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REVIEW ARTICLE

A Review on Treatment of Supraorbital and Supratrochlear Neuralgia

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Abstract: Supraorbital and supratrochlear neuralgias are rare forms of neuropathic pain caused by damage or trauma to the supraorbital or supratrochlear nerves. Treatment options include oral medications, nerve block treatment, peripheral nerve stimulation, neuroma resection, endoscopic nerve decompression, pulsed radiofrequency, ultrasound-guided radiofrequency thermocoagulation, manual therapy, and cognitive behavioral therapy. Oral medications include drugs like carbamazepine, topiramate, gabapentin, clonazepam, and amitriptyline. Nerve block treatment involves injections of drugs to block nerves causing neuralgia. Peripheral nerve stimulation is a safe, reversible treatment for headaches caused by supraorbital neuralgia. Pulsed radiofrequency has shown long-term pain relief, while ultrasound-guided radiofrequency thermocoagulation has shown total pain relief within one month. Emerging therapeutic approaches include cryoneurotomy, trigger point therapy, and acupuncture with semi-conductive laser therapy. Combining ultrasound guidance with RFT could decrease recurrence rates and side effects. This review discusses about the anatomy, symptoms, causes, treatment options, comparative analysis, efficacy, limitations, side-effects, and novel therapeutic approaches for treatment of supraorbital and supratrochlear neuralgias.

Keywords: Supraorbital neuralgia; Supratrochlear neuralgia; Pulsed Radiofrequency; Nerve block treatment; Radiofrequency thermocoagulation; Neuroma resection.

1. Introduction

Supraorbital and supratrochlear neuralgias are neuropathic pain conditions associated with damage or dysfunction of the supraorbital or supratrochlear nerves respectively [1]. These conditions can cause severe, recurring pain in the facial and forehead regions if left untreated. The supraorbital nerve originates from the ophthalmic division of the trigeminal nerve, which is a purely sensory nerve [1]. It travels through the supraorbital notch or foramen in the skull, in close proximity to the supraorbital artery [1]. The supraorbital notch lies medial to the frontal notch, where the supratrochlear nerve emerges between the trochlea and supraorbital foramen/notch [2]. The supratrochlear and supraorbital nerves arise from the division of the frontal nerve, coursing supero-laterally and outside the annular tendon [3]. The supratrochlear nerve supplies sensation to the medial aspect of the forehead.

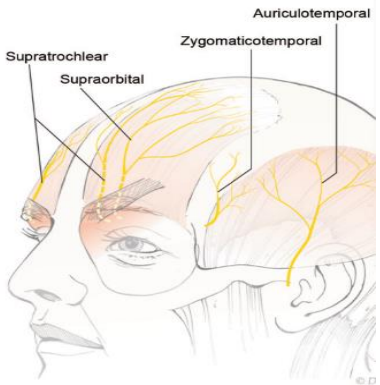

Figure 1. Supraorbital and supratrochlear nerves

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The diagnostic criteria for supraorbital neuralgia include [4]:

1. Intermittent or constant pain in the region of the supraorbital notch and medial forehead, innervated by the supraorbital nerve

2. Tenderness near the supraorbital nerve in the supraorbital notch

3. Pain relieved by local anesthetic block or ablation of the supraorbital nerve

Supratrochlear neuralgia has a distinct presentation that can be differentiated clinically from other similar headaches and neuralgias. The pain is localized to the lower medial forehead skin supplied by the supratrochlear nerve and may radiate to the eyebrow and superior-medial orbit [5]. The pain can be constant or intermittent in nature. Due to the complex anatomical relationship between the supraorbital and supratrochlear nerves, neuralgic pain in this region has typically been attributed to supraorbital neuralgia [6].

The superficial location of the supraorbital and supratrochlear nerves makes them highly vulnerable to trauma and compression [6]. According to the International Classification of Headache Disorders (ICHD), supraorbital neuralgia may present with paroxysmal and chronic pain, with tenderness commonly elicited at the supraorbital foramen [6]. Trauma to the supraorbital region can damage the supraorbital and supratrochlear nerves as they transition from an intraorbital to subcutaneous location to innervate the forehead and anterior scalp [7]. Patients may also report headaches, tinnitus, dizziness, hearing issues, sensory disturbances, and seizures [3].

It is hypothesized that primary supraorbital neuralgia, likely caused by mild chronic injury to the orbit or supraorbital notch, differs clinically from traumatic supraorbital neuralgia induced by significant external forces [5]. The supraorbital nerve may cross nearby arteries and the orbital wall along its course. This specific anatomical trajectory could allow for intermittent minor nerve stress during eye movements, resulting in stretching, angulation, traction, or friction of the nerve. The nerve and small artery may even share a common adventitia. Consequently, a nearby artery could cause microvascular compression of the nerve, leading to supraorbital neuralgia [5]

2. Treatment modalities

2.1. Oral medications

Oral medications used for supraorbital and supratrochlear neuralgia include carbamazepine (800 mg/day), topiramate (200 mg/day), gabapentin (1200 mg/day), clonazepam (4 mg/day), and amitriptyline (25 mg/day) [8]. Other medications used on a daily basis include paracetamol, ibuprofen, tramadol, pregabalin, oxycodone, oxycontin, naratriptan, sumatriptan, and Excedrin [9].

2.2. Nerve block treatment

Nerve block treatment involves injections of local anesthetics and steroids to block the nerves causing neuralgia. A supraorbital nerve injection containing local anesthetic and steroid can provide short-term pain relief but may cause skin discoloration [10]. Drugs used for nerve blocks include ropivacaine, bupivacaine, lidocaine, mepivacaine, and prilocaine [11]. A standardized injectable solution of 4 mL of 0.5% bupivacaine and 1 mL of 80 mg/mL methylprednisolone acetate is commonly used [12]. The supraorbital foramen is located by palpating the midpoint of the supraorbital ridge, and the solution is injected across the supraorbital and supratrochlear nerves.

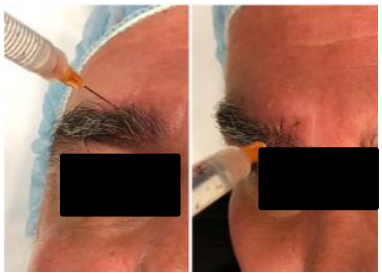

Figure 2. Supraorbital nerve injection for nerve block

2.3. Botulinum Toxin A Injection

Botulinum toxin A injection into the corrugator supercilii muscle can help decompress the supraorbital neuromuscular bundles as a non-surgical treatment [13]. Approximately 15 IU of BoNT/A dissolved in sodium chloride 0.9% solution is injected into each corrugator muscle using a 25-gauge needle at 5 injection sites per side [9].

2.4. Peripheral Nerve Stimulation

In peripheral nerve stimulation, temporary electrodes are used to stimulate the nerve responsible for the painful area. If effective, the patient may proceed with permanent electrode implantation for supraorbital or supratrochlear nerve stimulation [8]. An Octade lead is placed in the supraorbital groove and anchored in the postauricular region. A pulse generator is implanted in the infraclavicular membrane and calibrated to provide sufficient stimulation to the painful area. Patients are given a handheld programmer to adjust stimulation [14].

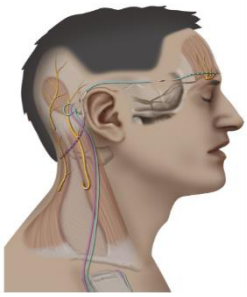

Figure 3. Implantable Pulse Generators attached to the supraorbital and occipital electrodes

2.5. Neuroma Resection

When neuralgia is caused by painful neuromas, neuroma resection is performed. Injured axons proliferate after trauma in an attempt to re-establish distal connections. When regenerating axons fail to reach distal endoneurial tubes, they multiply at the site of disruption, forming a disorganized mass of neural and fibrous tissue called a neuroma. Resection of the neuroma and relocation of the proximal nerve stump away from the vulnerable supraorbital ridge is a peripheral nerve approach to this problem [7]. Supraorbital and supratrochlear nerve neuromas are surgically resected, with the proximal nerve ends placed within the orbit, providing significant relief without complications [15].

2.6. Endoscopic Nerve Decompression

Endoscopic nerve decompression is a surgical procedure performed after pharmacological preoperative treatment. The endoscopic technique completely releases the supratrochlear and supraorbital nerves by cutting the periosteum at the supraorbital ridge level and bluntly dissecting the entire glabellar muscle group [9]. The open transpalpebral approach, an extension of upper blepharoplasty, achieves decompression by completely excising the glabellar muscles while preserving the periosteum and fascial bands of the supraorbital ridge. The endoscopic approach has been shown to provide better outcomes compared to the transpalpebral approach and is recommended as the first choice when anatomically feasible [16].

2.7. Pulsed Radiofrequency

Pulsed radiofrequency (PRF) is a neuromodulation technique that does not cause nerve damage after treatment. However, the efficacy of percutaneous PRF in treating refractory idiopathic supraorbital neuralgia remains unknown [17]. PRF is thought to be a safe neuromodulatory method for treating neuralgic pain, with electromagnetic fields potentially playing a role in neuromodulation, although the exact mechanism of action is unclear [18]. The procedure involves sedating the patient, preparing and draping the orbit, identifying the supraorbital notch under fluoroscopy, anesthetizing the skin with lidocaine, inserting an insulated needle until it contacts the superior border of the supraorbital notch, performing sensory stimulation, administering 1% lidocaine, and conducting PRF for 120 seconds at 42°C [10].

2.8. Ultrasound-Guided Radiofrequency Thermocoagulation

Ultrasound-guided radiofrequency thermocoagulation (RFT) involves monitoring non-invasive blood pressure, oxygen saturation, and electrocardiograms. The patient's back skin is connected to a pain management generator, and 1% lidocaine is used for supraorbital nerve blocks. An ultrasound probe is moved to the forehead, and a 21-gauge RFT trocar needle is used to penetrate the surface. The procedure parameters are 60°C for 75s, 65°C for 75s, 70°C for 75s, 75°C for 75s, and 80°C for 75s. As the block's effects wear off, hypoalgesia occurs in the supraorbital nerve's innervation area, indicating successful nerve ablation [4].

2.9. Manual Therapy

Manual therapy, including soft tissue therapy and friction massage at the affected nerve, can help relieve symptoms of pain, numbness, and paresthesia [19].

2.10. Cognitive Behavioral Therapy

Cognitive-behavioral therapy addresses the emotional aspects of pain. Common components include relaxation training, operant conditioning, and focusing on specific attitudes and beliefs that may elicit behavioral or emotional pain responses. Social support groups have been found to benefit individuals with chronic pain, particularly migraine [21].

2.11. Cryotherapy or Cryoneurotomy

Cryoneurotomy or cryotherapy involves the application of intense cold to nerves to block them and relieve pain symptoms. While commonly used for trigeminal neuralgia, it is not yet widely employed for supraorbital and supratrochlear neuralgias [22].

2.12. Relocation and Implantation of Proximal Nerve Stump

In selected patients with chronic, post-traumatic supraorbital neuralgia, excision of the supraorbital and supratrochlear nerves with end-to-end coaptation of the proximal nerve stumps via a neural tube appears to be an effective treatment [23]. One approach involves resecting the neuromas and guiding the proximal nerve stumps through a biodegradable conduit, but requires removal of both nerves and risks neuroma recurrence in a vulnerable site. Another method involves splitting the supraorbital and supratrochlear nerves and implanting the proximal end within the orbit's soft tissue, potentially leading to the recurrence of an intraorbital neuroma causing pain with eye movement [7].

2.13. Neurolysis

The proposed mechanism for a nerve block with lidocaine is the blockade of fast-acting sodium channels, resulting in decreased cross-excitation among adjacent afferent nerve fibers and reduced spontaneous and triggered after-discharges. This electrochemical environment increases the threshold for ectopic impulse generation and decreases afferent discharges from nociceptors. The blockade of sodium channels creates in vivo conditions favorable for pain reduction, which is more persistent with 10% lidocaine [24]. Greater occipital nerve block (GONB) with 10% lidocaine is administered to patients under fluoroscopic guidance while sedated with intravenous fentanyl and midazolam. The amount of 10% lidocaine used is up to 80% of the maximum dose based on 4 mg/kg body weight [25].

2.14. Acupuncture

Acupuncture involves inserting 1.5-inch No. 28 filiform needles into the patient's acupoints after routine disinfection, with the patient in a sitting or supine position. Following the onset of the needling sensation, the needles are manipulated using the even needling technique and retained for 30 minutes, with twisting every five minutes. The treatment is administered once daily [26].

3. Comparative analysis of different treatment modalities

When comparing the available treatments for supraorbital and supratrochlear neuralgia, the first-line treatment is typically pharmacological therapy, which includes carbamazepine, clonazepam, gabapentin, baclofen, atenolol, metoprolol, phenytoin, and valproic acid. However, these medications often fail to provide complete pain relief and can have significant side effects, leading approximately half of the patients to undergo surgery. Surgical procedures such as gamma knife radiosurgery, microvascular decompression, glycerol rhizotomy, radiofrequency thermal rhizotomy, cryotherapy, excision of the frontal nerve and/or branches through a brow stab incision, and injury to the peripheral nerve or trigeminal ganglion via a percutaneous approach are associated with variable recurrence rates and risks [27]. Although pharmacological management is the most common approach, various conservative and invasive (surgical) treatments have been proposed. Administration of opioids, neuromodulators (antiseizure medications, antidepressants, and beta-blockers), either alone or in combination, provides pain relief in nearly half of the patients with headache secondary to supraorbital neuralgia, particularly in idiopathic presentations of the disease. Peripheral nerve stimulation may be considered a safe and reversible treatment option for patients with supraorbital neuralgia-related headache who respond poorly to pharmacological treatment, avoiding irreversible alternatives such as surgery [8].

Table 1. Comparison of treatment modalities for supraorbital and supratrochlear neuralgia

Treatment Modality	Efficacy	Limitations and Side Effects
Oral medications	Provides pain relief in some patients	May not provide complete pain relief, can cause drowsiness, dizziness, and gastrointestinal issues
Nerve block treatments	Provides short-term pain relief	May cause skin discoloration, requires repeated injections
Botulinum toxin A injections	Decompresses supraorbital neuromuscular bundles	Effects are temporary, repeated injections may be necessary
Peripheral nerve stimulation	Safe and reversible treatment option	Requires surgical implantation of electrodes and a pulse generator
Neuroma resection and proximal nerve stump relocation	Provides significant pain relief	Risk of neuroma recurrence
Endoscopic nerve decompression	Better outcomes compared to transpalpebral approach	Surgical procedure with potential complications
Pulsed radiofrequency	Safe neuromodulatory method	Long-term efficacy in treating refractory idiopathic supraorbital neuralgia remains unknown
Ultrasound-guided radiofrequency thermocoagulation	Provides significant pain relief	Procedure may need to be repeated if recurrence occurs
Manual therapy and cognitive-behavioral therapy	Helps manage pain and improve quality of life	May not address the underlying cause of the neuralgia
Cryoneurotomy, trigger point therapy, and acupuncture	Emerging therapeutic approaches with promising results	Further research needed to establish efficacy and long-term outcomes

Supraorbital and greater occipital nerve blocking is also an effective preventive treatment for both episodic and chronic migraine [28]. Nerve blocking is one of the most commonly used and effective methods for treating various neuralgias. Neuroma resection and relocation of the proximal nerve stump to a region slightly away from the vulnerable supraorbital ridge is one approach to treat supraorbital and supratrochlear neuralgia. In a study of eight patients, there was a significant decrease in visual analog score at a mean of 16 months following surgery, with 88% of patients reporting a post-operative pain reduction of at least 50%. One treatment attempt failed [7]. In cases of neuralgia caused by hyperactivation of the corrugator supercilii muscle (CSM), over 80% of cases showed that nonsurgical treatments, such as Botulinum toxin type A (BTA) injections into CSM and surgical techniques to decompress the supraorbital neurovascular bundles, were effective in reducing this type of headache, also known as supraorbital rim syndrome [13]. Some studies show that individuals with supraorbital neuralgia who are unresponsive to standard treatments such as oral medication, nerve blocking, or pulsed radiofrequency can benefit from ultrasound-guided radiofrequency thermocoagulation. Radiofrequency thermocoagulation can be repeated if recurrence occurs, and the procedure remains beneficial [4]. CT-guided supraorbital nerve radiofrequency thermocoagulation can effectively treat ophthalmic herpetic neuralgia, reducing the need for anal gesics and improving quality of life [29].

Pulsed radiofrequency has been found to be an effective treatment for supraorbital neuralgia, providing significant pain relief. In a case report, a 32-year-old female patient with a two-year history of stabbing pain in the left frontal and supraorbital region experienced long-term pain relief following pulsed radiofrequency treatment of the left supraorbital nerve [18]. Another study demonstrated that ultrasound-guided pulsed radiofrequency could effectively treat supraorbital neuralgia, with significant pain reduction observed at one, three, and six months post-treatment [30]. Manual therapy techniques such as soft tissue therapy and friction massage at the site of the affected nerve can help alleviate symptoms of pain, numbness, and paresthesia associated with supraorbital and supratrochlear neuralgia [19]. Cognitive-behavioral therapy has also been shown to be beneficial in managing chronic pain conditions, including headaches and neuralgias, by addressing the emotional and psychological aspects of pain [21].

Emerging therapeutic approaches for supraorbital and supratrochlear neuralgia include cryoneurotomy, trigger point therapy, and acupuncture combined with semi-conductive laser therapy. Cryoneurotomy, although not yet widely used for these specific neuralgias, has shown promise in treating trigeminal neuralgia [22]. Trigger point therapy, which involves the application of pressure to specific points in the muscles to relieve pain, has been used in conjunction with other treatments for headaches and facial pain [31]. Acupuncture, when combined with semi-conductive laser therapy, has demonstrated effectiveness in reducing pain and improving quality of life in patients with supraorbital and supratrochlear neuralgia [26].

4. Efficacy and Limitations of Treatment Modalities

The efficacy of various treatment modalities for supraorbital and supratrochlear neuralgia varies, and each approach has its limitations and potential side effects. Oral medications, while often used as a first-line treatment, may not provide complete pain

relief and can cause adverse effects such as drowsiness, dizziness, and gastrointestinal issues [8]. Nerve block treatments can provide short-term pain relief but may cause skin discoloration and require repeated injections [10].

Botulinum toxin A injections have shown promise in decompressing the supraorbital neuromuscular bundles, but the effects are temporary, and repeated injections may be necessary [13]. Peripheral nerve stimulation is a safe and reversible treatment option, but it requires surgical implantation of electrodes and a pulse generator [14]. Neuroma resection and relocation of the proximal nerve stump can provide significant pain relief, but there is a risk of neuroma recurrence [7].

Endoscopic nerve decompression has been shown to provide better outcomes compared to the transpalpebral approach, but it is a surgical procedure with potential complications [16]. Pulsed radiofrequency is a safe neuromodulatory method, but its long-term efficacy in treating refractory idiopathic supraorbital neuralgia remains unknown [17]. Ultrasound-guided radiofrequency thermocoagulation can provide significant pain relief, but the procedure may need to be repeated if recurrence occurs [4].

Manual therapy and cognitive-behavioral therapy can help manage pain and improve quality of life, but they may not address the underlying cause of the neuralgia [19, 21]. Cryoneurotomy, trigger point therapy, and acupuncture combined with semi-conductive laser therapy are emerging therapeutic approaches that show promise, but further research is needed to establish their efficacy and long-term outcomes [22, 26, 31].

5. Novel Therapeutic Approaches

Novel therapeutic approaches for supraorbital and supratrochlear neuralgia aim to improve treatment outcomes, reduce side effects, and provide long-lasting pain relief. One promising approach is the combination of ultrasound guidance with radiofrequency thermocoagulation. By using ultrasound to guide the placement of the radiofrequency probe, the accuracy of the procedure can be improved, potentially leading to better outcomes and fewer complications [32].

Table 2. Novel therapeutic approaches for supraorbital and supratrochlear neuralgia

Novel Therapeutic Approach	Potential Benefits	Current Status
Combination of ultrasound guidance with radiofrequency thermocoagulation	Improved accuracy of the procedure, potentially leading to better outcomes and fewer complications	Promising approach, further research needed to establish efficacy and safety
Platelet-rich plasma (PRP) injections	Promotes nerve healing and reduces pain by delivering growth factors and cytokines to the affected nerves	Case reports show promising results, further research needed to establish efficacy and safety
Gene therapy	Modulates pain signaling pathways and promotes nerve regeneration by delivering therapeutic genes	Early stages of development, further research needed to establish safety and efficacy

Another novel approach is the use of regenerative medicine techniques, such as platelet-rich plasma (PRP) injections, to promote nerve healing and reduce pain. PRP contains growth factors and cytokines that can stimulate tissue repair and regeneration [33]. In a case report, a patient with refractory supraorbital neuralgia experinced significant pain relief following ultrasound-guided PRP injection into the supraorbital nerve [34].

Gene therapy is another potential avenue for the treatment of supraorbital and supratrochlear neuralgia. It may be possible to modulate pain signaling pathways and promote nerve regeneration by delivering therapeutic genes to the affected nerves [35]. However, gene therapy for neuralgias is still in the early stages of development, and further research is needed to establish its safety and efficacy.

6. Conclusion

Supraorbital and supratrochlear neuralgias are rare but debilitating conditions that can significantly impact a patient's quality of life. While various treatment options are available, including oral medications, nerve blocks, surgical interventions, and neuromodulatory techniques, the efficacy and limitations of each approach vary. Emerging therapeutic approaches, such as the combination of ultrasound guidance with radiofrequency thermocoagulation, regenerative medicine techniques, and gene therapy, show promise in improving treatment outcomes and reducing side effects. More research is needed to establish the long-term efficacy and safety of these novel approaches and to develop personalized treatment strategies based on individual patient characteristics and the underlying cause of the neuralgia.

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Author's short biography

Dr Riddhi Shukla

A senior faculty member associated with the Pharmacology field for more than 11 years. She has experience teaching various subjects such as Human Anatomy and Physiology, Pathophysiology, Pharmacology, Clinical Pharmacokinetics, Pharmacoepidemiology, and Pharmacoeconomics. She has authored two books and published more than 7 national and international articles. Additionally, she has attended 10 international and 50 national conferences. Her major research interests lie in diabetes and associated complications, as well as cardiovascular disorders

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Miss Richa Polra

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