Pain Practice

RESEARCH ARTICLE

Minimally Invasive, Micro-Autologous Fat Transfer for Secondary Occipital Neuralgia

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ABSTRACT

Objective: To evaluate the role of Autologous Fat Transfer (AFT) for secondary occipital neuralgia (SON).

Background: Secondary occipital neuralgia manifests as neuropathic pain developing after traumatic tissue injury. Multidisciplinary management mainly relies on analgesic medications and local anesthetic and steroid infiltrations. Autologous fat transfer restores subcutaneous tissue, mechanically releasing scar from nerve fibers. In this study, we show the therapeutic uses of AFT for secondary, drug-resistant headaches.

Materials and Methods: In this retrospective study, 19 patients with secondary occipital neuralgia associated with occipital scalp scarring were included. All patients presented with symptoms of unremitting greater or lesser occipital neuralgia, which temporarily improved (> 50% temporary reduction in pain intensity) following local anesthesia infiltration of the scar. Patients' evaluation of pain by visual analog scale (VAS), number of acute spasmodic pain events and medication intake per month were assessed before and 12 months after AFT. Evolution of tactile detection thresholds and allodynia patches was determined by Weinstein monofilaments.

Results: A comprehensive clinical follow-up was made 12 months after AFT. Eighteen patients experienced a reduction of symptoms > 50%. Ten of these were pain-free. The pain level reduced from 8.7 to 3. A reduction of 85% of acute pain events per month was noted after surgery (from 23.6 to 4.6). Finally, a 74% reduction in medication intake was also seen. No complications were observed.

Conclusions: AFT is a novel, regenerative approach for secondary occipital neuralgia. While more studies are needed to better understand the mechanisms of action, the results from this minimally invasive technique should be regarded as an important asset in regenerative medicine for treating post-traumatic headaches.

Abbreviations: AFT, autologous fat transfer; SON, secondary occipital neuralgia.

The study was conducted in Global Medical Institute, Avenue Jomini 8, 1004 Lausanne, Switzerland.

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1 | Introduction

Secondary occipital neuralgia manifests as neuralgia-type pain that develops after tissue injury because of trauma, surgery, radiofrequency ablation, cryotherapy or radiotherapy [1]. The etiology is postulated to be secondary to distorted neural pathways due to scar tissue formation, tissue adhesion, and neuroma formation [2, 3].

Management strategies for these complex neuropathic pain syndromes involve a multidisciplinary approach, including pharmacologic pain relief, physical therapy, and, in some instances, surgical and ablative interventions (e.g., neuroma ablation surgery). The goal is to temporarily denervate scar tissue or neuromas to reduce pain [4]. While analgesic medications have only limited local effects, invasive approaches result in additional scarring leading to unpredictable degrees of relapse, which may further complicate management [5, 6].

Recently, it has been suggested that autologous fat transfer (AFT) can be used as a minimally invasive and regenerative interface to decrease adhesions between nerves and scar tissue, improving lower limb neuropathic pain [7].

The use of fat and the attendant stem cell component in the treatment of neuralgias represents an innovative and promising avenue in the field of headache management [8–11]. This procedure involves the transfer of a patient's own adipose tissue to the painful site(s) associated with neuralgia triggers. This procedure aims to provide a structural, interface to support nerve gliding [8]. Additionally, the concentration and transfer of stem cells in the grafting process may add additional biological and regenerative potential [12–14].

While research in this area is rapidly evolving, early studies, and anecdotal evidence suggest that AFT may offer a novel and minimally invasive approach to addressing the root causes of secondary neuralgias [8, 15].

In this study, we retrospectively studied the effects of fat grafting treatment on secondary occipital neuralgia.

2 | Materials and Methods

2.1 | Patients Selections

In this retrospective analysis, we analyzed a cohort of 19 patients (17 females and 2 males) who sought our medical attention between 2019 and 2023. All patients were diagnosed with secondary occipital neuralgia, failing to respond to analgesic medication. The symptoms were associated with occipital scalp scarring, within the territories innervated by the great occipital nerve (GON) and lesser occipital nerve (LON). The scars were attributable to previous operations, traumas, radiotherapy or radiofrequency ablation. Specifically, 9 of the 19 patients exhibited scarring from previous neurosurgical procedures, 5 from radiofrequency treatments, 2 from occipital nerve stimulator implantation, and 3 from post-traumatic injuries of the occipital region. The prevalence of symptoms related to GON involvement was universal among all patients (19 of 19). Of the group, 17 individuals also manifested symptoms possibly related to LON involvement (17 of 19).

Prior to surgical intervention, comprehensive assessments were conducted to evaluate the severity of pain and its impact on daily life. These assessments included evaluation of each patient's Visual Analogue Scale (VAS) pain, frequency of monthly, acute spasmodic pain events, and the frequency of medication intake.

Inclusion criteria were a reduction of pain (> 50% temporary reduction in VAS) following nerve block with 1% lidocaine with epinephrine in the scar [15]. Patients with a negative response to the nerve block and/or with undefined pain (not anatomically corresponding to a plausible nerve involvement) were excluded.

Tactile detection thresholds and allodynia patches were analyzed with Weinstein monofilaments (Aesthesio, San José, CA). All assessments were performed by a single assessor (G.P.) with the patients in a seated position and closed eyes. The monofilaments exert pressure ranging from 0.008 to 300 g/mm^2. The filaments were applied perpendicular to the skin until they bent 2–3 mm. Measures were taken in the middle of the allodynic area before treatment and 12 months post-op.

2.2 | Technique of Harvest and Infiltration

Briefly, the donor site was infiltrated with a solution of 0.5 L of NaCl and 0.5 mg of epinephrine via a small infiltration cannula (Gems tumescent Infiltrator, 2.1 mm 14G, Tulip Medical, USA). Local anesthesia was not infiltrated during the harvest due to its potential cytotoxic activity [7, 16]. Subcutaneous fat was manually extracted via an 18G blunt cannula (Tonnard Harvester, 2.1 mm, Tulip Medical, USA or equivalent) attached to a 20 cc Luer lock (BD, Canada), pre-filled with 5 mL of Ringer solution (RL). Four 20 cc syringes were used for each procedure.

The fat graft was transferred to 1 cc syringes and injected in the subcutaneous tissue using an 18G blunt injection cannula and a Maft gun (Dermato Plastica Beauty Co. Ltd. Kaohsiung, Taiwan) with a fanning technique performing a subcision underneath the scars and recreating the subcutaneous tissue layer (Figure 1). No sharp cannula was used to limit tissue injuries and bleeding. Each delivered fat aliquot was set at 1/120 mL (each parcel volume 0.0083 mL). The use of the Maft gun increased the

FIGURE 1 | Maft Gun assisted adipose fat transfer in the occipital area.

control on fat delivery by distributing microscopic and homogenous fat deposits, avoiding boluses and limiting graft necrosis. Fat was injected while retracting the cannula [17]. The graft volume ranged between 10 and 20 cc. This could vary depending on the extent of the allodynic zone (average area to be treated was 10 cm^2). After fat transfer, patients were instructed to keep their heads lifted with two pillows when laying on the bed to improve lymphatic drainage for 7 days following the procedure.

To confirm the adipose graft takes, under the scars, an ultrasound was carried out before and 3 months after the procedure.

All operations were performed under intravenous sedation.

2.3 | Statistical Analysis

Two-tailed paired t tests were used to compare the intensity of pain reported before surgery (baseline) and during the last visit. A p value <0.05 was considered significant.

The analysis of the results was approved by an internal review board.

3 | Results

Patients had a median age of 52.7 years (range 27–73 years), presented to our clinic after an average of 19 years from the onset of symptoms (range 1–49 years).

Before surgery, patients had a pain threshold < 4 g in the testing with Weinstein monofilaments.

Most patients demonstrated marked improvements in their symptoms, with 18 individuals experiencing a significant (> 50%) amelioration in their overall pain condition as a final result. Of these, 10 patients experienced almost complete reduction of pain (> 91%). Before the surgical intervention, the median Visual Analogue Scale (VAS) score for this cohort stood at 8.7 (range 10–6). After the surgery, a decline in VAS scores was observed decreasing to an average of 3. Prior to AFT, patients endured a range of acute spasmodic pain events per month between 30 (constant daily pain) and 12, yielding an average of 23.6 days with acute events. Post AFT, a reduction of 85% was noted, corresponding to 4.6 days per month (range 15–0).

Generally, the drug intake was 26.8 analgesic and anti-inflammatory doses per month. After AFT a reduction of 74% was noted, with an average post-AFT usage of 7 analgesic doses per month. Pain threshold improved from < 4 g to > 10 g 12 months post AFT. No surgical complications were reported. No differences between the six-month and the twelve-month follow-up visits were noted.

4 | Discussion

In this study on secondary occipital neuralgia, we observed positive, long-term effects of AFT. While several approaches have been proposed ranging from pharmacological to more invasive procedures (such as ablative radiofrequency and neuroma surgery), AFT seems to achieve satisfactory pain reduction in most patients without complications.

Our group routinely performed surgery for secondary neuralgias to identify and treat nerve lesions, including neuroma excision and proximal nerve stump muscle burial. In our experience, AFT is more effective than neuroma surgery for post-traumatic neuropathy possibly due to the rich anastomotic network between different nerves and blood vessels in the occipital region, not allowing for the complete resolution of the problem by addressing the main nerve branches [7, 18, 19].

Patients presenting with symptoms of chronic occipital neuralgia and scars are very common in our practice. These patients have a history of trauma or surgery and are often unwilling to take additional risks with invasive procedures. The entrapment of the nerve inside the scar might be worsened with additional neurolysis or surgical dissection. AFT is often welcomed by the patients as a first approach in particular knowing that there is a high chance of relief in the first session with only minimal risks.

Fat harvested with the described technique has a higher chance of survival because it mechanically selects the smaller adipocytes from the lipoaspirate and controlled, small aliquots of fat cells are distributed in the recipient zone via the MAFT gun increasing graft take. The smaller surface of the individual cells and fractioned aliquots of AFT require less time to engraft via revascularization and angiogenesis [7].

Particular attention must be made to avoid tissue injury and bleeding at the recipient site. We use blunt, small caliber cannulas to reduce trauma at the recipient site and bleeding risk. The excessive presence of blood or lymph due to tissue injury at the recipient site can compromise grafted cell survival. The use of a controlled fat delivery system as opposed to a normal syringe, increases the control of graft delivery and reduces the trauma due to the controlled pressure of injection.

AFT also likely provides a regenerative effect on the nerve fibers and myelin in addition to detaching them from the surrounding scar, thus allowing nerve gliding without mechanical resistance with the head movements.

The stem cell component of the lipoaspirate (commonly called the stromal vascular fraction or SVF) may have played a role as stem cells are critical in tissue repair and regeneration. While the procedure chosen to extract fat has a higher concentration of SVF compared with normally extracted lipoaspirate, no specific proof of the SVF relative contribution has been made in this study. Future work will concentrate on defining the potential of SVF concentrates on painful scars and compare them with micro-fat grafts where SVF was not concentrated [13, 14].

In summary, the efficacy of current pharmacologic therapeutics for secondary migraines is hindered by the unique pathophysiology of this condition. Altered neural pathways and mechanical compression associated with these headaches are some of the issues making this condition refractory to conventional pharmacologic treatments. Tailoring treatment approaches to address these specific causes and mechanisms of secondary neuralgias, often in conjunction with other therapeutic modalities, is essential for optimizing outcomes in affected individuals.

5 | Conclusions

Autologous fat transfer is gaining acceptance in the treatment of nerve pathology and neuropathic pain [7]. These findings expand the evidence that AFT is a simple and reliable strategy to treat secondary occipital neuralgia. This novel technique and promising outcomes in refractory occipital neuralgias should serve as a catalyst for other studies to refine the technique and further understand its mechanism(s) of action.

Author Contributions

All listed authors have contributed to the manuscript substantially and have agreed to the final submitted version. The authors have all been involved in the clinical treatment of patients and in the writing and revision of the article.

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Ethics Statement

The data collection was conducted as a retrospective quality assessment study and all procedures were performed in accordance with the ethical standards of the national research committee and the 1964 Helsinki Declaration and its later amendments.

Consent

All patients have signed an informed consent allowing the authors to anonymously use the retrospective data.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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