications emerging. Perhaps, pain syndromes involving the head and face are among the most challenging to treat. Occipital neuralgia is a common pain condition. A significant number of patients with occipital neuralgia have intractable pain despite optimal medication, blocks and other therapies. Surgical therapies have traditionally consisted of resection and lesioning procedures. Recently, neurostimulation has been utilized for treating occipital neuralgia.

The authors report a series of 11 patients with intractable occipital neuralgia who underwent trial of occipital nerve stimulation. All patients underwent neuropsychological clearance and successful occipital nerve blocks. The authors used a percutaneous approach with implantation of quadripolar wire electrodes and intraoperative verification of paresthesias covering the occipital region of pain. All patients underwent a stimulation test-trial lasting five to seven days. Eight of eleven patients undergoing the initial trial received a permanent implant. Five patients had significant long-term pain relief (ranging from 60–80%) with an average of 22 month follow-up.

The authors provide an important contribution to the field of neuromodulation and chronic pain neurosurgery. They have shown good outcomes using a minimally invasive approach and long term follow-up. The results from this series should encourage further controlled studies with larger series of patients.

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