

# Botox influences the control of emotions in the brain

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Has shown that botulinum toxin injections not only affect muscles, but also the emotional control centre in the brain: Professor Dr. Tillmann Krüger. Credit: Karin Kaiser / MHH

The bacterial toxin botulinum toxin (BTX)—colloquially known as

Botox—is probably known to most people as a remedy for wrinkles. But botulinum toxin can do even more: if it is injected into the forehead, for example, it can alleviate depression. It also dampens negative emotions in people with borderline personality disorder, who suffer from extreme mood swings.

Professor Dr. Tillmann Krüger, senior physician and research group leader at the Clinic for Psychiatry, Social Psychiatry and Psychotherapy at the Hannover Medical School (MHH), proved this years ago—together with his colleague Privatdozent (PD) Dr. Marc Axel Wollmer from the Asklepios Campus Hamburg of Semmelweis University. Now the psychiatrists have found out where and how BTX influences the negative program in the brain. With the help of magnetic resonance imaging (MRI), they have visualized the neuronal effects in borderline patients. The result: [botulinum](#) toxin influences the so-called amygdala or almond nucleus in the temporal lobe in the brain, where fears arise and are processed. The work was recently published in the journal *Scientific Reports*.

## **Feedback between muscles and psyche**

Negative moods are expressed on the face in the so-called glabellar region, the area of the lower middle forehead. When we are angry or tense, two different types of muscles contract and cause frown lines or worry lines to appear above the root of the nose. When botulinum toxin is injected into the glabellar region, it paralyzes these muscles between the eyebrows. Because [facial expressions](#) and [psychological state](#) are closely linked, this also reduces the intensity of emotions.

"A relaxed forehead conveys a more positive feeling, so to speak," explains Professor Krüger. In science, this feedback is discussed as facial feedback theory. In an earlier meta-analysis, Professor Krüger and his team had already demonstrated that a BTX injection into the

glabellar region has a [positive influence](#) on mood and mood arousal.

Depressive symptoms improve significantly as a result. "The treatment has several advantages at once: Since the paralyzing effect lasts for three or more months, an injection also only needs to be given at these intervals. The infrequent injections are also less costly than some other therapy options and have a very good tolerance and acceptance among patients," Professor Krüger explains.

## **Botulinum toxin curbs emotional constant fire in the tonsil nucleus**

And this works for depression as well as for [borderline personality disorder](#). About three percent of Germans suffer from this disorder, and more than 62% of those affected are women. By interrupting the [feedback loop](#) between the forehead muscles and the brain, botulinum toxin also changes the emotional feedback. The researchers were able to prove this in the brains of borderline patients who had been treated with a botulinum toxin injection in the glabellar region. Just four weeks later, the patients had significantly reduced symptoms, which was also shown in the MRI images.

"We were able to see that botulinum toxin curbs the emotional constant fire in the tonsil nucleus, which accompanies the high-grade inner tension of the affected persons," says the psychiatrist. A comparison group treated with acupuncture also showed improved clinical symptoms, but not the neuronal effects in the MRI examination. However, the feedback between muscles and brain does not only work in the glabellar region.

This is the result of a database study in which Professor Krüger and his colleague Professor Wollmer were involved and which was already published in the journal *Scientific Reports* at the end of 2021. In

collaboration with the University of California San Diego, they found that [botulinum toxin](#) can also alleviate anxiety disorders when injected into the head muscles, the muscles of the upper and lower limbs and the neck muscles.

So far, however, BTX treatment for mental illnesses has not been included in the services provided by health insurance companies. The psychiatrist hopes that this will change when the mode of action has been better researched.

Botulinum toxin, colloquially known as Botox, is the strongest known neurotoxin. It is produced by the bacterium *Clostridium botulinum* in the absence of air and causes so-called botulism. The symptoms of poisoning are usually caused by eating poorly preserved food in which the bacterial [toxin](#) has accumulated. This inhibits the transmission of excitation from [nerve cells](#) to other cells, especially at the junctions to [muscle](#) and blood.

**More information:** Tillmann H. C. Kruger et al, Neuronal effects of glabellar botulinum toxin injections using a valenced inhibition task in borderline personality disorder, *Scientific Reports* (2022). [DOI: 10.1038/s41598-022-17509-0](https://doi.org/10.1038/s41598-022-17509-0)

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