



Relevant anatomy of facial region and clinical analysis of common complications in botulinum toxin and filler injections

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Abstract

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Aim: This study analyzes the prevalent problems associated with Botulinum toxin and filler injections. By concentrating on the Iranian populace, we seek to elucidate the particular obstacles and adverse effects associated with these prevalent cosmetic operations. Healthcare professionals must implement preventive efforts and be equipped to address any consequences. A comprehensive understanding of anatomy is essential for achieving optimal outcomes.

Materials and Methods: This retrospective-descriptive study analyzed the medical records of female patients treated with Botox and dermal fillers at the private dental clinic between 2019 and 2024. The study focused on comparing the most common complications associated with each treatment for botulinum toxin and filler injections. Exclusion criteria included patients with pre-existing skin conditions, chronic diseases, or other significant health concerns. This study aimed to analyze the frequency and severity of problems, contextualizing data with current literature to evaluate the relative safety and efficacy of different cosmetic operations.

Results: In our study, we identified the most common complications associated with Botox and filler injections. For Botox, the top three issues were no correction (20.22%), redness (15.1%), over and under correction (9.5%). As for fillers, the most frequent complications include inflammation (25.9%), pain (25.9%) and erythema (22.2%).

Conclusion: This study highlights the importance of understanding facial anatomy, specifically complications in the context of Botox and filler injections, emphasizing the importance of meticulous technique and a strong understanding of anatomy to minimize risks. The insights provided will assist practitioners in better complications, ultimately enhancing the safety and outcomes of cosmetic procedures.



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Introduction

Facial dermatology issues impact not only function but also attractiveness, which are predicted on intricate anatomical aspects. Understanding normal anatomy is essential to treating dermatological issues while maintaining the features and functions of the face. Understanding the topographic anatomy of the face is crucial for carrying out invasive treatments correctly [1]. Precise structural and functional organization of the anatomical features is necessary for its physiological, expressive, aesthetic, and identity-related activities [2].

It is customary to divide the face into three horizontal sections. From the superior helix insertion to the lateral

canthus, an upper horizontal line situated above the zygomatic arch defines the midface. The oral commissure is the bottom boundary, which starts at the tragal cartilage's inferior border. The midface's lower border to the chin is the lower face, while the hairline to the top border is the upper face. The anterior and lateral portions of the face, which reach from the lateral orbital rim to the oral commissure, are divided by a vertical line of retention ligaments, which include the zygomatic, mandibular, temporal, and masseteric ligaments [3].

There are eight facial regions listed in the International Anatomical Terminology [4]. Aesthetic units have also been assigned to the face [5]. The facial muscles are classified into two categories: masticatory muscles and mimetic muscles.

The mimetic muscles, which elevate or depress the lips and eyebrows, are crucial for the facial expressions. Sphincteric

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activity is provided to the mouth and ocular orifices via these structure [2]. The facial skeleton, which supports the soft tissue above it, is where the muscles responsible for facial expression begin to penetrate into the skin.

It is possible to distinguish four separate anatomic layers even if they frequently overlap: First-layer muscles include the rectus oculi, risorius, zygomaticus minor, and depressor anguli oris; second-layer muscles include the levator labii superioris, risorius, zygomaticus major, and depressor labii inferior. Third-layer muscles include platysma and orbicularis oris; fourth-layer muscles include buccinator, mentalis, and levator anguli oris [1].

The superficial fascia and superficial musculoaponeurotic system (SMAS) invest in the more superficial three layers, forming the SMAS-mimetic muscle complex. The deep-seated muscles buccinator, mentalis, and levator anguli oris supply to their anterior surface, while the superficial muscles receive their neurovascular supply from their posterior surface due to the facial nerve's deep placement in this plane [2,6,7]. Three plexuses are formed by the vessels in the face: the subcutaneous, deep facial, and subdermal plexuses. These plexuses are connected by perforating arteries. Deep circulation to the anterior face is supplied by the facial plexus, which is located behind or through the mimetic muscles.

The external carotid artery's branches provide the majority of the face's blood flow.

The facial artery is the main outgrowth of the external carotid artery in the face. The ophthalmic artery, the internal carotid artery's first branch, helps to deliver blood to the face. The ophthalmic artery supplies the majority of blood to the anterior region of the forehead, the upper two-thirds of the nose, and the eyes. It enters the bony orbit through the optic canal. The lacrimal, supraorbital, supratrochlear, and other branches of external nasal arteries and infratrochlear arteries [8,9].

Due to their connections to the cavernous sinus, the facial superficial veins are extremely significant clinically. Because the angular vein can flow in two different directions, into the ophthalmic or facial veins, blood from the face may enter the cavernous sinus through the latter. As a result, infections from the face could penetrate the brain. The "danger triangle" of the face refers to the region that drains through the facial vein and includes the lips, medial canthus, and nose. The angle of the mouth and the nose bridge define the boundaries of this bilateral triangle, which was made popular by Maes in 1937. The angular vein, supraorbital, suprachalchal, and superior ophthalmic veins, as well as the deep facial vein, pterygoid plexus, and inferior ophthalmic vein, are the possible routes via which the facial vein communicates with the cavernous sinus. [9,10,11].

For dermatologists, the anatomy of the face and extratemporal components of the facial nerve are of great importance [12,13]. The skin of the face, except for a small area around the mandibular angle and the auricular lobe, is largely innervated through the three branches of the trigeminal nerve, the fifth cranial nerve (CN V).

Botox and soft tissue filler injections sometimes cause complications such as bruising, erythema, and pain. Botox

with 67.0% bruising, fillers with 79.0% swelling, and chemical peels with 58% redness are the most common complications [14]. Niamtu et al. have estimated a 95% success rate for patient satisfaction of 20 units of Botox per treatment area (glabella, frontalis, or lateral canthus). He listed overcorrection, undercorrection, asymmetric result, upper eyelid ptosis, dysphagia, neck weakness, perioral droop compromised result in the elderly, bruising, intravascular injection, lagophthalmos, exposure keratosis, globe perforation diplopia (lateral rectus) and psychosomatic problems [15]. Findings of Dayan (2013) showed patients requiring high doses, are at greater risk of BoNTA-related complications that can be decreased by proper injection techniques and conservative dosing [16]. Considering that brow ptosis and asymmetry are common adverse effects of botulinum toxin the most common adverse effects associated with fillers are the local injection-related effects manifesting as erythema, edema, pain, and ecchymosis. It was concluded that the treating physician is well-versed with the various fillers and botulinum toxin complications and their management as some of the complications can be severely debilitating [17].

Sethi et al. (2021) evaluated headache as the most common adverse condition with 5.38%, followed by hypersensitivity reaction (2.90%) and nasopharyngitis (3.08%) [18]. Using FACE-Q evidence of satisfactory rating among patients before and after surgery, revealed high appearance-related psychosocial distress before surgery, which significantly dropped after surgery. This algorithm can guide the surgeon in formulating a suitable plan with fewer complications and a high satisfaction rate [19].

Clinicians must employ known prevention strategies and be able to undertake appropriate remedial treatment for all potential complications. For this purpose, knowledge of anatomy and careful injection techniques are fundamental to achieving optimal outcomes [20].

Materials and Methods

This retrospective-descriptive study was conducted on the records of patients that utilized botulinum toxin and filler injections at Dr. Ali Mortazavi's Clinic between 2019 and 2023. The Ethics Committee of Istanbul Atlas University (approval date and number (23.11.2023-34994) approved this study. This study was conducted according to the Declaration of Helsinki.

This research was conducted among 200 female patients who developed complications after Botox injection in the injected area of facial region and the patients are between the ages of 25 and 65. Furthermore, 27 out of 78 individuals experienced problems following filler injections in the facial region, with ages ranging from 25 to 65 years in this study. Most of the injections were done in the forehead, vermilion, around the eyes, and around the nose.

The material we used in botulinum toxin injections are consisting of a purified form of botulinum toxin type A, a neurotoxin produced by the bacterium *Clostridium botulinum* and the materials of filler injections are used in dermal fillers, including hyaluronic acid, collagen, poly-L-lactic acid, and calcium hydroxylapatite. We evaluate the patients regarding the complications after the Botox injections. In this study, patients who had skin problems and

diseases especially skin cancer or other cancers, pregnancy, diabetic disease, allergic reactions, chronic disease, or who is not included in the age range have been excluded.

The patient’s facial region exhibits complications such as redness, over and under correction, brow ptosis, infections, headache, and pain and the complications in filler injection is ecchymosis, erythema (redness), inflammation and specially necrosis of nose.

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According to patients who visited the clinic for botulinum toxin and filler injections during a specific timeframe; this article will describe issues observed in certain individuals following Botox and filler injections. We did systematically analyze datas, organizing information into tables for quantification and comparison. This data-driven approach, which emphasizes ratios and percentages, enhances the interpretation of treatment outcomes, allowing for more meaningful conclusions about the efficacy of Botox and filler injections. This evidence-based methodology continually refines our protocols, leading to improved patient outcomes.

Results

In Botox injection, side effects usually appear between 8 to 24 hours. This research showed that the side effects of Botox are usually different from each other and depend on the patient’s skin and the type of complication. In these

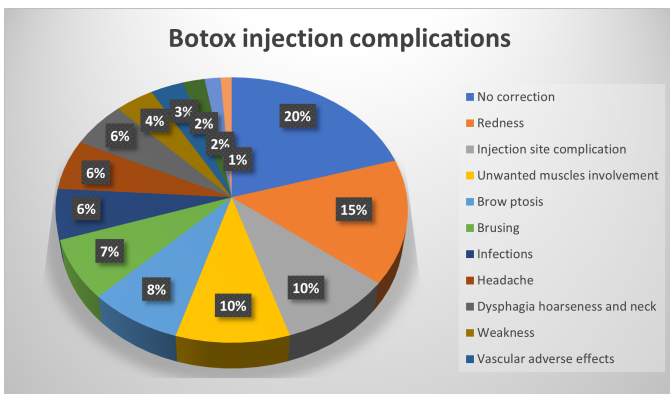


Figure 1. Related graphic for Botox injections complications.

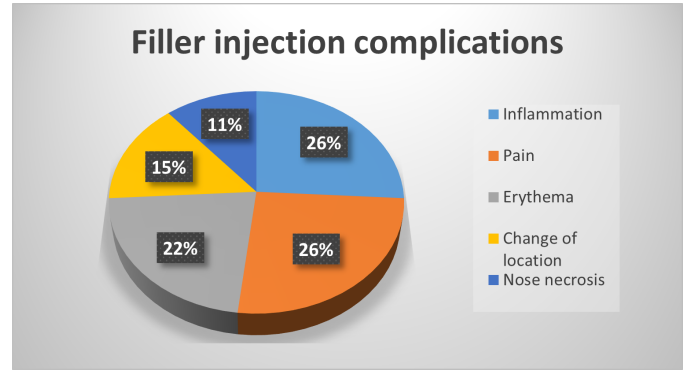


Figure 2. Related graphic for filler complications.

Table 1. The percentage of botulinum toxin injections.

Complication	Number of cases	Percentage of cases in complications (178)
No correction	36	20.22%
Redness	27	15.1%
Over and under correction	17	9.5%
Injection site complication	17	9.5%
Unwanted muscle involvement	14	7.8%
Brow ptosis	13	7.3%
Brusiy	11	6.17%
Infections	11	6.17%
Headache	10	5.6%
Dysphagia, hoarseness and neck weakness	7	3.9%
Vascular adverse effects	6	3.3%
Lip ptosis and asymmetry	4	2.2%
Pain	3	1.6%
Asymmetry	2	1.1%

Table 2. The percentage of filler injection complications.

Complication of injection	Number	Percentage of cases in complications (27)
Inflammation	7	25.9%
Pain	7	25.9%
Erythema	6	22.2%
Change of location	4	14.8%
Nose necrosis	3	11.1%

cases, swelling and erythema are reduced and disappear within a week, but the ptosis lasts up to two months.

For the second follow-up visiting the patients within a week, we use direct inspect and history of their diseases to diagnose the type of complications.

A total of 178 evaluated patients experienced complications following Botox injections. The percentage of complications of Botox injections are reported in Figure 1. The most common complication filler injections are indicated in Figure 2.

In this study, we observed 178 individuals who had Botox injections. Experienced complications, which are described as follows: No correction was the most common adverse condition reported (20.22%), followed by redness

Table 3. Common complications from previous studies.

Study	Complications
Bai 2018 [21]	Headache 20.93%
Carruthers 2002 [32]	Headache (15.3% vs 15.0%), Back pain (1.5% vs 5.0%)
Carruthers 2003 [33]	Headache (11.4% vs 20.0%) Erythema (3.0% vs 2.9%), Oedema (0.5% vs 4.3%) Pain (2.0% vs 1.4%) Infection (2.0% vs 0%)
Wu 2009 [29]	Headache (8.8% vs 1.7%) Ptosis (0.6% vs 0%)
Stotland 2007 [34]	Headache (12%)
Carruthers 2005 [33]	Headache (RCT, 11.2%; OL, 7.5%) Eyebrow ptosis (2.5% in both trials)
Kawashima 2009 [35]	Headache (4.9–7.2%) Pain (1.1–4.4%)
Brandt 2009 [31]	Headache (10% vs 8%) Eye disorders (9% vs 8%) Ptosis (3% vs 0%)
Cohen 2009 [24]	Headache (5.8% fixed, 4.2% variable dose) Ptosis (1% fixed, 2% variable dose)
Rubin 2009 [36]	Headache (12% vs 3%) Pain (4% vs 1%)
Kane 2009 [37]	Headache (2% vs 3%) Ptosis (2% vs 0%) Injection site disorders (6% vs 5%)
Monheit 2007 [25]	Headache (16.8% vs 10.6%) Nasopharyngitis (8.6% vs 8.5%) Ptosis (0.8%)
Lowe 2005 [38]	Infection (primarily common cold; average 11.5% vs 15.6%), Injection-site bruising (average 9.2% vs 12.5%), Headache (average 6.9% vs 3.1%)
Lowe 2002 [39]	Bruising (11–25%)
Carruthers 2003 [22]	Headache (average 22%) Bruising (average 10.2%) Eyebrow ptosis (48 U, 10%; 32 U, 21%)
Carruthers et al. 2009 [23]	Brow ptosis (average 8.3%) Headache (average 5.0%)
Bulstrode 2002 [40]	Brow ptosis (22/25)
Mazzuco and Hexsel 2010 [30]	Asymmetric smile (6.2%)

(15.1%) and over- or under-correction (9.5%) associated with Botox injections in Table 1. Among 78 patients who received facial filler injections, 27 experienced complications. Primary complications included inflammation and pain (25.9%), erythema (22.2%) among the cases associated with filler injection complications in Table 2.

The incidence of adverse events occurring with botulinum toxin A (BoNT-A) for lines on the side of the lips, lines on the forehead, and around the nasal area are listed in

Table 1.

For the second visit and re-checking the patient, they have to return to the clinic after one week. Restylane and Dysport U brands are usually used in Botox injection and Deep and Neurmis for filler injection.

The main component of Restylane is a dermal filler made of hyaluronic acid, while Dysport is a type of botulinum toxin. Restylane Silk is a gel of hyaluronic acid generated by *Streptococcus* species of bacteria, chemically

crosslinked with BDDE, stabilized and suspended in phosphate buffered saline at pH=7 and concentration of 20 mg/mL with 0.3% lidocaine. Each syringe of Restylane lip filler contains 1 mL of hyaluronic acid (HA) gel. Each 300 Unit vial of DYSPOORT® is to be reconstituted with 1.5 mL of preservative-free 0.9% Sodium Chloride Injection, USP prior to injection. The concentration of the resulting solution will be 20 Units per 0.1 mL.

Neuramis Light Lidocaine is a filler based on hyaluronic acid 20 mg/ml, intended for prolonged skin biorevitalization, correction of fine wrinkles, long-lasting renewal of skin hydrobalance, and moisturizing the lips.

Discussion

In this study, we looked at the complications that can come from botulinum toxin and filler injections among 205 female patients. For botulinum toxin injections, the most common issues were no correction (20.22%), redness (15.1%), and over or under correction (9.5%). For filler injections, the main problems included inflammation (25.9%), pain (25.9%), and erythema (22.2%).

When comparing our findings with those from other studies, some interesting patterns emerge. Bai reported a headache incidence of 20.93% among Botox patients, which is much higher than the 5.6% we observed. Similarly, Carruthers found headache rates as high as 22% in some groups, again higher than what we saw [21-22]. This difference might be because of variations in the patients themselves, how the injections were done, or the doses used.

Carruthers et al. found brow ptosis in 8.3% of patients, slightly higher than our 7.5%. The variations could be due to differences in where the injections were given, techniques, or how long the patients were followed up [23]. However, our findings are in line with Cohen, who reported ptosis rates between 1% and 2%, suggesting that ptosis might be less common when the injections are done by experienced hands or with techniques designed to avoid this complication [24].

Regarding injection site complications, our study found an incidence of 9.5% for Botox injections, similar to Monheit, who reported rates between 6% and 12.5%. This consistency highlights the importance of proper injection technique and aftercare to reduce these issues [25].

For filler complications, we found inflammation and pain each affecting 25.9% of patients. This differs from Dayan, who pointed out high-dose injections as a major risk factor for complications, especially in patients needing larger volumes of filler [26]. The difference might be due to different injection methods or patient groups. Additionally, Niamtu noted issues like overcorrection, under correction, and asymmetry, similar to our findings, though his rates were higher, possibly due to stricter reporting or patient management practices [27]. Sethi et al. reported headache as the most common adverse effect (5.38%), followed by hypersensitivity reactions (2.90%) and nasopharyngitis (3.08%) [28]. These results suggest a broader range of mild adverse effects compared to our focused assessment of local complications, highlighting the need for thorough patient monitoring to catch all potential issues, even those not directly related to the injection sites.

Wu reported a lower rate of ptosis (0.6%) compared to our 7.3% [29]. This significant difference could be due to different definitions of ptosis, injection techniques, or follow-up protocols. Wu's study used a precise injection technique aimed at minimizing ptosis, which may explain their lower rates.

Mazzuco and Hexsel reported asymmetric smiles in 6.2% of their cases, higher than the 2.2% we found [30]. This could be due to differences in patient anatomy, injection techniques, or subjective assessments of asymmetry. Our lower rate may indicate more precise injection techniques or better pre-procedural planning.

Brandt identified eye disorders in 9% of cases and ptosis in 3%, different from our findings of ptosis (7.3%) and other Botox-related complications [31]. The higher incidence of eye issues in Brandt's study might be due to more aggressive dosing or techniques closer to the eyes. Overall, our results are in line with the broader literature, though some differences highlight the impact of specific clinical practices and patient management strategies. Relevant previous studies are presented in Table 3 [32-40]. These comparisons show how important it is for practitioners to stay informed about different techniques and their associated complication rates to improve patient outcomes.

The relatively lower complication rates in our study suggest that the injection techniques and patient care protocols we used were effective in reducing risks. Focusing on proper anatomical knowledge and conservative dosing likely helped achieve these positive outcomes. Our findings highlight the importance of ongoing education and careful technique to ensure patient safety and satisfaction.

While this study provides valuable insights, it has some limitations. The sample size, although significant, might not fully represent the broader population of Botox and filler recipients. Additionally, the retrospective and descriptive nature of the study and reliance on clinic records could introduce reporting biases. Future research should aim to include larger, more diverse populations and consider prospective study designs to verify these findings.

The use of Botox and filler injections is increasing due to their effectiveness and relatively low risk. However, practitioners must remain aware of potential complications. Our study emphasizes the importance of precise technique and comprehensive anatomical knowledge in minimizing adverse effects. By following best practices and staying updated on the latest research, practitioners can maintain high standards of patient care in aesthetic medicine.

Conclusion

In conclusion, the ever-increasing use of Botulin toxin for cosmetic purposes is fueled by its reliable success rate, low risks, and speedy recovery, setting it apart from traditional surgical options. However, as its use becomes more widespread, there is a predicted rise in various negative reactions. Practitioners must have a comprehensive understanding of potential complications for different uses to guarantee the safety of their patients. By continually educating themselves and staying informed, they prioritize patient well-being and elevate standards in the ever-evolving realm of aesthetic medicine. In botulinum and

filler injections, it is essential to assess the Basic Topographic Anatomy of the facial region and consider individual differences for each patient before administration. Regardless of one's familiarity with the clinical anatomy of the area or the physician's level of skill, the potential for injecting Botox and fillers into variants of arteries, veins, and nerves must not be overlooked in the event of difficulties.

Current mapping investigations of the region's architecture, considering the variability in collagen structure and distribution among genders, age groups, and races, will illuminate strategies for preventing and mitigating issues.

Ethical approval

The Ethics Committee of Istanbul Atlas University (approval date and number 30.03.2023-25523) approved this study.

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