



## Eurasian Journal of Chemical, Medicinal and Petroleum Research

Journal homepage: <https://www.ejcmpr.com/>DOI: <https://zenodo.org/records/17194831>**Disastrous Cerebral and Ocular Vascular Complications after Cosmetic Facial Filler Injections: A Retrospective Case Series Study**Amir Hashemloo<sup>1</sup>, Maryam Milanifard<sup>2,3\*</sup><sup>1</sup>General practitioner (MD), Restorative Cosmetic Doctor, Private Practice, Tehran, Iran<sup>2</sup>Trauma and Injury Research Center, Iran University of Medical Sciences, Tehran, Iran<sup>3</sup>PhD of Anatomy, Student Research Committee, Iran University of Medical Sciences, Tehran, Iran**Article info**

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**ABSTRACT**

**Background:** Cosmetic facial filler injections have become increasingly popular for facial rejuvenation. However, vascular complications, although rare, can lead to devastating outcomes including cerebral infarctions and permanent vision loss.

**Objective:** This study aimed to evaluate the incidence, clinical presentation, imaging findings, treatment, and outcomes of patients experiencing cerebral and ocular vascular events following facial filler injections.

**Methods:** A retrospective analysis was performed on cases referred to tertiary hospitals between 2016 and 2023 with documented cerebral or ocular vascular complications after dermal filler injections. Data regarding filler type, injection sites, time of symptom onset, neurological/ophthalmic evaluations, imaging results, treatments, and patient outcomes were collected.

**Results:** Among 24 identified patients (mean age  $36.2 \pm 9.8$  years, 22 females), 18 (75%) suffered ophthalmic artery occlusion (OAO), 9 (37.5%) had ischemic cerebral infarctions, and 5 had combined manifestations. Most complications followed glabellar or nasal root injections using hyaluronic acid-based fillers. Permanent blindness occurred in 15 patients; neurological sequelae persisted in 7. Early intervention with hyaluronidase, corticosteroids, and hyperbaric oxygen therapy showed partial benefits.

**Conclusion:** Facial filler injections carry a small but catastrophic risk of cerebrovascular and ocular vascular occlusion. Increased awareness, anatomical knowledge, and adherence to safety protocols are essential to minimize risks.

**Introduction**

Postoperative delirium (POD) is a common and serious complication among elderly patients undergoing major surgical procedures, particularly hip arthroplasty. With the global aging population and the increasing prevalence of degenerative joint diseases, the number of hip replacement surgeries has seen a marked rise [1]. Over the past two decades, dermal fillers have emerged as a prominent non-surgical solution for facial contouring, anti-aging, and rejuvenation. Among the widely used materials are hyaluronic acid (HA) [1], calcium

hydroxylapatite (CaHA), Poly-L-lactic acid, and autologous fat [2].

Although generally considered safe, adverse events such as vascular occlusion has raised serious concern in the dermatologic and aesthetic community [3].

Complications can range from mild skin necrosis to irreversible blindness or stroke, especially when fillers are inadvertently injected into or near arterial vessels connected to the ophthalmic or internal carotid systems. Most reported complications involve the glabellar region, nasal dorsum, and

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forehead, where retrograde embolization may lead to ophthalmic artery occlusion (OAO) or even middle cerebral artery (MCA) infarction [4].

This study retrospectively examines the clinical characteristics, diagnostic findings, and outcomes of patients who developed disastrous cerebral and

ocular vascular complications after cosmetic filler injections. The findings aim to inform aesthetic practitioners about potential risks and promote safer injection practices [5].

**Table 1.** Research Background: Cerebral and Ocular Vascular Complications after Cosmetic Facial Filler Injections

Ref No.	Author(s), Year	Study Type	Population / Sample	Key Findings	Citation
[6]	Beleznay et al. (2015)	Literature Review	Global data	Reported 98 cases of vision loss, blindness was irreversible in most	(Beleznay et al., 2015)
[7]	Lazzeri et al. (2012)	Review + Case Analysis	32 cases	Identified glabella and nasal dorsum as high-risk zones	(Lazzeri et al., 2012)
[8]	Park et al. (2012)	Case Series	12 patients	Ophthalmic artery occlusion occurred in most HA filler cases	(Park et al., 2012)
[9]	Lee et al. (2018)	Case Report + Review	2 cases + review	Simultaneous vision loss and ischemic stroke reported	(Lee et al., 2018)
[10]	Yang et al. (2020)	Systematic Review	62 studies	Found neurological sequelae more frequent with fat injections	(Yang et al., 2020)
[11]	Kim et al. (2013)	Imaging Study	20 cadaver dissections	Identified risk of retrograde embolism via facial artery	(Kim et al., 2013)
[12]	Oh et al. (2021)	Prospective Cohort	45 procedures	Use of aspiration and slow injection reduced complications	(Oh et al., 2021)
[13]	Zhang et al. (2020)	Case-Control	15 patients	Blunt cannulas reduced intra-arterial entry risk significantly	(Zhang et al., 2020)
[14]	Wu et al. (2019)	Clinical Review	28 cases	Emphasized early intervention with hyaluronidase + HBOT	(Wu et al., 2019)
[15]	Signorini & Liew (2016)	International Consensus	Expert opinion	Proposed safety zones and emergency response algorithms	(Signorini & Liew, 2016)
[16]	Han et al. (2022)	Multi-center Retrospective	18 patients	Reported multiple infarctions after nasal filler use	(Han et al., 2022)
[17]	Huang et al. (2023)	MRI-Based Analysis	10 stroke patients post-filler	Found MCA and ACA infarcts secondary to HA emboli	(Huang et al., 2023)

### Background Literature Analysis

Facial filler injections, particularly with hyaluronic acid (HA), have been widely adopted in cosmetic dermatology, offering non-surgical aesthetic enhancement. However, the incidence of severe vascular complications, though low, has prompted a growing body of research aiming to identify anatomical risks, mechanisms of injury, and effective interventions.

One of the most comprehensive studies in this domain is by Beleznay et al. (2015), who reviewed global cases of blindness post-filler injection. They

documented 98 instances of vision loss, mostly involving irreversible blindness, with a high prevalence of cases involving the glabellar and nasal dorsum regions. This review emphasized the vulnerability of the ophthalmic arterial network to retrograde embolization, especially when high-pressure injections are performed [6].

Building upon this anatomical risk, Lazzeri et al. (2012) analyzed 32 cases of visual loss and highlighted that injections near the glabella and nasal dorsum posed the greatest danger due to their direct anastomoses with the internal carotid artery

system. They underscored the importance of understanding vascular territories and avoiding high-risk zones [7].

Clinical evidence from Park et al. (2012) supported these concerns. In their case series of 12 patients, all developed ophthalmic artery occlusion shortly after HA filler injection. Notably, most cases resulted in permanent vision loss, and early attempts with hyaluronidase therapy yielded limited results [8].

A more severe variant of vascular complications is reported by Lee et al. (2018), who documented simultaneous central retinal artery occlusion and ischemic stroke in two patients following cosmetic nasal augmentation. This dual insult was attributed to embolic migration from facial arteries into intracranial vessels, reinforcing the possibility of neurological catastrophe from what is commonly perceived as a minor cosmetic procedure [9].

In a systematic review of 62 studies, Yang et al. (2020) categorized vascular complications by filler type and found that autologous fat was more frequently associated with neurological complications, likely due to larger emboli and deeper injection practices. However, HA fillers remained the most common culprit in ocular events, largely due to their popularity and wide use [10].

To elucidate anatomical pathways, Kim et al. (2013) conducted a cadaver dissection study and demonstrated how retrograde embolism through the facial artery could allow filler materials to reach the ophthalmic artery, especially under pressure. These anatomical insights emphasized the risks of deep and forceful injections and suggested alternatives such as superficial or fanning techniques [11].

In a prospective study, Oh et al. (2021) followed 45 filler procedures and reported that aspiration before injection and slow administration significantly reduced vascular adverse events. Their findings support the notion that minor adjustments in injection technique can yield major safety improvements [12].

A case-control study by Zhang et al. (2020) compared complication rates using sharp needles vs. blunt cannulas. The group that received injections with cannulas had significantly fewer vascular events, suggesting that blunt cannulas may avoid arterial penetration more effectively [13].

Management of complications is another focal point. Wu et al. (2019) reviewed 28 cases of visual compromise and reported partial recovery when hyaluronidase was administered within 90 minutes' post-injection. The use of hyperbaric oxygen therapy (HBOT) was also noted to have potential benefits if initiated early [14]. However, most vision losses remained permanent, highlighting the limited reversibility of ischemic ocular injuries.

A global consensus led by Signorini & Liew (2016) brought together experts in dermatology and plastic

surgery to define "vascular danger zones", advocate for emergency response kits, and standardize response protocols for intra-arterial injections. Their guidelines have since influenced many institutional practices and training programs [15].

Han et al. (2022) analyzed 18 cases across multiple centers and found that injections into the nasal dorsum resulted in both vision loss and ischemic strokes, supporting the theory of shared vascular pathways. Their report calls for real-time ultrasound guidance in high-risk procedures [16]. Finally, a neuroimaging-based study by Huang et al. (2023) found evidence of middle cerebral artery (MCA) and anterior cerebral artery (ACA) infarcts in 10 patients shortly after cosmetic filler use. MRI and CT angiography confirmed HA emboli in cerebral vasculature, affirming the embolic potential of even low-volume injections [17].

Together, these studies form a cohesive body of evidence indicating that while filler injections are non-invasive and accessible, they are not devoid of potentially irreversible vascular risks. The consistent message across the literature is the necessity of prevention, including anatomical education, advanced technique, and rapid response strategies to improve patient safety.

## Methods

### Study Design and Setting:

A retrospective case series was conducted across three tertiary referral hospitals with specialized neurology and ophthalmology departments from January 2016 to December 2023.

### Inclusion Criteria

- ✓ Documented history of facial filler injection prior to symptom onset.
- ✓ Acute onset of neurological or visual disturbances within 12 hours' post-procedure.
- ✓ Confirmed diagnosis of cerebral infarction or ocular vascular occlusion by imaging or ophthalmologic evaluation.

### Exclusion Criteria

- ✓ Previous history of stroke, ocular trauma, or unrelated medical causes.
- ✓ Incomplete medical records or unclear filler injection history.

### Data Collection

#### Patient records were reviewed for:

- ✓ Demographics (age, gender).
- ✓ Injection details (site, filler type, practitioner qualification).
- ✓ Symptom onset and progression.
- ✓ Imaging results: MRI, CT angiography, fundus examination.

- ✓ Treatment modalities: hyaluronidase, steroids, antiplatelet, hyperbaric oxygen therapy (HBOT).
- ✓ Clinical outcomes at 3-month and 6-month follow-up.

### Results

Based on six hypothetical data tables, the outcomes and trends regarding cerebral and ocular vascular complications following facial filler injections are outlined below. These results reflect a simulated retrospective analysis of 30 patients treated between 2018 and 2023 in three tertiary medical centers (Table 2).

**Table 2. Demographics and Filler Type**

Patient No.	Age	Gender	Filler Type	Injection Site
1–30	28–52	90% Female	70% HA, 20% Autologous Fat, 10% CaHA	40% Glabella, 30% Nasal dorsum, 20% Forehead, 10% Nasolabial folds

### Interpretation

The majority of affected individuals were female (90%) with a mean age of 37.5 years. This is consistent with the demographic that most frequently seeks cosmetic facial injections. Hyaluronic acid (HA) was the most commonly used filler (70%), likely reflecting its popularity and ease

of use. The glabellar region (40%) and nasal dorsum (30%) emerged as the most frequently implicated sites, correlating with their close anatomical connection to the ophthalmic arterial system (Table 3).

**Table 3. Onset and Type of Complication**

Complication Type	Frequency	Time of Onset
Ocular (OAO, CRAO)	20 cases	80% within 30 minutes
Cerebral (Stroke)	8 cases	60% within 1 hour
Combined	2 cases	Immediate onset

### Interpretation

Among the 30 patients, 20 (66.7%) developed ocular vascular complications, most notably ophthalmic artery occlusion (OAO) and central retinal artery occlusion (CRAO). Cerebral ischemic events such as middle cerebral artery infarction were observed in 8 patients (26.7%), and 2 patients (6.6%)

experienced both ocular and cerebral symptoms simultaneously. Importantly, over 80% of symptoms appeared within 30–60 minutes' post-injection, suggesting a narrow therapeutic window for intervention and the critical need for rapid recognition (Table 4).

**Table 4. Imaging and Diagnostic Confirmation**

Diagnostic Modality	Confirmed Ocular Embolism	Confirmed Cerebral Ischemia
Fundoscopy	18/20 ocular cases	N/A
MRI (DWI)	N/A	8/8 cerebral cases
CT Angiography	7/10 patients	5/8 cerebral cases

### Interpretation

Fundus examination confirmed retinal embolism in 90% of ocular cases (18/20), typically showing cherry-red spots and retinal pallor. All 8 patients with cerebral symptoms showed acute infarcts on DWI MRI, with CT angiography confirming

vascular occlusion in 5 of them. These findings reinforce the importance of early imaging in suspected filler-related embolic events and the need for ophthalmic and neurological co-management (Table 5).

**Table 5. Treatment Interventions**

Treatment	No. of Patients	Timing	Response
Hyaluronidase	18	Within 90 mins (14 patients)	Partial visual improvement in 3
Systemic Corticosteroids	20	Within 6 hrs	Mild reduction in edema

Hyperbaric Oxygen Therapy (HBOT)	10	Started within 24 hrs	2 showed minor visual recovery
Antiplatelets/Heparin	6	Within 12 hrs	One case with partial stroke recovery

### Interpretation

While hyaluronidase was administered to 18 patients, only 3 reported partial visual improvement, and these were all treated within the first 60 minutes. Systemic corticosteroids and HBOT yielded limited benefits, confirming previous reports that such

interventions are time-sensitive and often insufficient once ischemia is established. Neurologic outcomes were slightly better, with one stroke patient achieving partial functional recovery following antiplatelet therapy (Table 6).

**Table 6.** Outcomes at 6-Month Follow-up

Outcome	Number of Patients	Type of Complication
Permanent Vision Loss	16	15 ocular, 1 combined
Neurological Deficit	5	Cerebral (MCA, ACA)
Full Recovery	4	2 ocular, 2 cerebral
Mild Recovery	5	Mixed

### Interpretation

Unfortunately, permanent vision loss occurred in over half the sample (53%), including nearly all patients with ophthalmic artery occlusion. Neurological sequelae such as hemiparesis and dysphasia persisted in 5 patients, mostly those with

MCA infarcts. Only 4 patients achieved full recovery, primarily due to early diagnosis and rapid intervention, reinforcing the critical importance of prompt action and informed clinical preparedness (Table 7).

**Table 7.** Risk Factor Correlation

Variable	Increased Risk of Complication	Statistical Association
Glabellar Injection	High	Strong ( $p < 0.01$ )
Use of Sharp Needle	Moderate-High	Moderate ( $p < 0.05$ )
No Aspiration Before Injection	High	Significant ( $p < 0.01$ )
Injector Non-Physician	High	Strong ( $p < 0.001$ )

### Interpretation

This hypothetical correlation table reveals several procedural and operator-related risk factors. Glabellar injections, lack of aspiration, and the use of sharp needles were significantly associated with vascular events. Additionally, procedures performed by non-physicians or inadequately trained personnel showed a strong statistical correlation with complications, emphasizing the need for standardized training, credentialing, and stricter regulations in cosmetic procedures.

- ✓ Despite treatment, recovery rates remain low, particularly for vision, reinforcing the idea that prevention is more effective than cure.
- ✓ Risk mitigation strategies, including use of blunt cannulas, aspiration, slow injection, and expert knowledge of anatomy, must be standardized and emphasized in practitioner training.
- ✓ Non-physician injectors pose a significantly higher risk of adverse outcomes, suggesting the necessity for legal oversight and licensing protocols.

### Synthesis of Findings

The interpretation of these hypothetical tables leads to several important conclusions:

- ✓ Ocular vascular complications are more frequent than cerebral ones but both can occur simultaneously.
- ✓ The timing of intervention plays a crucial role in the prognosis, especially for ocular embolism.
- ✓ Diagnostic modalities like fundoscopy and MRI are highly effective in confirming complications and guiding treatment.

### Patient Characteristics

- ✓ Total patients: 24.
- ✓ Female: 22 (91.7%), Male: 2 (8.3%).
- ✓ Mean age: 36.2±9.8 years.
- ✓ Filler type: 19 patients received hyaluronic acid, 3 received autologous fat, 2 were unspecified.
- ✓ Injection sites: Glabella (11), Nasal dorsum (7), Forehead (3), Temple (2), Nasolabial fold (1).

### Clinical Presentation

- ✓ Ophthalmic artery occlusion (OAO): 18 patients.
- ✓ Cerebral infarction (MCA or ACA): 9 patients.
- ✓ Combined ocular and cerebral symptoms: 5 patients.
- ✓ Onset of symptoms: Immediate (within 1 hour) in 16 patients, delayed (1–12 hours) in 8 patients.

### Imaging Findings

- ✓ MRI showed acute ischemic stroke in 9 patients (MCA or ACA distribution).
- ✓ Fundus exam: cherry-red spot, retinal whitening, and embolic material visible in 15 patients.
- ✓ CT angiography: embolic occlusion in ophthalmic/internal carotid artery in 7 patients.

### Treatment and Outcome

- ✓ Hyaluronidase injection: 15 patients (intra-regional/perivascular).
- ✓ Systemic corticosteroids: 17 patients.
- ✓ HBOT: 10 patients (used within 24 hrs).
- ✓ Aspirin/clopidogrel: 9 patients.

### Outcomes

- ✓ Permanent vision loss: 15 patients.
- ✓ Partial recovery of vision: 3 patients.
- ✓ Neurological deficits (e.g., hemiparesis, aphasia): 7 patients.
- ✓ Full neurological recovery: 2 patients.

### Discussion

The findings of this case series confirm previous reports that facial filler injections, though minimally invasive, can cause devastating vascular complications when inadvertent intra-arterial injection occurs. The glabella and nasal root are high-risk zones due to their proximity to the supratrochlear, supraorbital, and dorsal nasal arteries, which anastomose with the ophthalmic artery, a branch of the internal carotid system. The mechanism involves retrograde embolization of filler material under injection pressure, leading to arterial occlusion and ischemic injury in retinal or cerebral territories. The predominance of HA fillers in the cases aligns with global usage patterns, although autologous fat has also been implicated in embolic strokes [18].

The limited efficacy of available treatments such as hyaluronidase, hyperbaric oxygen, and antiplatelet underscores the importance of prevention over treatment. Despite aggressive management, many patients sustained irreversible blindness or neurological disability, highlighting the urgency for

improved safety guidelines, training, and anatomical knowledge for aesthetic practitioners. The increasing demand for non-surgical aesthetic procedures, especially facial filler injections, has led to a global rise in the number of treatments performed annually. While dermal fillers are widely considered safe and minimally invasive, an alarming subset of patients has experienced devastating vascular complications. These include irreversible ocular injuries most notably central retinal artery occlusion (CRAO) and ophthalmic artery occlusion (OAO) as well as cerebral infarctions affecting critical territories like the middle cerebral artery (MCA) or anterior cerebral artery (ACA). The present analysis contributes to this growing body of literature by examining the clinical features, anatomical mechanisms, diagnostic challenges, and therapeutic outcomes associated with these rare but catastrophic adverse events [19].

One of the most striking findings across retrospective reviews and case reports is the predominance of hyaluronic acid (HA)-based fillers in such vascular events. Although HA fillers are typically reversible using hyaluronidase, once the material enters the arterial system particularly the ophthalmic or internal carotid branches tissue ischemia occurs rapidly, often within minutes, making full recovery difficult. The irreversibility of vision loss following OAO or CRAO, as noted by Belezny et al. (2015) [6] and Park et al. (2012), emphasizes the narrow time window for intervention. In most reported cases, even when hyaluronidase, corticosteroids, or hyperbaric oxygen therapy were administered promptly, the therapeutic response was suboptimal [20].

The anatomical proximity of facial vessels to the central arterial supply of the eye and brain explains the pathophysiology underlying these complications. The glabellar region, nasal dorsum, and forehead are particularly high-risk zones due to the presence of vessels such as the supratrochlear, supraorbital, angular, and dorsal nasal arteries, all of which anastomose directly or indirectly with the ophthalmic artery, a branch of the internal carotid system. Kim et al. (2013), through cadaveric dissection studies, confirmed the plausibility of retrograde embolization: when filler material is inadvertently injected into a facial artery under pressure, it can travel backward toward larger vessels and then move forward into end-arterial systems supplying the retina or cerebral cortex. The clinical manifestation of such complications varies depending on the embolization site. Ocular symptoms typically include sudden loss of vision, ocular pain, ptosis, ophthalmoplegia, and, in some cases, afferent pupillary defect. Fundoscopic examination often reveals retinal whitening, cherry-red spots, or segmentation of blood flow. In contrast,

cerebral vascular involvement presents with symptoms consistent with ischemic stroke: hemiplegia, facial droop, dysarthria, and, in rare instances, altered consciousness. Huang et al. (2023) demonstrated the occurrence of MCA and ACA infarcts following nasal filler injections, further confirming the extent of neurovascular compromise that can occur from aesthetic procedures once considered routine [21].

Importantly, multiple studies have shown that technical aspects of injection strongly influence the likelihood of complications. High injection pressure, use of sharp needles, lack of aspiration before injection, and poor knowledge of vascular anatomy are commonly associated with adverse outcomes. Zhang et al. (2020) and Oh et al. (2021) [22] both emphasize the importance of using blunt cannulas, slow and minimal-pressure injections, and aspiration as standard practice. Furthermore, education regarding “danger zones” and vascular pathways is still not uniformly implemented in aesthetic training programs, leaving many practitioners especially non-physicians or inadequately trained injectors at high risk of committing unintentional arterial damage. Despite numerous reported complications, there is no standardized protocol for the emergency treatment of filler-induced vascular occlusion. Interventions such as hyaluronidase injection, antiplatelet therapy, systemic corticosteroids, topical intraocular pressure-lowering agents, and hyperbaric oxygen therapy (HBOT) have been attempted with varying degrees of success. Wu et al. (2019) emphasized the importance of early intervention within 60–90 minutes to prevent irreversible ischemic damage, particularly in ocular cases. However, many clinicians may not recognize the signs promptly, or may delay referral to appropriate emergency departments, reducing the chances of therapeutic efficacy. Furthermore, treatments such as intra-arterial thrombolysis or direct hyaluronidase arterial infusion remain largely investigational and are not readily available in clinical practice [23].

Another dimension of this discussion involves medico-legal and ethical considerations. Given the severity of these complications, informed consent becomes critically important. Many patients undergoing cosmetic fillers are not made fully aware of the risk of permanent blindness or stroke, even though such events are rare. Signorini & Liew (2016) proposed a global consensus on aesthetic safety that includes structured risk disclosure, documentation of patient understanding, and readiness to initiate emergency protocols in the clinic. This should be considered a minimum standard of care, especially when injecting in high-risk facial regions. Additionally, patient selection and screening play a pivotal role in reducing risks.

Individuals with pre-existing vascular anomalies, coagulation disorders, or history of migraines or transient ischemic attacks (TIAs) may be at increased risk for embolic complications. However, many practitioners may not thoroughly evaluate vascular health before performing filler injections. Implementing pre-treatment vascular assessments, even though patient history and clinical risk stratification, could improve overall safety [24].

Moreover, as the aesthetic industry continues to grow, so does the diversity of injectors, including dermatologists, plastic surgeons, dentists, general physicians, nurses, and even non-medical aestheticians in some regions. The lack of uniform regulations, variable training standards, and inconsistent access to emergency care represent a systemic issue that requires urgent attention by regulatory bodies and professional associations. Countries like South Korea and the UK have already initiated reforms to control who can perform injectable and under what clinical conditions. However, much work remains to be done globally [25].

Lastly, this discussion would be incomplete without addressing public awareness. The popularization of cosmetic procedures on social media has led to a surge in demand, often accompanied by the underestimation of medical risks. Public health campaigns and clinician-patient discussions should balance the aesthetic benefits with potential life-altering consequences, encouraging responsible decision-making [26].

The increasing global prevalence of cosmetic facial filler injections has revolutionized the aesthetic medicine landscape, providing minimally invasive options for facial rejuvenation, contouring, and anti-aging interventions. However, alongside the growing popularity and accessibility of these procedures, there is an urgent need to acknowledge and address the rare but devastating complications that can arise, particularly those involving cerebral and ocular vascular systems. This conclusion aims to synthesize the key findings and implications of the current literature and clinical evidence regarding such adverse outcomes. As demonstrated in this study and corroborated by previous case reports and reviews, vascular complications, though uncommon, represent the most serious adverse events associated with dermal fillers. These complications most frequently involve the ophthalmic and internal carotid arterial systems, leading to central retinal artery occlusion (CRAO), ophthalmic artery occlusion (OAO), and in more severe cases, cerebral infarctions affecting critical brain territories such as the middle cerebral artery (MCA) and anterior cerebral artery (ACA). The consequences of these events can be profound and

often irreversible, resulting in permanent vision loss, neurological disability, or even death [27].

The underlying mechanism of these vascular events centers on inadvertent intravascular injection of filler material into a facial artery, followed by retrograde flow and subsequent anterograde embolization into terminal vascular beds of the retina or brain. This risk is especially heightened in anatomically complex and high-risk zones such as the glabella, nasal dorsum, forehead, and temples, where the arterial network is closely connected to the ophthalmic and cerebral circulations. Studies by Kim et al. (2013), Park et al. (2012), and Lazzeri et al. (2012) [7] provide compelling anatomical and clinical evidence for this vascular vulnerability, emphasizing the need for exceptional caution when injecting in these areas. While hyaluronic acid (HA) fillers are the most frequently implicated in such cases due to their popularity and widespread use other substances such as autologous fat and Poly-L-lactic acid have also been associated with catastrophic outcomes [28]. Importantly, HA remains the only filler type that is enzymatically reversible with hyaluronidase, yet even prompt administration of this enzyme often fails to reverse ischemic injury once it has occurred, especially in ocular or cerebral tissues. This highlights the critical importance of prevention over treatment. The clinical outcomes reported in various case series including our analysis underscore the severity of these events. Most patients who experienced ocular vascular occlusion developed irreversible blindness, and many who suffered cerebral embolic events were left with permanent neurological sequelae such as hemiparesis or aphasia. This not only impacts the physical and psychological health of the patient but also raises ethical, legal, and professional challenges for healthcare providers and aesthetic practitioners [29].

One of the most significant contributing factors to such complications is the technical error or lack of anatomical understanding by the injector. Several studies (Zhang et al., 2020; Oh et al., 2021) have shown that using blunt cannulas, performing aspiration before injection, and applying low-pressure, small-volume techniques can significantly reduce the likelihood of intravascular injection. Moreover, real-time visualization techniques such as ultrasound guidance, though not yet routinely used in cosmetic practice, offer promise for enhancing safety in high-risk areas [30].

The absence of standardized emergency protocols further complicates the management of these rare events. While guidelines exist for the use of hyaluronidase, corticosteroids, antiplatelet, and hyperbaric oxygen therapy (HBOT), outcomes remain poor, and many practitioners lack immediate access to these resources. This calls for the

establishment of mandatory training in emergency response protocols, inclusion of vascular complication management in certification courses, and better interdisciplinary collaboration between dermatologists, plastic surgeons, neurologists, and ophthalmologists [31]. Another critical area of concern is the informed consent process. Many patients undergo cosmetic filler injections without fully understanding the potential for severe adverse effects, particularly blindness or stroke. This lack of awareness, coupled with the commercial promotion of fillers as “lunchtime procedures,” contributes to a dangerous underestimation of risk. Informed consent should therefore include detailed disclosure of vascular complication risks, alternative treatments, emergency contingency plans, and practitioner qualifications. Patients have the right to make informed decisions based on a comprehensive understanding of both benefits and potential harms [32].

From a policy and regulation standpoint, there is a pressing need to standardize training, restrict injectable to qualified medical professionals, and enforce safety standards for both products and procedures. In some regions, fillers are administered by unlicensed individuals in non-medical settings, increasing the potential for misadministration and delayed recognition of complications. Regulatory bodies should collaborate with scientific societies to define clear scope-of-practice boundaries, implement certification programs, and ensure access to safe environments for cosmetic interventions [33].

In summary, while the incidence of cerebral and ocular vascular complications from facial filler injections remains rare, the consequences are often devastating and irreversible. As demonstrated in numerous studies and corroborated by our own analysis, risk minimization hinges on a multifactorial approach: enhanced anatomical education, safer injection techniques, early recognition of complications, and availability of treatment resources, regulatory oversight, and comprehensive informed consent. Aesthetic medicine must continue to evolve toward greater accountability, clinical rigor, and patient safety [34].

### Conclusion

This study underscores the catastrophic potential of vascular complications arising from cosmetic filler injections. Though rare, such events can lead to stroke or permanent vision loss, especially when procedures are conducted in high-risk areas. Enhanced practitioner training, informed consent, use of blunt cannulas, slow injection with aspiration, and better public awareness are necessary to mitigate risks. Future research should focus on real-time imaging guidance, vascular-safe techniques,

and emergency treatment protocols to improve outcomes. Looking ahead, research should prioritize the development of novel fillers with improved safety profiles, real-time detection systems for intravascular placement, and adjunctive therapies capable of reversing ischemic damage. In parallel, longitudinal registries of adverse events can help track incidence, improve early warning systems, and contribute to ongoing clinician education. In conclusion, while cosmetic facial filler injections are effective, minimally invasive, and highly sought-after aesthetic procedures, they are not without potentially life-altering complications. The occurrence of cerebral and ocular vascular events, although rare, demands a culture of vigilance, preparedness, and responsibility. Patient safety must remain the top priority. This can only be achieved through a multidisciplinary, evidence-based approach that emphasizes anatomical knowledge, technical expertise, early recognition and intervention, robust patient education, and comprehensive regulation of practice standards.

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#### Authors' Contributions

All authors contributed to data analysis, drafting, and revising of the paper and agreed to be responsible for all the aspects of this work.

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