THE CLINICAL ASPECTS OF USING AN UPPER FACE MAPPING SYSTEM FOR ADMINISTRATION OF BOTOX®

E. Razumovskaya, plastic surgeon, cosmetologist, chief physician of the Renaissance Cosmetology clinic, Samara, Russia

Here we present the authoring system of mapping of the upper third of the face designed to achieve more accurate and predictable result when using BOTOX®. The suggested mapping algorithm is based on individual anatomical and functional peculiarities of the patient's face allowing the physician to ensure the safest and the most effective correction.

The mapping basically presumes some unification, however, when developing our mapping system, we took into account not only fixed anatomical landmarks (in their entire individual variability), but the dynamic changes when applying functional mimic tests as well.
For illustration purposes, the facial mapping system is presented as "traffic lights" where the points (areas) of the safest and the most effective correction are shown in green, additional points (areas) - in yellow, the areas where injections should not be performed - in red.

"Traffic lights" is a pictorial mapping system of the upper third of the face for performing injections of botulinum toxin.

The suggested sectoring consists of horizontal lines, which determine the levels of botulinum toxin administration, and vertical lines dividing the face into segments. The horizontal sectoring is based both on visual or topographical landmarks and the results of functional tests.

A. Horizontal sectoring

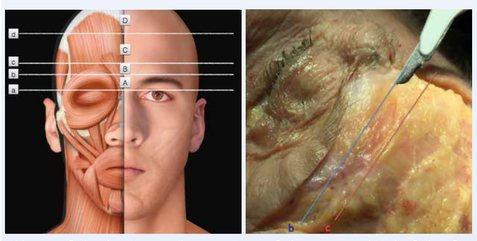
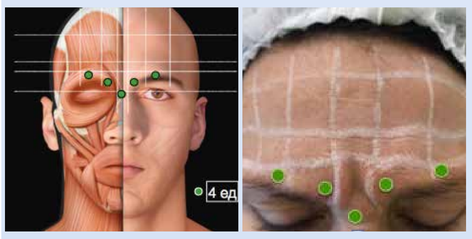
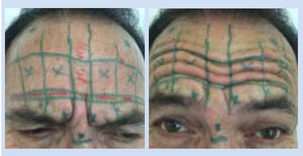


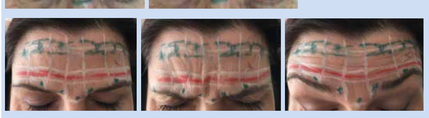
Chart of the horizontal sectoring of the upper third of the face

Level A. In our chart, this level is shown in green.
The line A is drawn along the horizontal crease (wrinkle) on the bridge, which is either static or forming in the course of the mimic test, when the patient is asked to wrinkle his/her nose (a grimace of disgust or contempt). This line corresponds to the level of attachment of the procerus muscle (m. procerus).
The line B is drawn at the level of the corrugator supercilii muscle (m. corrugator supercilii) inserting to the skin.
In order to draw subsequent horizontal lines, it is necessary to estimate the functional activity of the frontalis muscle (m. frontalis). The patient is asked to raise his/her eyebrows as high as possible, and the upper and the lower boundaries of the contracted part of the frontalis muscle are marked. These lines will be the ***lines C and D,*** respectively. Anatomically, the line D corresponds to the level of the fibers of the frontalis muscle becoming the aponeurosis.
The lines A and B confine the ***level A***, where the muscles with the depressor-like contraction vector (m. procerus, m. corrugator supercilii, upper portion of m. orbicularis oculi) are located. This is the level of active physician's manipulations when administering botulinum toxin - so called green zone of the "traffic lights".
Classic chart of localization of the points of Botox® administration into the interbrow muscles and standard dose of 20 Units (4 Units of the product to each of 5 points).



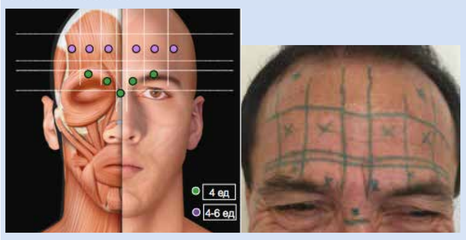
Level B - red zone in our "traffic lights", as Botox® injections to this area are not advisable. The level B is located between the lines B and C. Remember that the line C corresponds to the lower edge of the contracted venter frontalis musculi occipitofrontalis. Anatomically, this line passes in the area of the contact between the orbital portion of the orbicularis oculi muscle and is usually located 1.5 cm upwards the upper edge of the bony orbit.
In practice, the width of the level B largely depends on the activity of the fibers of the lower portion of the frontalis muscle and may be 2-3 mm to 1 cm.



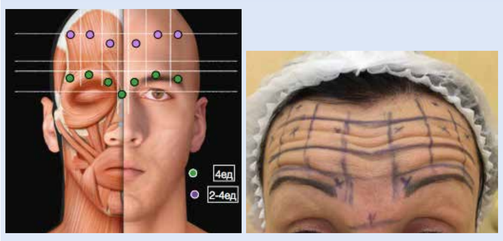


This is the level where "the conflict of interests" of the depressor muscles and the levator muscle (lower portion of the frontalis muscle) occurs. In order to prevent undesirable aesthetic results, it is not recommended to perform toxin injections at this level!
The level C is located between the lines C and D. The line D is drawn through the lower point of the aponeurosis of the frontalis muscle. This level corresponds to and has the height of the working part of the frontalis muscle. Its width depends on the height of the forehead and may vary from 2 to 5-7 cm. Botox® injections at this level allow to individualize the procedure of botulinum toxin therapy depending on unique peculiarities of mimic, anatomical and functional characteristics of the frontalis muscle, the patient's gender, and age-related changes in the patient's face. Both green and yellow zones of the "traffic lights" are located at this level, and the expediency of performing injections to these areas is determined by the physician. The dose of botulinum toxin type A (BTA) is also selected on an individual basis.

The degree of relaxation of the frontalis muscle determined the position and shape of the brows. In male patients, onabotulinumtoxin A should be injected to the frontalis muscle at the level C, 2-2.5 cm upwards the edge of the bony orbit or 1-1.5 cm upwards the line C, positioning the points of injections to form one horizontal line and considering the dose of 3-4 Units of the product per each point. The choice of the level, administration regimen and total dose (15 Units) of injections into the frontalis muscle made as described above allows to achieve optimal aesthetic result.



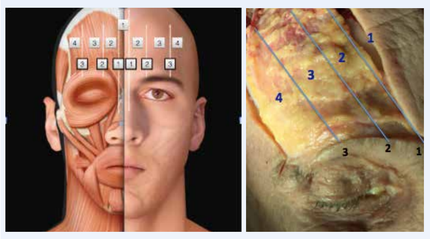
When performing these injections in female patients, the problem is dual - to smooth the wrinkles of the forehead and to lift the eyebrows forming more open gaze. In this case, the points of administration of BTA into the frontalis muscle should be located 2-2.5 cm above the line C. The dose per each injection point is lower than in males and equals to 2-2.5 Units.



The level D is located above the line D. It is well pronounced in patients with high forehead or low aponeurosis. If there is the actively working frontalis muscle at this level, Botox® injections into this portion of the muscle can be performed both in females and males. This level belongs to the areas of effective and safe correction, therefore, it is highlighted in green and yellow. The red color indicates the central part of this level - injections performed here do not pose any risk but are futile as it is undoubtedly the area of the aponeurosis.

B. Vertical sectoring

Vertical sectoring of the upper third of the face allows to perform injections of onabotulinumtoxin A with marked and predictable lifting effect. In fact, in this area of the face the lifting effect refers to elevation of either the whole eyebrow or its part. The vertical mapping lines are drawn according to anatomical landmarks, while also determining the localization and functional activity of the interbrow muscles and the frontalis muscle.
Three lines should be drawn in each side of the face.



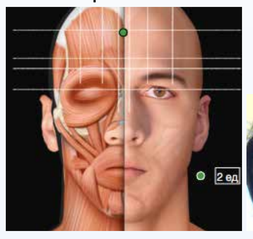
The **line 1** is drawn medial to the head of the brow, i.e. medial to the area of fixation of m. corrugator supercilii to the bone. Between the lines 1 of the right and left halves of the face, there is a central segment (segment 1) located at the projection of the fibers of m. procerus, central fibers of m. frontalis and its aponeurosis.
The **line 2** is drawn in such a way so that the tail of m. corrugator supercilii and the area of this muscle insertion into the skin are located laterally relative to it. Between the lines 1 and 2, there is a **segment 2,** which includes m. corrugator supercilii with the area of its fixation to the bone, upper-medial portion of m. orbicularis oculi and medial portion of m. frontalis.
The **line 3** is drawn through the highest point of the eyebrow or 3 mm medial to the frontal crest. Between the lines 2 and 3, there is a **segment 3**. This zone includes the tail of m. corrugator supercilii, the upper portion of m. orbicularis oculi and the most actively working fibers of the venter of m. frontalis.
To the lateral of the line 3, there is a **segment 4**, which includes the upper-lateral portion of m. orbicularis oculi and the lateral fibers of m. frontalis.
Here we can clearly allocate the central segment (segment 1) and three lateral segments on each side.
The practical significance of the vertical sectoring is that it allows to perform functional segmental lifting of eyebrows.

3. USE OF THE MAPPING SYSTEM IN CLINICAL PRACTICE

Let us see what effects may be achieved when understanding and considering the intermuscular relationships in all segments obtained as a result of mapping of the upper third of the face.

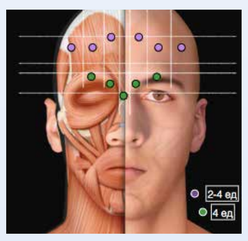
A. Correction in the segment 1

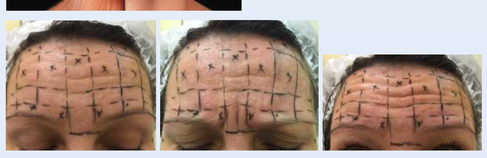
The segment 1 includes the aponeurosis and weakly active fibers of m. frontalis with centrifugal vector of contraction (levators) and active m. procerus with centripetal vector of contraction (depressor). It is virtually always reasonable to denervate m. procerus by administration of BTA to the point of aponeurotic muscle fixation (4 Units of Botox®) while avoiding injections to the central part of the frontalis muscle.
However, if a clearly fixed and immobile aponeurosis is seen and there are pronounced skin folds when the frontalis muscle is actively contracted, 1-2 Units of the product should be injected in close proximity to the aponeurosis in order to avoid unnatural mimic as a result of denervation of other portions of the frontalis muscle.



B. Correction of the position of the head of the eyebrow (manipulations in the segment 2)

The segment 2 is a key zone for making a decision regarding the position of the head of the eyebrow. This is where the head of m. corrugator supercilii and the area of its bone fixation, m.depressor supercilli, upper-medial and lateral portions of m. procerus are located being the muscles belonging to the group of depressors of the kinematic chain. The medial fibers of m. frontalis form the levator group.
In order to lift the head of the eyebrow in this segment, BTA injections should be performed into the medially located point of m. corrugator supercilii at the recommended dose of 4 Botox® Units. It is also mandatory to perform an injection into m. procerus (see the description of manipulations in the sector 1).
In case of low forehead, the product is not injected into m. frontalis, or is injected into the point located at the level C close to the line D. The dose of the product in this case should be equal to minimum recommended dose - 2 Units per point on each side.

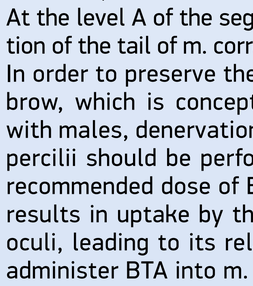


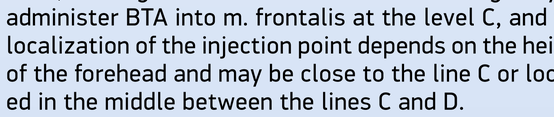


B. Correction of the shape of the eyebrow (manipulations in the segment 3)

The segment 3 is the area of complex balance of intermuscular interactions. BTA injections in this segment allow to achieve lifting of the middle third of the eyebrow, actually changing its shape! Selective work with the muscles in this segment allows to make the eyebrow more flat, straight or arched, with elevation of its middle third.
At the level A of the segment 3, there is an area of insertion of the tail of m. corrugator supercilii.
In order to preserve the position and shape of the eyebrow, which is conceptually important when working with males, denervation of the tail of m. corrugator supercilii should be performed by injecting the standard recommended dose of Botox® (4 Unit), which inevitably results in uptake by the nerve receptors m.orbicularis oculi, leading to its relaxation. It is also obligatory to administer BTA into m. frontalis at the level C, and the localization of the injection point depends on the height of the forehead and may be close to the line C or located in the middle between the lines C and D.

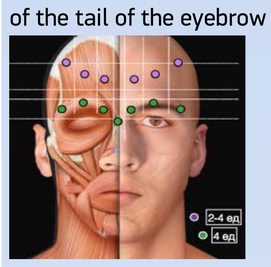
The objective of lifting of the middle third of the eyebrow is typical for females. Botox® injections to the segment 3 either should not be performed at all, or should be performed at the level C or close to the line D at the dose of 1-2 Units per point. Injections into the tail of m. corrugator supercilii and m. orbicularis oculi at the level A are normally performed in standard techniques and doses.





D. Lifting of the tail of the eyebrow (manipulations in the segment 4)

The segment 4 includes the upper-lateral portion of m. orbicularis oculi and lateral fibers of the frontalis muscle. Botulinum injection therapy in this segment is especially successful. Chart of location of injection points for lifting of the tail of the eyebrow in females.



Segmental work with certain portions and fibers of the frontalis muscle, as well as with the complex of depressors - m. procerus, m. corrugator supercilii, m. orbicularis oculi – allows to achieve the planned effect when performing correction of the shape and position of the eyebrows. This a real step towards the individual, accurately verified prediction of the result of both the current procedure and subsequent ones, as we can precisely protocol and register the course of correction using the suggested detailed mapping of the upper third of the face.

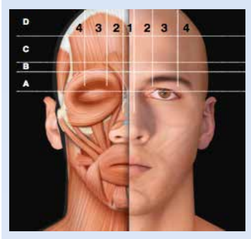


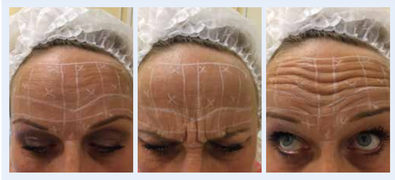
Table 1. *Table for introduction of Botox® doses used for correction of the upper third of the face into an outpatient medical record*

Segment/ level	4	3	2	1	2	3	4
D		2 Units	2 Units		2 Units	2 Units	
C	1.25 Units	2 Units	2 Units	1 Unit	2 Units	2 Units	1.25 Units
B							
A	4 (2+2) Unit		4 Units	4 Units	4 Units		4 (2+2) Unit

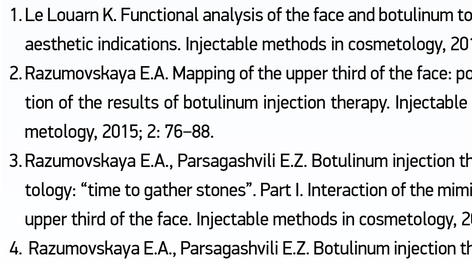
So detailed protocol will allow to analyze the result in the future and change the chart of location of the injection points or clarify their dose, if necessary.

D. Clinical case example

Below we present an example of using of the suggested mapping from our clinical practice



Segment/ level	4	3	2	1	2	3	4
D		1 Unit	1 Unit		1 Unit	1 Unit	
C	1 Unit	1 Unit	1 Unit		1 Unit	1 Unit	1 Unit
B							
A	4 (2+2) Unit	1 Unit	4 Units	2 Units	4 Units	1 Unit	4 (2+2) Unit



5. CONCLUSION

The suggested mapping system of the upper third of the face, which includes vertical and horizontal sectoring, allows to allocate the areas of performing effective and safe injections and the area of performing additional injections, as well as to avoid the areas where Botox® injections are either associated with complications, or ineffective. When performing the mapping, not only fixed anatomical landmarks (in their entire individual variability), but the dynamic changes observed when applying functional mimic tests are taken into account as well. Therefore, the mapping is adapted to the specific patient and allows to perform correction using Botox® as indicated in official guidelines but taking into account individual peculiarities and preferences.

References

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