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Efficacy of Botulinum Toxin Type A Injection on Masseter Hypertrophy

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Abstract

Background and Objectives: Masseter hypertrophy (MH) is characterized by abnormal enlargement of the masseter muscle (MM), leading to aesthetic concerns and functional impairment. This study aimed to evaluate the clinical efficacy and safety of botulinum toxin type A (BTX-A) injections for the reduction of masseter muscle hypertrophy (MMH).

Methods: A prospective clinical study was carried out in the Maxillofacial Department of Rizgary Teaching Hospital from February 2018 to August 2019 and 19 patients were included who were suffering from MH. The condition was clinically diagnosed. With the diluted BTX-A (30IU in ringer lactates injected at five masseter points, 6 iu each points), Pre-injection and post-injection performance measurements were performed at 12 weeks on a patient-self-reported scale using a visual analog scale (VAS).

Results: This study's findings indicate that 12 weeks after the administration of BTX-A, there was a significant efficacy in reducing MMH, with only one patient exhibiting no change in muscle hypertrophy post-injection but after injection was reduced and one patient exhibit herniation

Conclusion: This study established that the use of BTX-A significantly decreased MMH. These results suggest that BTX-A can be utilized as a safe and risk-free method with maximum effectiveness in treating MMH.

Keywords: Botulinum Toxin, Hypertrophy, Masseter Hypertrophy, Visual Analogue Scale

1-Introduction :The masseter muscle (MM), one of the muscles involved in chewing, is a robust superficial quadrangular muscle that originates from the zygomatic arch and attaches along the angular and lateral surfaces of the mandibular ramus. Its main function is to elevate the mandible and contribute to its forward movement to some extent (1).

Masseter hypertrophy (MH) is a condition characterized by abnormal enlargement of the MM, which can result in aesthetic concerns and functional impairment (2)(3). The etiology of this condition is multifactorial, with contributing factors including parafunctional habits, such as bruxism (teeth grinding), or even genetic predispositions (4). The pathophysiology underlying MH is believed to involve the proliferation of muscle fibers and an increase in muscle volume, potentially exacerbated by local metabolic changes within muscle tissue (5).

Patients presenting with MH may exhibit various signs and symptoms, the most prominent being conspicuous enlargement of the jawline, which can lead to a square facial appearance (6). This may be accompanied by discomfort, pain, and fatigue in the muscles, particularly after prolonged use, as well as difficulty in performing routine oral functions (7). Complications arising from untreated MH extend beyond aesthetic concerns. Patients may experience temporomandibular joint (TMJ) pain, alterations in dental occlusion, and even the development of TMJ disorders (8, 9). Moreover, persistent muscle enlargement can lead to chronic pain syndrome and may significantly affect a patient's quality of life (6).

Treatment approaches for MH range from conservative methods, such as physiotherapy and dental interventions, to manage parafunctional habits to invasive procedures, such as surgical reduction (10). However, Botulinum Toxin Type A (BTX-A) injections have emerged as a minimally invasive treatment modality that offers a significant reduction in muscle size without the risks associated with more invasive surgical procedures (11, 12).

The BTX-A is a neuromodulator that induces temporary muscle paralysis, thereby reducing muscle volume over time. This toxin inhibits the release of acetylcholine, a neurotransmitter responsible for muscle contraction, leading to a reduction in muscle tone and size (13). The use of BTX-A for MH has shown promising results in the management of muscle-generated dental diseases and functional or esthetic dental conditions. Kim et al. (2010) showed that BTX-A injection is a promising treatment option for MH, but further studies are needed to confirm this finding (14).

The necessity of conducting the present study lies in the ever-evolving landscape of aesthetic and therapeutic interventions, where the demand for minimally invasive yet effective treatments is always high. Since limited studies in this field have been conducted in the Middle East, especially Iraq, this study aimed to evaluate the clinical efficacy and safety of botulinum toxin A for the reduction of MMH.

2-Methods and Materials

Study Design and Setting :This prospective clinical study was conducted over a period of 18 months from February 2018 to August 2019 at the Maxillofacial Department of Rizgary Teaching Hospital. The objective of this study was to ascertain the clinical effectiveness of BTX-A injections in reducing MMH and evaluate its safety profile.

Participants :The participants were selected based on convenience sampling. The sample consisted of 19 patients who presented to the consultant maxillofacial department with unilateral or bilateral MH.

Inclusion criteria were patients aged at least 12 years and demonstrating unilateral or bilateral masseteric hypertrophy without bony swelling. Exclusion criteria were set to ensure patient safety and the integrity of the results. Individuals with a history of myasthenia gravis, known sensitivity to botulinum toxin, infection at the prospective injection site, or pregnant or lactating women were excluded from the study.

Injection Site and Landmarks

The injection process consists of three distinct steps. Initially, the primary cause of a square-shaped face and MM volume were estimated through physical examination. To objectively assess muscle thickness, measurements were taken under the muscle between the earlobe and the corner of the mouth. Subsequently, the safety injection zone was demarcated using four lines (Figure 1).

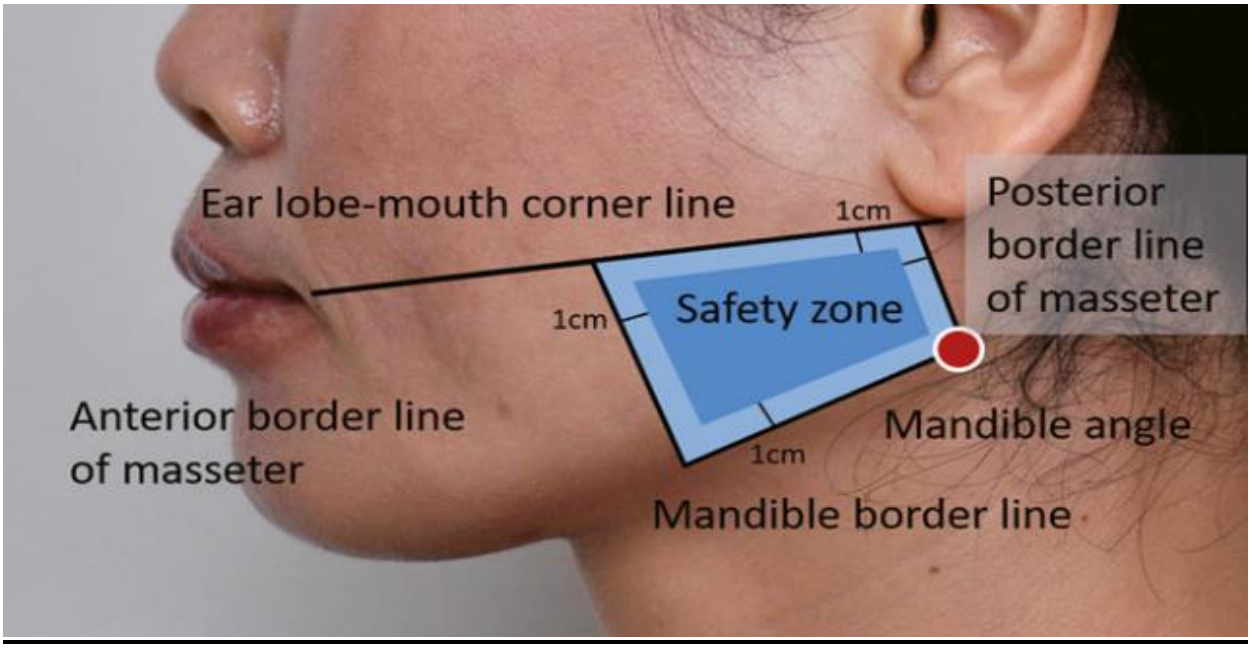

Figure (**1**)**:** Injection safety zone. It is marked in lighter blue, and the ideal injection safe zone 1 cm from each border is marked in darker blue.

A line connecting the earlobe and mouth corner was drawn, and two lines marking the anterior and posterior margins of the MM were identified through palpation between the earlobe and mouth corner. A rectangular zone was established by connecting the mandible angle, which is considered a safety zone owing to the absence of significant anatomical structures beneath the line connecting the mouth corner and earlobe. In the final step, the injections were administered at five specific points, considering the diffusion of the toxin. Figure 2.

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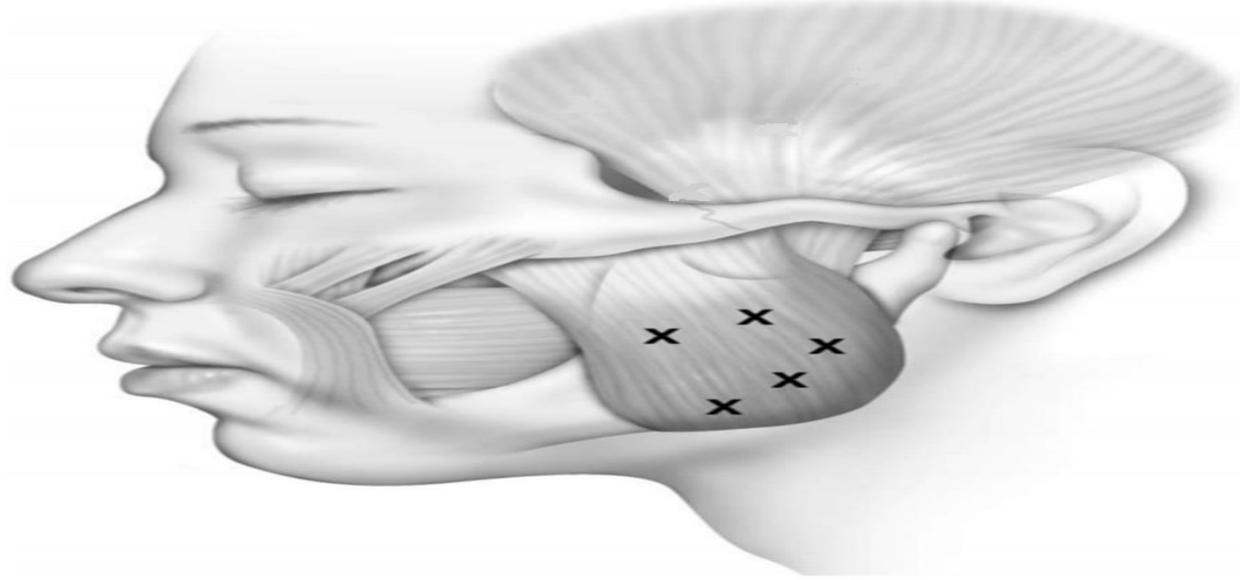

Figure (**2**)*:* Injection and diffusion areas (16).

Dilution and Dose :Before injection, the skin covering the area around the ear and cheek was disinfected using an antiseptic solution. To identify the appropriate injection area, patients clenched their jaws to enable palpation of the posterior, inferior, and superior boundaries of the MM. Lyophilized BTX-A (Dysport) was mixed with ringer lactate to achieve a final concentration of 30 IU, whereas a vial of Dysport containing 500 U was mixed with 4 ml of sterile saline. Portions of 1 ml (equivalent to 30 IU) were evenly administered through a 30-gauge needle. It was noted that excessive dilution could exacerbate pain at the injection site, whereas too little dilution might lead to dosage or injection errors.

Data Collection :Data collection included pre- and post-injection photographs at 12 weeks to visually document changes in the MM. The patients also self-assessed the treatment effect using a VAS ranging from 0 (no change) to 100 (excellent) at each post-injection interval (0=no change,1-25 = fair, 26-50 = medium, 51-75 = good,76-100 = excellent).

Ethical Endorsement :The study protocol received ethical approval from the Institutional Review Ethical Committee of the Kurdistan Council of Medical Specialists. Informed consent was obtained from all participants after thorough explanation of the study's purpose, procedures, potential risks, and benefits. This study was performed in accordance with the ethical standards of the Declaration of Helsinki.

Statistical analysis :The collected data were analyzed using Statistical Package for the Social Sciences (SPSS) software, version 27. A paired t-test was employed to compare pre- and post-injection measurements, with a p-value of less than 0.05 considered statistically significant. Descriptive statistics were used to provide a comprehensive summary of data.

3-Results

:Nineteen patients with MMH were included in this study. The mean age of the patients was 29.258 ± 8.263 years, comprising 15 females and 4 males, with a follow-up period of 12 weeks (Figure 3).

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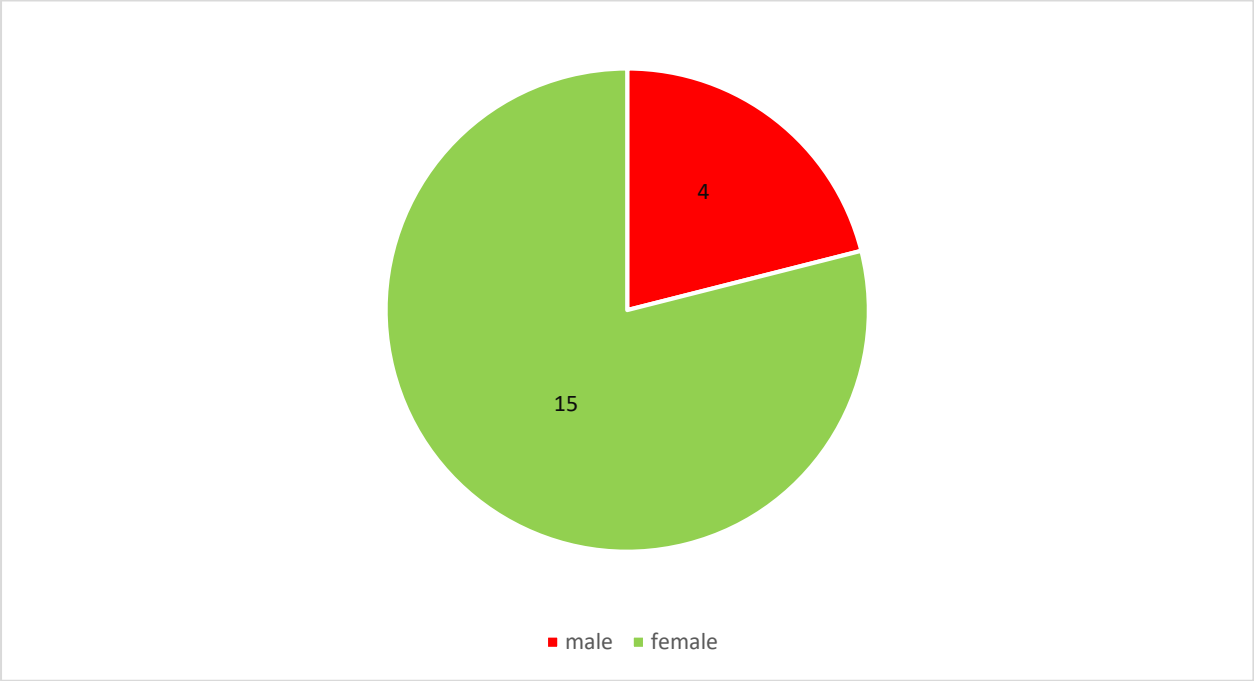

Figure (**3**)**.** Sex distribution of participations

An assessment of the changes in the MM and the effects of the injection based on the VAS was conducted. The results showed that among 19 individuals, the therapeutic effects were rated as 'Fair' in one (5.2%) patient, 'Medium' in two (10.5%), 'Good' in three (15.8%), and 'Excellent' in thirteen (68.5%) patients (Table 1).

Table (**1**)**. treatment's effect according to VAS**

Treatment's Effect	Frequency (%)
0 (No Change)	**0**
1-25 (Fair)	**1 (5.2%)**
26-50 (Medium)	**2 (10.5%)**
51-75 (Good)	**3 (15.8%)**
76-100 (Excellent)	**13 (68.5%)**

Based on toxin injection a significant reduction was observed before injection (A) (B) and after injection (C) from the angle of the lower jaw to the most prominent point of the chin (pogonion). (Figure 4)

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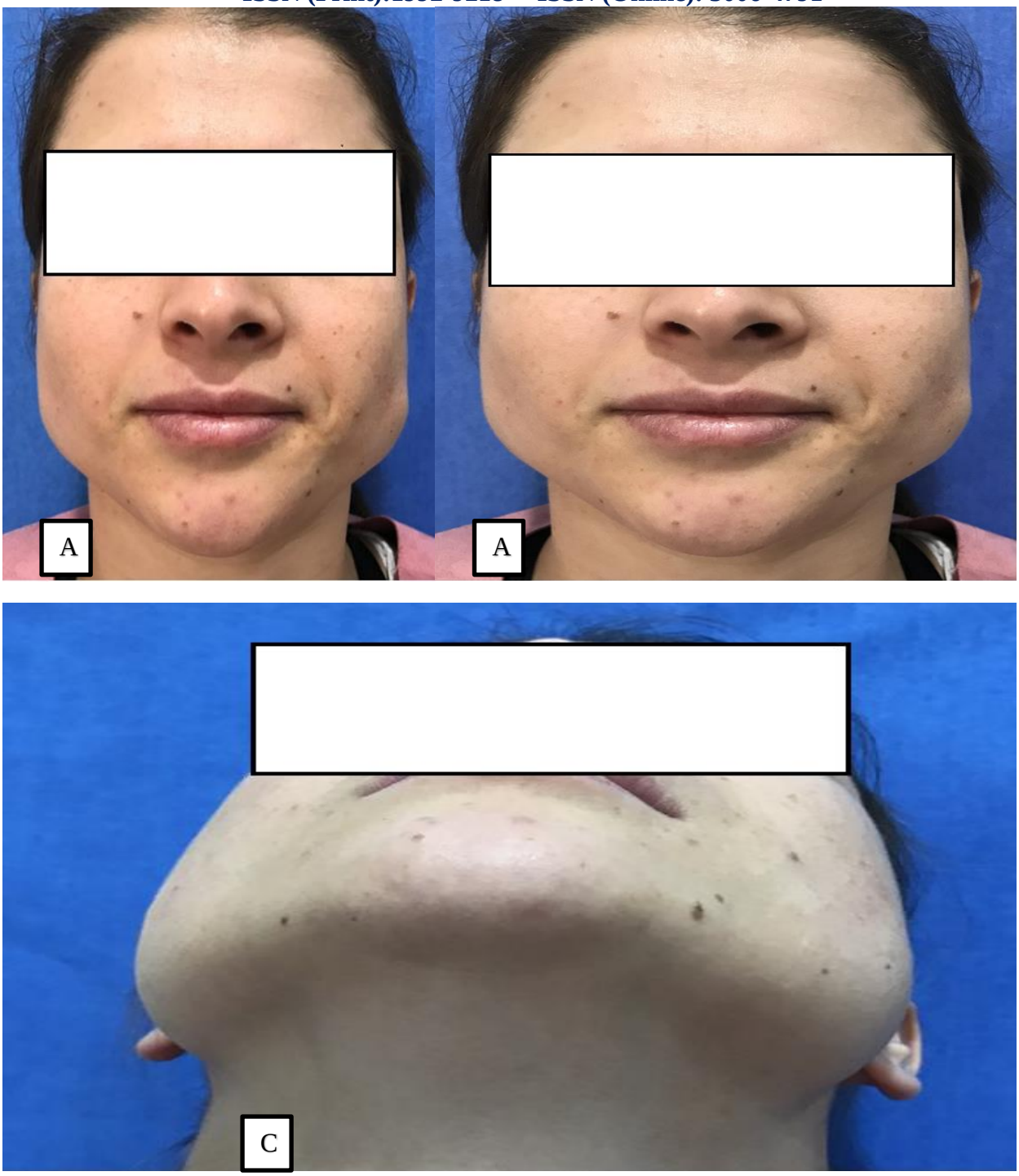
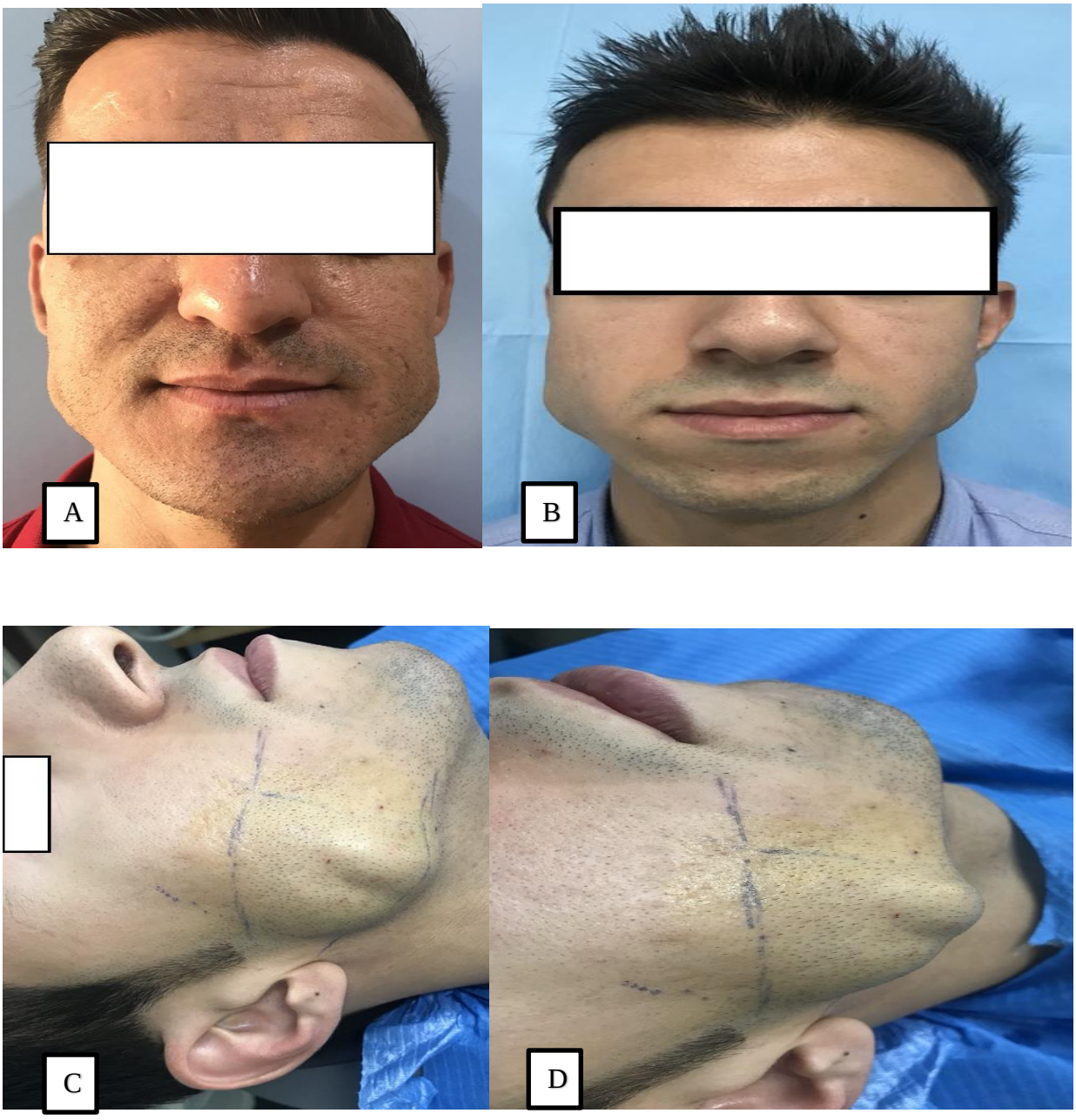


Figure (4 **)**: Pre-injection of botulinum toxin type A (BTX-A) frontal view of the patient with bilateral masseter hypertrophy (A) (B). Post-injection of botulinum toxin type A (BTX-A) frontal view follow up (B).

The hypertrophy of the master muscle before the injection of botulinum toxin type A (BTX-A) was quite clear in the patient. (Figure 5 (A) (B))

Before injection, the skin covering the area around the ear and cheek was disinfected using an antiseptic solution. To identify the appropriate injection area, patients clenched their jaws to enable palpation of the posterior, inferior, and superior boundaries of the MM. Lyophilized BTX-A (Dysport) was mixed with ringer lactate to achieve a final concentration of 30 IU, whereas a vial of Dysport containing 500 U was mixed with 4 ml of sterile saline. Portions of 1 ml (equivalent to 30 IU) were evenly administered through a 30-gauge needle. A line was drawn from the tragus to the corner of the mouth, which represents the upper border, and the lower border was marked with the aim of limiting the injection site at a distance of 1.5 to 2 cm from the lower border of the lower jaw to avoid injury to the lower jaw. (Figure 5 (C) (D))

A significant reduction of the masseter muscle hypertrophy after injection is evident from the angle of the lower jaw to the most prominent point of the chin (pogonion). (Figure 5 (E) (F) (G))



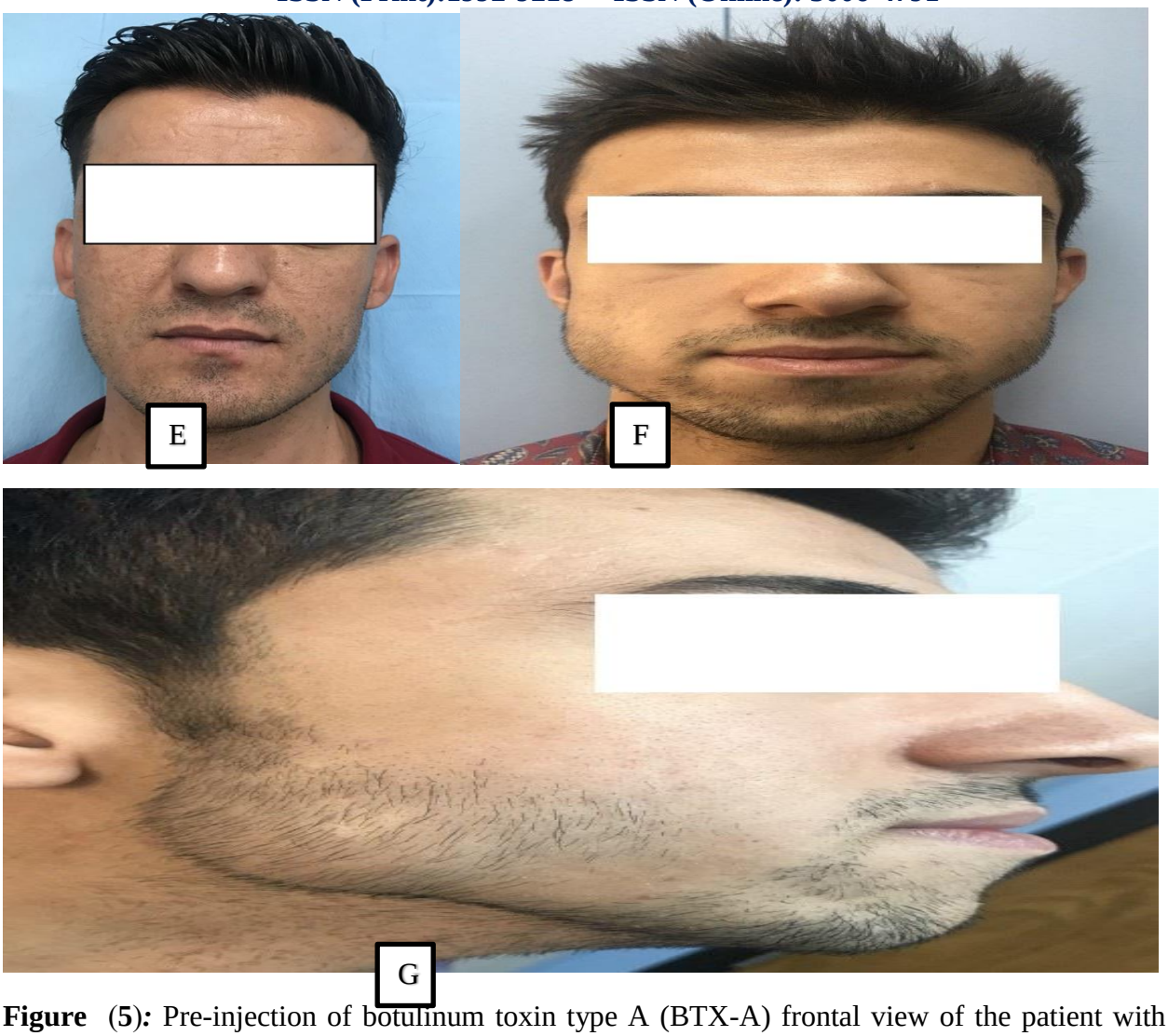


Figure (5)*:* Pre-injection of botulinum toxin type A (BTX-A) frontal view of the patient with bilateral masseter hypertrophy (A) (B). Preoperative marking injection points (C) (D). Post-injection of botulinum toxin type A (BTX-A) frontal view at follow up (E) (F) (G).

4-Discussion :This study aimed to evaluate the efficacy and safety of BTX-A in reducing MH. The results after 12 weeks post-injection underscored the high efficacy of BTX-A in reducing MMH, with only one patient showing no alteration in muscle hypertrophy after the treatment. The VAS-based outcomes also indicated a decrease in mean pain among patients after 12 weeks.

The BTX-A is commonly used as a non-surgical method for facial wrinkle reduction and the treatment of certain muscular disorders (17). It is a protein derived from the bacterium Clostridium botulinum that works by blocking nerve signals to the muscles, thus controlling muscle movement and reducing contractions (18).

One of the problems associated with MMH is its aesthetic impact, potentially leading to the sagging and broadening of the lower facial areas. While traditional surgical methods in the facial regions are common, the use of BTX-A injections for reducing MMH has become more prevalent in recent years. Klein et al. (2014) conducted a study with the aim of investigating the effectiveness of the use of abotulinum toxin in the treatment of master's hypertrophy in

Brazilians. Ten Brazilian female patients with mastoid hypertrophy were injected with 90 units of abobotulinum toxin A on each side and followed up for 24 weeks. The results showed that the use of toxins not only improved MH, but also improved tooth grinding (19). Lee et al. (2016) monitored eight patients weekly after botulinum toxin A injection for mastic hypertrophy. The findings indicated a consistent, phased decline in muscle thickness following administration of botulinum toxin A for masseteric hypertrophy. This decrease initially manifested during the clenching phase, followed by a simultaneous decrease during the resting phase. The most significant size reduction was observed at 11 weeks, followed by gradual restoration of muscle size (11).

The use of BTX-A to improve people's appearance and aesthetics has also received more attention. A study by Cheng et al. (2019) in the United States evaluated the effects of Botulinum Toxin injections on masseter reduction in East Asia. Their findings support the efficacy of BTX-A in this application, recommending further studies on the potential effects and mechanisms of BTX-A injections (20).

Since most side effects of BTX-A manifest within 4 weeks post-injection and typically dissipate after 3 months, patient dissatisfaction may occur. Thus, attention to anatomical location, injection technique, and dosage is crucial (21). A study using animal models, such as mice by Tsai et al. (2015), showed that initial injections of BTX-A reduced muscle activity, and increased dosages further diminished muscle activation. However, these effects warrant further investigation in humans (22).

In addition to the significant and beneficial effects of BTX-A injection in the facial area, excessive and long-term use of BTX-A in the facial regions may lead to complications such as facial muscle atrophy and could complicate neurological diagnoses in patients (23).

5-Conclusions :In conclusion, the results of the current study confirm that the use of BTX-A can significantly reduce MMH. Based on these findings, BTX-A has been proven to be a safe and effective method with minimal complications in patients. Future studies should consider the timing of reminder injections, side effects, and injection techniques to improve the outcomes.

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