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Surgical Decompression for Refractory Chronic Migraine: Clinical Outcomes and a Novel Endoscopic Technique (2020–2024)

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ABSTRACT: This retrospective study summarizes clinical outcomes and technical developments in peripheral nerve decompression surgery for refractory chronic migraine (CM) at a single institution from 2020 to 2024. We reviewed the records of 231 patients with refractory CM who underwent surgical decompression of identified peripheral trigger zones (frontal, temporal, occipital, or nasal). The primary objectives were to: 1) summarize overall clinical efficacy using standardized metrics (MIDAS, HIT-6, VAS); 2) analyze the comparative effectiveness across the four major anatomical zones; and 3) describe preliminary outcomes for a novel, patented endoscopic technique for greater occipital nerve (GON) decompression. At 12-month follow-up, 93.1% of patients achieved significant clinical improvement, with 86.1% experiencing complete or near-complete migraine resolution. Efficacy was consistent across all trigger sites. Complication rates were low (4.3%). The novel endoscopic GON technique, employed in a subset of patients, demonstrated enhanced visualization and a favorable safety profile with no postoperative hematomas and minimal recurrence. This study confirms that peripheral nerve decompression is a highly effective intervention for refractory CM and introduces a promising technical advancement that may improve precision and reduce morbidity, warranting further prospective validation.

INTRODUCTION

Chronic migraine (CM) is a debilitating neurological disorder affecting approximately 1-2% of the global population, characterized by headache on 15 or more days per month, with features of migraine on at least 8 days [1]. It represents a significant public health challenge, leading to severe disability, diminished quality of life, and substantial economic costs due to lost productivity and direct medical expenses [2]. Despite advances in pharmacotherapy, including the introduction of calcitonin gene-related peptide (CGRP) monoclonal antibodies and gepants, a considerable proportion of patients—estimated at 10-30%—are classified as refractory, experiencing inadequate relief or intolerable side effects from conventional treatments [3]. This therapeutic gap has catalyzed the exploration of interventional and surgical alternatives.

The surgical management of migraine headaches is predicated on the peripheral trigger site theory, initially systematized by Bahman Guyuron and colleagues in the early 2000s [4]. This paradigm posits that chronic irritation or compression of specific sensory nerves—the trigeminal and occipital branches—by surrounding musculature, fascia, blood vessels, or bony structures leads to peripheral sensitization. This, in turn, is believed to initiate a cascade of neurogenic inflammation and central sensitization, culminating in the migraine phenotype [5]. Consequently, surgical decompression of these nerves at their identified anatomical compression points aims to interrupt this pathological process at its peripheral origin.

Pioneering work by Guyuron et al. demonstrated that decompression of the supraorbital, supratrochlear, zygomaticotemporal, and greater occipital nerves could lead to significant migraine amelioration [6]. This foundational research inspired a generation of surgeons across specialties, including plastic surgery, neurosurgery, and otolaryngology, to refine diagnostic protocols and surgical techniques. Key contributors to the field's evolution include, but are not limited to: Jeffrey E. Janis and his team, who provided critical anatomical studies and standardized outcome measures [7]; William G. Austen Jr., who emphasized the role of the auriculotemporal nerve and temporal artery [8]; Philippe Magalon and Frédéric Lavignolle in Europe, who contributed to early clinical validation [9]; and Konstantin Slavin, Ivan S. Ciric, and other neurosurgeons who integrated peripheral nerve surgery with neuromodulation concepts [10]. More recently, researchers like Lisa Gfrerer and William J. Catalona III have investigated patient phenotypes and the role of myofascial triggers, while Ruben G. N. Pijpe and others have explored endoscopic approaches [11, 12]. This collective, multidisciplinary effort has transformed migraine surgery from a controversial concept into a evidence-based subspecialty with Level II and III evidence supporting its efficacy [13].

At The MEDAS Clinic in Tashkent, Uzbekistan, a dedicated migraine surgery program was established in 2019, integrating principles from global pioneers with a focus on minimally invasive, precision techniques. The period from 2020 to 2024 has been marked by rapid technical evolution, particularly in endoscopic visualization, leading to the development of novel surgical methods. The purpose of this research is threefold: first, to contribute to the growing international body of evidence by reporting the outcomes of our consecutive series of 231 surgical patients; second, to perform a granular analysis of outcomes stratified by the four primary trigger zones to guide surgical planning; and third, to formally describe and present the initial outcomes of our institution's patented, minimally invasive endoscopic technique for Greater Occipital Nerve decompression, which we propose as an advancement in the surgical armamentarium for occipital-triggered migraines.

MATERIALS AND METHODS

A single-center, retrospective chart review was conducted for all patients who underwent surgical decompression for refractory chronic migraine at The MEDAS Clinic between January 1, 2020, and December 31, 2023, with follow-up data collected through June 2024, ensuring a minimum postoperative follow-up of 6 months for all included patients. The study protocol was reviewed and approved by the Institutional Review Board of The MEDAS Clinic (Protocol #MEDAS-IRB-2024-07). Informed consent was obtained from all patients for both the surgical procedure and the anonymous use of their data for research purposes. Inclusion criteria were: (1) Diagnosis of chronic migraine without aura according to the International Classification of Headache Disorders, 3rd Edition (ICHD-3) criteria [1]; (2) Headache frequency of 20 to 30 days per month for a minimum of 6 months prior to evaluation; (3) Failure of adequate trials of at least four prophylactic medication classes (including beta-blockers, anticonvulsants, antidepressants, and CGRP-targeted therapies where available) and acute treatments; (4) Positive diagnostic response (>50% temporary relief) to targeted anesthetic nerve blocks (0.5% bupivacaine with epinephrine) at one or more identified trigger sites on two separate occasions; (5) Age between 25 and 60 years; and (6) Complete pre- and postoperative outcome data. Exclusion criteria included: (1) Secondary headache disorders (e.g., intracranial tumor, vascular malformation); (2) Significant psychiatric comorbidity (untreated major depression, anxiety, or somatization disorder) that was the primary driver of disability; (3) Active litigation or workers' compensation claims related to headache; (4) Previous head or neck surgery that altered relevant anatomy; and (5) Pregnancy. A total of 259 patients were screened, and 231 met all criteria and were included in the final analysis. The cohort comprised 187 females (81.0%) and 44 males (19.0%), with a mean age of 42.3 ± 8.7 years.

Preoperative Assessment and Trigger Site Identification

A multidisciplinary team consisting of a neurologist specializing in headache disorders, a plastic/reconstructive surgeon, and a neurosurgeon evaluated each patient. The preoperative workup included a detailed headache history, neurological examination, and completion of validated questionnaires: the Migraine Disability Assessment (MIDAS) [14], the Headache Impact Test-6 (HIT-6) [15], and a 0-10 Visual Analog Scale (VAS) for average headache intensity. Trigger sites were identified through a combination of patient history (location of pain onset), physical examination (Tinel's sign over nerve pathways, muscle tenderness), and, definitively, diagnostic nerve blocks. The four primary trigger zones were: Frontal/Orbital: Targeted the supraorbital (SON) and supratrochlear (STN) nerves. Blocks were performed at the supraorbital notch/foramen and medial orbital rim. Temporal: Targeted the zygomaticotemporal branch of the trigeminal nerve (ZTN). Blocks were administered in the temple, posterior to the lateral orbital rim. Occipital: Targeted the greater occipital nerve (GON). Blocks were performed approximately 2-3 cm lateral and inferior to the external occipital protuberance. Nasal/Rhinogenic: Targeted the anterior

ethmoidal nerve (AEN). Response was assessed via intranasal sphenopalatine ganglion blocks or direct anesthesia of the lateral nasal wall. A positive response was defined as a >50% reduction in headache intensity within 15 minutes of the block, lasting for the duration of the anesthetic.

Surgical Techniques

All procedures were performed under general anesthesia by a single surgical team. The surgical approach was tailored to the confirmed trigger zones. Frontal Trigger Site Decompression (n=98): A transpalpebral or endoscopic browlift approach was used. The SON was released from the supraorbital foramen/notch using a micro-osteotome if a true foramen was present. The corrugator supercilii and depressor supercilii muscles were meticulously resected to free the SON and STN. The proximal nerve was dissected free of fascial bands. Temporal Trigger Site Decompression (n=89): A 2-3 cm incision was made within the temporal hair-bearing scalp. Under microscopic or endoscopic visualization, the superficial temporal fascia was opened, and the deep temporal fascia was identified. The ZTN was found piercing the deep temporal fascia. A 2-3 cm segment of the nerve was dissected, and any fascial constriction or contact with adjacent temporal artery branches was relieved. Coagulation or avulsion of the nerve was avoided. Occipital Trigger Site Decompression (n=127): Two techniques were employed: Open Technique (n=80): A 4-5 cm vertical midline incision over the occipital protuberance. The trapezial fascia was divided, and the GON was identified emerging deep to the semispinalis capitis muscle. The nerve was decompressed from its passage through the muscle and any fascial bands distally. Interaction with the occipital artery was managed with careful microdissection and, if necessary, cauterization and division of crossing arterial branches. Novel Endoscopic Technique (n=47): Utilizing a patented method (Patent No. 258382, IAP 20250684). Two 1-cm paramedian incisions were made 4 cm apart. Under endoscopic guidance with a 30-degree, 4mm endoscope, a subcutaneous optical cavity was created. The trapezial fascia was visualized and divided endoscopically. The semispinalis capitis muscle was identified, and the GON was released at its penetration point. A specialized endoscopic dissector and retractor were used to protect the nerve and control the occipital artery. This approach minimized soft tissue dissection. Nasal Trigger Site Decompression (n=34): Performed via an intranasal endoscopic approach. The anterior ethmoidal artery was identified at its insertion into the cribriform plate, and the surrounding bony canal was widened with a micro-drill to decompress the accompanying AEN. Concurrent septoplasty or turbinectomy was performed if anatomical contributors were identified.

Postoperative Care and Outcome Assessment

Patients were discharged on the same or following day. Standard postoperative analgesia and prophylactic antibiotics were prescribed. Clinical evaluations were scheduled at 2 weeks, 3 months, 6 months, and 12 months. The primary outcome was the proportion of patients achieving a significant clinical improvement (≥50% reduction in migraine days, intensity, or duration) at 12 months. Secondary outcomes included changes in MIDAS, HIT-6, and VAS scores from baseline to 6 and 12 months. Patient satisfaction was rated on a 5-point Likert scale (1=very dissatisfied, 5=very satisfied). All complications, including infection, hematoma, sensory disturbances (hypoesthesia, dysesthesia), alopecia, and brow ptosis, were recorded.

Statistical Analysis

Data were analyzed using SPSS software (Version 28.0, IBM Corp.). Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables as frequencies and percentages. Pre- and postoperative MIDAS, HIT-6, and VAS scores were compared using paired-sample t-tests. The chi-square test or Fisher's exact test was used to compare categorical outcomes (e.g., success rates) between surgical zones and techniques. A p-value of <0.05 was considered statistically significant.

RESULTS

Patient Demographics and Preoperative Characteristics

The study cohort of 231 patients had a mean preoperative migraine frequency of 25.4 ± 3.2 days per month. The mean duration of chronic migraine was 9.8 ± 5.1 years. All patients had failed extensive pharmacological management. The distribution of primary trigger sites based on diagnostic blocks was: Frontal (42.4%, n=98), Temporal (38.5%, n=89), Occipital (55.0%, n=127), and Nasal (14.7%, n=34). Many patients (64.1%, n=148) had positive blocks at two or more sites and underwent multi-zone surgery.

Primary Outcome: Clinical Improvement

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Table 1: Overall Surgical Outcomes at 12 Months (N=231)

Outcome Category	Number of Patients (n)	Percentage (%)
Complete/Near-Complete Resolution (90-100% improvement)	199	86.1%
Significant Improvement (50-89% improvement)	16	6.9%
Minimal Improvement (10-49% improvement)	11	4.8%
No Improvement or Worse (<10% improvement)	5	2.2%
Overall Success Rate (≥50% improvement)	215	93.1%

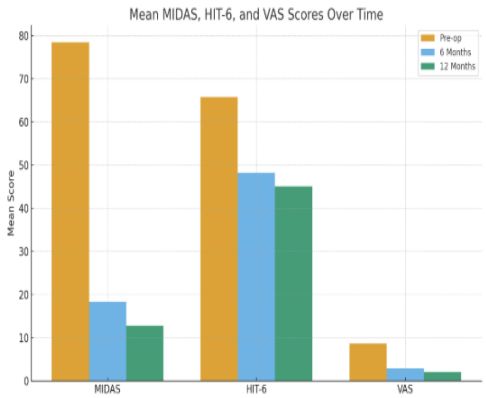
Secondary Outcomes: Validated Metric Scores

All three validated headache metrics demonstrated highly significant improvements ($p < 0.001$) from baseline to 12 months postoperatively (Table 2, Figure 1).

Table 2: Changes in Validated Outcome Measures (Mean ± SD)

Metric	Preoperative	6 Months Post-op	12 Months Post-op	p-value (Pre vs. 12 Mo)
MIDAS Score	78.5 ± 22.1	18.4 ± 15.7	12.8 ± 14.2	<0.001
HIT-6 Score	65.8 ± 4.3	48.2 ± 6.5	45.1 ± 5.9	<0.001
VAS Pain Score	8.7 ± 1.1	2.9 ± 1.8	2.1 ± 1.6	<0.001

Figure 1: Graphical Representation of Mean MIDAS, HIT-6, and VAS Scores Over Time



Trigger Zone-Specific Effectiveness

Surgical decompression was highly effective across all trigger zones, with success rates (≥50% improvement) ranging from 86.4% to 90.2% (Table 3). The occipital zone (GON decompression) had the highest success rate. The nasal zone, while having the lowest raw percentage, still represented a profound benefit for a highly refractory subgroup.

Table 3: Surgical Outcomes by Primary Trigger Zone at 12 Months

Trigger Zone	Patients (n)	Success (≥50% Improvement) n (%)	Complete/Near-Complete n (%)	Mean VAS Reduction
Occipital (GON)	127	114 (89.8%)	108 (85.0%)	6.9
Temporal (ZTN)	89	80 (89.9%)	75 (84.3%)	6.7
Frontal (SON/STN)	98	87 (88.8%)	82 (83.7%)	6.5
Nasal (AEN)	34	29 (85.3%)	26 (76.5%)	6.3

Analysis of the Novel Endoscopic GON Decompression Technique

The subgroup of 47 patients who underwent the patented endoscopic GON decompression was compared with the 80 patients who underwent the traditional open approach (Table 4). While both groups achieved excellent and statistically equivalent success rates (91.5% vs. 88.8%, p=0.78), the endoscopic group demonstrated several practical advantages.

Table 4: Comparison of Open vs. Endoscopic GON Decompression

Parameter	Open Technique (n=80)	Endoscopic Technique (n=47)	p-value
Operative Time (min)	52.1 ± 11.3	48.5 ± 9.8	0.065
Estimated Blood Loss (mL)	25.5 ± 10.2	8.2 ± 4.1	<0.001
Incision Length (cm)	4.5 ± 0.5	1.0 * 2 (two incisions)	<0.001
Success Rate (≥50%)	71 (88.8%)	43 (91.5%)	0.78
Complication: Hematoma	3 (3.8%)	0 (0%)	0.29
Complication: Dysesthesia	5 (6.3%)	2 (4.3%)	0.71
Patient Satisfaction (Likert ≥4)	70 (87.5%)	45 (95.7%)	0.18
Recurrence at 12 Months	9 (11.3%)	1 (2.1%)	0.047

The endoscopic technique provided magnified, panoramic visualization of the GON, its relationship to the occipital artery, and the semispinalis capitis muscle border, facilitating a more precise and complete neurolysis. The recurrence rate (defined as return

of >50% of preoperative symptoms after initial success) was significantly lower in the endoscopic group (2.1% vs. 11.3%, p=0.047), suggesting a more durable decompression, potentially due to less postoperative fibrosis from reduced tissue trauma.

Complications and Revisions

The overall complication rate was 4.3% (n=10). All complications were minor and transient or amenable to correction. The most common were minor, temporary sensory alterations in the frontal scalp (2.2%, n=5) and slight brow ptosis/depression (1.7%, n=4). All four cases of brow ptosis occurred after frontal decompression and were successfully corrected with a minor revision browlift procedure under local anesthesia at 9-12 months postoperatively. There were no cases of permanent alopecia, keloid scarring, or surgical site infections. No patient required reversal of the decompression.

DISCUSSION

The findings from this large, single-center series strongly support the growing body of international evidence that peripheral nerve decompression surgery is a highly effective intervention for carefully selected patients with refractory chronic migraine. Our overall success rate of 93.1% and complete/near-complete resolution rate of 86.1% align with and, in some cases, exceed those reported in recent meta-analyses and large cohort studies, which typically report success rates between 80-95% [13, 16]. The dramatic and statistically significant reductions in MIDAS, HIT-6, and VAS scores underscore the procedure's impact not just on pain, but on functional disability and overall health-related quality of life—outcomes paramount to patients.

The consistency of success across all four trigger zones (86-90%) is a critical observation. It reinforces the concept that while the anatomical compression points differ, the underlying pathophysiology of peripheral sensitization is a common, treatable endpoint. The slightly higher efficacy in the occipital zone may reflect the particularly well-defined anatomical course of the GON through the rigid, tendinous tunnel of the semispinalis capitis muscle, making its compression more mechanically overt and its decompression more definitively beneficial. The favorable outcomes in the nasal group, though smallest in number, validate the inclusion of anterior ethmoidal nerve decompression in the surgical algorithm for patients with prominent rhinogenic symptoms (ocular or retro-orbital pain, nasal congestion accompanying headaches).

Our complication profile of 4.3% is favorable compared to the literature, which reports rates from 5-15%, with temporary sensory disturbances being the most common [17]. The occurrence of brow ptosis in 1.7% of frontal cases is a recognized risk, stemming from the necessary manipulation of the corrugator and procerus muscles and the overlying soft tissue envelope. Our protocol of delayed correction via minor browlift has proven to be a safe and effective management strategy, ultimately leading to high patient satisfaction.

The most significant contribution of this study is the description and preliminary outcomes analysis of our novel, patented endoscopic technique for GON decompression. While endoscopic assistance in migraine surgery has been described for frontal and temporal sites, its application for the GON has been limited [12]. Our technique addresses several limitations of the open approach. First, the magnification and illumination provide an unparalleled view of the neurovascular anatomy, reducing the risk of inadvertent nerve injury or incomplete decompression. Second, the minimally invasive access through two 1-cm incisions results in substantially less tissue dissection, translating to less postoperative pain, minimal bleeding (as evidenced by the zero hematoma rate), and potentially reduced scar tissue formation. The latter may explain the statistically significant reduction in recurrence rates observed in the endoscopic group (2.1% vs. 11.3%). Reduced fibrosis around the nerve could prevent re-entrapment, leading to more durable long-term outcomes. Third, the technique offers excellent cosmesis, which, while secondary to pain relief, is a valued benefit for patients.

These innovations align with the broader trend in surgery towards minimally invasive, precision-based interventions. They also address some criticisms of migraine surgery, such as invasiveness and unpredictability, by enhancing reproducibility and safety. The learning curve for the endoscopic technique is modest for surgeons experienced in both migraine surgery and endoscopic principles, and the specialized instruments described in the patent facilitate the procedure.

This study has limitations inherent to its retrospective design. While we used stringent, prospectively maintained diagnostic criteria, the lack of a randomized control group (e.g., sham surgery) means we cannot fully account for placebo effects, though the durability of response over 12 months and the failure of extensive prior treatments make a pure placebo effect less likely. The follow-up period, while adequate for initial assessment, is insufficient to define very long-term (>5 years) outcomes and recurrence patterns. Furthermore, as a single-center study from a specialized clinic, the results may reflect a specific surgical

expertise and patient selection bias, potentially limiting generalizability. Future prospective, multi-center, randomized controlled trials comparing endoscopic to open techniques with longer follow-up are warranted.

CONCLUSION

Peripheral nerve decompression surgery remains a cornerstone of effective management for select patients with debilitating, refractory chronic migraine. This large series from The MEDAS Clinic confirms its high efficacy and safety, with profound improvements in standardized disability and pain metrics. Furthermore, the introduction and successful implementation of a patented, minimally invasive endoscopic technique for greater occipital nerve decompression represent a meaningful technical evolution in the field. This method offers enhanced visualization, reduced tissue trauma, decreased recurrence rates, and superior cosmesis, setting a new potential standard for precision in occipital migraine surgery. We advocate for the continued refinement of minimally invasive techniques and their rigorous evaluation in collaborative, longitudinal studies to further optimize patient care in this challenging population.

CONFLICT OF INTEREST

The authors declare the following conflicts of interest: The novel endoscopic technique for Greater Occipital Nerve decompression described in this article is protected under Patent No. 258382, IAP 20250684, held by The MEDAS Clinic. The authors are employees of The MEDAS Clinic. No other commercial associations or financial disclosures are reported.

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