

Botulinum Toxin in facial rejuvenation

Dr Bob Khanna provides an overview of the basic concepts required to achieve softening and often resolution of facial lines and wrinkles

It certainly seems that no other drug or toxin has raised so much controversy and popularity in society and medicine. Derived from the bacterium *Clostridium*, Botulinum BTX has had a most diverse range of uses from chemical warfare to the treatment of muscle spasms in children.

In fact recent evidence suggests that injections of BTX can cure some types of depression. From Fidel Castro's Cohibas being dipped in BTX by the CIA in the 1960s to being the most popular form of facial rejuvenation procedure today, it seems BTX is here to stay.

Although there are seven serotypes of BTX the most widely used and researched serotype is Botulinum Toxin A (BTX A) of which

Table 1
History of Botulinum Toxin (BTX)

1822	Neurologic effects first noted from sausage ingestion
1895	Bacteria identified as cause of botulism (Prof Van Ermengem)
1940s	BTX-A isolated, purified (Prof Shantze et al)
1960s	Studies of BTX-A in animal muscle
1970s	First tested in strabismus patients (Dr Alan Scott)
1989	First FDA approval – Strabismus, blepharo-spasm
1980s and 1990s	Studied for treatment of dystonias, spasticity, selected other conditions (Carruthers et al)
2000	FDA approval for cervical dystonia
2004	FDA approval for primary axillary hyperhidrosis

there are now three main reputable brands: Botox (Allergan, USA), Dysport (Ipsen, UK) and Xeomin (Merz, Germany).

A reduction of muscle contraction is achieved by injecting an appropriate dose of BTX A into the tissue and thereby reversibly inhibiting the release of acetylcholine (Figure 1).

In order to achieve optimum facial aesthetic outcomes with BTX, it is essential to grasp certain fundamental principles:

1. Facial anatomy

In particular the muscles of facial expression. It could be argued that the primary function of the facial muscles is to act as sphincters for the orbital and oral cavities to enable the most primitive functions of sight and eating. Hence secondarily in humans we have learnt to utilise these muscles in non-verbal communication in the form of facial expression.

As well as trying to understand the origins, attachments and orientation of each of the facial muscles, it is vital to appreciate the anatomical variations that occur not only from person to person but also within the same individual.

Since most of the time a particular muscle is directly injected by a given dose of BTX, it is important to assess and account for the neighbouring vital anatomical structures. In particular this applies to blood vessels so as to avoid any unnecessary operative trauma (Figure 3).

2. Musculo-dynamics

Once the knowledge of the three-dimensional arrangement of the facial musculature is gained, it is imperative to understand the func-

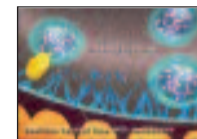
Erratum:

In the 5 April 2007 issue of *Dentistry*, this article was published with errors in picture captions. *Dentistry* apologises to readers who may have been confused by this. The author provided the right information and here is the corrected version.



Dr Bob Khanna is a cosmetic and reconstructive dental surgeon. He runs clinics in Ascot, Harley Street and Manchester, and carries out a full spectrum of treatments from aesthetic dentistry, surgical implantology and bone regeneration procedures to full-mouth rehabilitation. He was the first dentist in the UK to

venture into facial aesthetic procedures utilising Botox and dermal fillers over 10 years ago. Internationally renowned as a leading lecturer, trainer and expert in aesthetic medicine, Dr Khanna has trained over 4,500 doctors, dentists and plastic surgeons in non-surgical facial rejuvenation procedures and has pioneered many of the techniques.



Figures 1a-d: A diagrammatic representation of a neuromuscular junction and the effect of BTX on inhibiting acetylcholine release and therefore reducing muscular contraction

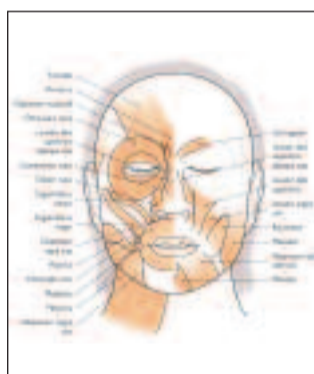


Figure 2a: The facial muscles - the right side shows the more superficial muscles and the left the deeper muscles

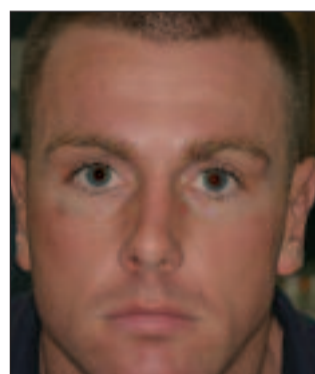


Figure 2b: A patient at rest - a non-expressive pose

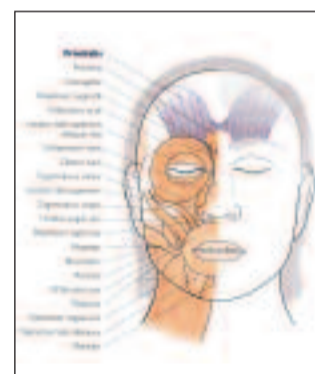


Figure 4a: The frontalis muscle - the brow elevator



Figure 4b: A patient raising his eyebrows (frontalis contraction)

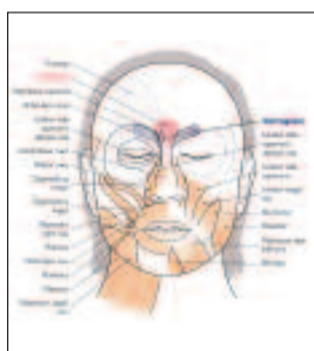


Figure 5a: The major 'frown' muscles (glabellar brow depressors)



Figure 5b: A patient frowning (contracting the brow depressors)

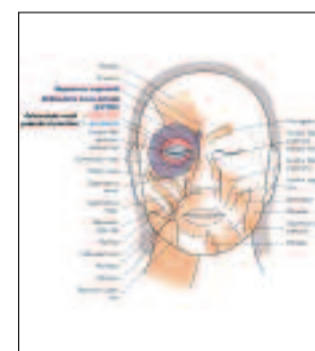


Figure 6a: Obicularis oculi - the orbital sphincter responsible for 'crows feet'



Figure 6b: The patient smiling (accentuating crows feet)

tional aspects of these muscles. This is primarily because the relative contraction of any given muscle will indirectly cause the creasing or wrinkling of the overlying skin in that region due to the obvious sub-dermal connection and intimacy of the most superficial muscle fibres.

Taking this simplistic view, it seems logical that if an appropriate dose of BTX is injected in the responsible dynamic muscle then the wrinkling can be softened or diminished depending on the dose and number of sites targeted. However, whilst this may indeed be correct in theory, one must also appreciate the knock on effect this can have on other neighbouring regions of the face.

In order to help our understanding it is convenient to categorise the muscles of facial expression as either having an 'elevator' function or one of a 'depressor' (or rarely both), particularly with respect to the orbital and oral cavities.

The muscles of facial expression are in a dynamic equilibrium of muscle tone at the rest position. A simplistic but helpful way of looking at this is to think of a tug-of-war competition between the elevators and the depressors. Hence at rest the rope is not being pulled to either side significantly, i.e. the brow position or lips are

static.

If, however, the frontalis is super activated, brow elevation will occur i.e. the elevator wins the tug of war. Conversely, if the procerus or corrugators are super activated, brow depression will occur if the net pull is strong enough to overcome the frontalis elevation.

The same principles can be applied to the lower face with the respective elevators and depressors.

3. Customised treatment

Following a thorough patient assessment and consultation - combining the knowledge of the respective musculo-dynamics with the particular patient requirements - the operator must carefully target the relevant muscles at the appropriate sites with a sufficient dose of BTX required to bring about the facial changes that are requested.

Figures 7 and 8 demonstrate a typical case in a young man who wanted 'softening' of the horizontal forehead lines and vertical frown lines as well as the lateral orbital lines ('crow's feet').

The challenge here was to bring about these changes without altering the brow position at rest. The injection sites used (Figure 7) are depicted (the dosages used are not relevant for discussion in this

article). Figures 9a to 9d show a lady who requested a non-surgical brow lift treatment with BTX. The same principles of musculo-dynamics were applied here, but in this case it was important to favour the brow elevator 'team' (i.e. the frontalis) and weaken the brow depressor 'team' (i.e. procerus, corrugators, obicularis oculi and depressor supercilli) with precise injections of BTX. The patient is shown at rest three weeks following the treatment. Ordinarily, such a result is only achieved with a surgical brow lift procedure.

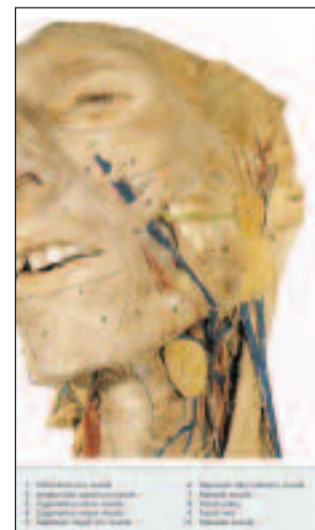


Figure 3: The intimacy of the blood vessels with the facial musculature

Table 2
Muscles of facial expression

Elevators	Depressors
Frontalis (Brow)	Procerus (Brow)
Zyg major (upper lip)	Corrugator Supercilli (Brow)
Zyg minor (upper lip)	Depressor Supercilli (Brow)
Lev anguli oris (upper lip)	Obicularis oculi (Brow)
Lev labii superius (upper lip)	Depressor anguli oris (lower lip)
Lev labii superius alaeque nasi (upper lip)	Depressor labii inferioris (lower lip)
Dilator naris (nostrils)	Depressor septi nasi (nasal tip)
Mentalis (chin)	Platysma (chin)
Depressor septi nasi (upper lip)	Mentalis (lower lip)
Risorius (upper lip)	



Figure 7a: Injection sites for BTX treatment to the frontalis to give the result in Figures 8b and 8c



Figure 7b: Injection sites for BTX treatment to the glabellar brow depressors to give the result in Figures 8d



Figure 7c: Injection sites for BTX treatment to the lateral obicularis fibres to give the result in Figure 8e

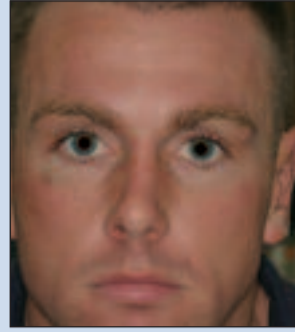


Figure 8a: The patient at rest before BTX treatment

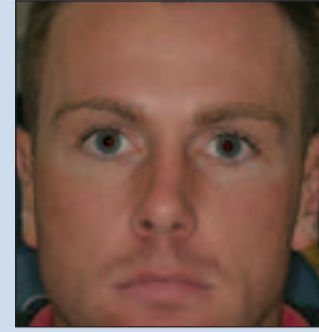


Figure 8b: The patient at rest two weeks after BTX treatment

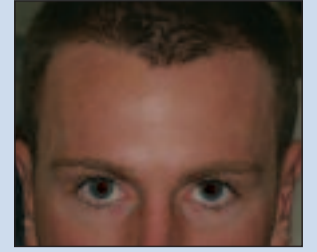


Figure 8c: The patient on brow elevation after BTX treatment compared with Figure 4b (note the frontalis has been sufficiently immobilised to diminish the horizontal forehead lines)

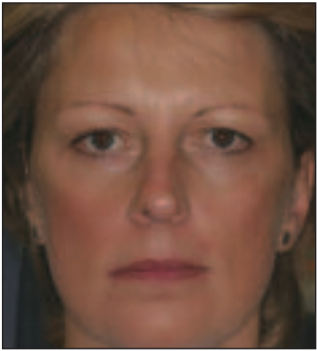


Figure 9a: A patient at rest before treatment (note the heaviness of the upper eyelid region)



Figure 9b: The patient three weeks after non-surgical brow lift treatment (note the aesthetically improved appearance of the eyes and resolution of the asymmetry)



Figure 9c: A close-up before BTX



Figure 9d: A close up after BTX brow lift showing the obvious improvement in upper lid display and flared arches

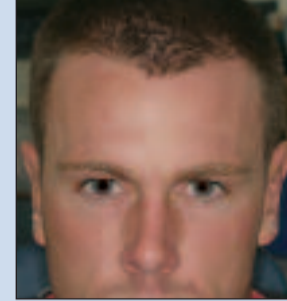


Figure 8d: The patient trying to frown three weeks after BTX treatment - the glabellar frown muscles have been immobilised

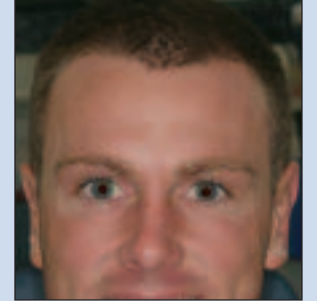


Figure 8e: The patient smiling three weeks after BTX treatment (note the reduction in the crow's feet compared with Figure 6b)

Dr Bob Khanna will be appearing at The World Aesthetic Congress 2007 in June. To book your tickets call 0800 371 652, email seminars@fmc.co.uk or visit www.independentseminars.com/wac
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