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Psychological Consequences of Cosmetic Botox Therapy

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ABSTRACT

The face plays an essential role in social communication, both through its permanent features, which indicate age, and through dynamic changes in facial expressions, which convey emotional states and intentions. There is a bidirectional relationship between facial expressions and mood—emotions influence facial expressions, while facial expressions, in turn, impact well-being. Mirror neurons cause observing another person's facial expressions to evoke similar feelings in the observer.

When injected locally, botulinum toxin blocks cholinergic transmission, leading to muscle relaxation. By smoothing out facial wrinkles, the face becomes a less expressive indicator of emotions and mood. Botox is commonly used to reduce wrinkles caused by the contraction of the corrugator muscle, which gives the face a sad or stern appearance. Consequently, this treatment can lead to an improved mood. For this reason, Botox is being explored as a potential method of antidepressant therapy.

Aim: This article aims to review the psychological consequences of cosmetic Botox therapy, including changes in facial expressions and their impact on conveying and receiving emotions.
Materials and Methods: A comprehensive literature review was conducted using PubMed, focusing on articles and research papers published between 1985 and 2024. Search terms included “botulinum toxin”, “botox”, “depression”, “mood”, “face”, “facial expressions”, and “emotions”.
Keywords: botox, botulinum toxin, depression, emotions, facial expressions, mood

Introduction

The human face plays a crucial role in social communication, serving as a primary medium through which we convey our intentions. Over time, individuals develop the ability to interpret facial expressions, which provide a wealth of information beyond mere words. These expressions reflect our mood, mental and physical well-being, and even age—elements shaped by a lifetime of experiences, emotions, fatigue, and the countless smiles that may leave their mark as wrinkles. [1]

Facial expressions are deeply connected to our emotional states; our feelings are visually represented through the nuances of our expressions. Likewise, recognizing mood changes in others influences our facial cues—mirror neurons facilitate a subconscious alignment of our expressions in response to the body language and facial signals of those we interact with.[1] For example, smiling while reading a cartoon could increase amusement. Charles Darwin suggested this feedback loop between the expression of and an experience of emotions, and there is now an accumulation of evidence illustrating how facial-muscular action can affect our mood and perception.[2,3]

An inability to express emotions facially can also influence mood. Studies show that patients with facial paralysis often experience symptoms of depression.[4] The severity of their

depression appears to be linked to the extent of their impaired ability to smile, with those unable to smile being more prone to depression. It is suggested that the absence of positive facial feedback from smiling makes it more difficult to sustain a positive mood.[5]

However, with advancing age, the decline in skin elasticity and the emergence of expression lines can contribute to a facial appearance that may be perceived as increasingly somber or melancholic.[1]

A widely embraced anti-aging solution for many individuals is botulinum toxin, more commonly referred to as Botox. This toxin functions by blocking cholinergic transmission, resulting in muscle relaxation. When applied to the face, Botox effectively smooths out expression wrinkles, a technique frequently utilized in aesthetic medicine for facial rejuvenation, which is often regarded as a significant indicator of age.[2,5,6]

For example, by relaxing the corrugator muscle—responsible for frowning—we can reduce its contractions and limit the expression of emotions through facial movements. This leads to a more serene and less fatigued appearance, which may, in turn, enhance the individual's mood. Due to these effects, the medical field is investigating the potential of Botox as a treatment for depression.[2,5,6]

Mechanisms of Face Perception

Facial perception involves various cognitive processes that allow individuals to recognize and interpret facial features such as age, gender, and emotions.[7]
For several decades, psychological research has devoted significant attention to the capacity to recognize emotions through facial expressions. In recent years, this domain of inquiry has been further enriched by various neurobiological insights derived from experiments involving brain lesions, electroencephalography (EEG, including event-related potentials), magnetoencephalography (MEG), positron emission tomography (PET), and functional magnetic resonance imaging (fMRI).[8] The extensive array of findings complicates the ability to provide a straightforward summary and suggests that facial emotion recognition cannot be ascribed to a limited number of specific brain structures. Rather, it is becoming increasingly

evident that this process is underpinned by multiple strategies and engages a comprehensive network of diverse brain regions.[8,9]

Understanding these mechanisms is essential for advancing research in fields such as psychology, neuroscience, and artificial intelligence. This exploration involves examining the visual, emotional, and social cues that influence how faces are perceived and categorized. Insights gained from studying these mechanisms can enhance applications such as facial recognition technology and social communication strategies.[1, 7] The ability to recognize faces is linked to various skills, cognitive functions, and areas of the brain.[7] Some research suggests that difficulties in recognizing facial emotions may result from various mechanisms, including cognitive impairments, deficits in social information processing, specific changes in brain systems responsible for face perception, or co-occurring conditions.[9]

The human face operates fundamentally as both a transmitter and receiver of communicative messages within social contexts, which is essential for effective interaction and survival. This concept was initially examined by Charles Darwin in his seminal 1872 work, "The Expression of the Emotions in Man and Animals."[10] Through facial observation, individuals often form judgments regarding various characteristics, including intelligence, honesty, kindness, and hostility; however, these assessments can occasionally be misleading. The recognition of faces as integrated entities is facilitated by specialized neurons located in the fusiform gyrus of the temporal cortex and the lateral occipital complex. Notably, facial recognition is optimized when the face is oriented with the forehead positioned upward.[8,11]

Initially, the study of facial expressions predominantly focused on their role as social signals that communicate emotions to others. However, there is a growing recognition that facial expressions also function as receptors of emotions, thus completing the process of communication.[8,12]

Facial Expressions and Emotional States

Daily experiences for individuals often encompass a variety of interactions with others. These exchanges communicate not just factual details but also offer insights into the sender's self-disclosure, the characteristics of the relationships among those involved, and the hidden motives

influencing the communication. In addition to the factual elements, the expression and understanding of emotions are essential for effective communication.[13]

Facial expression encompasses the observable movements of the face, which are governed by specific patterns of muscle activity. These expressions can be identified and interpreted by others, serving a vital function in human expressive behavior. They are particularly effective in conveying emotions. The comprehension of emotions through facial expressions necessitates advanced cognitive processing within the brain. This processing not only assesses the current visual input but also relies significantly on contextual information and memory. [8,13] Emotions can be articulated through various means, including gestures and vocal intonation. Nevertheless, the human face is one of the most critical instruments for expressing emotions. Research indicates that variations in facial expressions can significantly influence or even initiate emotional experiences.[6] For a period, the relationship between facial expressions and mood was not clearly established regarding unconscious facial movements. These movements may be elicited by factors such as mirror neurons or the emotional context of events that are either observed or described. The mirror mechanism for action posits that the actions of others, akin to our own, possess a specific structure that is related to motor goals. This goal-oriented motor structure enables immediate recognition of actions performed by others, whether they consist of isolated motor acts or entire sequences of movements organized in accordance with defined goal hierarchies.[6, 14] As soon as we see that frown on our relevant other's brow and her dark eyes fixed on us, her face movements take on a certain feel for us thanks to our own motor repertoire, and we start searching for what may have gone wrong. But this kind of motor understanding is rarely devoid of an emotional colouring, and our ability to understand another person's emotions rely, among other things, on a similar mechanism. Not only do we understand that something has gone wrong, but we also know that something is wrong for her and that this isn't making her feel very happy. Her expressive scowl is immediately filled with meaning thanks to our emotional vocabulary of acts, and our perception of her emotional state is directly mapped on this repertoire. It is by virtue of such a mapping that the scowl comes to bear for us that emotional colouring which characterizes it. [14] This perspective does not aim to disregard the validity of alternative approaches for interpreting an individual's motor and emotional behaviors. Additionally, it does not claim that every element of social cognition can be reduced to these processes.[13,14]

Botox and facial rejuvenation

Botulinum toxin, recognized as one of the most toxic biological substances, is a neurotoxin produced by the bacterium Clostridium botulinum.[15] It is the most poisonous biological substance that is currently known.[16] Botulism has been recognized since the early 19th century, and there was speculation about its cause. The first case of botulism is believed to have occurred in 1735, although in 1822, it was suggested that a "fatty acid" found in sausages was responsible for the condition. [16, 17] This organism synthesizes eight distinct exotoxins (A, B, C1, C2, D, E, F, and G), each of which disrupts neural transmission by inhibiting the release of acetylcholine, the primary neurotransmitter at the neuromuscular junction, thereby leading to muscle paralysis.[15] The ability to inhibit acetylcholine release is both durable and reversible while also demonstrating minimal side effects.[18] When botulinum toxin is administered via injection into a muscle, it specifically targets the neuromuscular junction, resulting in muscle paralysis by inhibiting the release of acetylcholine from presynaptic motor neurons.[15,19]

Botulinum toxins exert their effects on four distinct sites within the body:

- Neuromuscular junctions,
- Autonomic ganglia,
- Postganglionic parasympathetic nerve endings,
- Postganglionic sympathetic nerve endings that release acetylcholine.[15,20]

The heavy (H) chain of the toxin specifically and irreversibly interacts with high-affinity receptors present on the presynaptic surface of cholinergic neurons. Subsequently, the toxin-receptor complex undergoes internalization via the process of endocytosis. Once inside the cell, the disulfide bond linking the two chains is cleaved, which enables the toxin to enter the cytoplasm.[15,19]

The light (L) chain engages with several proteins, including synaptosomal-associated protein SNAP-25, vesicle-associated membrane proteins, and syntaxin, all of which are located within nerve terminals. This interaction serves to inhibit the fusion of acetylcholine-containing vesicles with the presynaptic membrane.[18,19]

The maximum effect of paralysis is typically seen about 4 to 7 days after the injection. The doses of all commercially available botulinum toxins are measured in units of biological activity, where one unit corresponds to the calculated median intraperitoneal lethal dose (LD50) in female Swiss-Webster mice. [15]

Although nerve terminals do not undergo degeneration, the blockade of neurotransmitter release is irreversible. Restoration of function can occur through the sprouting of new nerve terminals and the establishment of new synaptic connections, a process that typically requires two to three months.[15] The efficacy of the treatment is significantly influenced by the careful selection of patients, as well as the determination of the appropriate dosage and injection site.[18]

Currently, botulinum toxins are extensively employed in the treatment of various medical conditions, including:

- strabismus,
- focal dystonias,
- hemifacial spasm,
- spastic movement disorders,
- headaches,
- overactivity of smooth muscles,
- oesophageal disorders (achalasia, diffuse oesophageal spasm, oesophageal diverticulosis),
- sustained sphincter of Oddi hypertension,
- gastric pyloric spasms,
- hypersecretion of glands supplied by cholinergic sympathetic or parasympathetic neurons,
- ptyalism,
- increased tearing,
- hyperhidrosis (axillary, palmar, gustatory),
- intrinsic rhinitis,
- and certain chronic ailments that inadequately respond to conventional medical therapies.

The exploration of new potential applications is progressing rapidly.[15,16]

It is estimated that between 5% and 15% of patients who have received repeated injections of earlier toxin formulations developed secondary nonresponsiveness due to the production of neutralizing antibodies. Key risk factors associated with the development of these antibodies include the administration of more than 200 units in a single session and the occurrence of repeat or booster injections within one month of the initial treatment.
There is hope that the new formulation will exhibit a reduced risk of immunogenicity and a lower potential for the production of neutralizing antibodies, primarily due to its diminished protein content. However, this assertion has not yet been validated through clinical trials. In studies involving rabbits, no antibody formation was detected after six months of treatment with the new formulation, whereas the previous formulation resulted in antibody formation in all subjects by the fifth month.[15,21,22]

In the cosmetic field, botulinum toxin is utilized to reduce the appearance of wrinkles, lines, and folds on the face, chin, neck, and chest. It is also applied in dermatological treatments to address excessive sweating. In general, injections of botulinum toxin are well tolerated and associated with minimal side effects. However, a comprehensive understanding of the functional anatomy of facial muscles is imperative for the accurate administration of this treatment in clinical contexts. [15,16]

The evolution of cosmetology has introduced a wide range of non-surgical techniques for facial contouring and combating visible signs of aging, in addition to plastic surgery. These methods now represent a significant portion of cosmetic procedures. While Botox injections are among the most effective options for skin rejuvenation, botulinum toxin creams have also entered the market. Nevertheless, experts in cosmetology and dermatology assert that these creams have a substantially weaker impact and cannot serve as a substitute for injection therapy. Botox injections yield remarkable results, smoothing the skin and erasing wrinkles. It is no wonder this treatment has become highly popular among those who prioritize their appearance. [6,23]

Botox and emotions

Botox is widely recognized for its ability to reduce facial wrinkles; however, it is also associated with notable side effects, particularly a diminished capacity for emotional expression. Recent research has highlighted a further impact of Botox: a reduced ability to fully experience emotions. When administered intramuscularly, Botox induces paralysis of facial muscles, leading to a smoothing of wrinkles but concurrently limiting the range of facial expressions. This restriction presents consequences that extend beyond the cosmetics; facial expressions are integral to the emotional experience, and individuals with limited facial mobility may struggle to fully engage with their emotions.[24]

Furthermore, there is a prevalent belief that Botox therapy may weaken emotional connectivity. This is attributable to its impairment of emotional expression through facial cues as well as its potential to hinder the perception of emotional signals from others. Some individuals report considerable awareness of this effect and express dissatisfaction with it. [23,24]

Following Botox treatment, individuals retain the ability to respond to emotional stimuli; however, the contraction of fewer facial muscles results in a diminished transmission of facial expression signals—such as those corresponding to sadness—to the brain. Subsequent studies have investigated the implications of altered facial expressions due to Botox treatment and the subsequent reduction in sensory signals that reach the brain, considering how these changes might influence emotional states. Researchers investigated whether alterations in facial expressions from Botox and the ensuing decrease in sensory signal intensity to the brain impacted emotions, in contrast to filler treatments that did not alter muscle activity.[24] Those treated with Botox demonstrated somewhat diminished emotional sensitivity, particularly showing less intense responses to moderately pleasant stimuli. The overall differences in emotional perception between pre- and post-procedure did not attain statistical significance. Two months following treatment, nine out of ten participants showed no clinical signs of depression. This indicates that the injections, along with the facial feedback mechanism, might affect mood. Nonetheless, this conclusion requires caution, as participants were informed of the hypothesis, there was no control group, and findings pertain to individuals with a clinical diagnosis, reflecting both emotional and non-emotional improvements.[24]

Botox has become an invaluable tool for studying the relationship between facial expressions and mood, as it allows for the precise deactivation of specific muscles. Research typically involves individuals undergoing cosmetic procedures who are aware they are receiving Botox. It is common that control groups receiving a placebo are not included in these studies.[24,25]

Most research consists of conducting mood surveys and documenting changes in facial appearance through photography. This occurs before a person's first Botox treatment and after a set period following the procedure. The most common timeframe for observation is around two months, as this is when the full effects of Botox become evident. [24,25]

In these studies, Botox is most frequently injected into the glabellar muscle, a common target in cosmetic treatments. This area helps reduce frown lines between the eyebrows, which often give the face a sad or tired appearance. Smoothing out these wrinkles can positively impact not only one's appearance but also overall well-being.[25]

Botox has been studied to determine whether the activation of neural circuits in the brain that generate emotions through the deliberate imitation of facial expressions relies on the activity of facial muscles. To explore this, researchers employed functional magnetic resonance imaging (fMRI). Using this brain imaging technique, they examined the neural correlates of intentional facial mimicry expressing sadness and fear, both before and after administering Botox to the glabellar muscle.[26] The results revealed that after Botox treatment, the activation of the left amygdala during the imitation of an angry facial expression, along with its functional connection to brainstem regions involved in autonomic emotional responses, was significantly reduced. These findings suggest that Botox may inhibit the social transmission of negative emotions by diminishing facial expressiveness and its influence on the brain mechanisms responsible for processing and interpreting emotions.[26]

Botox was studied to investigate whether the activation of facial muscles plays a causal role in understanding emotional sentences. The experiment aimed to determine if paralyzing the facial muscles associated with expressing negative emotions, specifically the corrugator muscles, would impair the comprehension of sentences that evoke sad or angry moods, without affecting the understanding of pleasant sentences. In these studies, participants who were scheduled to receive Botox treatment were injected to paralyze the corrugator muscle, a common site for

Botox therapy due to its role in forming wrinkles between the eyes.[26,27] Researchers analyzed their ability to process emotional content both before the procedure and two weeks after the treatment. The results indicated that, under normal conditions, angry sentences were read more slowly than sad or happy ones. After receiving Botox injections, the reading time for both angry and sad sentences significantly increased, while the reading speed for happy sentences remained unchanged. These findings suggest that Botox treatment, which aims to reduce wrinkles around the nose, may diminish patients' emotional responses to negative stimuli. The study underscores the functional importance of the bidirectional relationship between emotions and language, with facial muscle movements serving as an intermediary factor.[26,27]

The Psyche and the Use of Botox

The research on the effect of Botox on emotional expression and perception was inspired by the fact that Botox injections into the eyebrow muscles restrict the ability to consciously furrow them. However, it was unclear whether this limitation also affects unconscious reactions.[28]

In a study, volunteers received Botox injections in the muscles responsible for frowning. Photos of their faces were taken both before the injections and one week afterward. These photos were then shown to forty individuals who were unaware of the study's purpose, and they were asked to evaluate the emotions expressed by the people in the pictures.[28]

The evaluations revealed that the number of individuals perceived as angry and terrified significantly decreased after the procedure. Additionally, the number of people appearing sad slightly decreased, while the number of individuals considered happy showed a substantial increase.[28]

These results suggest that Botox treatment led to participants appearing happier and exhibiting a more positive mood compared to those who used other wrinkle-reducing methods that do not affect the frowning muscles.[28]

Given that many patients with depression can often be recognized by their sad facial expressions—characterized by a furrowed brow, raised inner brow ends, and drooping mouth

corners—the researchers decided to investigate whether alleviating this sad expression could improve the condition of those suffering from depression.[28]

An experiment was conducted with patients suffering from antidepressant-resistant depression, who were administered botox injections into the corrugator muscle and the procerus muscle. The results were promising – wrinkles disappeared, the sad expression faded, and within two months, depression symptoms completely resolved in nine patients, with one showing significant improvement. However, studies on the use of botox in depression are still in the experimental phase and conducted on a small scale.[28,29]

Currently, standard treatment for depression involves the use of antidepressant medications, primarily selective serotonin reuptake inhibitors, often in combination with cognitive therapy to support pharmacotherapy. The results of these treatments are not much better than using a placebo, and the costs are high and continue to rise. The use of botox in depression appears to be a promising alternative. Although there are still few publications on the use of botox for depression, the theoretical foundations, potential effectiveness, and relatively low costs suggest that it would be worth conducting comparative clinical studies to evaluate the effectiveness of botox compared to currently used antidepressant medications. [28, 29, 30]

Conclusions

The wrinkle removal procedure involving botulinum toxin, commonly known as Botox, functions by paralyzing specific facial muscles, resulting in a more youthful appearance and creating the illusion of reversing a person's chronological age. This process induces noticeable psychological changes, attributable in part to an enhanced sense of attractiveness. Furthermore, these changes arise from the paralysis of particular facial muscles, which diminishes the capacity to perceive emotional signals from others and reduces the intensity with which individuals experience their own emotions. This treatment also complicates the effective communication of emotional states, as the facial expressions typically associated with specific feelings become less pronounced or may even be absent.

As Botox primarily targets the muscles that express emotions such as sadness, anger, and fear, those who undergo this treatment may find themselves feeling more emotionally detached while

simultaneously experiencing negative emotions with less intensity. Consequently, these individuals may adopt a more optimistic outlook on life, feel less encumbered by adverse emotional experiences, and often appear more content to others. This transition toward a more positive emotional state can have substantial advantages regarding social interactions and overall life satisfaction, thereby enhancing one's social success and personal well-being.

Moreover, the mood improvements observed in some patients following Botox treatment may hold significant promise for therapeutic applications, particularly for those suffering from depression, including forms resistant to traditional pharmaceutical interventions. Recent studies indicate that Botox may provide an alternative or complementary option for addressing certain psychological conditions, proving beneficial for individuals who do not respond favorably to conventional treatments.

After more than two decades of Botox's use in cosmetology, it is clear that the psychological benefits associated with this procedure significantly outweigh the potential negative side effects. Its capacity to enhance both aesthetic appearance and emotional well-being supports a strong argument for its ongoing use and further investigation, especially for individuals seeking to improve their overall quality of life.

Disclosure:

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