DEVICE FOR QUANTITATIVE MEASUREMENTS OF THE FACIAL MUSCLES CONTRACTIONS

Aleksandar Godic, MD, PhD, Consultant Dermatologist, London Dermatology Centre, London
Lucija Marn, MSc Cosmetics and Janko Zmitek, PhD, VIST-School of Applied Sciences, Institute of Cosmetics, Ljubljana, Slovenia

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Introduction

The device for quantitative measurement of the facial muscles contractions (QMFC) (Figure 1) has been developed to monitor facial muscles contractions and relaxations due to different stimuli. It enables quantitative measurements of facial expressions resulting from the activity (contraction, expansion and relaxation) of individual muscles or muscle groups. It also determines movements induced by external forces. It can be widely used in medicine, particularly in aesthetic dermatology, neurology, and physiotherapy. In addition it can be used in development and testing of efficiency of different products, devices and procedures for reducing the facial muscle contraction and consequently improvement of the skin wrinkles.

Fig 1. The prototipe of the QMFC. Two flat attaching elements on the each side of the spring bow are placed on the are of the skin of which the underlying muscle contretions/relaxations wants to be monitored.

Aim

The effect of the botulinum toxin (from the same manufacturer) for the facial muscles paralysis varies even in one person at same doses at different time of application and depends on many factors. The aim of the study was to develop a method to objectivize its efficiency and to otptimize treatment with botulinum toxin in every individual to achieve best results.

Methods

The device for quantitative measurement of the facial muscles contractions (QMFC) consists of mechanical parts (spring bow, tension element and attachment pieces), which are connected with wire to the detector of electrical signals, which transforms analogue into digital signals which are then processed by computerized software algorithm. The device was calibrated (KF=620) and the repeatability, punctuality, accuracy, and linearity of it were set in a series of experiments of repeated contractions of the different facial areas in healthy volunteers. The results of the measurements are presented as dynamic changes of the skin movements (in milimeters) in a given time reflecting underlying muscle(s) contraction(s) (Figures 2 and 3).

Methods (cont'd)

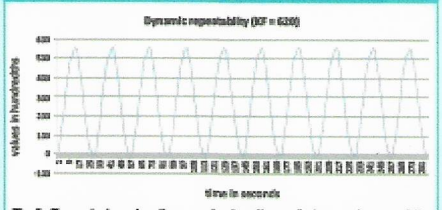

Fig 2. Repeated contractions and relaxations of observed area of the face (*in vivo*). The device was initially calibrated (KF=620) and an average maximum dynamic response was calculated in a series of ten repeated contractions of tested area; 100 values of hundreds equals 1 mm of the skin movement.

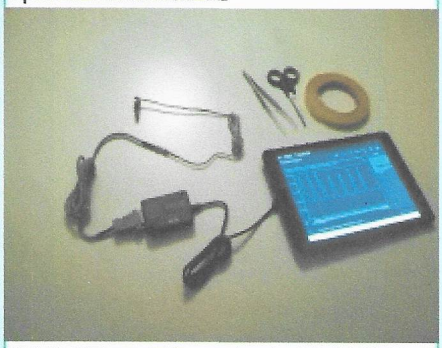

Fig 3. The QMFC connected to a computer and analysis of electrical signals and graphical presentation of the repetitive muscles contraction of observed area of the face is demonstrated.

Results

We tested our device in the 25 year old female volunteer who was treated for the first time in her life with botulinum toxin type A (Vistabel®, (Allergan, Ireland) for the facial wrinkles. Initial measurements of contractions of the skin covering different muscles of the forehead (such as *m. corrugator supercilii, procerus, frontalis*) was recorded (day 1) and repeated afterwards two times daily; an average value was calculated. She received 40 units of botox at the day 2 spread over 9 areas of the forehead (not showsn), and additional 20 units on the day 9. The experiment lasted until the contractability of the muscle/facial experssion was that of its original state and effect of botulinum toxin type A lasted about 6 months (Figures 4 and 5).

Fig 4. The QMFC attached to the nasal bridge of a volunteer measuring muscle activity of the muscles *m. procerus*

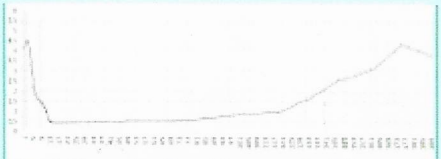

Figure 4. Average values of repeated measurements of skin movements above *m. procerus* before the first application (day 1) and then twice a day afterwards (each morning and evening); dotted lines represents applications of Botox (days 2 and 9); y axis, skin movement in mm, x axis, days.

Discussion

It is well known that effect of botulinum toxin on the facial muscles varies among individuals and depends on the muscles size, its ability to generate force of contraction, sex (men have in general stronger and bigger muscles) but also on previous treatments which weakens muscles if treatment is regularly repeated. Different anatomical areas also respond differently depending on the product which is injected but furthermore there are differences even in one person when same product and dose is injected at different time. "Old school" of teaching of botox application is therefore robust since same approach is not optimal for everyone leading to suboptimal results. Our device for quantitative measurement of the facial muscles contractions (QMFC) enables to plan botox treatment individually and also to compare efficiency of products which are on the market.

Conclusions

In conclusion, we present newly designed device for monitoring facial muscle contractions in patients treated with botox which can be helpful to choose optimal product, its dosage and plan treatment individually. In addition, QMFC may be useful in testing new products for reducing facial muscle contraction and in evaluation of patients with neurodegenerative diseases and their monitoring.

References

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Contact Information

Aleksandar Godic, MD, PhD
Consultant Dermatologist
London
aleksandar.godic@gmail.com