Nonendoscopic Deactivation of Nerve Triggers in Migraine Headache Patients: Surgical Technique and Outcomes

Lisa Gfrerer, M.D.
Daniel Y. Maman, M.D.
Oren Tessler, M.D.
William G. Austen, Jr., M.D.

Boston, Mass.

Background: Low efficacy, significant side effects, and refractory patients often limit the medical treatment of migraine headache. However, new surgical options have emerged. Dr. Bahman Guyuron and others report response rates between 68 and 95 percent after surgical deactivation of migraine trigger sites in select patients. In an effort to replicate and expand migraine trigger-site deactivation surgery as a treatment option, the authors' group and others have developed nonendoscopic algorithms. The exclusion of endoscopic techniques may be useful for surgeons with little experience or limited access to the endoscope and in patients with challenging anatomy.

Methods: Forty-three consecutive trigger deactivation procedures in 35 patients were performed. Preoperative and 12-month postoperative migraine questionnaires and patient charts were reviewed. Response to surgery in terms of migraine symptom relief and adverse events were evaluated.

Results: The overall positive response rate was 90.7 percent. Total elimination of migraine headaches was reported in 51.3 percent of those with a positive response, greater than 80 percent resolution of symptoms was reported in 20.5 percent, and 28.2 percent had resolution between 50 and 80 percent. No significant effect was reported following 9.3 percent of procedures. There were no major adverse events.

Conclusions: Nonendoscopic trigger deactivation is a safe and effective treatment in select migraine headache patients. Although surgical techniques and understanding of the mechanisms of relief are evolving, results continue to be promising. This series confirms that excellent results can be attained without the endoscope. The authors continue to study these patients prospectively to improve patient selection and refine the protocol. (*Plast. Reconstr. Surg.* 134: 771, 2014.)

CLINICAL QUESTION/LEVEL OF EVIDENCE: Therapeutic, IV.

Migraine headaches affect 17.1 percent of women and 5.6 percent of men in the United States, with an increase in incidence every year.[1–4] Despite advances in the management of migraine headache, standard therapies often fail to relieve symptoms, harbor significant side effects, and are contraindicated in a large number of migraine sufferers.[5,6]

In 2000, Dr. Bahman Guyuron made significant observations that led to the development of a novel surgical treatment of select refractory migraine patients. He reported in a series of patients who had undergone forehead rejuvenation procedures that 31 of 39 patients (79.5 percent) with migraines noted improvement in their headaches.[7] Independently, the injection of botulinum toxin at migraine headache trigger sites had been shown to successfully alleviate symptoms of affected patients.[8,9] These reports led to the theory that compression of craniofacial nerves could play a key role in triggering migraines in specific patients. This hypothesis has been strengthened by multiple studies demonstrating that musculature, vessels, bony foramen, and fascial bands can compress nerve branches at proposed migraine trigger sites.[10–16]

From the Division of Plastic and Reconstructive Surgery, Massachusetts General Hospital, Harvard Medical School.
Received for publication February 3, 2014; accepted April 8, 2014.

DOI: 10.1097/PRS.0000000000000507

Disclosure: *The authors have no financial interest to declare in relation to the content of this article.*

Dr. Guyuron subsequently conducted several studies supporting this hypothesis.[17–23] He was the first to describe a comprehensive surgical approach of four major migraine headache trigger points.[17]

Dr. Guyuron and his group proved efficacy in several trials, including a prospective placebo-controlled trial in which patients were randomized to either an actual surgery group or a sham surgery group.[20] In the actual surgery group, 83.7 percent of patients experienced at least 50 percent reduction in migraine headaches compared with 57.7 percent of shams. Furthermore, 57.1 percent of the actual surgery group reported complete elimination of migraine headaches, compared with only 3.8 percent in the sham group.[20] In a subsequent report, patients who underwent actual surgery were followed, and 88 percent continued to report a positive response to surgery after 5 years.[18]

Dr. Guyuron has taught many surgeons to select and treat suitable candidates. Consequently, other groups have independently published their results.[25–27] A meta-analysis of both prospective and retrospective studies performed shows response rates between 68 and 95 percent ($n = 346$) for selected patients.[23]

Similarly motivated by Dr. Guyuron and these promising results, our group and others have developed algorithms for the surgical treatment of migraine headache patients that do not require the endoscope (Fig. 1). Although Dr. Guyuron has previously described the transpalpebral release of the supraorbital and supratrochlear nerves, he uses the endoscopic approach for the supraorbital, supratrochlear, and zygomaticotemporal nerves when released in concert. We use a transpalpebral approach for all of the anterior triggers, including the zygomaticotemporal nerve (Fig. 2).

Certainly, the advantages of a nonendoscopic approach to the anterior triggers are seen in patients with less favorable endoscope anatomy, such as a long forehead and/or high hairline, thin or no hair, or obesity. Previously, these patients would routinely undergo endoscopic frontal trigger-site release including the zygomaticotemporal, supraorbital, and supratrochlear nerves.[17] Decompressing both trigger sites through a transpalpebral incision reduces the number of incisions, allows for direct access, and avoids the endoscope in these unfavorable anatomical situations. Furthermore, 27 percent of orbits display a supraorbital foramen versus a notch. It is currently believed that these bony tunnels need to be osteotomized to adequately release the nerve. Through a transpalpebral incision, osteotomy of a supraorbital foramen and release of the nerve is direct. Although using a percutaneous approach assisted by the endoscope is well described by Guyuron, some may find this particularly challenging. Finally, this may be beneficial for surgeons without access to or experience with the endoscope. We hypothesized that similarly successful results could be obtained with this nonendoscopic algorithm.

PATIENTS AND METHODS

Patient Selection and Data Analysis

Approval from the Massachusetts General Hospital Institutional Review Board was obtained. All patients previously underwent a full neurologic examination by headache specialists to confirm the diagnosis of migraine headache in accordance with the guidelines established by the International Headache Society. All participants suffered from chronic refractory migraine headache and had failed multiple preventative medications; women were not pregnant or nursing. All participants completed a pretreatment migraine headache questionnaire evaluating migraine frequency, duration, and intensity. Potential nasal and intracranial abnormality was evaluated with a computed tomographic scan. Patients underwent thorough clinical evaluation performed by the senior author (W.G.A.). Patients' migraine histories, physical examination, and previous treatment with botulinum toxin type A (Botox; Allergan, Inc., Irvine, Calif.) and/or nerve blocks were evaluated to confirm nerve compression headaches. Patients with a history consistent with refractory nerve compression headaches, who had been previously treated with Botox and/or nerve blocks and reported a significant positive response, were considered for surgery. If treatment history was unclear or inconsistent, patients were referred back to a neurologist or pain specialist for further treatment. If their history was consistent but their response to nerve block or Botox was unclear or inadequate, patients were advised to undergo Botox therapy and nerve blocks. If complete or significant improvement of intensity and/or frequency of migraine headache resulted from these diagnostic maneuvers, surgical treatment was offered. All nerve blocks and some Botox treatments were administered by the senior author. The senior author evaluated all responses. Eight of 43 patients (18.6 percent) had nasal blockage on physical examination and/or computed tomographic scan. These patients were excluded from the study, as they were referred to an ear, nose,

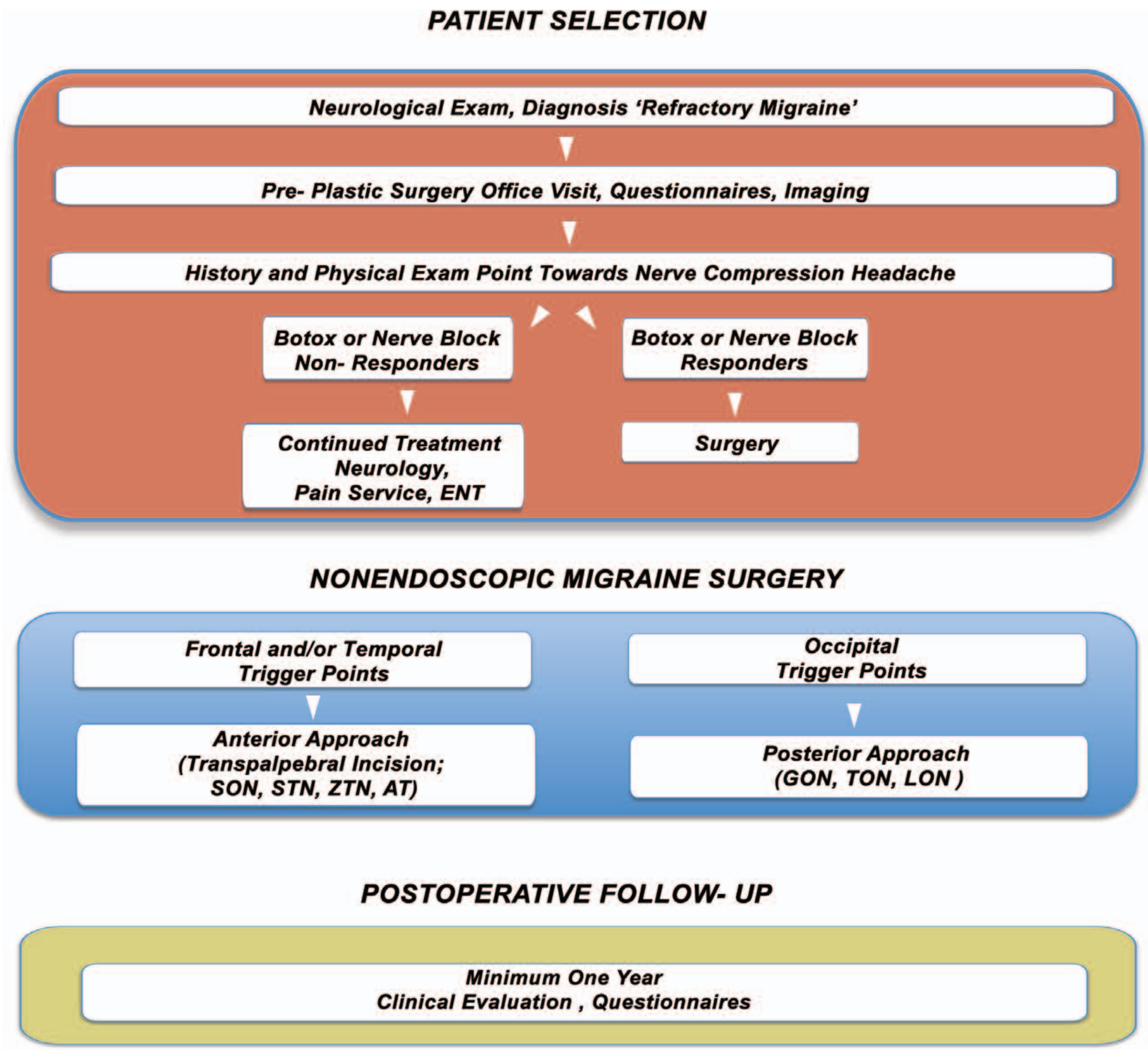

Fig. 1. Algorithm for nonendoscopic surgical treatment of migraine patients. As demonstrated by the proportions of this illustration, patient selection is the most important factor in success of surgery. *SON*, supraorbital nerve; *STN*, supratrochlear nerve; *ZTN*, zygomaticotemporal nerve; *AT*, auriculotemporal nerve; *GON*, greater occipital nerve; *TON*, third occipital nerve; *LON*, lesser occipital nerve; *ENT*, ear, nose, and throat.

and throat specialist for initial treatment. Eight of the remaining 35 patients (22.9 percent) had a second procedure because of unmasking of a latent trigger point. A total of 43 procedures on 35 patients including frontal (n = 26), temporal (n = 27), and occipital (n = 21) migraine trigger-site decompression were performed. Response to surgery in terms of migraine symptom relief and adverse events was reported based on postoperative evaluation by the senior author and a migraine headache questionnaire evaluating migraine frequency, duration, and intensity. The Migraine Headache Index was calculated as the product of migraine headache severity (scale of 1 to 10), migraine headache duration (fraction of 24 hours), and migraine headache frequency (days per month). A retrospective review of these 43 consecutive procedures was performed. The primary outcome was improvement of Migraine Headache Index. Four categories were used to describe postoperative outcome: (1) total elimination (100 percent resolution); (2) resolution (>80 percent reduction of Migraine Headache Index); (3) partial resolution (50 to 80 percent reduction of Migraine Headache Index), and (4) no resolution (<50 percent reduction of Migraine

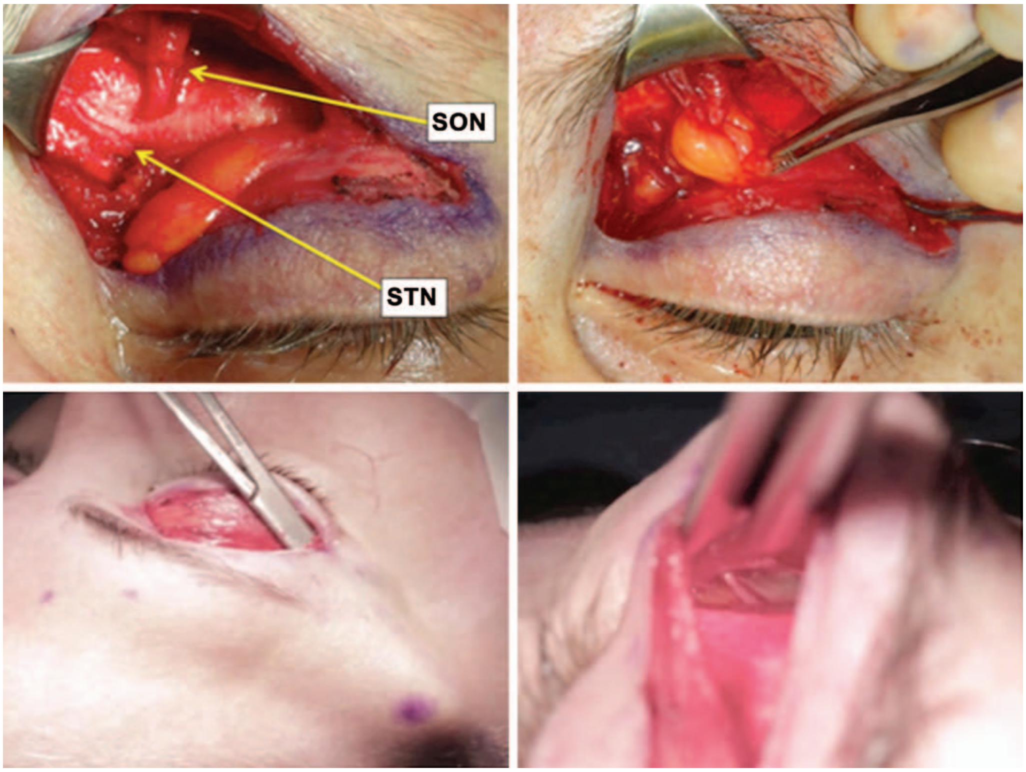

Fig. 2. Anterior nonendoscopic approach for frontal (*above*) and temporal (*below*) trigger points through a transpalpebral incision. Supraorbital nerve exiting the bony foramen, supratrochlear nerve medial to the supraorbital nerve after corrugator supercilii resection (*above*, *left*), and adipose flap to protect nerves (*above*, *right*) are shown. Transpalpebral approach to the zygomaticotemporal nerve (*below*). *SON*, supraorbital nerve; *TON*, third occipital nerve; *STN*, supratrochlear nerve; *ZTN*, zygomaticotemporal nerve.

Headache Index). Data were analyzed using STATA Version 12.1 (StataCorp, College Station, Texas). Descriptive statistics were computed for all variables. Paired *t* tests were used to compare migraine headache frequency, severity, duration, and Migraine Headache Index from baseline and after surgery. Values of $p < 0.01$ were considered significant. Unpaired *t* tests were used to compare outcomes of our transpalpebral approach to an endoscopic approach published by Liu et al.[28]

Study Population

The patient population consisted of 35 patients, 30 women and five men, with an average age of 46.1 ± 12.7 years (range, 20 to 72 years). The mean body mass index was 26.9 ± 5.7, with 22.8 percent of patients presenting with a body mass index greater than 30. The average follow-up was 17.5 ± 4.7 months (range, 12 to 29 months).

Surgical Technique

After careful patient selection, trigger-site deactivation surgery to release frontal, temporal, and occipital migraine headache trigger points was performed as either single or combined procedures. The frontal trigger site was approached by means of an upper blepharoplasty incision, with dissection to the orbital rim. The supraorbital and supratrochlear nerves were identified at the orbital rim (Fig. 2). Their course was followed exiting the orbit, and the nerves and accessory branches were freed from muscle, fascia, and blood vessels. If nerves were compressed by fascia, the fascia was divided. If nerves were compressed through a bony foramen, direct osteotomies were performed. If a notch was identified, the band was released by gentle traction and scissors dissection. The glabellar muscle group, including the corrugator supercilii, depressor supercilii, and the lateral portion of the procerus muscles, was removed. After confirming that the nerves had been completely released from any surrounding structures, a laterally based medial fat pad flap was wrapped around the nerves for their protection (courtesy of Robert R. Hagan). The zygomaticotemporal branch of the trigeminal nerve was located through the same transpalpebral incision. Careful dissection along the inferior lateral orbital rim over the deep temporal fascia was performed. The superficial temporal fascia was carefully lifted off the deep temporal fascia with an elevator and a lighted retractor to retract tissue and protect the sentinel vein and the temporal branch of the facial nerve.[29] Careful dissection around the vein to identify the zygomaticotemporal nerve was performed. Once identified, the zygomaticotemporal nerve was grasped with a Jake and avulsed.

The auriculotemporal nerve was identified preoperatively at the maximum point of pain and a short incision was made in this area or, if unclear, in the superior preauricular area. The nerve was either divided from the superficial artery and the artery was ligated and removed, or the nerve-artery bundle was ligated. Because the auriculotemporal nerve is extremely small, it is sometimes difficult to separate these structures.[12,30] The occipital trigger sites were approached as described by Dr. Guyuron.[17] If patients experienced pain and symptoms specific to the lesser occipital nerve, a separate incision was made over this nerve at the posterior border of the sternocleidomastoid muscle and it was avulsed (Fig. 3).

RESULTS

Surgical Outcomes

Forty-three procedures were performed on 35 patients. Eight patients (22.9 percent) underwent a secondary procedure. Migraine headache trigger-site procedures were grouped into frontal sites [$n = 26$ (60.5 percent)], temporal sites [$n = 27$ (62.8 percent)], and occipital sites [$n = 21$ (48.8 percent)]. Five temporal site procedures (11.6 percent) included release of the auriculotemporal nerve. Twelve occipital procedures (27.9 percent) included decompression of the lesser occipital nerve (Table 1). Overall, there was a 90.7 percent ($n = 39$) response rate (>50 percent reduction in Migraine Headache Index) after migraine trigger-site release. Of these, 20 (51.3 percent) had total elimination (100 percent) of migraine headaches. Eight (20.5 percent) resulted in a reduction of Migraine Headache Index of 80 to 100 percent. Eleven (28.2 percent) showed a reduction of symptoms greater than 50 percent. Four (9.3 percent) showed no significant improvement. The greatest relief of symptoms could be seen in the occipital release group, with 71.4 percent of procedures resulting in greater than 80 percent resolution of symptoms, followed by 63 percent in the temporal and 61.5 percent in the frontal group. Partial resolution of greater than 50 percent occurred in 30.8 percent of frontal, 29.6 percent of temporal, and 19.4 percent of occipital trigger-site releases. No resolution (<50 percent) of symptoms was seen in 7.7 percent of frontal, 7.4 percent of temporal, and 9.5 percent of occipital procedures. Two of five auriculotemporal nerve releases (40 percent) showed resolution greater than 80 percent, two (40 percent) showed partial resolution greater than 50 percent, and one (10 percent) showed no resolution (<50 percent). Eleven of 12 lesser occipital nerve releases (91.7 percent) led to greater than 80 percent resolution of symptoms,

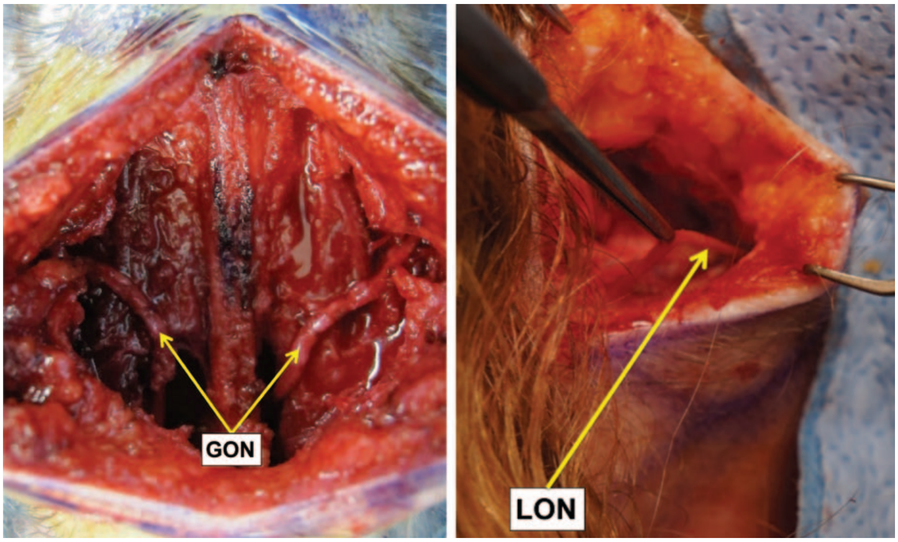

Fig. 3. Posterior approach. greater occipital nerve (*left*) and lesser occipital nerve (*right*) after decompression. *GON*, greater occipital nerve; *LON*, lesser occipital nerve.

Table 1. Migraine Headache Trigger-Site Distribution and Outcomes

Type of Procedure	No. (%)	No Resolution (<50%) (%)	Partial Resolution (50–80%) (%)	Resolution (>80%) (%)
Frontal (SON, STN)	26 (60.5)	2 (7.7)	8 (30.8)	16 (61.5)
Temporal (ZT)	27 (62.8)	2 (7.4)	8 (29.6)	17 (63.0)
AT	5 (11.6)	1 (20)	2 (40)	2 (40)
Occipital (GON, TON)	21 (48.8)	2 (9.5)	4 (19.4)	15 (71.4)
LON	12 (27.9)	0 (0)	1 (8.3)	11 (91.7)

SON, supraorbital nerve; STN, supratrochlear nerve; ZT, zygomaticotemporal nerve; AT, auriculotemporal nerve; GON, greater occipital nerve; TON, third occipital nerve; LON, lesser occipital nerve.

Table 2. Mean Migraine and Headache Frequency, Duration, and Severity*

Variable	Before Surgery	After Surgery (12 mo)	Average Difference from Baseline	*p*†
Migraine headache frequency (days/mo)	18.5 ± 10.4	3.7 ± 6.0	14.7 ± 9.9	<0.01
Migraine headache duration (days)	0.7 ± 0.5	0.2 ± 0.4	0.5 ± 0.3	<0.01
Migraine headache intensity (scale of 1–10)	9.2 ± 1.0	3.3 ± 3.3	5.9 ± 3.3	<0.01
MHI	99.4 ± 95.7	10.1 ± 18.0	89.3 ± 92.3	<0.01

MH, Migraine Headache Index.
*All values are expressed as mean ± SD.
†The *p* values were obtained from *t* tests.

whereas one (8.3 percent) resulted in partial resolution greater than 50 percent (Table 1).

Average migraine frequency (18.5 ± 10.4 to 3.7 ± 6.0), duration (0.7 ± 0.5 to 0.2 ± 0.4), and intensity (9.2 ± 1.0 to 3.3 ± 3.3) improved significantly from baseline ($p < 0.01$). The Migraine Headache Index improved from 99.4 ± 95.7 to 10.1 ± 18.0 12 months after surgery (Table 2). There were no major adverse events. Temporary anesthesia occurred in 100 percent of patients. Two patients (5.7 percent) experienced lasting occipital numbness at 1 year. Two patients (5.7 percent) experienced intense itching after surgery. One patient (2.9 percent) developed a hypertrophic scar on the occiput, which responded to Kenalog (Bristol-Myers Squibb, New York, N.Y.) injection.

DISCUSSION

Although migraine headache is one of the most debilitating diseases in modern society, its exact pathology remains unclear and there is no consensus on curative treatment. Dr. Bahman Guyuron has developed surgical interventions for improvement and elimination of migraine headache symptoms by deactivating migraine trigger sites[17] that have proven to be successful in the long term.[18] Other groups have been able to repeat these promising results.[15,25,27] Migraine trigger-point deactivation surgery has become a highly debated and controversial subject among plastic and reconstructive surgeons and neurologists. In an effort to continue to validate the surgical treatment of migraine headache resulting from nerve compression and to assist in increasing its accessibility to a wider patient population, our group and others have developed an algorithm for nonendoscopic surgical treatment of migraine headache.

Our results show response rates (>50 percent) of 90.7 percent (n = 43), and improvements in migraine frequency, duration, and intensity, postoperatively from baseline. These data are comparable to previous studies and confirm migraine trigger-point decompression surgery as an effective treatment for preselected migraine headache patients.[15,18,23]

The reported overall response rate (>50 percent) was 92.3 percent (n = 26) to frontal trigger-point release, 92.6 percent (n = 27) to temporal release, and 90.8 percent (n = 21) to occipital release, which is comparable to other studies describing single–trigger-point response rates.[15,17,31] Previous studies have used either a transpalpebral or endoscopic approach to decompress frontal migraine headache trigger points. In these reports, the temporal trigger site was always released endoscopically. Our group and others around the country have begun to approach the frontal and temporal triggers routinely without the endoscope. Although further evaluation is necessary, temporal trigger-site release through a transpalpebral incision seems to be as effective as an endoscopic approach. Our response rate for temporal trigger-site release of 92.6 percent is comparable to 99 percent seen by Guyuron et al.,[17] 86 percent seen by Liu et al.,[31] and 89.4 percent shown by Janis et al. with the endoscope.[26]

The only previous study comparing an endoscopic approach versus an open approach in migraine trigger-site deactivation surgery was published by Liu et al.[28] The frontal trigger site involving supraorbital and supratrochlear nerve decompression was evaluated. Significantly higher response rates (improvement >50 percent) in an endoscopic nerve decompression group (89 percent) versus a transpalpebral group (79 percent) were observed. Our overall response rate of 90.7 percent (>50 percent improvement) is comparable to the 89 percent rate achieved by Liu et al. in the endoscopic decompression group. Similarly, the overall response rate in our frontal trigger point decompression group of 92.3 percent is comparable to these published results with the endoscope, and there is no significant difference in improvement of mean Migraine Headache Index (84.7 ± 29.5 percent in our frontal transpalpebral group versus 89.0 ± 31.4 percent in Dr. Guyuron's frontal endoscopic group; data not shown) ($p = 0.51$). Liu et al. did not look at response rates between the endoscopic and transpalpebral groups for the temporal trigger sites, which would be an interesting comparison to further assess the advantages and disadvantages of these techniques.

Dr. Guyuron achieves extraordinary results with the endoscope. He has proven that for surgeons familiar with the endoscope, this technique provides an effective and safe way of decompressing both frontal and temporal trigger sites. His approach is, without question, the criterion standard for migraine surgery. However, an open transpalpebral approach seems to be comparable in terms of safety and response rates and may make migraine trigger-site decompression surgery more accessible to surgeons with less experience or with limited access to the endoscope.

Release of the auriculotemporal nerve through ligation of the nerve and/or vessel resulted in reduction of Migraine Headache Index greater than 50 percent in four of five patients (80 percent). Currently, there are no recommendations regarding treatment of the auriculotemporal nerve trigger site, although potential compression points have been described anatomically.[12,30] Our sample size is too small to draw any conclusions, but we believe this is an important subject for future studies. Morbidity in our patient population was minimal, with temporarily reduced sensation in all patients.

We observed that lesser occipital nerve release led to resolution of migraine headache (>50 percent) in all procedures ($n = 12$). Eleven (91.7 percent) resulted in resolution of symptoms (>80 percent). Of these, eight (66.7 percent) experienced total elimination. One procedure (8.3 percent) resulted in partial resolution (>50 percent) of symptoms. Lee et al. published the only other study discussing the anatomy and release of the lesser occipital nerve.[24] They showed that the occipital artery and fascial bands along its course could potentially compress the lesser occipital nerve. They found that seven of eight patients experienced success with this operation (defined as >50 percent reduction in the migraine headache index) after decompression. Surprisingly, between 2000 and 2011, only eight patients were presented to Guyuron's group for lesser occipital nerve decompression. We have treated 12 lesser occipital nerves in a much smaller patient population. Although our series of lesser occipital nerve triggers is small, excellent results can be achieved. Presurgical planning should always include questioning for potential pain at lesser occipital nerve compression points. Furthermore, residual migraine pain after occipital nerve decompression of the greater occipital nerve may be attributable to lesser occipital nerve entrapment and should be evaluated in nonresponders and partial responders.

In summary, we believe that an anterior transpalpebral approach to release frontal and temporal trigger sites may achieve success rates similar to those of an endoscopic approach, which further validates nerve decompression surgery (regardless of technique) as a treatment option for a select group of migraine patients. Furthermore, the release of the lesser occipital nerve may be beneficial for patients with pain at this trigger site. Our study has inherent weaknesses associated with a retrospective design and small patient numbers. We did not record postoperative medication changes, which could have introduced a bias into our results. We continue to study these patients prospectively to improve patient selection and refine our treatment protocols.

CONCLUSIONS

Migraine surgery is a valid method for treatment of a selected subpopulation of migraine headache patients. It has been shown to be successful by several groups, including ours. We believe that patient screening and selection are the keys to success. In collaboration with likeminded colleagues, we believe that migraine trigger-site decompression surgery should become a readily available treatment option. Further studies are necessary to elucidate the pathophysiology of migraine headache and the role of surgery to improve and even eliminate migraine symptoms.

William G. Austen, Jr., M.D.
Division of Plastic and Reconstructive Surgery
Massachusetts General Hospital
15 Parkman Street, WACC 435
Boston, Mass. 02114
wausten@partners.org

REFERENCES

1. Lipton RB, Bigal ME, Diamond M, Freitag F, Reed ML, Stewart WF; AMPP Advisory Group. Migraine prevalence, disease burden, and the need for preventive therapy. *Neurology* 2007;68:343–349.
2. World Health Organization. *The Global Burden of Disease 2004 Update*. Geneva: World Health Organization; 2004.
3. Centers for Disease Control (CDC). Prevalence of chronic migraine headaches: United States, 1980–1989. *MMWR Morb Mortal Wkly Rep.* 1991;68:331, 337–338.
4. Silberstein S, Loder E, Diamond S, Reed ML, Bigal ME, Lipton RB; AMPP Advisory Group. Probable migraine in the United States: Results of the American Migraine Prevalence and Prevention (AMPP) study. *Cephalalgia* 2007;27:220–229.
5. Dodick DW. Triptan nonresponder studies: Implications for clinical practice. *Headache* 2005;45:156–162.
6. Blumenfeld AM, Bloudek LM, Becker WJ, et al. Patterns of use and reasons for discontinuation of prophylactic medications for episodic migraine and chronic migraine: Results from the second international burden of migraine study (IBMS-II). *Headache* 2013;53:644–655.
7. Guyuron B, Varghai A, Michelow BJ, Thomas T, Davis J. Corrugator supercilii muscle resection and migraine headaches. *Plast Reconst Surg.* 2000;106:429–434; discussion 435–437.
8. Silberstein S, Mathew N, Saper J, Jenkins S; for the Botox Migraine Clinical Research Group. Botulinum toxin type A as a migraine preventive treatment. *Headache* 2000;40:445–450.
9. Behmand RA, Tucker T, Guyuron B. Single-site botulinum toxin type a injection for elimination of migraine trigger points. *Headache* 2003;43:1085–1089.
10. Janis JE, Ghavami A, Lemmon JA, Leedy JE, Guyuron B. Anatomy of the corrugator supercilii muscle: Part I. Corrugator topography. *Plast Reconstr Surg.* 2007;120:1647–1653.
11. Janis JE, Ghavami A, Lemmon JA, Leedy JE, Guyuron B. The anatomy of the corrugator supercilii muscle: Part II. Supraorbital nerve branching patterns. *Plast Reconstr Surg.* 2008;121:233–240.
12. Janis JE, Hatef DA, Ducic I, et al. Anatomy of the auriculotemporal nerve: Variations in its relationship to the superficial temporal artery and implications for the treatment of migraine headaches. *Plast Reconstr Surg.* 2010;125:1422–1428.
13. Janis JE, Hatef DA, Ducic I, et al. The anatomy of the greater occipital nerve: Part II. Compression point topography. *Plast Reconstr Surg.* 2010;126:1563–1572.
14. Janis JE, Hatef DA, Hagan R, et al. Anatomy of the supratrochlear nerve: Implications for the surgical treatment of migraine headaches. *Plast Reconstr Surg.* 2013;131:743–750.
15. Janis JE, Hatef DA, Reece EM, McCluskey PD, Schaub TA, Guyuron B. Neurovascular compression of the greater occipital nerve: Implications for migraine headaches. *Plast Reconstr Surg.* 2010;126:1996–2001.
16. Totonchi A, Pashmini N, Guyuron B. The zygomaticotemporal branch of the trigeminal nerve: An anatomical study. *Plast Reconstr Surg.* 2005;115:273–277.
17. Guyuron B, Kriegler JS, Davis J, Amini SB. Comprehensive surgical treatment of migraine headaches. *Plast Reconstr Surg.* 2005;115:1–9.
18. Guyuron B, Kriegler JS, Davis J, Amini SB. Five-year outcome of surgical treatment of migraine headaches. *Plast Reconstr Surg.* 2011;127:603–608.
19. Guyuron B. Discussion: Migraine surgery practice patterns and attitudes. *Plast Reconstr Surg.* 2012;129:629–630.
20. Guyuron B, Reed D, Kriegler JS, Davis J, Pashmini N, Amini S. A placebo-controlled surgical trial of the treatment of migraine headaches. *Plast Reconstr Surg.* 2009;124:461–468.
21. Guyuron B, Tucker T, Davis J. Surgical treatment of migraine headaches. *Plast Reconstr Surg.* 2002;109:2183–2189.
22. Guyuron B, Tucker T, Kriegler J. Botulinum toxin A and migraine surgery. *Plast Reconstr Surg.* 2003;112(5 Suppl):171S–173S; discussion 174S.
23. Kung TA, Guyuron B, Cederna PS. Migraine surgery: A plastic surgery solution for refractory migraine headache. *Plast Reconstr Surg.* 2011;127:181–189.
24. Lee M, Brown M, Chepla K, et al. An anatomical study of the lesser occipital nerve and its potential compression points: Implications for surgical treatment of migraine headaches. *Plast Reconstr Surg.* 2013;132:1551–1556.
25. Dirnberger F, Becker K. Surgical treatment of migraine headaches by corrugator muscle resection. *Plast Reconstr Surg.* 2004;114:652–657; discussion 658.
26. Janis JE, Dhanik A, Howard JH. Validation of the peripheral trigger point theory of migraine headaches: Single-surgeon experience using botulinum toxin and surgical decompression. *Plast Reconstr Surg.* 2011;128:123–131.
27. Poggi JT, Grizzell BE, Helmer SD. Confirmation of surgical decompression to relieve migraine headaches. *Plast Reconstr Surg.* 2008;122:115–122; discussion 123.
28. Liu MT, Chim H, Guyuron B. Outcome comparison of endoscopic and transpalpebral decompression for treatment of frontal migraine headaches. *Plast Reconstr Surg.* 2012;129:1113–1119.
29. Trinei FA, Januszkiewicz J, Nahai F. The sentinel vein: An important reference point for surgery in the temporal region. *Plast Reconstr Surg.* 1998;101:27–32.
30. Chim H, Okada HC, Brown MS, et al. The auriculotemporal nerve in etiology of migraine headaches: Compression points and anatomical variations. *Plast Reconstr Surg.* 2012;130:336–341.
31. Liu MT, Armijo BS, Guyuron B. A comparison of outcome of surgical treatment of migraine headaches using a constellation of symptoms versus botulinum toxin type A to identify the trigger sites. *Plast Reconstr Surg.* 2012;129:413–419.