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Ultrasound-Guided Occipital Nerve Block in the Management of Refractory Headache and Its Outcomes: A Prospective Study

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Abstract

Purpose Headache severely impacts health and lifestyle, causing distress and leading to accommodative changes in affected individuals. Treatment options available for refractory headache range from a conservative approach to advanced forms. The purpose of our study was to evaluate the effectiveness of ultrasound-guided occipital nerve block (ONB) in the management of refractory headaches using visual analog scale (VAS) score and Barrow Neurological Institute Pain Intensity Score (BNIPIS).

Methods A study sample of 30 eligible patients with refractory headaches including occipital neuralgia, migraine, tension headache, cluster headache, and vascular headaches aged between 18 and 65 years were included in our study. VAS and BNIPIS were noted for each patient before and after the procedure. ONB was given around the target nerve under aseptic precaution. Two milliliters of 0.5% bupivacaine was used as an injection solution for all patients.

Results The mean VAS score in acute pain at pre-treatment and post-treatment after 24 hours and 3 months was found as 7.53, 1.53, and 3.20, whereas in chronic pain the score was 8.13, 3.07, and 5.87, respectively. Pre-treatment pain levels in acute and chronic subjects in BNIPIS IV and V category shifted to category I and II after 24 hours (postinjection) that later were recorded II and III, respectively, after 3 months.

Conclusion Standard treatment guidelines are given by the international headache association for the management of headaches. The use of ONB is well advocated and practiced for a long time. In our study, we found that the use of greater occipital nerve block reduced pain levels affecting VAS and BNIPIS, which was more effective in acute cases than in chronic cases.

Keywords
- occipital nerve block
- visual analog scale
- Barrow Neurological Institute Pain Intensity Score

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Introduction

Headache is not an uncommon experience in today's era, which is experienced by most individuals at some point, irrespective of cause. It is one of the major causes of disability. The reason for it being called a disability is due to its direct and indirect impact on socioeconomic welfare as well as its aftermath, especially in refractory headaches.[1] Headache persisting for more than three months has been tagged as a "chronic headache" with its resistance to any form of treatment being deemed as a "refractory headache."[1]

Current pharmacological management for headaches is accomplished by the use of tricyclic antidepressants, serotonin reuptake inhibitors, and anticonvulsants, which help to manage the condition to a certain extent. Nonsteroidal anti-inflammatory drugs and paracetamol are not of much significance as they do not provide any relief or only minimal relief to the individual. Advent and research of newer management techniques help to resolve unaddressed issues faced by the use of conventional treatment modalities.[2] New diagnostic, as well as treatment modalities, have been formulated to be minimally invasive in nature and be effective to a certain extent, especially in refractory cases that encompass peripheral nerve blocks.[3] Advantage of this technique includes pain relief as well as a reduction in the frequency of attacks.[2]

The greater occipital nerve (GON) is a primary sensory nerve (a derivative of the medial branch of the dorsal ramus of the C2 spinal nerve) that forms a sensory unit encompassing the occipital region. Once it comes out from in between the atlas and axis of the spine, it traverses further to exit via a hole in the aponeurosis of the upper trapezius muscle. Injections into the GON have gained significant value owing to their capability to provide pain relief from occipital neuralgia, cluster headaches, cervicogenic headaches, trigeminal neuralgia, migraine, and tension-type headaches.[3]

Three areas of the GON infiltration site are[2] (1) at origin—between atlas (C1) and axis (C2); (2) intermediate site—surrounding obliquus capitis inferior muscle, where GON bends; and (3) superficial emergence—in perforating upper trapezius aponeurosis.

The lesser occipital nerve (LON), also known as the small occipital nerve, is a cutaneous ascending branch of the cervical plexus that arises from the ventral ramus of C2, hooks around the accessory nerve, and emerges along the posterior aspect of the sternocleidomastoid muscle at the punctum nervosum (Erb's point). The nerve then travels superiorly along the posterior border of the sternocleidomastoid muscle. At the occiput, the LON pierces the deep fascia and arborizes. The terminal branches of the LON communicate with lateral branches of the greater auricular nerve.[4]

Effectiveness and minimal invasive protocol in amalgamation with satisfactory results has favored ONB as a treatment modality by both the physician and patients.[5] Our study aimed to evaluate the effectiveness of ultrasound-guided occipital nerve block in the management of refractory headaches using visual analog scale (VAS) score, Barrow Neurological Institute Pain Intensity Score (BNIPIS).

Materials and Methods

This prospective study was conducted at Mahatma Gandhi Medical College and Research Institute, Pondicherry, after approval from review and ethics committee of institute, for a period of 15 months (January 2021–March 2022), wherein 30 contiguous patients who presented to neurology outpatient department (OPD) with refractory headaches along the course of GON were made part of the study after they fulfilled the inclusion criteria of age group between 18 and 65 years, irrespective of gender. All refractory cases of primary headache like occipital neuralgia, migraine, tension headache, cluster headache, and vascular headaches are included.

Patients were also assigned into two distinct groups based on the time from the onset of pain: patients experiencing pain for less than or equal to 3 months—acute pain category and patients experiencing pain for more than 3 months—chronic pain category

Procedure

Ultrasonography for all patients was performed using General Electric LOGIQ-S7 ultrasound machine in a sitting position. Scanning was done in transverse, longitudinal, and oblique planes with a 15 to 7 MHz small-footprint linear array transducer (hockey-stick transducer). VAS and BNIPIS scores with/ without a history of medication were recorded. Decision of the target nerve was made according to the patient's complaints and clinical signs, such as pain and dysesthesia in the distribution area (►**Fig. 1**). The injection

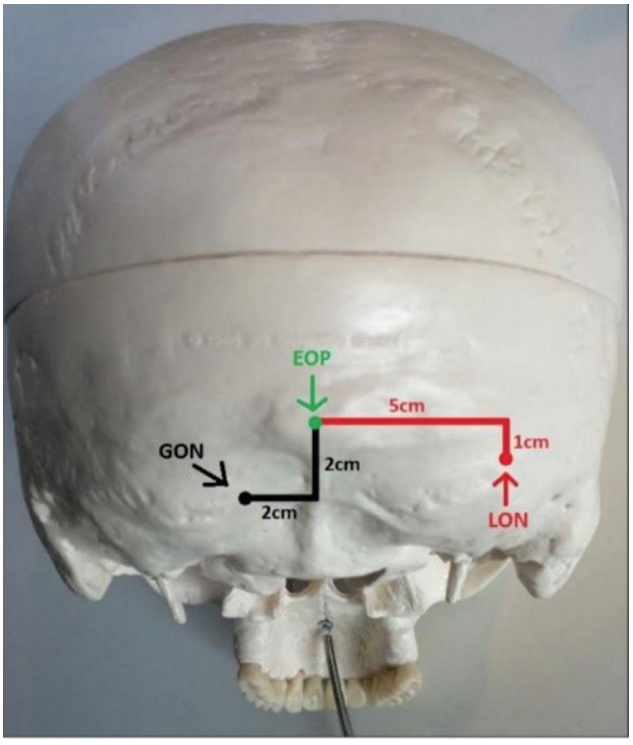

Fig. 1 Anatomical representation of greater and lesser occipital nerves block points according to position of external occipital protuberance. EOP, external occipital protuberance; GON, greater occipital nerve; LON, lesser occipital nerve.[8]

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Table 1 VAS score comparison between and within two groups at pre-treatment, 24 hours, and 3 months post-treatment

VAS Score	Duration of headache						*p*-Value b/w 2 groups
	Acute pain			Chronic pain			
	Mean	SD	Median	Mean	SD	Median	
Pre-treatment	7.53	1.19	7	8.13	1.06	8	0.148
After 24 hours	1.53	1.25	2	3.07	1.75	3	0.011*
After 3 months	3.20	2.60	3	5.87	2.17	6	0.009*

Abbreviations: SD, standard deviation; VAS, visual analog scale.
Note: The * mark signifies that the *p*-value is less than 0.05 hence it's significant.

site for the GON block was 2 cm lateral and 2 cm inferior to the external occipital protuberance, while the LON block was 5cm lateral and 1 cm inferior to the same bony landmark (►**Fig. 1**). Two milliliters of 0.5% bupivacaine was used as an injection solution for all patients. Under aseptic precautions, ONB was administered around the target nerve in the intermuscular fascial plane between semispinalis capitis muscle and inferior oblique capitis muscle, posteriorly in the nape of the neck. Reassessment and recording of VAS and BNIPIS were performed on follow-up visits, after 24 hours and 3 months respectively, for clinical evaluation.

Results

SPSS version 22 (IBM SPSS Statistics, Somers, New York, United States) was used to analyze data, ($p < 0.05$). For assessment in terms of the difference between the VAS score of two groups before the procedure, 24 hours after the ONB, and, finally, at follow-up after 3 months, paired *t*-test and repeated measures analysis of variance test were used.

Table 2 BNIPIS comparison between and within two groups at pre-treatment, 24 hours, and 3 months post-treatment

BNIPIS	Duration of headache	
	Acute pain	Chronic pain
	Median	Median
Pre-treatment	IV	V
After 24 hours	II	II
After 3 months	II	III

Abbreviation: BNIPIS, Barrow Neurological Institute Pain Intensity Score.

The mean VAS score in acute pain at pre-treatment and post-treatment after 24 hours and 3 months was found to be 7.53, 1.53 and 3.20 respectively, whereas the mean VAS score in chronic pain was found to be 8.13, 3.07, and 5.87, respectively (►**Table 1**).

Irrespective of the acute or chronic group, both showed an increase in VAS score at 3-month intervals in comparison to 24-hour intervals. The local anesthetic had a profound effect at 24-hour intervals as compared with pre-treatment, in the acute group with 79.7% of patients reporting less pain in comparison to 62.24% in the chronic group. Three months post-treatment assessment found the efficacy of treatment to be 42.50% in the acute group in comparison to 72.20% in the chronic group, proving the treatment efficacy of GON to be superior in acute cases than chronic cases.

At pre-treatment, patient distribution as per BNIPIS category I, II, III, IV, and V was 0, 0, 10, 8, and 12 patients, respectively, whereas at 3 months post-treatment, it was 4, 7, 12, 7, and 0 patients, respectively. Forty percent of patients accounted for the type V category of the BNIPIS scale at pre-treatment levels that was found to be the category I and II post-treatment showing significant improvement. On the evaluation of patients under the BNIPIS scale, we found the median at pre-treatment levels in acute and chronic categories to be at IV and V, respectively. Further assessment at 24 hours interval, the median in acute and chronic categories was found to be at II for each and after 3 months it was II and III respectively (►**Table 2**).

The effectiveness of GON block leading to complete resolution of pain (i.e., VAS score being 0) in the acute pain group was 40% in comparison to 6.7% in the chronic pain group pain. In contrast, 60% of patients had a partial reduction of pain in the acute group in comparison to 93.3% in the chronic group (►**Table 3**). There was a significant difference in effectiveness between the two groups. ($p = 0.009$).

Table 3 Effectiveness of greater occipital nerve block injection—bupivacaine for treatment of refractory headache

		Duration of headache					
		Acute pain		Chronic pain		Total	
		Count	%	Count	%	Count	%
Effectiveness	Effective	6	40.0	1	6.7	7	23.3
	Partial pain reduction	9	60.0	14	93.3	23	76.7
	Total	15	100.0	15	100.0	30	100.0

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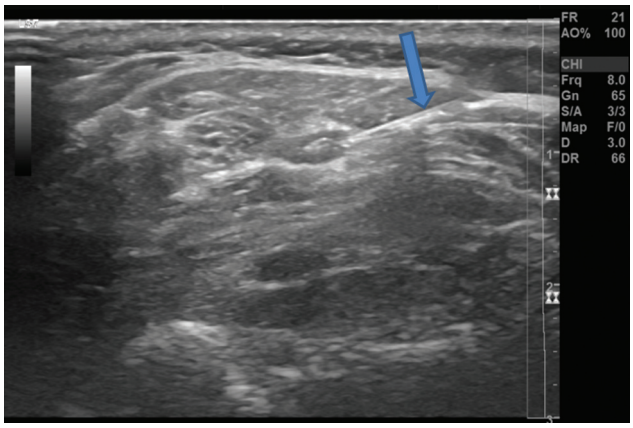

Fig. 2 (Case 1)—Ultrasonography image of greater occipital nerve block via 10 mL syringe needle into the perineural sheath for a patient with c/o occipital neuralgia.

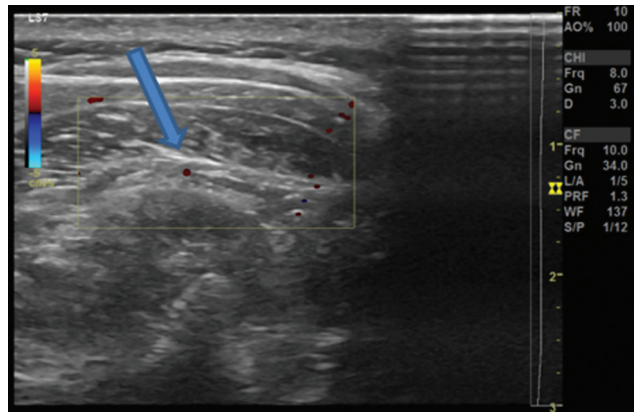

Fig. 4 (Case 2)—Ultrasonography image showing occipital artery as an identification point for greater occipital nerve.

Representative Cases

- ►**Fig. 2** (Case 1)
- ►**Fig. 3** (Case 1)
- ►**Fig. 4** (Case 2)
- ►**Fig. 5** (Case 2)
- ►**Fig. 6** (Case 3)

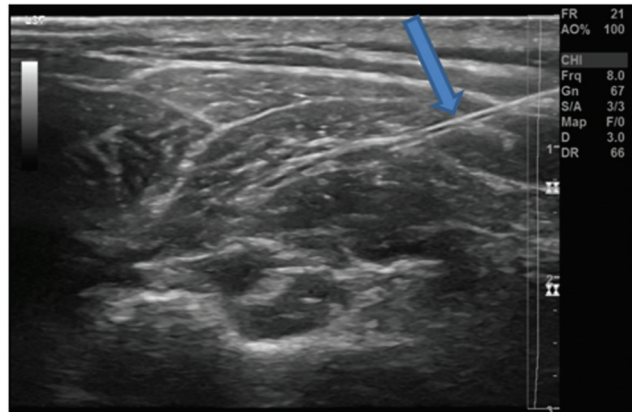

Fig. 5 (Case 2)—Greater occipital nerve block via 10 mL syringe needle into the perineural sheath for a patient with c/o occipital neuralgia.

Discussion

International Headache Society has categorized headaches into primary or secondary types. Primary headaches are those in which a headache is not caused by another disease or medical condition. It leads to considerable disability with a decrease in patients' quality of life. The most common types of primary headaches include migraine and tension-type headaches.[6,7] Secondary headaches are labeled as headaches that are caused by exogenous disorders like cerebrovascular disease, infection, musculoskeletal disorders, intracranial space-occupying lesions, and medication overuse headache.

Patients with chronic headaches suffer from higher levels of irritability while being impaired in normal daily routine activities, which lead to a search for remedies, with the immediate one being the use of pharmacological agents, which may only provide relief for a specified amount of time with resistance to drug dosage being an inadvertent outcome and complete resistance the final end-point.

The term refractory means "impervious." In the case of refractory headache, the term is rendered when all other

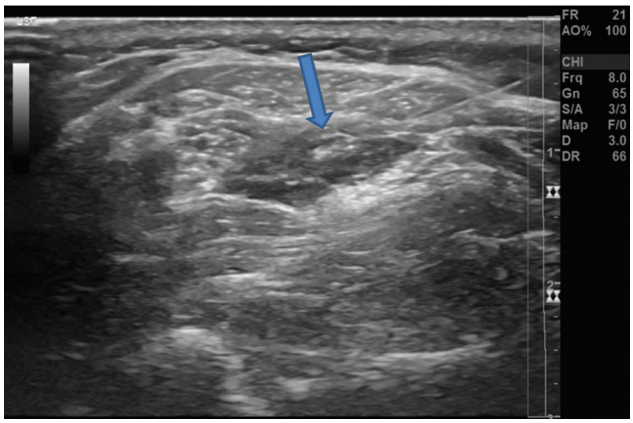

Fig. 3 (Case 1)—Ultrasonography image post-drug injection into the perineural sheath.

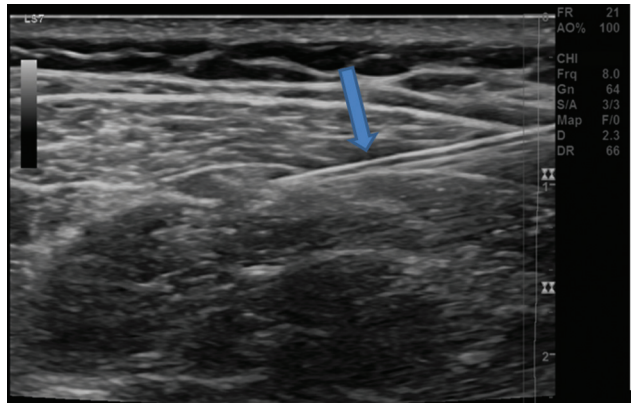

Fig. 6 (Case 3)—Ultrasonography image of greater occipital nerve block via 10 mL syringe needle into the perineural sheath for a patient with c/o tension headache.

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Table 4 Overall headache distribution

Headache		Occipital neuralgia		Migraine headache		Tension-type headache		Vascular headache	
Age		M	F	M	F	M	F	M	F
	<30 years	1	2	–	–	–	–	–	1
	31–40 years	2	6	–	1	–	1		1
	41–50 years	2	3	2	–	–	–	1	–
	51–60 years	2	1	–	–	–	1	–	–
	>60 years	2	1	–	–	–	–	–	–

treatment modalities have failed based upon treatment guidelines to deliver relief to the patient be it physical or psychological.[8] However, they should not be confused with the resistant type as they are diagnosed based on a different set of criteria.[8] Refractory headaches are resistant to most treatment options and persist throughout the treatment/management period, which act as a form of disability as the patient receives no relief/minuscule relief, which may make the patient's suffering beyond tolerable.

The International Headache Society defines occipital neuralgia as "Unilateral or bilateral paroxysmal, shooting, or stabbing pain in the posterior part of the scalp, following distribution of greater occipital nerve (GON) and/or lesser occipital nerve (LON)." Further, it is supplemented with tenderness over the corresponding dermatomes.[9–11]

ONB provides pain relief by altering nociceptive pathways in the brain. The hypothesis is that local anesthetic injections lead to diffuse noxious stimulus inhibitory control across the trigeminal–cervical complex, which averts the spread of nociceptive sensation in the route of primary sensory areas in the cortex.[12]

Occipital nerve block is a simple minimally invasive procedure, having a lesser learning curve for performing physicians with a low cost of drug and little potential for the drug-to-drug interactions

Most of our study subjects belonged to the 31 to 40 years age group at 36.7% with a mean age of 43.17 ± 11.93 years (►**Table 4**), which was comparatively higher than that observed by Palmar et al,[2] but less than that by Juškys and Šustickas[10] and Ryu et al,[13] which may be imparted to secondary hormonal changes. Our study showed a definite female predominance accounting for 60% of our subjects (►**Table 4**), whereas Ryu et al[13] found 70.37% female subjects, which was closest to that found in our study.

Our study consisted of 73.3% occipital neuralgia patients, 10% with migraine headache and vascular headache each, and 6.7% patients with tension headache (►**Table 5**), which were similar to the study done by Zipfel et al,[5] and contrasting results were observed by Ryu et al.[13]

Refractory headache along the distribution of GON was the major inclusion criteria for this study that can explain the higher proportion of occipital neuralgia patients, in contrast to other forms of primary headache including migraine/vascular/tension headaches where occipital region predominance is less common.

A significant decrease in mean VAS score at 24 hours compared with pre-treatment scores was observed in our study. However, an increase in mean VAS score at 3 months post-treatment was recorded compared with 24 hours post-treatment scores but not as high as pre-treatment scores, which was found to be statistically significant. After 3 months VAS score increased to 58% in the acute group, in comparison to pre-treatment, whereas it was only 27% in the chronic group (►**Table 1**).

Similar results were portrayed in a study done by Juškys and Šustickas,[10] and Zipfel et al[5] that was also in agreement with the study done by Golen and Okudan.[14] In the acute group, after a period of 24 hours there was a 79% drop in the VAS scores, which was 58% in the chronic group.

VAS score was found to be higher among the chronic pain group in comparison to the acute pain group, at all three intervals including pre-treatment, post-treatment after 24 hours, and after 3 months (►**Table 1**). Higher VAS scores can be attributed to many factors, be they pathophysiological or psychological in nature.

Table 5 Type of headache distribution

		Count	%
Type of headache	Migraine headache	3	10.0
	Occipital neuralgia	22	73.3
	Tension headache	2	6.7
	Vascular headache	3	10.0
	Total	30	100.0

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Amalgamation between pathophysiological and psychological factors plays a vital role in determining the disease process. Pathophysiological changes include central sensitization and change in pain threshold levels, inability to cope at low dosage medication, trauma leading to pain at the site of injection, and any adverse events that may ensue, while psychological changes are caused mainly due to mental strain suffered by the patient over a prolonged period that may impair the capability to judge pain levels.

Gul et al[15] compared bupivacaine and saline, and determined that 2-month and 3-month VAS scores were significantly superior to those of the placebo group. Viganò et al[16] and Ulusoy and Bolattürk[17] from their study also made it evident that there was a clinical improvement after GON block with a decrease in VAS scores, headache attack frequency, headache days per month, number of emergency visits, and duration of attacks. They also found that anxiety, depression, and sleep quality index improved with GON block.

VAS score has remained the gold standard test for the assessment of pain, however, to test the credibility of the score and to avoid patient error in the scoring pattern; we also recorded the score on the BNIPIS scale.

American Headache Society in the year 2013 put forward some recommendations concerning GON blocks but had no standardization concerning quantity/dosage, frequency, type of anesthesia (lidocaine or bupivacaine), and the exact site of injection.[14] Use of local anesthetics has been done to provide momentary relief to patients, which is practiced widely across the world; however, the use of the same has not been advocated as one of the treatment modalities by most physicians.

All patients who participated in our study received only GON block based on their area of distribution of pain. LON block could not be done due to the lack of availability of suitable candidates at the time of study and limited sample size. Positive results were obtained concerning the effectiveness of the treatment; however, the sample size was less to incorporate our treatment as a stand-alone treatment modality and requires more evidence. Prospective studies with a larger sample size are required to make occipital nerve block a part of the treatment protocol for the management of headaches.

Conclusion

Headache is a common diagnosis in medicine OPD and standard treatment guidelines are given by the international headache association for its management. The use of ONB is well advocated and practiced for a long time. In our study, we found that the use of GON block reduced pain levels affecting VAS and BNIPIS, which was more effective in acute cases than in chronic cases.

We need more studies with different drugs (e.g., steroids, local anesthetics) and combinations for more data on the role of ONB in the management of refractory headaches.

Ethical Approval

The study was reviewed by Mahatma Gandhi Medical College & Research Institutional Ethics Committee and was certified that it represented an accurate and complete description of the proposed research. The study was performed as per the approved protocol only.

Presentation at a Meeting

Organization: Department of Radiodiagnosis and Department of Neurology
Place: Mahatma Gandhi Medical College & Research Institute
Date: 23–11–2022

Conflict of Interest

None declared.

References

1 Güvençer M, Akyer P, Sayhan S, Tetik S. The importance of the greater occipital nerve in the occipital and the suboccipital region for nerve blockade and surgical approaches–an anatomic study on cadavers. Clin Neurol Neurosurg 2011;113(04):289–294
2 Palamar D, Uluduz D, Akarirmak U, et al. Ultrasound-Guided Greater Occipital Nerve Block: An Efficient Technique in Chronic Refractory Migraine Without Aura? Pain Physician 2015; 18:153–162 • ISSN 1533–3159
3 Sjaastad O, Bakketeig LS. Cluster headache prevalence. Vågå study of headache epidemiology. Cephalalgia 2003;23(07):528–533
4 Atlas of Ultrasound-Guided Regional Anesthesia (Third Edition). 2019; 363–365
5 Zipfel J, Kastler A, Tatu L, Behr J, Kechidi R, Kastler B. Ultrasound-guided intermediate site greater occipital nerve infiltration: a technical feasibility study. Pain Physician 2016;19(07):E1027–E1034
6 The International Classification of Headache Disorders. 3rd ed. International Headache Society; 2016
7 Garza I, Schwedt TJ. Diagnosis and management of chronic daily headache. Semin Neurol 2010;30(02):154–166
8 Sacco S, Braschinsky M, Ducros A, et al. European headache federation consensus on the definition of resistant and refractory migraine: developed with the endorsement of the European Migraine & Headache Alliance (EMHA). J Headache Pain 2020; 21(01):76
9 Rosa R. Real clinical practice: physiotherapy evaluation of disorders cranial-cervical-mandibular headaches in EBM. J Headache Pain 2017;18(Suppl 1):S42
10 Juškys R, Šustickas G. Effectiveness of treatment of occipital neuralgia using the nerve block technique: a prospective analysis of 44 patients. Acta Med Litu 2018;25(02):53–60
11 The International classification of headache disorders, 3rd edition (beta version). Cephalalgia 2013;33(09):629–808
12 Woolf CJ. Central sensitization: implications for the diagnosis and treatment of pain. Pain 2011;152(3, Suppl):S2–S15
13 Shim JH, Ko SY, Bang MR, et al. Ultrasound-guided greater occipital nerve block for patients with occipital headache and short term follow up. Korean J Anesthesiol 2011;61(01):50–54
14 Golen MK, Okudan DY. The efficacy of greater occipital nerve block in patients with chronic migraine. J Contemp Med 2021;11 (06):799–803
15 Gul HL, Ozon AO, Karadas O, Koc G, Inan LE. The efficacy of greater occipital nerve blockade in chronic migraine: a placebo-controlled study. Acta Neurol Scand 2017;136(02):138–144
16 Viganò A, Torrieri MC, Toscano M, et al. Neurophysiological correlates of clinical improvement after greater occipital nerve (GON) block in chronic migraine: relevance for chronic migraine pathophysiology. J Headache Pain 2018;19(01):73
17 Ulusoy EK, Bolattürk OF. The effect of greater occipital nerve blockade on the quality of life, disability and comorbid depression, anxiety, and sleep disturbance in patients with chronic migraine. Neurol Sci 2020;41(07):1829–1835

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