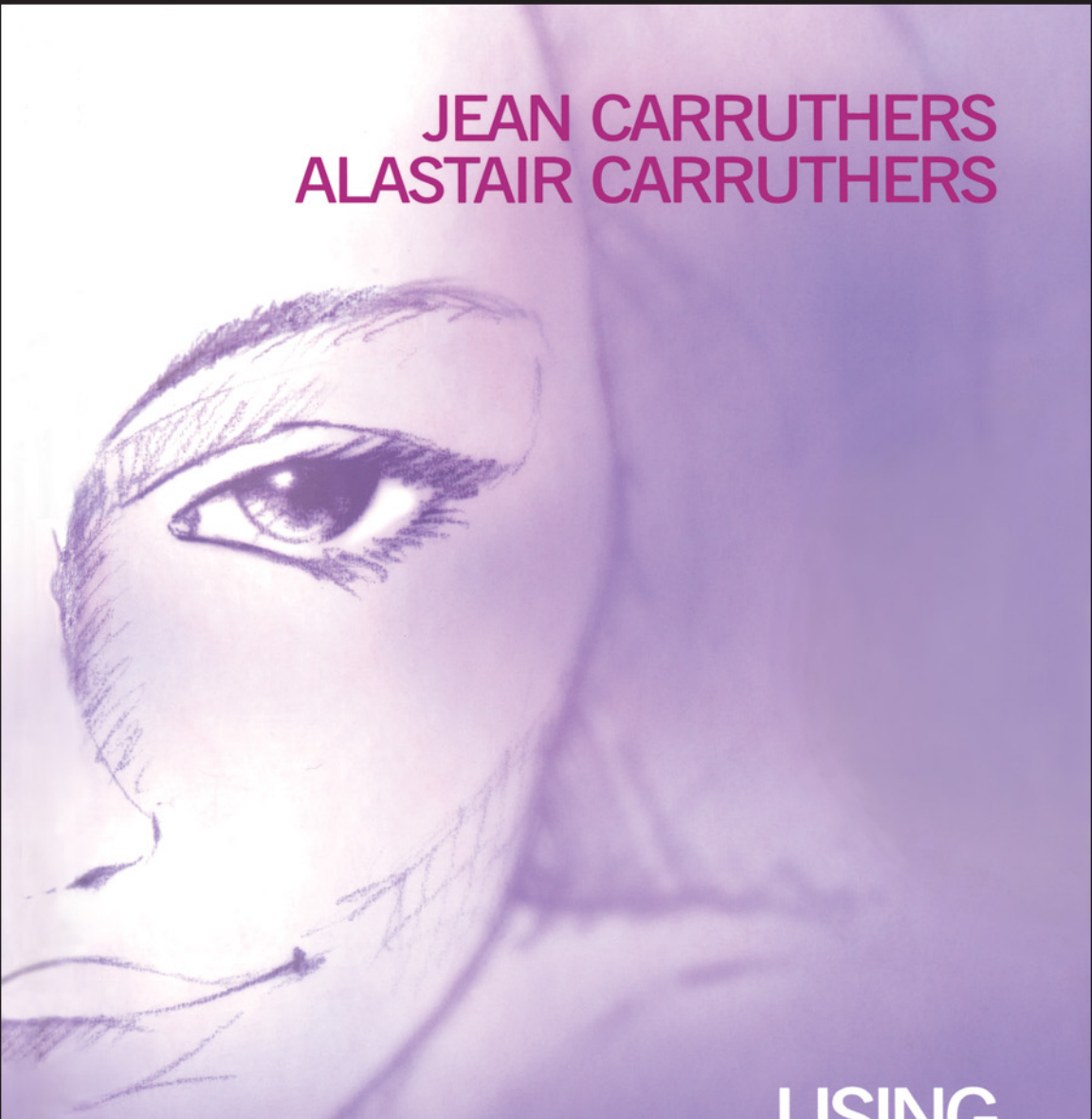
JEAN CARRUTHERS
ALASTAIR CARRUTHERS



USING BOTULINUM TOXINS COSMETICALLY

Martin Dunitz
Taylor & Francis Group

USING BOTULINUM TOXINS COSMETICALLY

USING BOTULINUM TOXINS COSMETICALLY

A PRACTICAL GUIDE

JEAN CARRUTHERS

MD, FRCS(C), FRC(Ophth)

Aesthetic Facial Ophthalmology

ALASTAIR CARRUTHERS

FRCP(C)

Carruthers Dermatology Centre Inc.
Vancouver, British Columbia, Canada

Martin Dunitz
Taylor & Francis Group

LONDON AND NEW YORK

First published in the United Kingdom in 2003
by Martin Dunitz, an imprint of the Taylor & Francis Group plc,
11 New Fetter Lane, London EC4P 4EE
Tel: +44 (0) 20 7583 9855
Fax.: +44 (0) 20 7842 2298
E-mail: info@dunitz.co.uk
Website: http://www.dunitz.co.uk
This edition published in the Taylor & Francis e-Library, 2005.

A CIP record for this book is available from the British Library.

ISBN 0-203-49984-0 Master e-book ISBN

ISBN 0-203-59570-x (Adobe e-Reader Format)
ISBN 1 84184 217 6 (Print Edition)

Distributed in the USA by
Fulfilment Center
Taylor & Francis
10650 Toebben Drive
Independence, KY 41051, USA
Toll Free Tel: +1 800 634 7064
E-mail: taylorandfrancis@thomsonlearning.com
Distributed in Canada by

Taylor & Francis
74 Rolark Drive
Scarborough, Ontario MIR 4G2, Canada
Toll Free Tel: +1 877 226 2237
E-mail: tal_fran@istar.ca
Distributed in the rest of the world by
Thomson Publishing Services
Cheriton House
North Way
Andover, Hampshire SP10 5BE, UK
Tel. +44 (0)1264 332424
E-mail: salesorder.tandf@thomsonpublishingservices.co.uk

Composition by Scribe Design, Gillingham, Kent, UK

CONTENTS

1
FOREWORD

At the beginning of the twenty-first century we live longer and more actively. However, while our adult longevity continues to extend, society does not welcome a tired and aged appearance. We wish to continue to look from the outside as young as we feel on the inside. People today view themselves as individuals with such positive attitudes about their ongoing mental and physical wellbeing that they have removed the outmoded ethic of guilt about improving their personal appearance.[1] So called 'lunch time procedures' such as cosmetic botulinum neurotoxin injections fit neatly into the lives of individuals trying to balance the ongoing responsibilities of family, friends, and job(s) with at least some time to enhance their own personal wellbeing.

Botulinum toxins, once feared as the world's most 'poisonous poison',[2] are now eagerly sought by the adult public as a way to soften negatively perceived lines of facial expression. Since 1987, when we first used botulinum toxin A (BOTOX) cosmetically,[3,4] we have understood the dramatic benefit that can be achieved by the use of this modality. Now the aesthetic world at large knows that cosmetic botulinum toxin treatment is safe and effective and, importantly, demands no downtime. Injecting physicians are increasingly aware that botulinum toxin treatment is also an adjunct to other aesthetic therapies such as soft tissue augmentation and laser resurfacing.[5]

The main purposes of this book are to discuss practical aspects of common facial and neck neurotoxin treatments and to act as a stimulus to physicians to advance the understanding and use of this important cosmetic modality.

2
AESTHETIC PHILOSOPHY

Beauty is defined in the *Oxford English Dictionary* as ‘a combination of qualities—including grace of form and charm of colouring that delights the sight or other senses’. Beauty has been recognized but is difficult to define across cultures and time. People today seek to appear rested, relaxed, harmonious and at peace. Studies of African tribal masks which portray exaggerations of human facial expression show that vertical lines in the face such as those between the brows in the glabella, at the melolabial folds and melomental folds all convey negative emotions such as anger, depression, fatigue, bitterness, disappointment and envy. Horizontal lines across the brow and radiating from the corners of the eye may be masculinizing features. Vertical lip lines are seen as the hallmark of the aged female lower face. Vertical neck bands such as the vertical platysmal bands give an impression of age and weakness. Horizontal neck lines, commonly seen in younger individuals, are suggestive of obesity and may detract from an important aesthetic determinant, the long, slender neck.

Self rejuvenation has become a huge industry because of the power of beauty to modify perception and behaviour in our colleagues and peers, friends and family. Demographics are changing so that we now have 70–80 million longer living ‘baby boomers’ born between 1946 and 1964[6] who wish to present their best to the world but with little or no downtime. The use of cosmetic botulinum toxins will probably continue to expand in the baby boomer cohort and their offspring for some decades to come.

3
ABOUT BOTULINUM NEUROTOXINS

PHARMACOLOGY AND MECHANISM OF ACTION

The family of botulinum neurotoxins includes seven distinct serotypes identified as A, B, C1, D, E, F and G. There are variations in their size and cellular mechanism of action and in their clinical usefulness. Types A, B and F have all shown beneficial effects in humans with A being the longest acting variant to date. Short acting toxins such as E and F may be of value post surgically or after trauma.

Botulinum toxins A and B are currently commercially available worldwide. They are composed of different strains of *Clostridium botulinum* bacteria and have both distinct and overlapping properties (Figure 1). Both are 150 kD di-chain polypeptides composed of a heavy chain and a light chain linked by a disulphide bond. Both are surrounded by non-toxic proteins during their biosynthesis to form a neurotoxin complex. Both can be found in a 500 kD form but A can also be found in a 900 kD form, and this has been

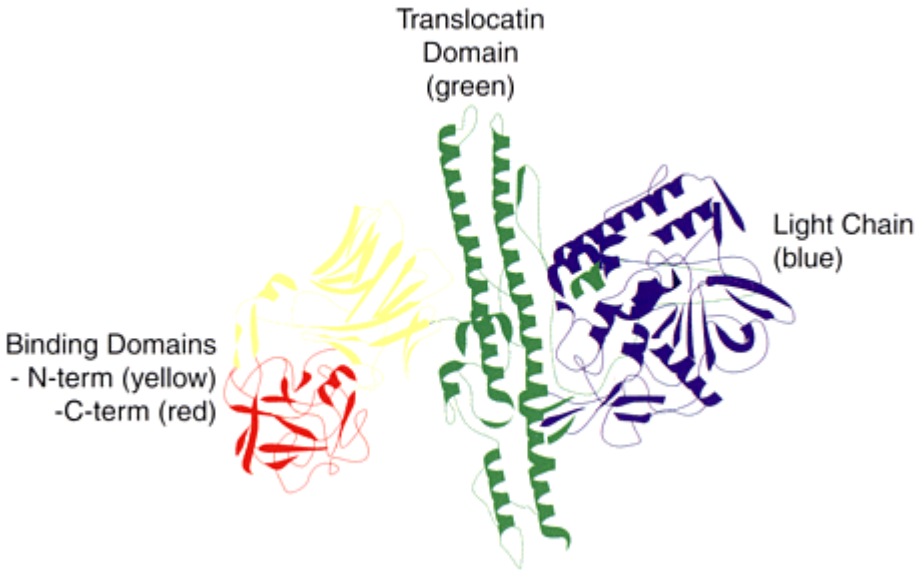


Figure 1

Botulinum toxin A molecule demonstrating heavy and light chains, binding domain.

the size reported for the crystallized type A toxin used clinically.

In both A and B neurotoxins the heavy chain is analogous to the key in the lock and is responsible for selective binding of the toxin molecule to presynaptic cholinergic nerve terminals. The light chain acts inside the cell to prevent acetylcholine vesicle release. Within the cell, the light chain of type A cleaves SNAP 25, a 25 kD synaptic cell-associated protein, while the light chain of type B cleaves vesicle-associated membrane protein (VAMP, also called synaptobrevin). After both type A and type B treatments, collateral sprouting of new nerve terminals occurs after time but eventually the original functional endplate is reestablished so that the sprouts regress as the clinical effects of the drug subside.

From the experience gained from cervical dystonia it appears there are some interesting differences in the clinical use of type B compared to A, in that the doses required with type B are many times greater than those used to treat the same indication with type A. There may also be some difference in immunogenicity and adverse event profile.

COMMERCIALLY AVAILABLE BOTULINUM TOXIN PRODUCTS

There are two type A toxins and one type B currently commercially available. The two type A toxins are BOTOX, manufactured by Allergan Pharmaceuticals (Irvine, California, USA), and Dysport, manufactured by Ipsen Limited (Slough, Berkshire, England) (Figure 2). Botulinum toxin B is trademarked as MYOBLOC in North America and Neurobloc in Europe and is manufactured by Elan Pharmaceuticals (San Francisco, California, USA) (Figure 3).

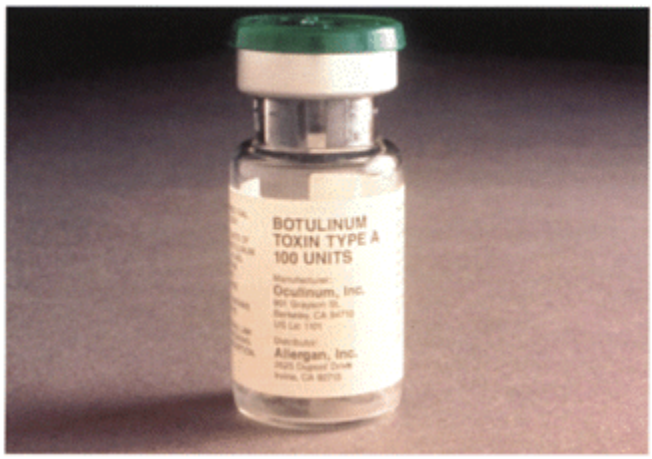


Figure 2

Commercially available vial of BOTOX. Note lyophilized formulation.

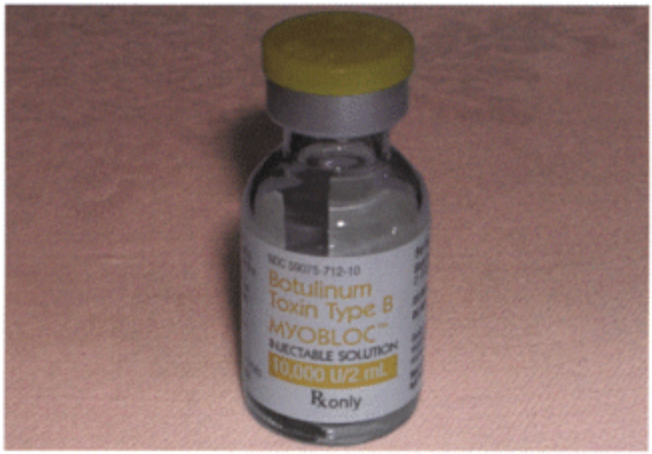


Figure 3

Commercially available vial of MYOBLOC, North American botulinum toxin B. Note liquid formulation.

BOTOX is widely available worldwide and has up to 90% of the global neurotoxin market. Dysport is not available in the USA or Canada but it is available in Europe and some other countries. MYOBLOC is currently only available in the USA but may soon become available in Canada and Europe. Both BOTOX and Dysport are sold in a lyophilized form but must be reconstituted with physiological saline, whereas MYOBLOC is sold as an aqueous solution of pH 5.6.

BOTOX was approved by the FDA in the USA in 1989 for use in strabismus, blepharospasm and hemifacial spasm in adults. Both BOTOX and MYOBLOC were approved for cervical dystonia in December 2000. The cosmetic use of BOTOX was approved in Canada in April 2001 and in the USA one year later in April 2002. Other cosmetic approvals and approval for hyperhidrosis have followed in many other jurisdictions.

DOSING

Doses of all botulinum toxin products are described in terms of units of biological activity (U). For all three products, one unit is defined as the amount of neurotoxin complex that is lethal in 50% of female 18–22 g Swiss Webster mice after an intraperitoneal injection (mouse LD_{50}). Cervical dystonia studies suggest an approximate ratio of 50:1 or 75:1 for the dosing ratio of MYOBLOC to BOTOX. Studies are currently being undertaken by us and others to establish the relationship between MYOBLOC and BOTOX units for cosmetic indications, but an interim conclusion is that the facial muscles appear to be proportionately less sensitive to MYOBLOC in comparison with BOTOX. This is interesting in the context of understanding differences between botulinum toxin A and botulinum toxin B. From the literature some corresponding dosing

information is available for Dysport and BOTOX where three to four times the dose of Dysport is needed compared to the BOTOX dosage to give an equivalent clinical result. Since both products are botulinum toxin A this must be due to a difference in formulation, resulting in lower availability of the neurotoxin in the Dysport preparation. Longevity is obviously identical when equivalent doses of botulinum toxin A are used, but this assumption is not yet proven for botulinum toxin B.

Before the physician uses any brand for a particular indication it is wise to be familiar with the available literature on the use of that specific brand.

IMMUNOGENICITY

Botulinum toxin can elicit an immune response with the production of IgG neutralizing antibodies that will prevent the patient responding to that botulinum toxin in the future. With botulinum toxin A at less than 100 U dosage there are no reports of individuals losing their ability to respond, and it has also been our experience with a combined 30 years of injecting experience that there has been no genuine secondary resistance developed to the toxin.

High doses of protein correlate with increased antigen and in 1997 Allergan produced a new batch of BOTOX with a much lower protein load per dose. Preliminary results and experimental animals in clinical use would seem to confirm that there has been a diminished incidence of antigenic response.

The antigenic potential of botulinum toxin B is not known, but the 50- to 100-fold higher doses required result in a 10–20 times larger protein load per dose. The clinical significance of this is not yet known; however, MYOBLOC contains proportionately less degraded neurotoxin protein, which may reduce its immunogenic potential.

ANATOMICAL CONSIDERATIONS

The cosmetic injection of BOTOX is much more like a surgical technique than a traditional simple isolated large muscle injection. Injecting an aliquot of medication into the upper outer quadrant of the thigh does not require the detailed understanding of the underlying musculofacial and skeletal anatomy plus understanding of facial aesthetic principles essential for successful cosmetic injection. It is our recommendation that the new injecting physician study the appended drawings of facial muscular anatomy (Figures 4–8), as well as visit a university department of anatomy for an in-depth review of the anatomy and function of the highly complex delicately layered facial musculature.[7] This should be combined with a study of different facial expressions in repose and in animation in order to understand individual subject variation in patterns of anatomy. Simply taking a ‘recipe’ approach to botulinum toxin injections will not give the refined result the public has come to expect. An individualized approach which combines the study of the individual’s anatomy, their aesthetic needs and the results they would like achieved is the fascinating challenge faced by all injecting physicians.

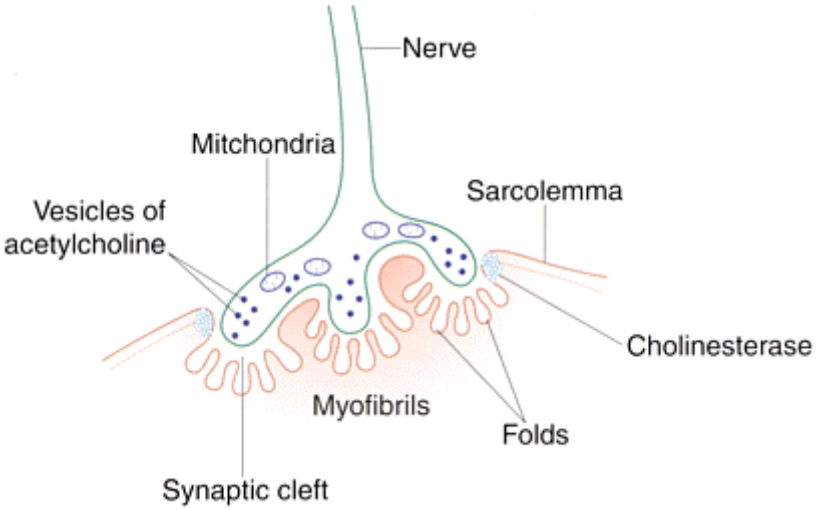


Figure 4

Motor neuromuscular junction showing synaptic cleft.

The dose of botulinum toxin required to achieve a given result will vary with a number of individual variables. Body weight is one such variable, with smaller individuals requiring a smaller dose than larger individuals. Males require a higher dose than females; older individuals also require a higher dose.

RECONSTITUTION, DILUTION AND HANDLING

Both BOTOX and Dysport are sold in lyophilized form and must be reconstituted with physiological saline prior to use. Both non-preserved and preserved saline have been used, the latter giving some local anaesthetic effect. Botulinum toxin B (MYOBLOC, Neurobloc) is sold as a stable non-preserved aqueous solution that may be further diluted with normal saline.

The appropriate amount of saline to be injected into each vial prior to clinical use varies, depending on how, where and why the drug is to be applied. For example, for some indications more neurotoxin diffusion is desired—as in the treatment of horizontal and vertical neck bands. In other locations such as the glabella, a discrete focused effect of the botulinum toxin is desired in order to avoid diffusion into the levator palpebrae superioris with consequent iatrogenic ptosis. Higher concentration injections (eg 1 cm^3 in the vial is 100 U/ml) allow for very low volume injections with precise placement of the toxin and little spread to non-targeted areas. In contrast, low concentration injections (2.5–10 U/ml) deliberately spread the toxin over a wider area. With lower concentration injections more diffusion is the rule. We routinely use the Beckton Dickinson Ultra-Fine 30 gauge hubless diabetic syringe for its dosing precision (Figure 9).

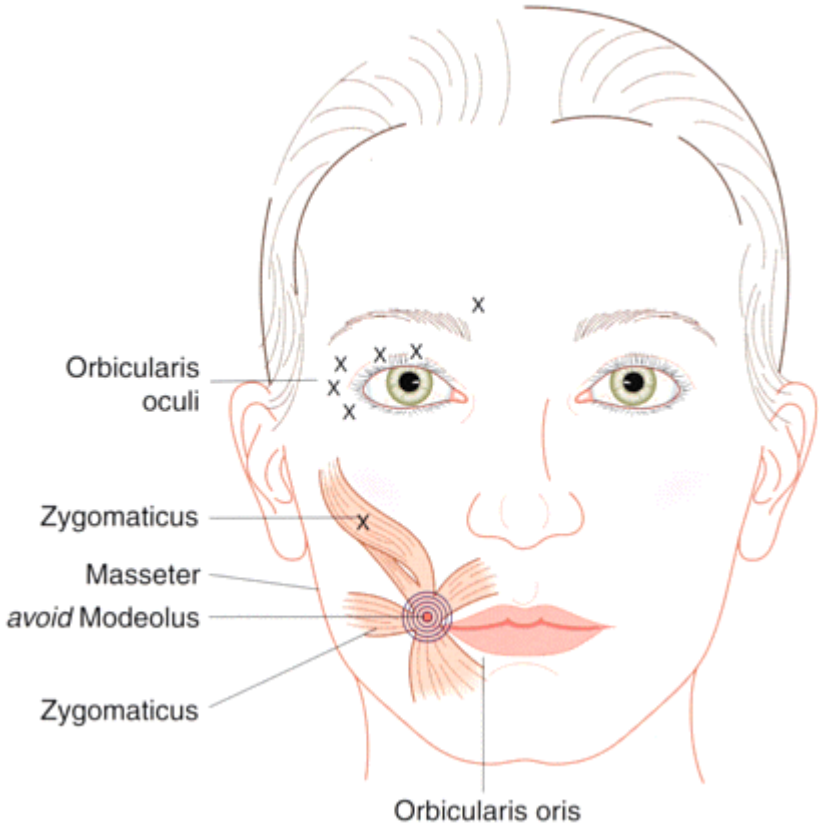


Figure 5

Muscular anatomy of the mid and lower face.

Although we recommend adhering to the manufacturer's guidelines for the storage and handling of all botulinum toxins, from a practical viewpoint use of reconstituted BOTOX over a few days after initial preparation is common practice. We have not heard of any adverse events or significant loss of potency resulting from this practice.[8]

CONTRAINDICATIONS AND PRECAUTIONS

The primary contraindication for botulinum toxin A therapy is the presence of any associated neuromuscular disorder that could amplify the affect of the neurotoxin. Myasthenia gravis and ALS (amyotrophic lateral sclerosis or Lou Gehrig's disease) are good examples. Some individuals with these conditions may be treated but only after the cosmetic physician consults with the patient's neurologist.

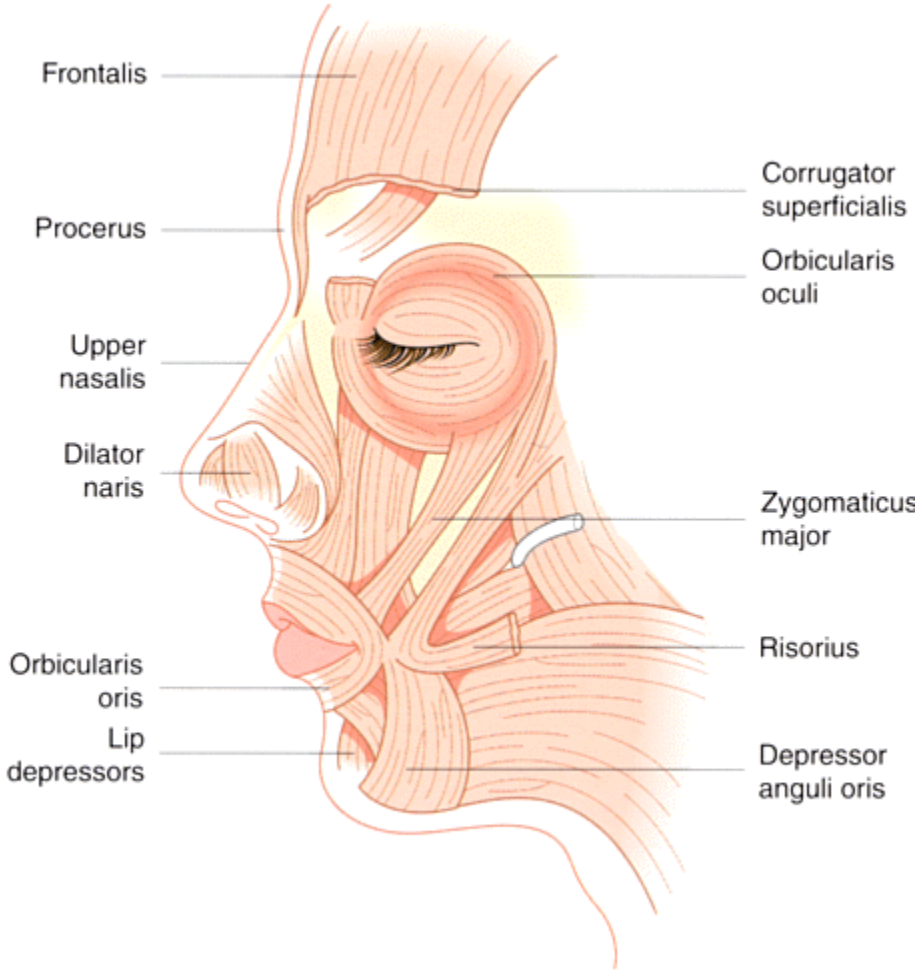


Figure 6

Diagrammatic lateral view of the facial muscular anatomy.

In pregnant women, cosmetic neurotoxin should not be used. Although we know of no adverse events in pregnant females, to us it makes eminent ethical sense to avoid neurotoxin use at a time when the fetus could even potentially be at risk.

Injections should not be made in any area of active infection.

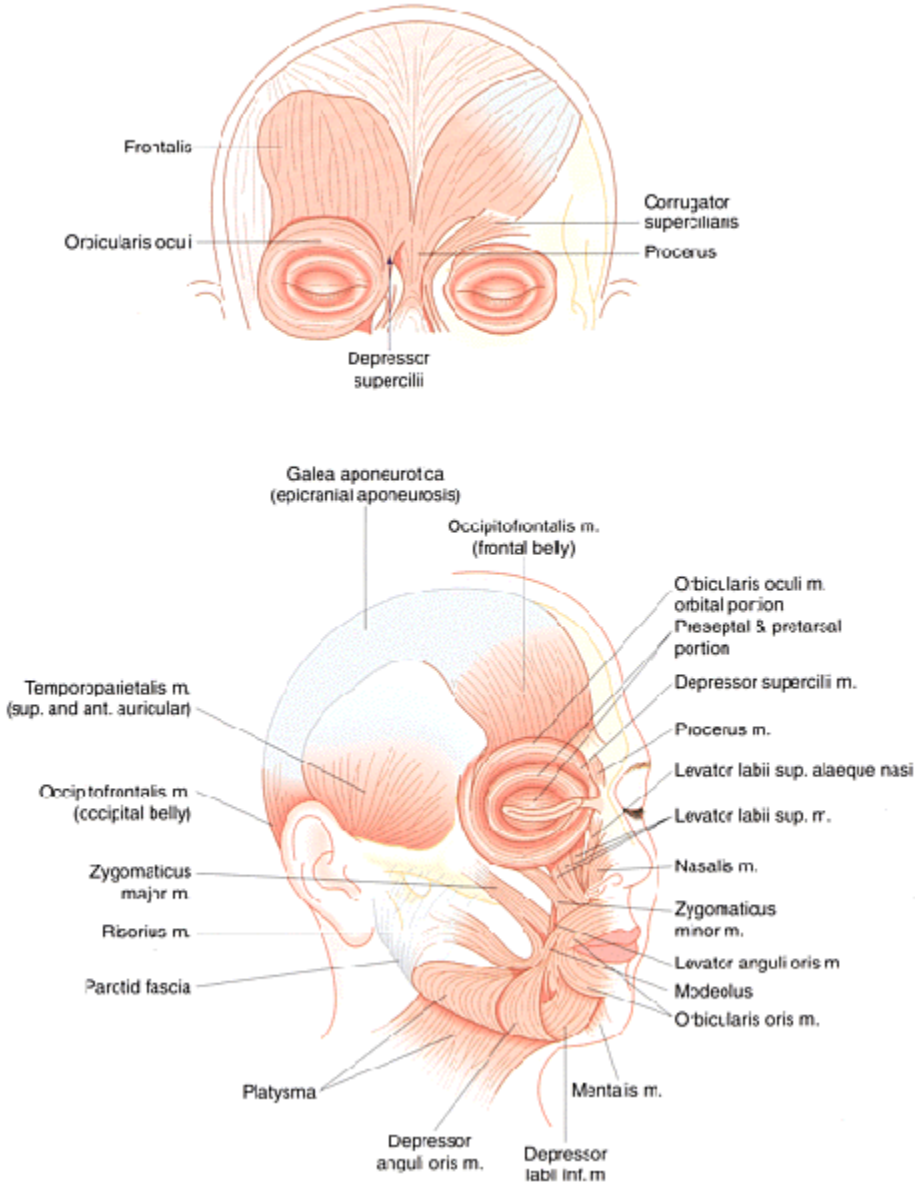


Figure 7

Diagrammatic views of facial musculature.

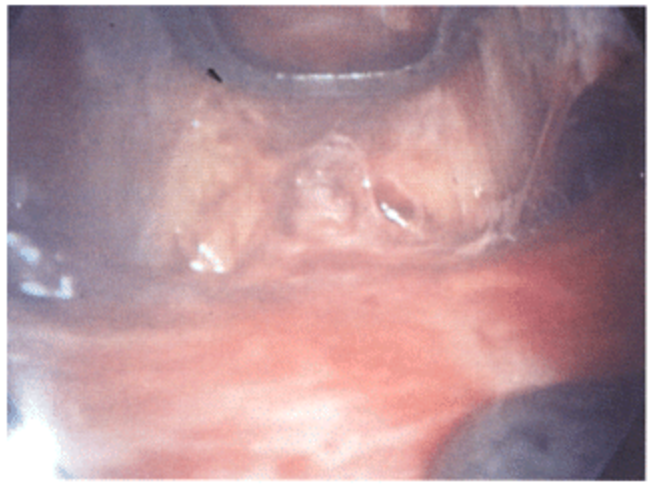


Figure 8

Endoscopic view of medial heads of both corrugators attaching to the lower frontal bone periosteum.

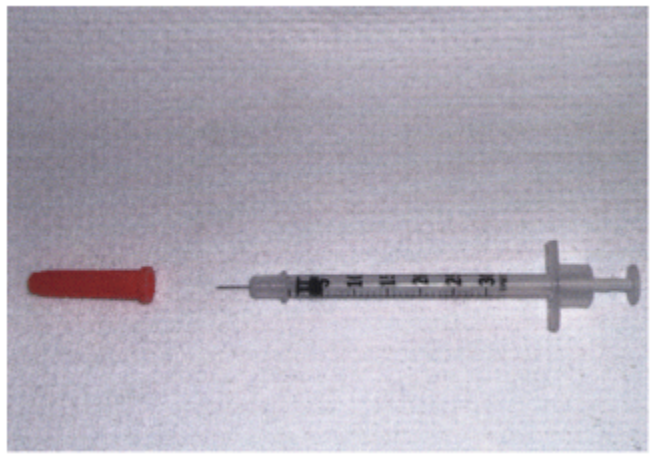


Figure 9

Beckton Dickinson Ultra Fine II hubless 7 mm 30 gauge diabetic syringe: 1 diabetic unit is 1 BOTOX unit when the vial is diluted with 1 cm^3 of sterile saline.

GENERAL INJECTION GUIDELINES

We follow consistent sterile technique in injecting our cosmetic patients. We use 30 gauge needles in order to minimize discomfort to the patient. In situations where the

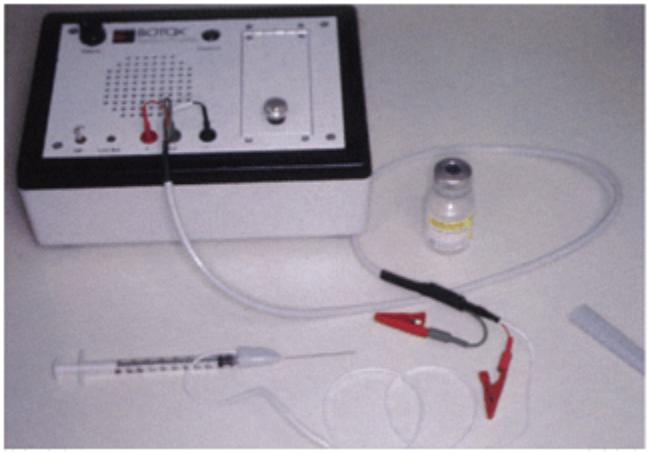


Figure 10

Allergan electromyographic (EMG) machine.

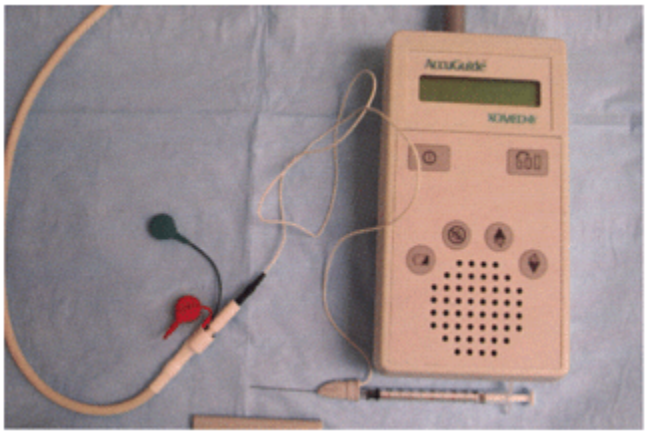


Figure 11

Xomed EMG machine.

Figure 12
The cosmetic botulinum neurotoxin consent form we use.

CONSENT TO BOTULINUM TOXIN TREATMENT FOR FACIAL WRINKLES

Rationale

I am aware that when a small amount of purified botulinum toxin (BOTOX) is injected into a muscle it causes weakness or paresis of that muscle. This appears in 2–4 days and usually lasts 4 months but can be shorter or longer.

I understand that botulinum neurotoxin can be used to soften the action of several muscles of facial expression. Regions that benefit from this treatment include the glabellar frown lines, the horizontal forehead lines, mild brow ptosis, crow's feet, infraorbital lines, zygomaticus and risorius lines, perioral folds and rhytides and folds including radial lip lines, melomental folds and mouth frown, apple dumpling chin and mental crease. Both vertical and horizontal neck lines and bands respond well to botulinum treatment.

Results and post-operative care

1. I understand that I will not be able to voluntarily use these muscles while the injection is effective but that this will reverse itself after a period of months, at which time retreatment is appropriate.
2. I understand that I must maintain upright posture and that I must not manipulate the area of the injection for thr 4-hour post-injection period.

Risks and complications

BOTOX treatment of frown lines can cause minor temporary droop of one eyelid in approximately 1% of injections. This usually lasts 2–3 weeks. Occasional numbness of the forehead lasting 2–3 weeks, bruising or transient headache has occurred. In perioral injections, the diffusion of the BOTOX may transiently weaken adjacent musculature.

In a very small number of individuals, the injection does not work as satisfactorily or for as long as usual.

Photographs

I authorize the taking of clinical photographs and their use for scientific purposes both routinely in my formal medical record as well as in scientific publications and presentations made by Dr Carruthers. I understand my identity will be protected and that I may examine the photographs in my patient chart.

Pregnancy and neurological disease

I am not aware that I am pregnant or have any significant neurological disease or systemic or local infection.

Payment

I understand that this procedure is cosmetic and that payment is my personal responsibility.

clinician is not clear about the underlying muscular anatomy, injection placement using an electromyography unit such as the Xomed EMG machine[9,10] can be very helpful (Figures 10 and 11).

TYPICAL TIME COURSE OF EFFECT

In most individuals the clinical effects of botulinum toxin A begin to appear at 1–2 days, peak in 1–4 weeks and gradually decline after 3–4 months. Some individuals can report effect as long as 6–12 months after injection. Particularly in those individuals who have undergone a series of treatments, it seems the total number of treatment sessions may increase the duration of clinical effect.

PATIENT EDUCATION

Our informed consent form is reproduced here (Figure 12). We feel it very important that the patients understand the basic pharmacology and likely effects, including any transient bruising, the typical time course of the clinical effect and the need for retreatment after 3–6 months. Subjects should also know about potential adverse events and contraindications to cosmetic treatment such as pregnancy, infection or coexisting neurological motor endplate disease (such as myasthenia gravis or ALS).

4
BROW INJECTIONS

GLABELLAR FROWN LINES

ANATOMY

Four muscles pull the brows down and in. These include corrugator superciliaris, orbicularis oculi, procerus and depressor supercilii (see Figures 6 and 7). Individual variation in anatomy, treatment sites and doses need to be individualized at each visit for each cosmetic subject.

We currently use seven injection sites when treating glabellar frown lines (Figures 13 and 14) and vary the dosage depending on the individual brow. For the average female brow without a lot of muscular volume we use a total of 25 U of botulinum toxin A (BOTOX). With greater muscle mass a total dose of 35–50 U of BOTOX may be necessary. In some men we have needed to use up to 80 U of BOTOX in one session. In addition, in males we usually add two further injection points, one above each lateral brow, vertically above the lateral canthus and above the orbital rim. Many males will recruit in this area, requiring this injection. Some females can also need injecting in this location (see below).

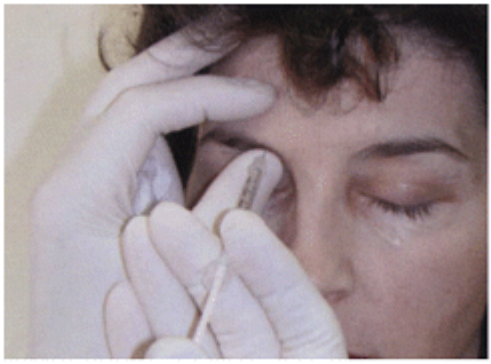


Figure 13

Vertical head positioning to inject glabellar BOTOX. Non-dominant thumb protects superior orbit of subject.

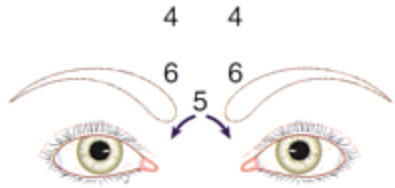


Figure 14

Technique for injection of arched brow.

We currently have no data to support recommendations about dosages of MYOBLOC (botulinum toxin B). Rather than relying on the empirical 50:1 MYOBLOC:BOTOX dosage discussed in the literature on cervical dystonia, we and others are currently performing a dose ranging study to establish the appropriate doses for cosmetic injection of MYOBLOC in the glabella. We have used MYOBLOC at both 50:1 and 100:1 dosages and found the product to be effective and safe for glabellar injection, although comparable doses appear to be greater than 100:1 for the facial muscles.[11,12]

INJECTION SITES AND DOSING

Ordinarily, 5–10 U are injected into the procerus at the mid-line at a point just above the 'X' joining the medial brow and the contralateral medial canthus (Figures 14 and 15). The area is massaged horizontally with the thumb, which safely distributes some BOTOX into the depressor supracilii. Using the medial canthus rather than the medial brow as

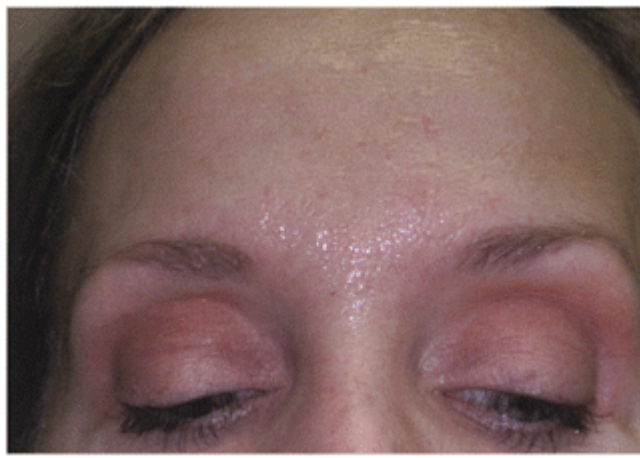


Figure 15

Normal female brow height at or above the bony orbital margin.

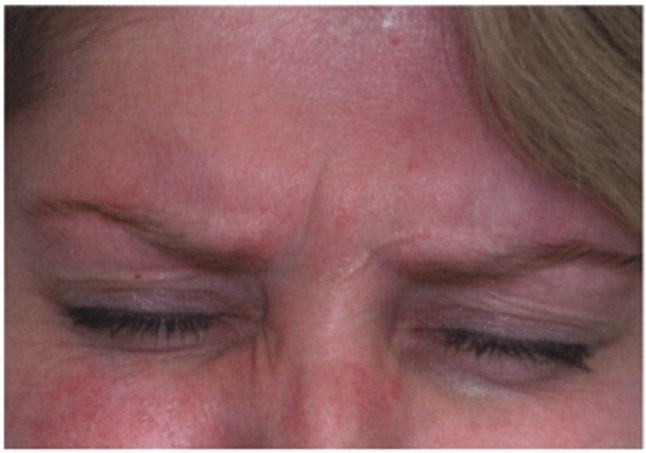


Figure 16

Female arched brow frowning prior to treatment with BOTOX.

the marker (women almost routinely shape their brows) the needle is inserted directly into the head of the corrugator just above the bony supraorbital ridge (Figure 9). After injecting 4–7 U in that location the needle is partially withdrawn but the tip kept beneath the skin. It is repositioned until it angles superiorly and the tip advanced until it is approximately 1 cm above the previous injection site in the orbicularis oculi. A further 3–7 U are injected (Figures 16–23).

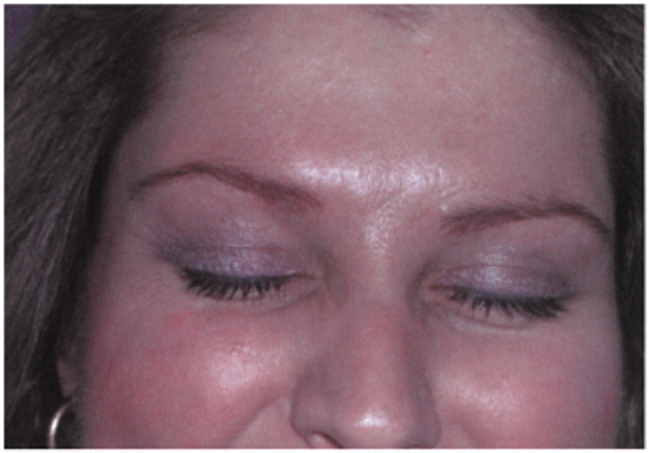


Figure 17

Female brow attempting to frown after treatment with BOTOX.

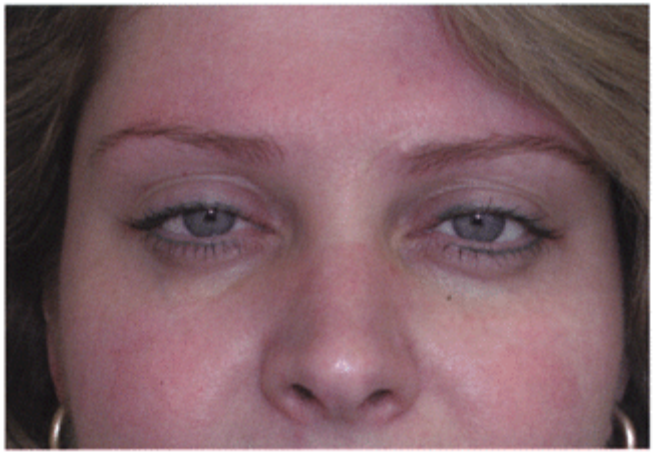


Figure 18

Arched brow at rest before treatment.

Figure 19

Arched brow at rest after treatment showing mild brow elevation.

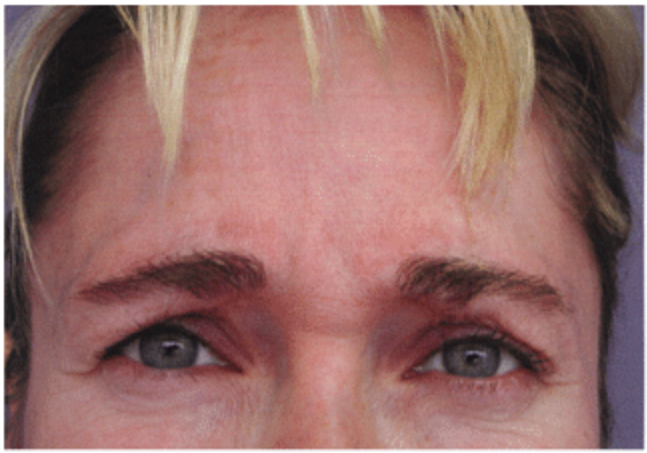


Figure 20

Horizontal procerus line inferior to the vertical glabellar folds.

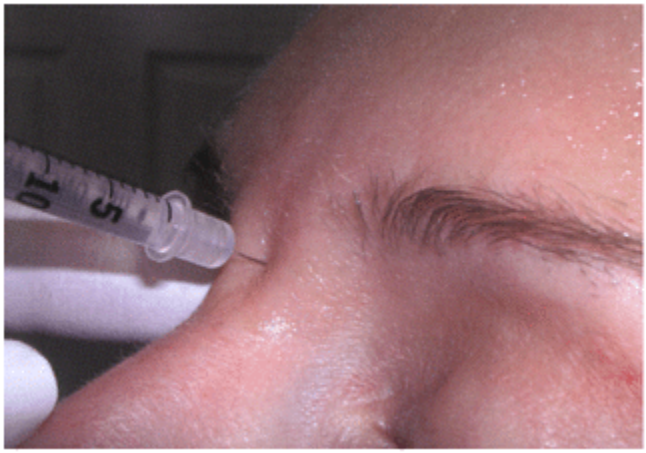


Figure 21

Procerus injection technique seen in semiprofile.

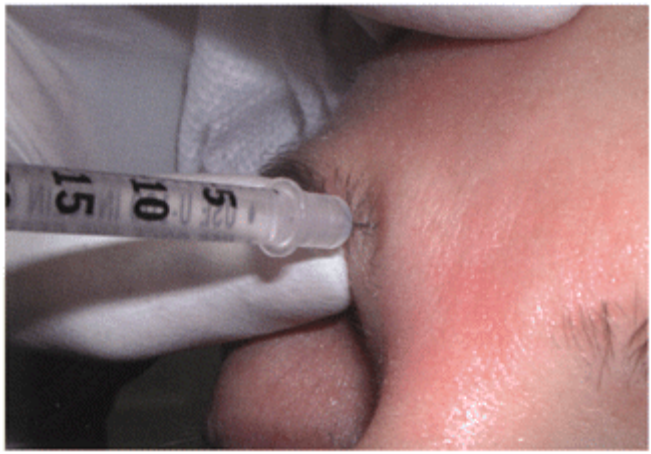


Figure 22

Injection medial head of right corrugator (direct).

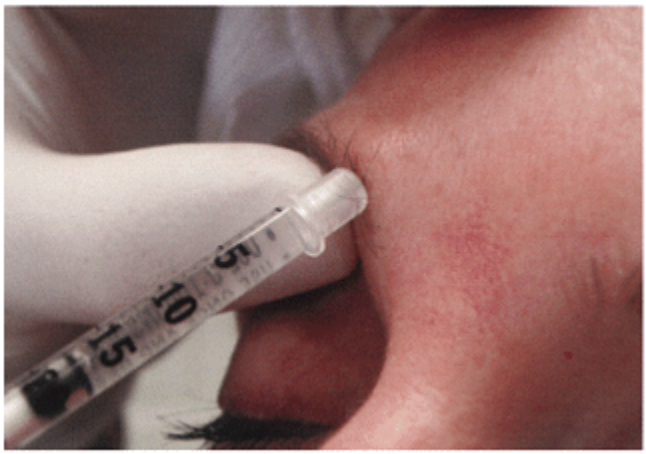


Figure 23

Angling the needle upwards to collapse the upper glabellar folds caused by the superior fibres of orbicularis.

For individuals with more horizontal brows an additional 2.5–5.0 U are injected 1 cm above the supraorbital notch in the mid-pupillary line on each side (Figures 24–29). From a practical point of view the majority of individuals requesting treatment of their glabellar area will need treatment at this site.

MINIMIZING EYELID PTOSIS

After the injections we ask our patients to remain vertical for the next 2–3 hours and to frown as much as possible in the first 30–60 minutes while the toxin is binding. We believe that by encouraging muscular activity and hence binding there is less toxin available to diffuse and cause problems such as ptosis.

We ask patients not to press or manipulate the treated area. To minimize the risk of blepharoptosis (less than 1% in our clinic) we recommend keeping the injection volume concentrated (eg 1 cm^3 per vial), accurately placing the injections and avoiding injecting closer than 1 cm above the bony supraorbital notch between the inner and outer canthi.

'MEDIA' BROW (FOR PLANNED RESIDUAL FROWNING ABILITY)

We treat many individuals in the acting profession or the visual media. It is particularly important to individualize the treatment for these patients because they make their living from their appearance and afford downtime even less than others. Actors on the stage need to over express in order to communicate their emotions. However, the majority of actors interact with either a television or a film camera: this is so much closer than normal person-to-person communication that they need to 'under express' in order to express an emotion. Many of these individuals will seek botulinum toxin treatment in order to reduce their facial movements, but not eliminate them. This is particularly true of newsreaders who need to transmit a positive view of life but need at the same time to be able to express compassion or concern.

For these individuals injection of the central brow with a single large injection can be an appropriate procedure. For example, a single injection of 15–20 U in a female or 20–

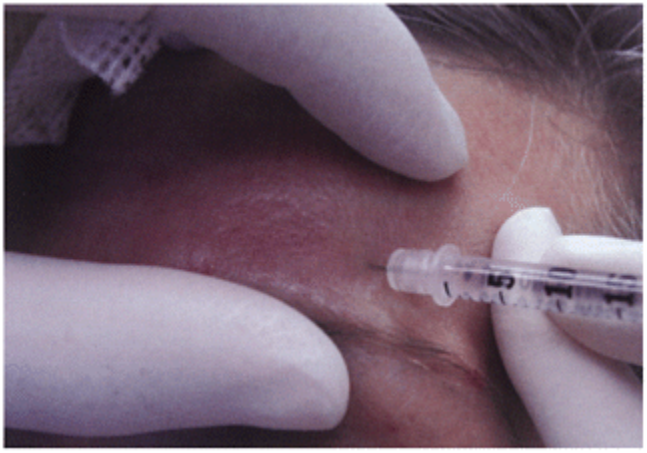


Figure 24

Technique for lateral brow elevation.

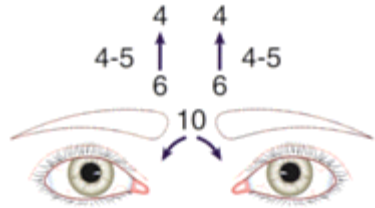


Figure 25

Unit placement for treatment of horizontal brow in a female subject.

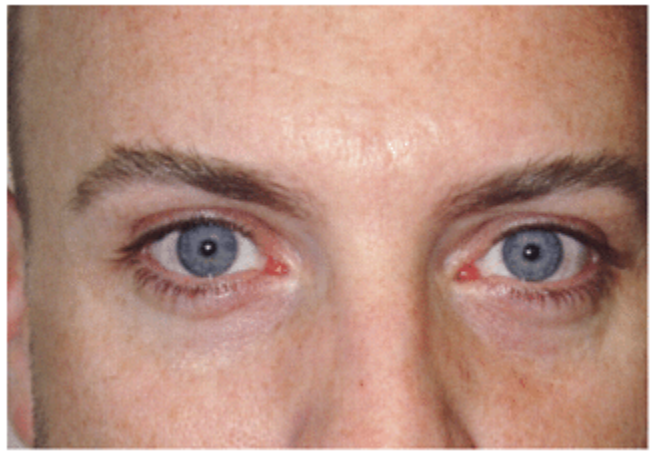


Figure 26

Pretreatment horizontal brows at rest in a female subject.

30 U in a male will reduce but not eliminate frowning and will probably give a minor brow lift, increasing the positive appearance. Adding 4–8 U under the tail of the eyebrow will give an additional lateral eyebrow lift (Figure 30).

Physicians treating a number of actors will receive other requests to manipulate the appearance in order to create a specific appearance. For example, partial weakening of frontalis can produce central brow depression and lateral brow elevation (the ‘Mr Spock’ eyebrow). We encourage readers to be cautious and to proceed slowly with these very observant patients, but the results that can be achieved are both appropriate and dramatic.

Figure 27

Pretreatment horizontal brows in full frown.

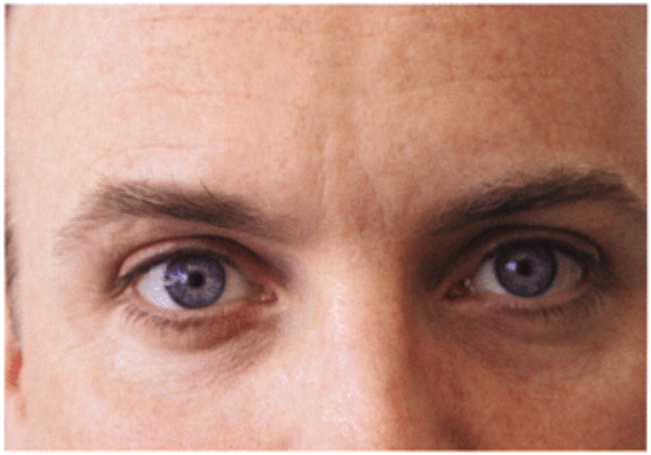


Figure 28

Post treatment horizontal brows at rest. Note the combined chemobrow-lift and more open relaxed expression.

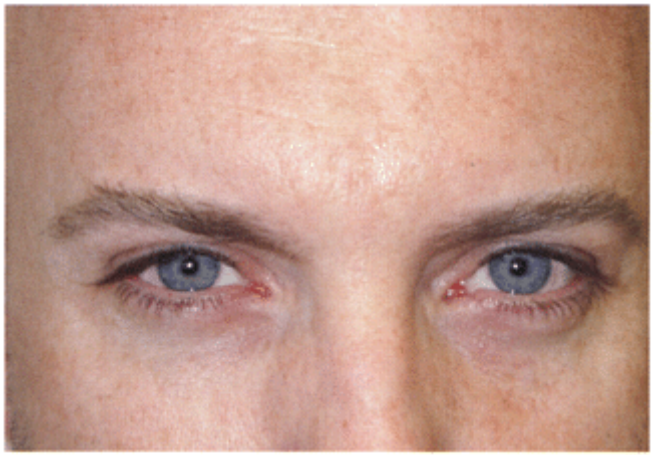


Figure 29

Post treatment horizontal brows at attempted frown. Note relaxation of glabellar skin and maintained brow elevation in comparison to position during full frown.

BROW LIFT

Figure 30

Injection technique for lateral brow in treatment of lateral brow ptosis, for lateral component of brow lift in ‘media’ brow. Note the needle tip is in orbicularis at its junction with the temporal fusion line as it changes from a horizontal to a vertical orientation of its fibres.

Lateral to this point it becomes a depressor of the lateral brow.

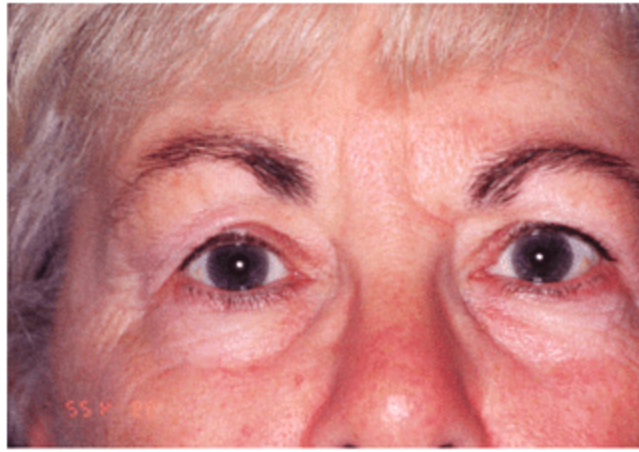


Figure 31

Asymmetric brow height is the rule rather than the exception in middle-aged women. This feature should be built in to the injection plan for these individuals to give them the best aesthetic result.

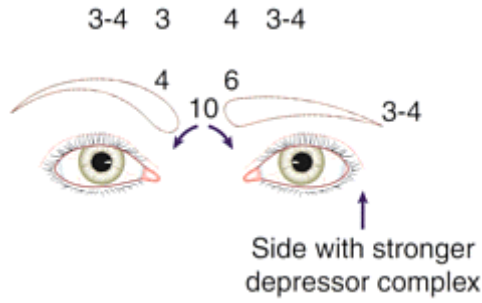


Figure 32

Injection pattern for one brow higher. The aim is to elevate the lower brow rather than to depress the higher.

Eyebrow ptosis is both common and a very negative appearance. The individual looks tired and aged, so improvement in this can be most welcome. In addition, elevated eyebrows are a very positive aesthetic determinant in most cultures.

Approximately 80% of middle-aged women have one eyebrow higher than the other (Figure 31).[13] Presumably the causation is multifactorial: they tend to use one brow depressor complex more, may also have more significant musculature and may sleep predominantly on that side. Consequently eyebrow elevation is an important part of the

world of cosmetic procedures. Soon after we started injecting botulinum toxins to get rid of frown lines we began to hear from our patients that they ‘liked the open-eyed look’ or other similar phrases indicating that the injection was producing a brow lift.

Initially we presumed this was due to the weakening of the central brow depressors, especially procerus, depressor supercilii and corrugator. We conducted a simple study in which we injected both the medial and lateral depressors and showed a significant central brow elevation in the majority of individuals.[14] Others performing similar studies looked at the brow lifting effect of botulinum toxins, with similar results.[15–17] More recently we analysed the eyebrow position in photographs of individuals in our glabellar dose-ranging study in females. Although these individuals were only injected centrally, their eyebrow lift was predominantly lateral. In other words, our previous theory about the mechanism of the brow lift was totally incorrect. Our current theory is that the brow lift is due to partial weakening of central frontalis by diffusion of the toxin.

The importance of this is that, presuming our current theory to be correct, we can use this knowledge to adjust eyebrow height. In the dose-ranging study mentioned above, subjects had no brow elevation at 10 or 40 U total dose, and more brow elevation at 30 than at 20 U. Hence 30 U appears to be the optimal dose in females for both the effect achieved (including brow lift) and duration. Of course, this is an average dose which needs to be individualized.

Individuals who experience brow ptosis are obviously very sensitive to any weakening of frontalis and should not in future be injected in the mid-pupillary line. Those who present with the ‘Mr Spock’ eyebrow have been injected too far laterally, and the lateral injection needs to be moved more medially for the next injection. In other words, by controlling the weakening of frontalis we can produce brow ptosis, brow lift, ‘Mr Spock’ eyebrow and even correct eyebrow asymmetry.

However, there is no question that eyebrows can be elevated by injection of the depressors and allowing elevators of the brow to act unopposed, as we demonstrated in our earlier paper. As a result, we now manipulate brow height and symmetry by attention to both the depressors and frontalis.

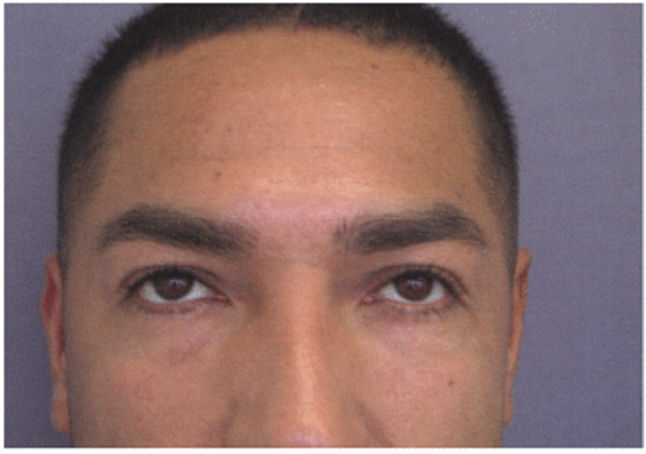


Figure 33

Masculine pattern horizontal brow—thicker, not arched, no exposure of the temporal superolateral bony orbital margin as in females. Note the relatively lower brow position at and below the bony superior orbital margin compared to the higher position of the female pattern brow.

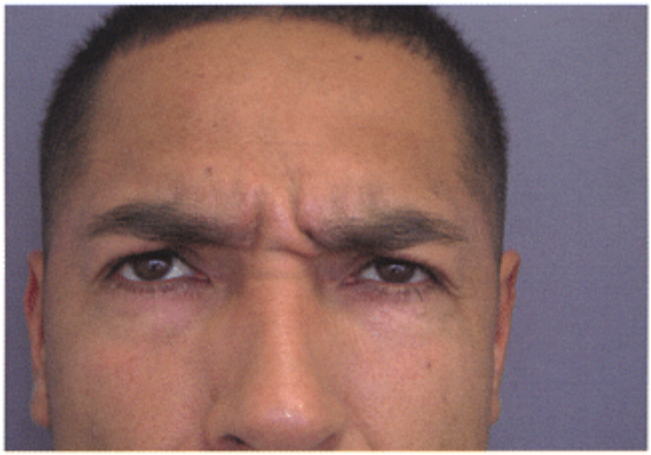


Figure 34

Masculine pattern brow in full frown pretreatment.

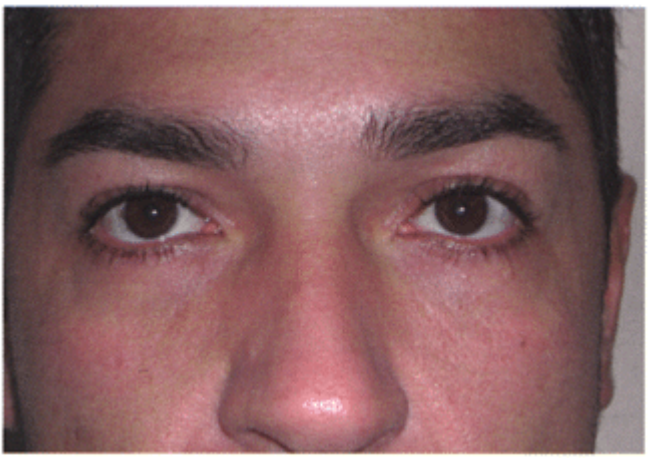


Figure 35a

Post treatment, at rest.

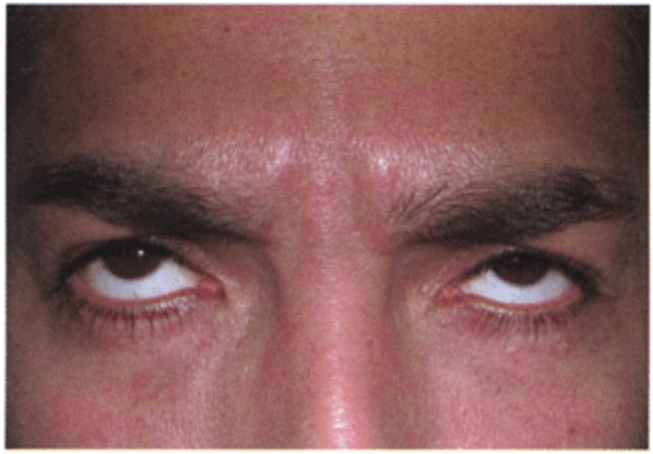


Figure 35b

Post treatment, attempted frown. Note residual glabellar crinkle achieved with media brow treatment for a male subject.

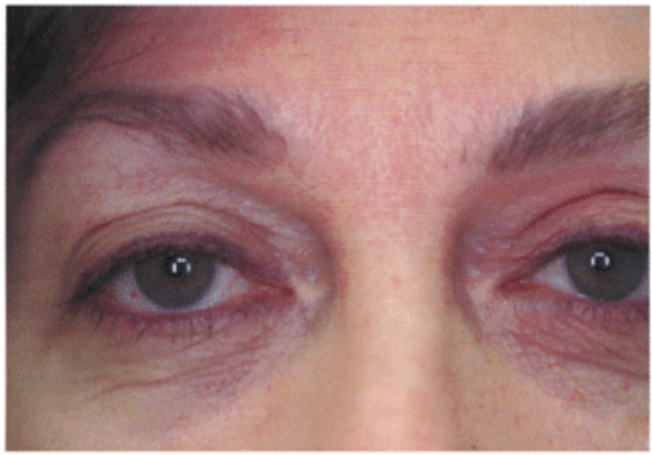


Figure 36

Lateral brow ptosis before BOTOX combined brow lift.

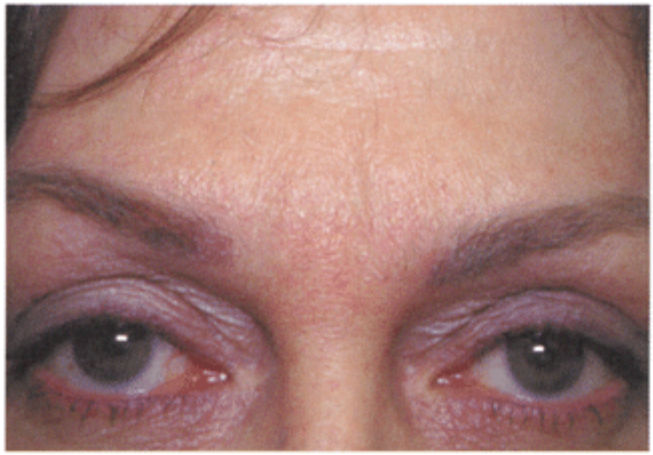


Figure 37

Lateral brow ptosis post temporal lift. A 1–5 mm lift can be achieved depending on anatomy and BOTOX dose. Usually 3–10 U dosage range with an average in most subjects of 5 U.

TECHNIQUE

LATERAL BROW PTOSIS

At the superolateral orbital rim the fibres of orbicularis oculi curve from horizontal to vertical. The centre of this curve in many individuals is where the temporal fusion line reaches the bony orbital rim. Injecting above the rim at this point produces a lateral brow lift (Figures 30–37). Typically, 4–6 U in females and 6–10 U in males are appropriate doses.

MEDIAL BROW PTOSIS

Medial brow ptosis causes a tired, aged and angry appearance. Clients report that the return of their medial brow ptosis and glabellar lines which become evident before their next appointment remind them to attend for retreatment because their colleagues and friends start commenting on how upset they are looking and tell them to ‘lighten up’.

Injecting 10–20 U of BOTOX in the procerus and 5–10 U into each medial corrugator will weaken the medial brow depressor musculature and allow frontalis to elevate the medial brow. If the lateral brow is also ptotic, the lift will be less marked than if the medial brow alone was ptotic, and review in 1–2 weeks will establish whether the subject has responded adequately to the neuro-toxin injections or whether a surgical procedure may be indicated in the future (Figure 38).

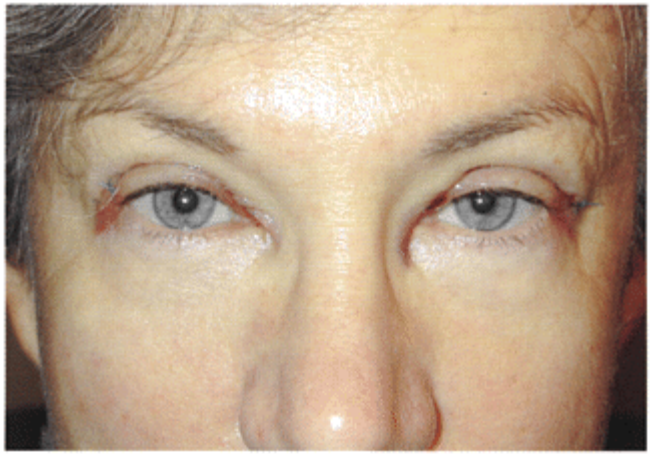


Figure 38

Medial brow ptosis in a female subject. The head of the brow is below the bony orbital margin medially. This creates an intense concerned expression.

‘MR SPOCK’ BROW (DELIBERATE LATERAL BROW OVER-ELEVATION)

For some individuals satisfactory brow position is achieved when the medial brow rests at its normal position at the bony orbital rim and when the lateral brow (particularly that portion lateral to the temporal fusion line) is elevated in a gull wing shape, which has been called the ‘Mr Spock’ eyebrow. The reason this is a desired result is an enhanced show of the bony superolateral bony orbital margin—an ultra feminizing brow characteristic. This brow can be achieved with two separate techniques, which may be combined to enhance the effect. The first is injection of the vertical fibres of the orbicularis at the temporal fusion line, as detailed above on ‘lateral brow ptosis’. If in addition neurotoxin is injected into the medial fibres of frontalis in a symmetrical fashion, this will allow the lateral frontalis fibres to overcompensate and lift the lateral brow even higher (Figures 39–42).[14]

COMBINED BROW LIFT

Injection in both procerus and the lateral brow at its junction with the temporal fusion line produces a brow lift of 1–3 mm.[14–17] This brow elevation exposes more of the upper eyelid skin in both females and males. The area revealed is called the platform or the

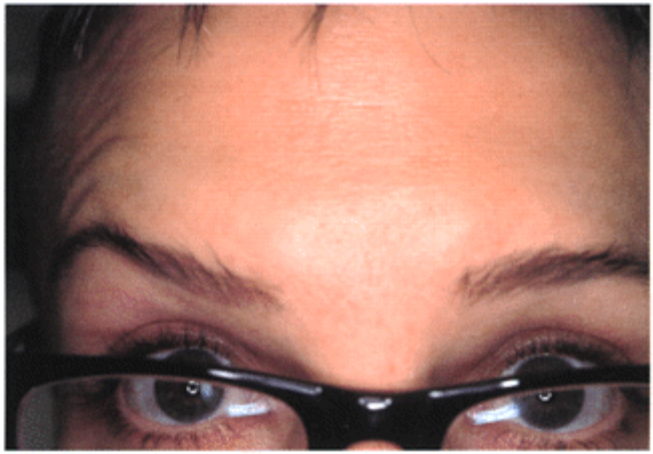


Figure 39

A ‘Mr Spock’ cocked eyebrow. The lateral fibres of frontal is are not weakened and are elevating the lateral brow. 2–3 U of BOTOX injected into the frontal is about 2 cm above the brow will relax this movement.

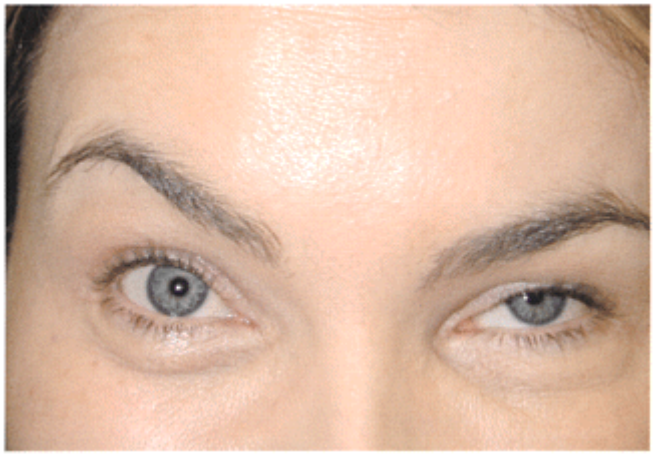


Figure 40

Right ‘Mr Spock’ brow before BOTOX.

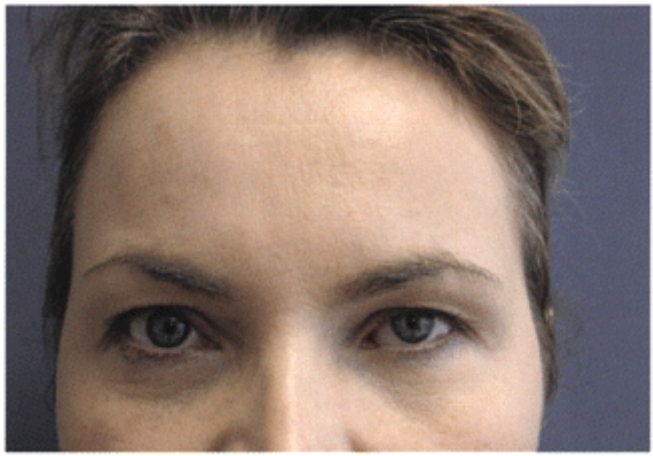


Figure 41

Right brow relaxed into a more symmetrical position after frontalis treatment with BOTOX.

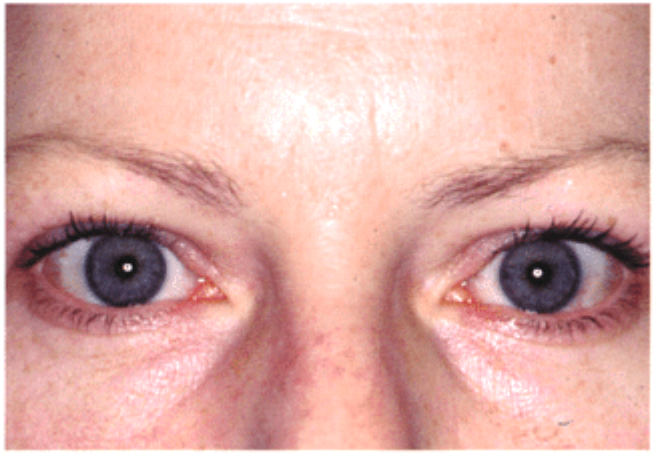


Figure 42

BOTOX chemobrow lift. Note upper eyelid fold and platform relatively obscured by the upper eyelid tissue dependent from the brow.

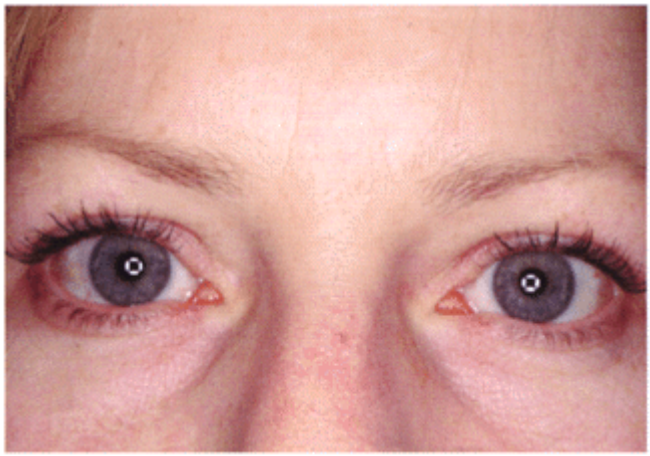


Figure 43

Post BOTOX treatment of procerus and medial corrugator with lateral brow elevation injection. Upper eyelid platform is now more open and the subject has a more relaxed and interested expression.

ellipse between the upper lashes and the upper lid fold. Women can then be more artistic with their application of eyeliner, eyeshadow and mascara. Both sexes appear more rested, interested and alert (Figures 43 and 44).

INJECTION OF THE LATERAL BROW

This paragraph should not be necessary if the preceding sections are read carefully, but we are often questioned about lateral brow injections and felt that this justified a separate section. Injection of the superolateral portions of orbicularis will have effects dependent on the location of the injection. Orbicularis oculi is interesting in that its response to botulinum toxins is very segmental. To achieve weakening of the muscle, injections must be placed much closer together than in other muscles, such as frontalis, where diffusion will produce a spread of effect. For this reason, injections into orbicularis oculi must be accurately located for this effect to be achieved.

Injection into the lateral horizontal portion of the muscle (approximately above the lateral canthus) will reduce frowning. Injection into the apex of the curve, as the muscle curves from horizontal to vertical, will produce lateral brow elevation. Finally, injection lower will produce softening of the crow’s feet, especially those above the level of the lateral canthus (see Figures 36 and 37). Note that it is essential that all these injections be delivered carefully above the bony orbital rim.

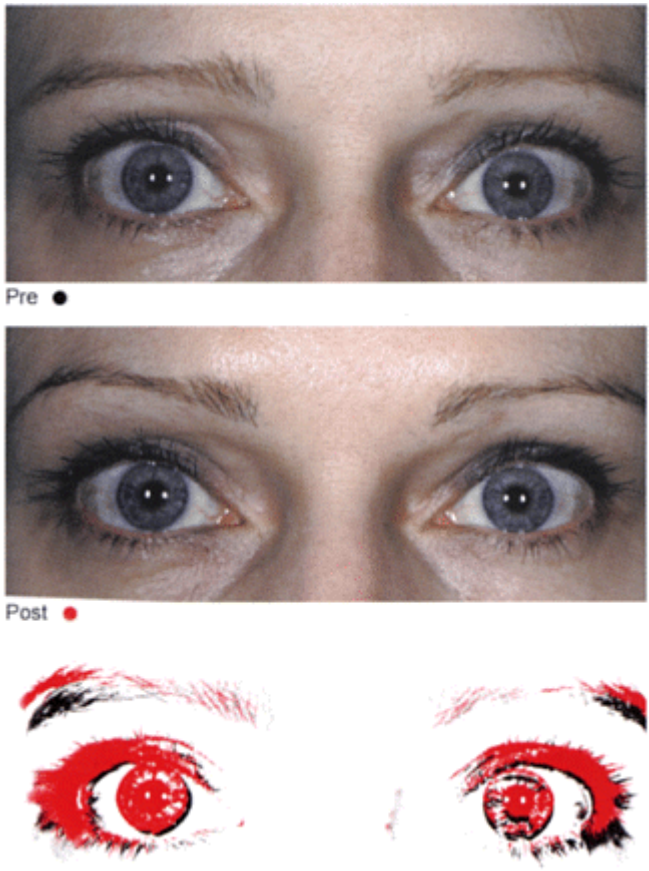


Figure 44

Digital overlay technique to show lateral brow elevation resulting from frontalis activity laterally. The brow depressor musculature was injected medially and at the mid pupillary line.

5
HORIZONTAL FOREHEAD LINES

RELEVANT ANATOMY

Horizontal forehead lines are produced by the action of the anterior frontalis portion of the occipitofrontalis muscle. The frontalis inserts superiorly into the galea and inferiorly into the procerus, corrugator supercilii, orbicularis oculi, depressor supercilii and the skin of the brow. In wishing to treat undesirable horizontal forehead lines, it is important to realize that this muscle is the only brow elevator. We thus feel that isolated treatment of frontalis is not appropriate and that a combination treatment with the brow depressors (as in the section on 'media' brow above) is aesthetically superior because it may prevent the otherwise inevitable iatrogenic brow descent. Brow ptosis is still a possible result of frontalis injections, and preinjection assessment is mandatory. Any individual with significant brow ptosis preinjection should probably be excluded or injected very gently with a low dose in a central location.

A simple test for functional frontalis activity is as follows. From a seated position facing the patient, instruct them to close their eyes. Alert them to what you are about to do, and gently smooth down the folds in the forehead. Then ask the individual to look at

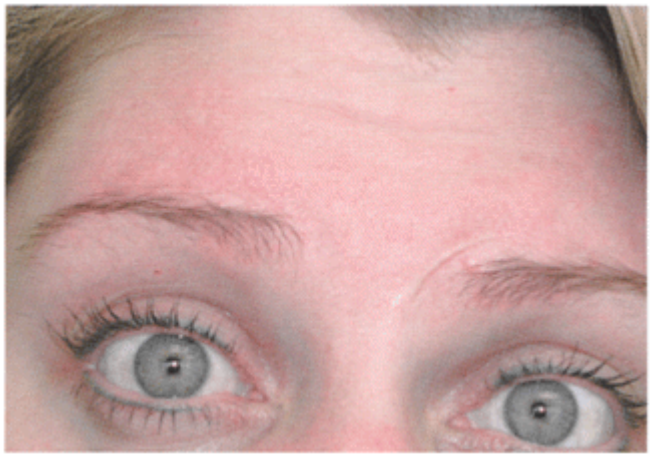


Figure 45

Horizontal forehead lines in a female subject before treatment of frontal is to treat the lines and cotreatment of the brow depressor musculature to prevent iatrogenic brow ptosis which may occur following isolated treatment of frontalis

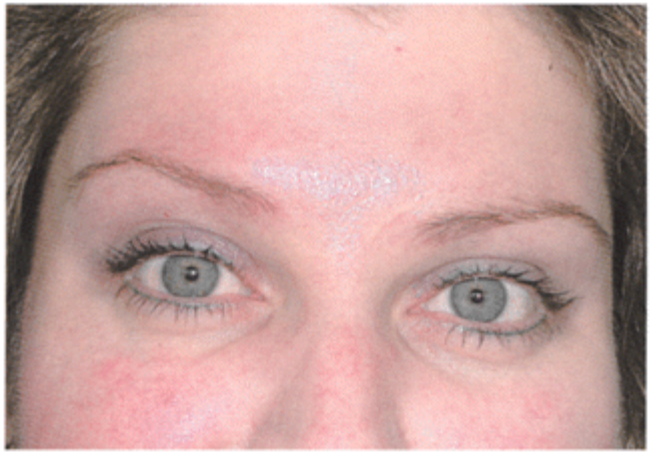


Figure 46

Post treatment appearance of horizontal forehead lines. Brow is smooth and still has natural movement.

Figure 47

Pre treatment deep horizontal forehead lines on full frontalis activation.

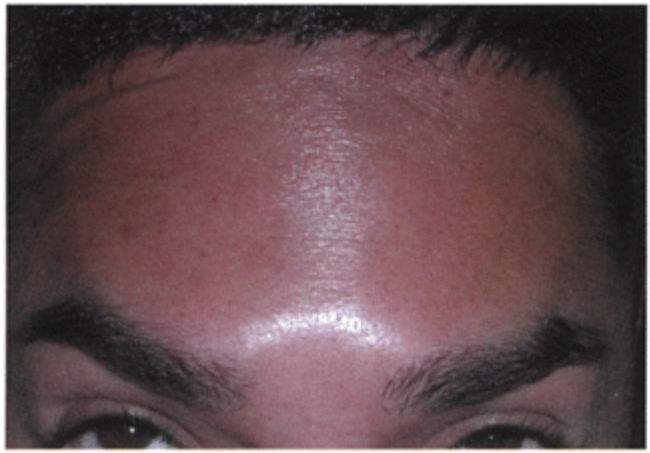


Figure 48

Post treatment horizontal forehead lines are smooth and the brow is not ptotic.

you. When they open their eyes, if there is a significant twitch of frontalis, this indicates that the individual is chronically using frontalis to elevate the brows in order to improve their visual fields. Injection in such an individual will drop their eyebrows, affecting their vision and producing an angry, hostile appearance.

Another important observation is that many women actively contract frontalis while they are applying make-up to the periocular area. It is important to warn them that this ability may be reduced after botulinum toxin weakening of frontalis.

It is also important to stress that the aim of treatment here is to weaken but not paralyse frontalis. There should be some residual function, particularly immediately above the eyebrows in order to produce eyebrow movement to convey emotion. In our judgement, this residual function is essential to the production of a satisfactory treatment response and to avoiding an unemotional and flat effect. Botulinum toxins should be used to enhance an individual's ability to express emotion, not reduce it (Figures 45–48)!

INJECTION SITE AND DOSING

We have reduced the amount of BOTOX we put into frontalis for horizontal forehead lines because we have found that, by cotreating the brow depressors with 10 U into the procerus and 5 U into each lateral orbicularis at its junction with the temporal fusion line, there is reduced downward force causing brow depression for the elevating frontalis muscle to counteract. Because of this we usually use as little as 10–20 U (2–4 U in four to five injection sites across the equator of the forehead; the most lateral injection is 1.5 cm medial to the lateral margin of wrinkling). In individuals who have a brow wider than 12 cm between the temporal fusion lines, a fifth or even sixth injection site may be necessary. We always suggest massaging the forehead upwards and obliquely

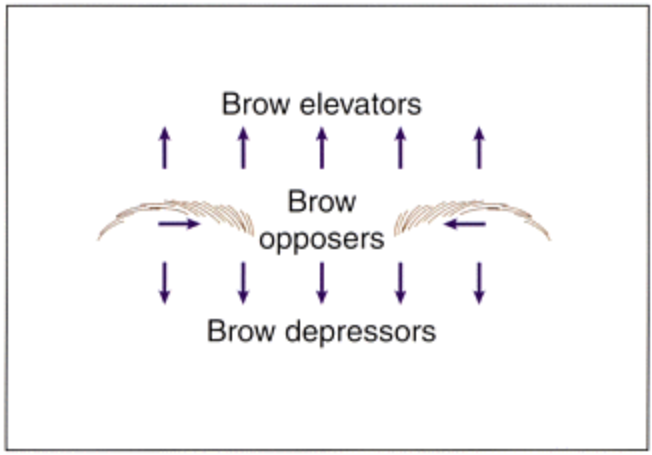


Figure 49

The brow is maintained in its position by the balance of force generated by the brow depressor muscles, the solo brow elevator and the brow adductor.

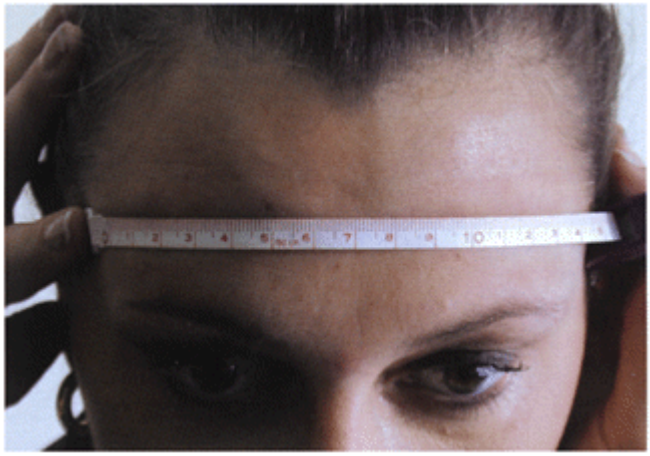


Figure 50

Decision about the dosage needed can be assisted by knowing whether the forehead is wider than 12 cm between temporal fusion lines. Five injection sites across the brow may be more appropriate for the wider forehead in addition to cotreatment of the brow depressor muscles to prevent brow ptosis.

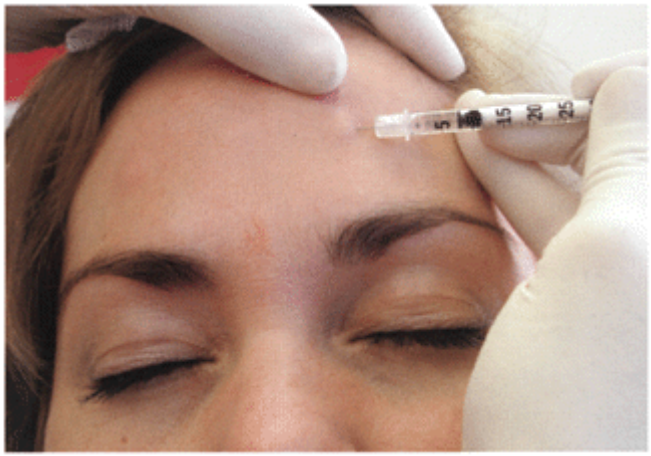


Figure 51

Technique for horizontal forehead line injection is to inject symmetrically at the mid brow at least 2 cm above the bony orbital margin along vertical meridia of the central pupillary line and the medial canthus.

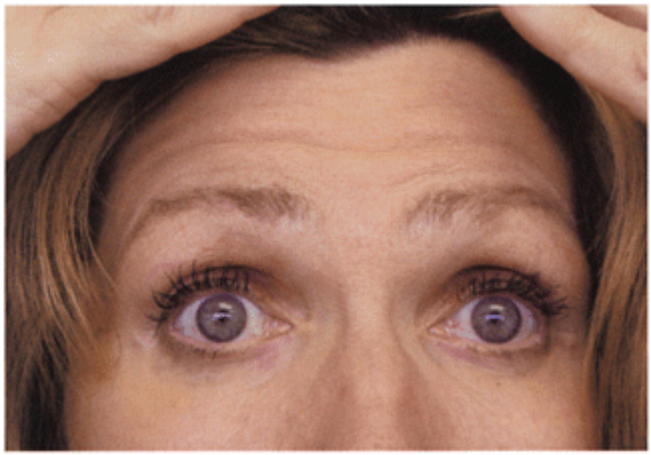


Figure 52

Female subject with deep horizontal forehead lines treated with 10 U of BOTOX total to the frontal is in the above pattern.

Figure 53

Female subject post treatment with softening of the lines.

immediately after the injection in order to give a smooth soft brow appearance. Make sure that the injection sites are no lower than 2–3 cm above the eyebrows because the lower fibres of frontalis are the focus of most of its elevating action (Figures 49–53).

Even with this cautious approach we still sometimes see a minor degree of brow ptosis or swelling of the upper eyelids. The results typically last 4–6 months. The dose of Dysport for this indication is 40–70 U, as reported in the literature.

COMBINED INJECTION OF GLABELLA AND HORIZONTAL FOREHEAD LINES

We suggest two approaches to combination treatment of the brow. For the first-time user it is highly appropriate to treat only the glabella and then to see the patient in 2 weeks and treat only what is necessary in the forehead. We see almost all our first-time botulinum toxin users at 2 weeks in order to assure the achievement of a satisfactory response, to discuss the response with the individual and to record it. Treatment of the brow has such a high approval rating that treatment of this area is ideal to educate the beginner with botulinum treatment. Experimentation can follow once they are convinced.

An alternative approach is to treat both the glabella and the horizontal forehead lines at a single session. In order to reduce the risk of brow ptosis, we recommend omitting the mid-pupil glabella injection in the knowledge that this may reduce the effectiveness of the frown line treatment but that it is a safer strategy. It is much easier to add a few units than to remove them!

6
PERIORBITAL AREA

LATERAL ORBITAL WRINKLES (CROW'S FEET)

RELEVANT ANATOMY

Crow's feet are produced by the vertically oriented fibres of the orbicularis oculi and by the elevators and retractors of the corner of the mouth, zygomaticus and risorius. Treatment of this area is aimed at weakening only the lateral part of orbicularis oculi. The injections cause a very segmental weakening of the more lateral vertically arranged fibres of the orbicularis, relaxing the radial skin folds as they extend posterior to the bony lateral orbital margin.[18] Full forced contraction of other parts of orbicularis is not affected, so there is no problem with eyelid closure and ocular protective mechanisms.

It is important to demonstrate to the individual prior to treatment the component of wrinkling due to orbicularis oculi and that due to the elevators of the corners of the mouth. This distinction is important in understanding the improvement that will be achieved in the lower eyelid area, and it will avoid disappointment if wrinkling of the

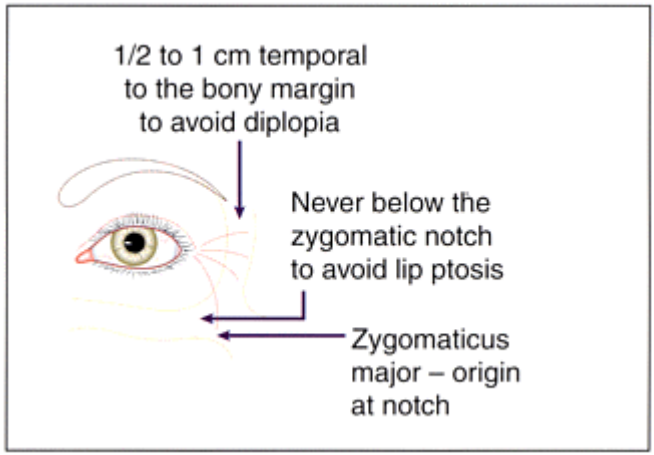


Figure 54

Crow's feet injections should be placed outside the bony orbital margin to avoid diffusion to the extraocular muscles and consequent diplopia and should not be placed less than 1 cm above the zygomaticus notch in order to avoid mid face and lip ptosis.

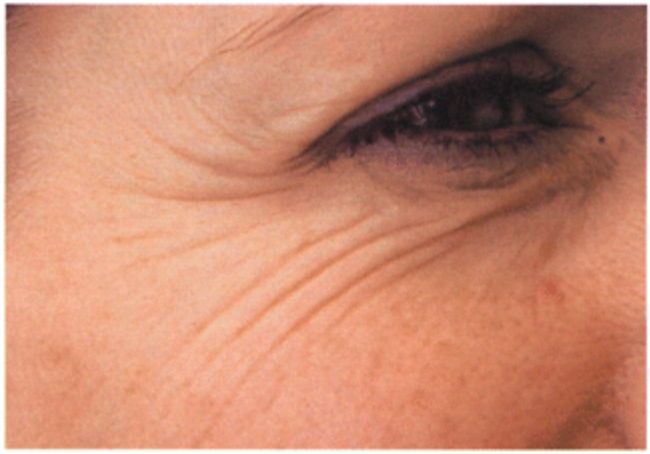


Figure 55

Crow’s feet before treatment with BOTOX 15 U per side in three injection locations.

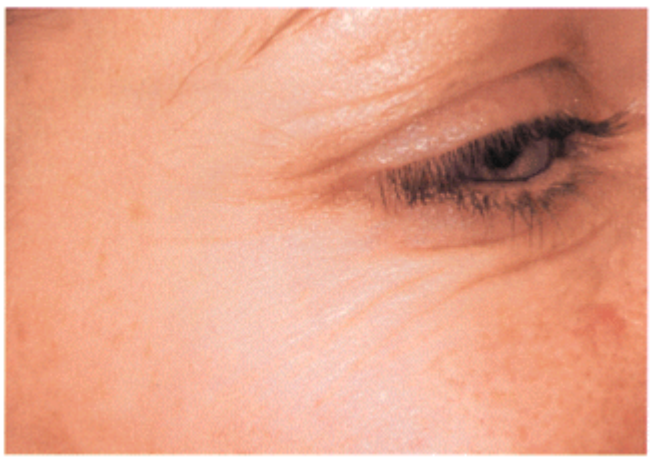


Figure 56

Crow’s feet after treatment. Note relaxation of temporal periocular lines.

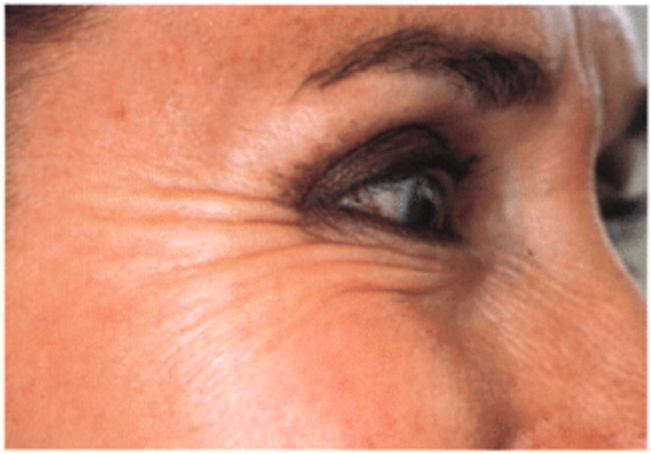


Figure 57

Crow’s feet extending more posteriorly than in previous subject before treatment.

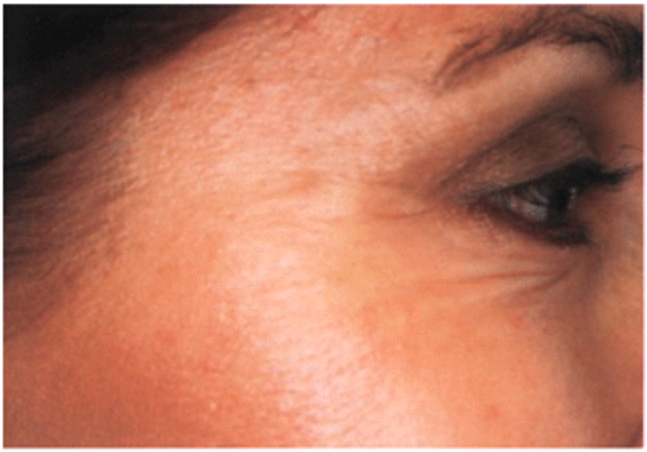


Figure 58

Crow’s feet after a double row of BOTOX 25 U per side.

lower eyelid is not improved. It is also important to assess and discuss the part that reduced skin laxity plays in lower eyelid wrinkling and to consider other therapeutic options if necessary (Figure 54).

INJECTION SITES AND DOSING

We start with 12–15 U per side distributed in equal parts between two and four injection sites. We try to use the most superficial injections possible in order to minimize bruising; particularly for the lower injections, intradermal injections are helpful. It is advisable to inject the crow's feet with the face relaxed as if one injects during forced contraction of the orbicularis and zygomaticus, botulinum toxin may in fact be injected more inferiorly and zygomaticus may be paralysed, resulting in the appearance of an ipsilateral facial palsy (Figures 55–58). The doses of Dysport used have been reported from 8 to 60 U. We do not yet have a recommended dosing for botulinum toxin B (MYOBLOC, Neurobloc),[11] but see above for suggestions.

INFRAORBITAL ORBICULARIS OCULI

Injection of hypertrophic orbicularis is a very exciting aesthetic treatment because it demonstrates the artistry of botulinum toxin injections.[19,20] Combining these injections with crow's feet injections is a particularly popular treatment option in individuals who tend to have more almond-shaped eyes or narrower palpebral apertures; it is especially popular and effective in younger females and individuals of Asian ethnic origin.

RELEVANT ANATOMY

Smiling transiently diminishes the perceived size of the palpebral aperture. Additionally, in some individuals there is hypertrophy of the pretarsal orbicularis in the lower lid, causing a 'jelly roll' appearance on a full smile, which tends to give the individual a plump appearance. Correction of these two problems can dramatically improve the appeal of some faces.

INJECTION SITES AND DOSING

Injection of 2–4 U of BOTOX into the lower pretarsal orbicularis 3 mm below the inferior ciliary margin in the mid-pupillary line will relax the palpebral aperture both at rest and when smiling (Figures 59–62).[20] Coincidental injection of the lateral orbital area has a synergistic effect with infraorbital injections. In the majority of females in whom this area is injected we do inject the lateral orbital area in order to produce an optimal cosmetic effect. As we have shown,[19,20] 2–4 U with injection of the lateral orbital area produces an optimal effect. Without lateral orbital injections, 4 U or more is necessary. As with all cosmetic botulinum injections, it is better to use a lower dose, reassess in 2 weeks and reinject as necessary.

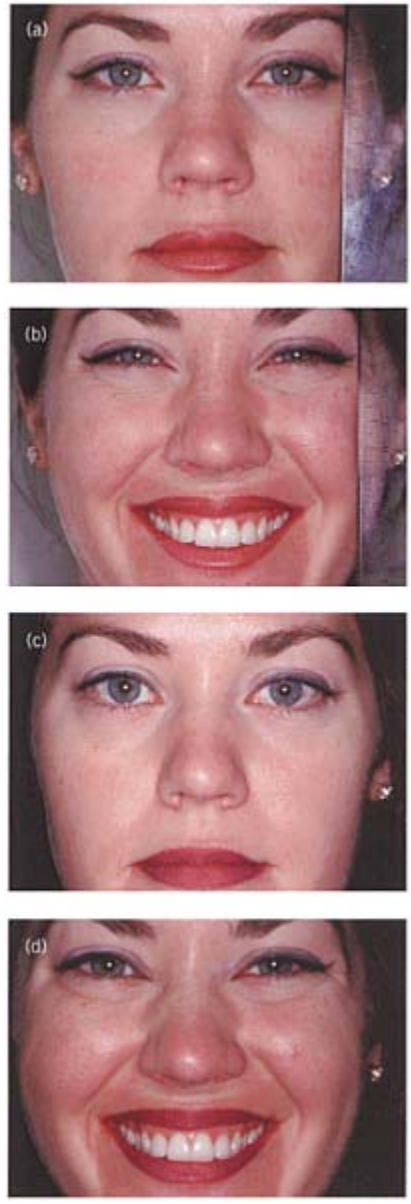


Figure 59

Infraorbital plus crow's feet injection. Palbebral aperture widens and hypertrophic orbicularis fold softens. Be sure subject has a normal snap test and that they do not suffer keratoconjunctivitis sicca before this treatment is offered.

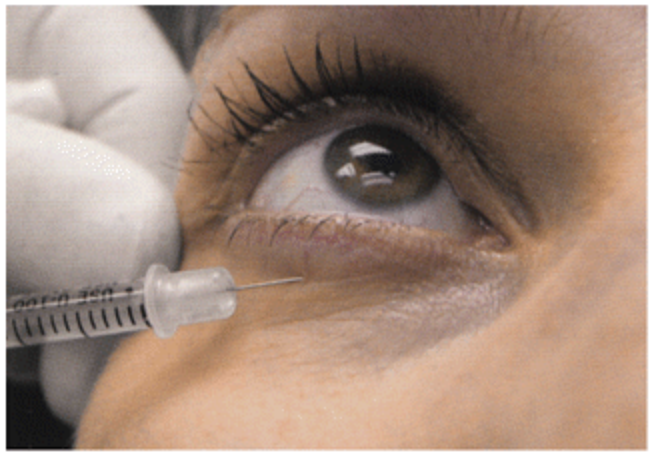


Figure 60

Injection technique for pretarsal orbicularis infraorbital injection. Note needle is held tangential to the globe to prevent accidental perforation of the globe if the subject were to suddenly change their position.

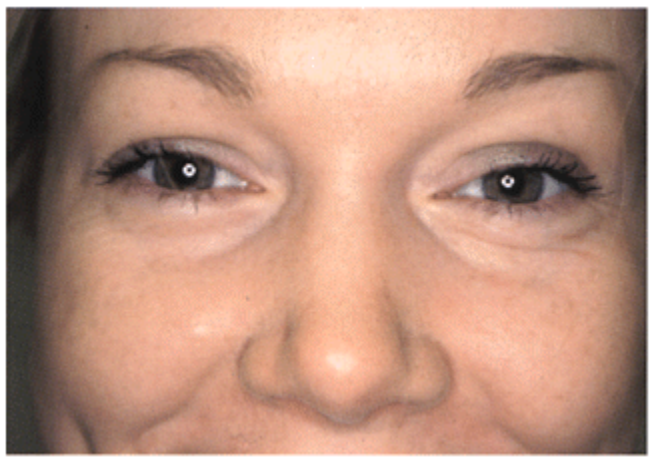


Figure 61

Orbicularis hypertrophy before treatment with 2 U of BOTOX 3 mm below the inferior ciliary margin.

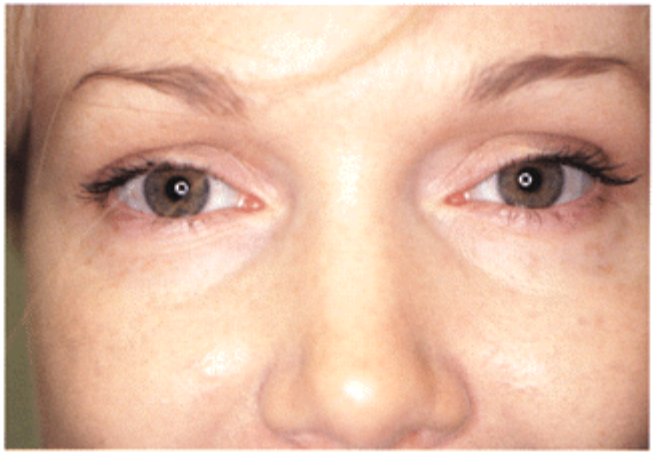


Figure 62

Subject post treatment: note softer periocular lines, wider more interested appearance.

Individuals who do not have a good preinjection snap test or normal tear secretion or who have had previous lower eyelid ablative laser resurfacing or infralash blepharoplasties without lateral canthopexy should not receive this treatment because they are predisposed to develop ectropion and lagophthalmos (exposure of the lower cornea).

7
MID AND LOWER FACE

BOTOX chemodernervation of the glabella, horizontal forehead lines and crow's feet has become the worldwide 'gold standard' for upper facial rejuvenation. Most physicians are familiar with the concept of volume depletion as being the principal aesthetic determinant in the lower face and have chosen not to use BOTOX in this region as a result. However, as expertise with the cosmetic use of botulinum toxin has increased, the appreciation that muscular contraction is also important in the lower face has become increasingly well accepted. Cosmetic neurotoxin injection has enhanced the results with soft tissue augmentation and laser resurfacing, especially in the lips and perioral region.[21]

Injection of the mid and lower facial musculature requires a much smaller unit injection dose than muscles in the upper face. Overdosing of the mid and lower facial musculature can give the appearance of a facial palsy and the result can last for approximately 6 months. We strongly recommend that only physicians who are already experienced with upper facial cosmetic injections attend a workshop or preceptorship on lower face anatomy, technique and dosing before adding this group of indications to their treatment plans.

UPPER NASALIS

Contraction of the muscular fibres of upper nasalis causes a fan of radial rhytides at the radix of the nose—the so-called 'bunny lines' or 'scrunch lines'. In an individual who has had botulinum treatment of the glabella area, it is not uncommon to see an overaction of upper nasalis and an increase in wrinkling in this area, the 'BOTOX sign' (Figure 63).[22]

RELEVANT ANATOMY

The transverse upper portion of nasalis runs over the bony dorsum of the nasal bones and then descends into the nasofacial groove, where it interdigitates with the muscular elevators of the upper lip.

The injection should thus be made relatively high on the bony dorsum of the nose in order to avoid diffusion of the neurotoxin into the lip elevators. The injections should also be well above and medial to the angular vein which runs superolateral to the nasalis into the middle fossa of the brain (Figures 64 and 65).[22]

Figure 63

Upper nasalis lines (‘bunny’ lines) pretreatment. 3–5 U are placed high on the dorsum of the nose away from the lip elevator muscles that are located in the nasofacial groove.

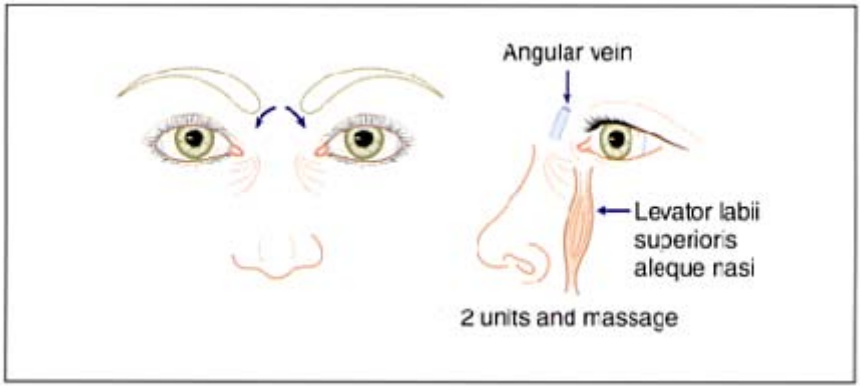


Figure 64

Technique for nasalis.

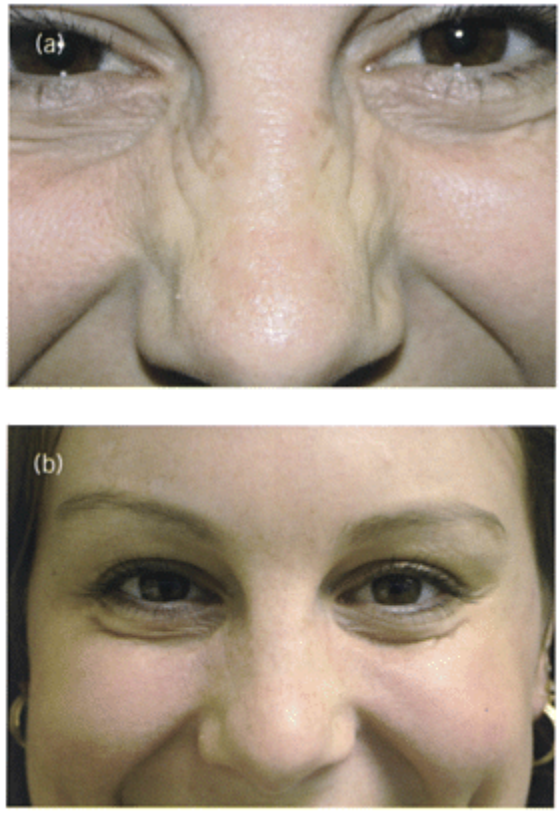


Figure 65

Pre and post treatment photographs of treated ‘bunny’ lines.

DILATOR NARIS HYPERFUNCTION (REPEATED NASAL FLARE)

Some individuals repeatedly dilate their nostrils. This may be involuntary and is thought to be a form of oromandibular dystonia. The repeated flaring can be embarrassing, particularly in social gatherings.

ANATOMICAL CONSIDERATIONS

The muscular fibres of dilator naris bridge the dorsum of the nose closer to the tip and insert into the lateral alar cartilages. Contraction (whether voluntary or involuntary) of these muscles causes dilatation of the nares. Injection along the alar cartilage from anterior to near the nostril to posterior at the nasal facial groove weakens the effect of this muscle (Figure 66).[22] Doses and injection sites can vary from individual to individual,

which is typical of dystonia. Careful assessment is critical to achieving a satisfactory result in these subjects.

MELOLABIAL FOLDS (IN SELECTED INDIVIDUALS ONLY)

ANATOMICAL CONSIDERATIONS

The lip elevator muscles, zygomaticus and risorius, both play a significant role in the aetiology of the melolabial folds. Injection of BOTOX into these muscles produces upper lip ptosis and as little as 1 U of BOTOX into each lip elevator complex produces effects that can last 6 months or more. For this reason we do not recommend injecting this site except in selected individuals who may have a congenitally shorter upper lip and for whom some elongation might be of aesthetic benefit (Figures 67 and 68). It is crucial to use very low doses such as 1–2 U and to inject symmetrically. Typically, injection is into levator labii superioris alaeque nasi, which will soften the upper part of the nasolabial fold.

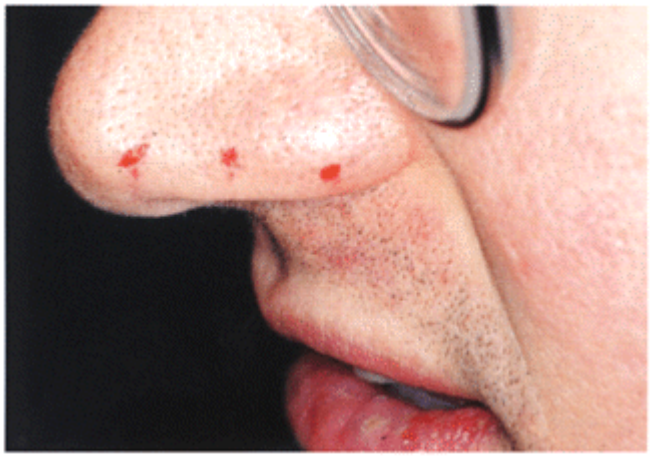


Figure 66

Dilator naris overaction results in constant flaring of the nostrils so that the individual is embarrassed. 10–30 U per side are required to stop the action.

MELOMENTAL FOLDS

ANATOMICAL CONSIDERATIONS

The melomental folds pass inferolaterally from the lateral corner of the mouth to the inferior jaw line. They are often deep and have been nicknamed ‘drool grooves’. The

melomental fold is framed by the heaviness of the jowl, and the thinning of the lips at the lateral corner of the mouth. The facial expression is often read as one of fixed disapproval, disappointment and fatigue. The lips are often thinned and may look more like a pencil stroke than a full soft youthful lip.

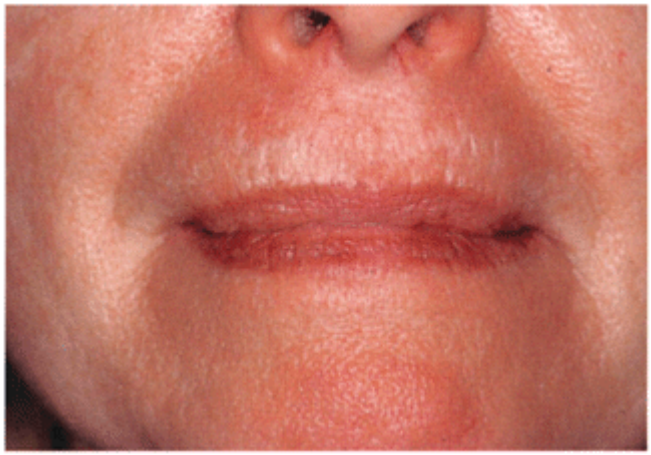


Figure 67

Treatment of the melolabial fold is not usually recommended because of the elongation of the upper lip, which can last 6 months.

The depressor anguli oris passes inferiorly between the modeolus at the lateral corner of the mouth down to the edge of the jaw line in line with the trajectory demonstrated by the melomental folds. The zygomaticus major is the direct antagonist and pulls the lateral corners of the mouth upwards, both muscles inserting into the modeolus.[22]

AESTHETIC CONSIDERATIONS

Resetting the power balance by softening the depressing action of the depressor anguli oris allows the zygomaticus muscle to take up the slack and elevate the corner of the mouth. This serves also to make the upper portion of the melomental fold less depressed. Combined treatment with soft tissue augmentation which itself can elevate the lateral corner of the mouth can make the individual appear younger and relaxed and positive again (Figures 69–75).[21,22]

The true product of overuse of depressor anguli oris is the superolateral to inferomedial lines seen on the side of the chin, below the corner of the mouth combined with a downturn at the corner. However, weakening of depressor anguli oris can improve the melomental folds, especially in combination with soft tissue augmentation agents.

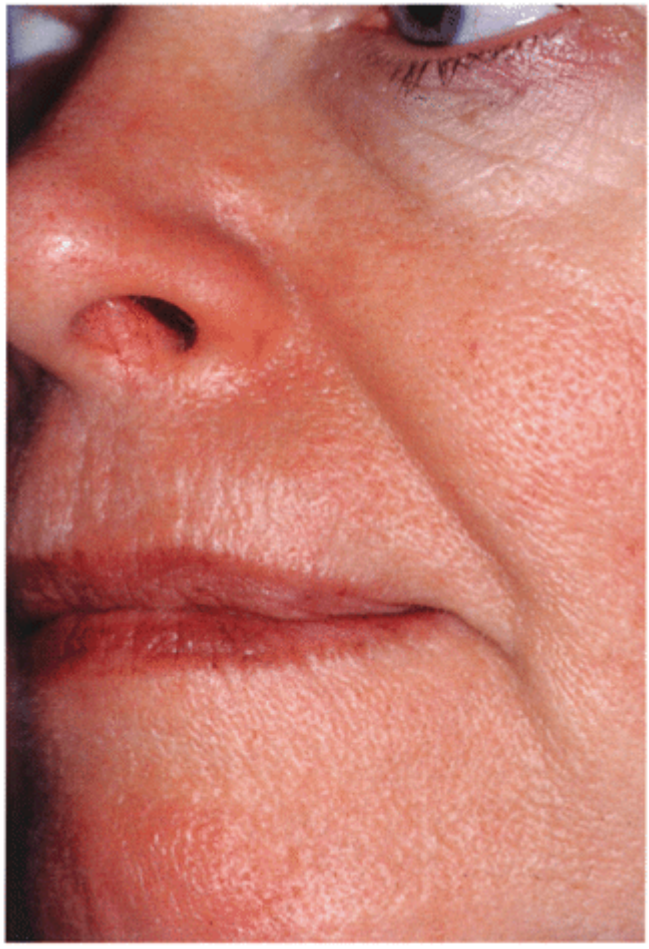


Figure 68

Semi profile view of the elongated upper lip.

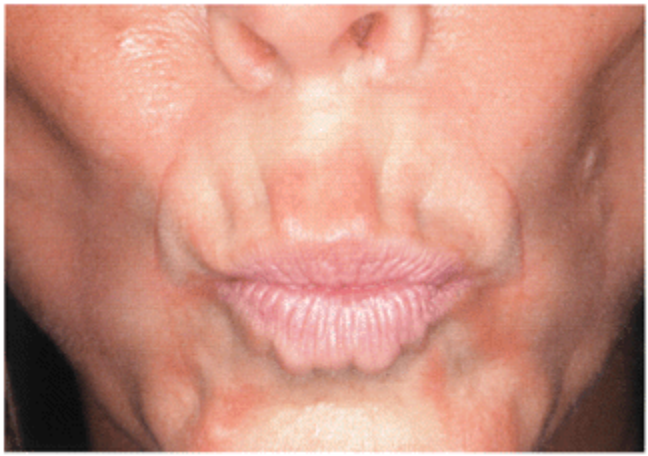


Figure 69

Mouth frown is a natural consequence of repeated use of orbicularis oris and depressor anguli oris. The resulting bitter and disappointed expression is interpreted as negative emotional content.

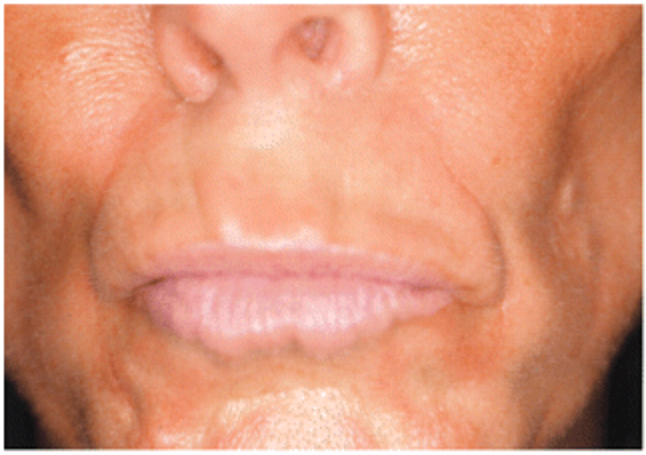


Figure 70

Dynamic action of depressor anguli oris.

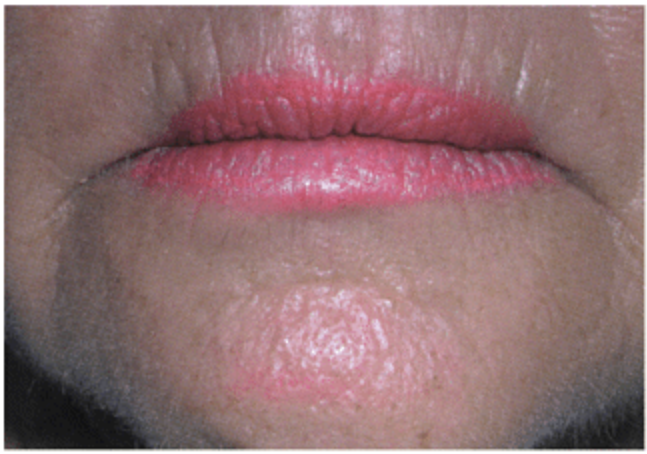


Figure 71

Surface anatomy of a successful injection of depressor anguli oris. If the depressor anguli oris is injected at the base of the melomental fold, diffusion to the lip depressors will occur. Instead, inject posterior to the melomental fold by following the melolabial fold to its extended junction with the margin of the mandible.

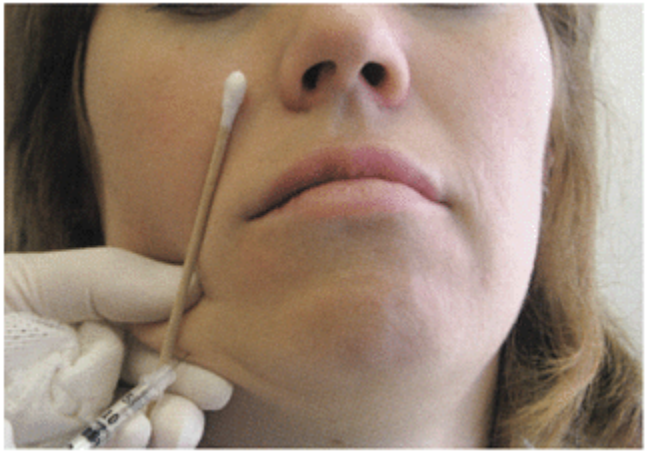


Figure 72

Mouth at rest preinjection of depressor anguli oris.

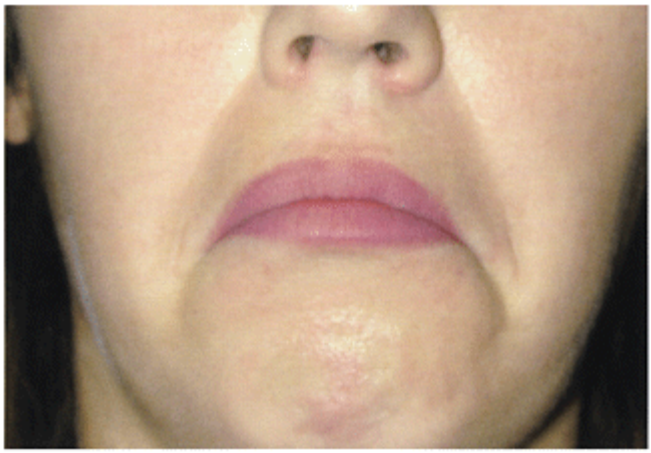


Figure 73

Mouth frown prior to injection.

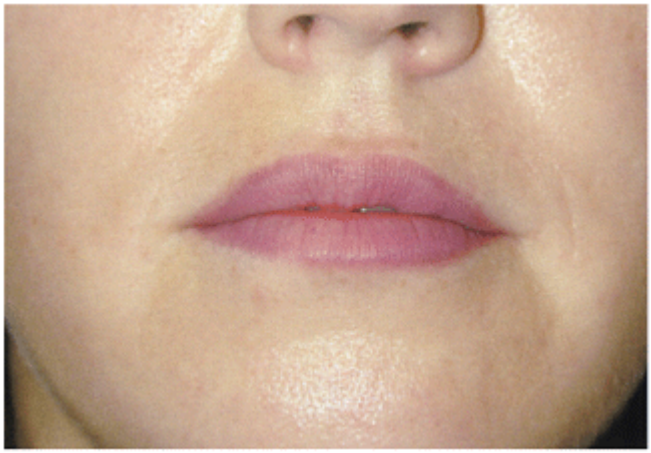


Figure 74

Mouth at rest post injection unchanged.

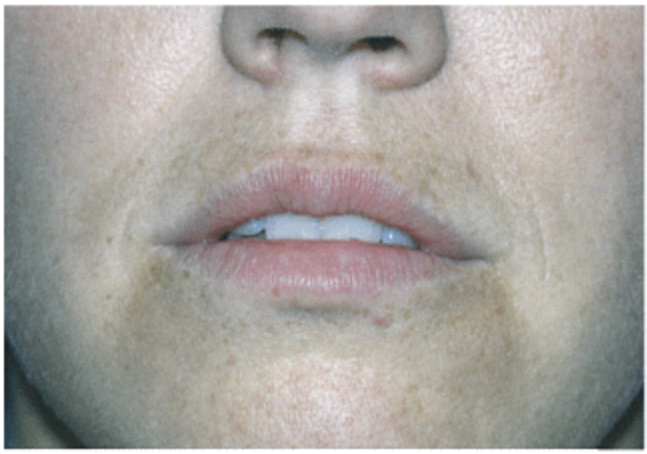


Figure 75

Mouth corners now unable to depress due to weakening of depressor anguli oris and unopposed action of zygomaticus major.

PERIORAL RHYTIDES (‘SMOKER’S LINES’)

Aging changes are particularly noticeable in the lips. Prominent changes include lengthening of the upper lip with loss of the youthful projection and reduced show of the red portion of the lips. Thinning of the tissues in combination with the above changes causes increased wrinkling and a tendency for lipstick to ‘bleed’ into the lines, which can be very distressing. These changes can be more obvious in individuals who have pursed their lips repeatedly, such as smokers, or who have played a musical instrument with embouchure.

INJECTION TECHNIQUE

Injection of 1–2 U of BOTOX per lip quadrant as symmetrically as possible across the philtrum can give positive cosmetic benefit with a pseudo aversion of the lips and without creating a paresis of the orbicularis oris that might interfere with elocution and suction. Despite this, some individuals complain of difficulty with lip proprioception post treatment and may even have difficulty putting on their lipstick. Before the treatment of BOTOX is given in the perioral area, the individual subject should have experienced a positive result with upper face crow’s feet or glabella injections so they understand what effect they may anticipate. Some individuals are emotionally unsuited to having this treatment because of their unrealistic expectations (Figures 76 and 77).

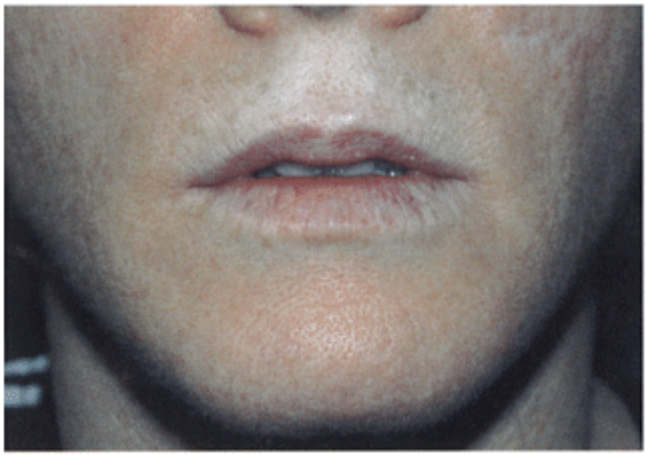


Figure 76

Radial lip rhytides are due to the repeated purse string action of orbicularis oris and also the associated photo damage and smoking. Inject 1–2 U per lip quadrant and only in individuals who have experienced BOTOX in the upper face.

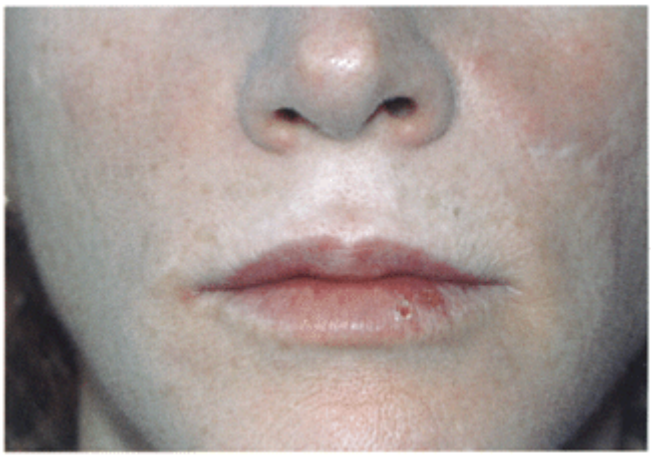


Figure 77

Softening of the radial lip lines post treatment.

UPPER GUM SHOW

This is a common problem occurring with individuals who have a naturally short upper lip. When they smile they show not only the bases of their incisors and canines but also a large segment of their gum line.

ANATOMICAL CONSIDERATIONS

Congenitally short upper lip with very active lip elevator muscles produces this problem. Injecting 1 U of BOTOX into each lip elevator complex in each nasofacial groove particularly under electromyographic guidance will relax the upper lip so that it cannot fully retract. Some individuals also do well with associated soft tissue augmentation.[23]

MOUTH FROWN

The frowning expression created by the permanent downward angulations of the lateral corners of the mouth causes a frustrated, disapproving and bitter appearance. This downward movement and narrowing of the mouth corners is caused by the action of depressor anguli oris in association with the normal photodamage and age related collagen and subcutaneous fat atrophy in the perioral area.[21]

ANATOMICAL CONSIDERATIONS

The depressor anguli oris passes inferiorly between the modulus at the lateral corner of the mouth down to the edge of the jaw line in line with the trajectory demonstrated by the melomental folds.[7] Injection too medially can affect the lip depressor muscles, elocution, smiling and thus confidence. Zygomaticus major is the direct antagonist to depressor anguli oris, and thus weakening depressor anguli oris with 3–5 U of BOTOX will allow zygomaticus major to elevate the corner of the mouth to a more horizontal relaxed position (see Figures 72–80).

In our clinic we have found the combination of BOTOX chemodernervation of depressor anguli oris with soft tissue augmentation to give the most refined and elegant cosmetic result.

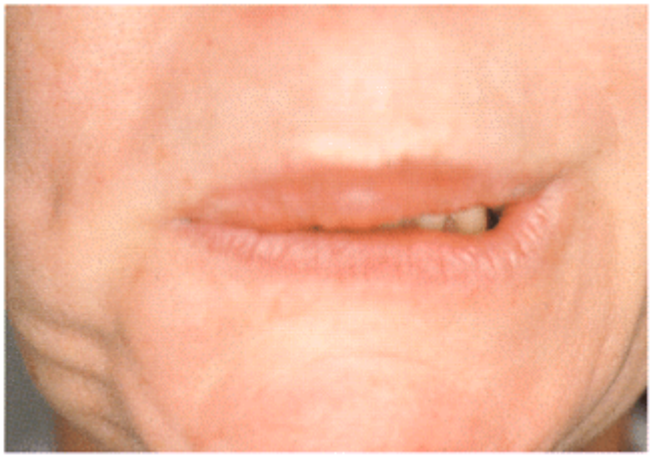


Figure 78

Complication of injection too medially in right melomental fold. Lip depressors weakened and yet the depressor anguli oris is functioning normally on the right.

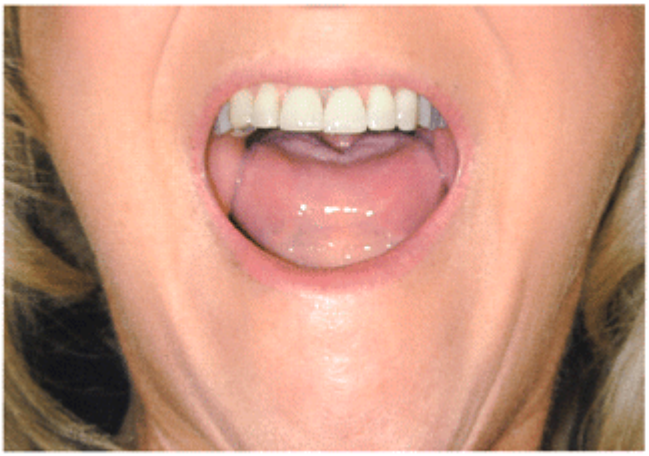


Figure 79

Poor depression of the lower lip due to iatrogenic depressor labii paresis.

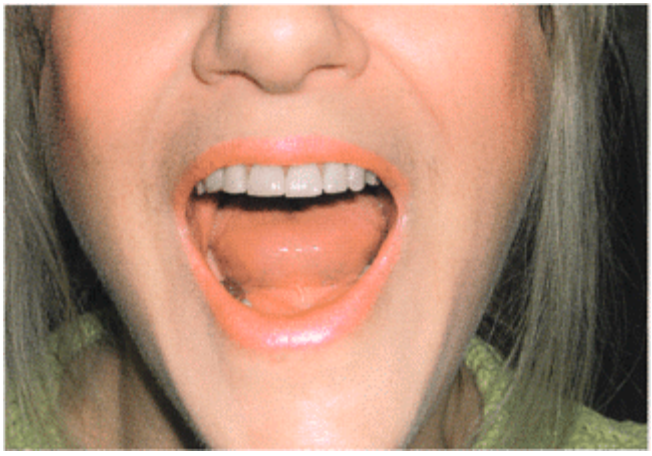


Figure 80

Five months later there is still incomplete recovery and the inferior dentition are just starting to become visible at full mouth opening.

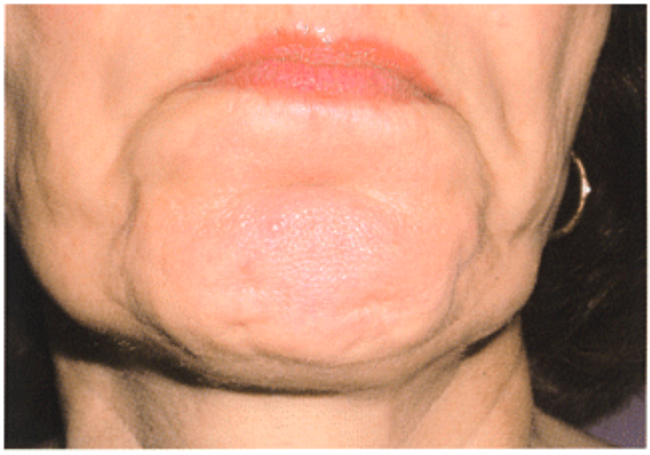


Figure 81

Mentalis overaction producing ‘apple dumpling’ chin in association with depressor anguli oris overaction and mouth frown.

MENTALIS

ANATOMICAL CONSIDERATIONS

Mentalis and depressor labii are actually very active muscles in the speech. Their action is disguised in youth by the normal amount of collagen in the dermis and subcutaneous fat. With atrophy of these a camouflaging structure of saying words like ‘so’ will result in an obvious visible muscle contraction in the chin—the so-called ‘apple dumpling’ appearance. BOTOX treatment of mentalis on either side of the point of the chin will soften the action of the mentalis, and with diffusion there may be also some effect of depressor labii. It is well to advise the individuals to stay upright after this injection and not to massage the area.

An associated treatment of the depressor anguli oris with the mentalis gives the most smooth and elegant treatment to the inferior perioral area and can be done at the same time as treatment with soft tissue augmentation or laser resurfacing (Figures 81–84).

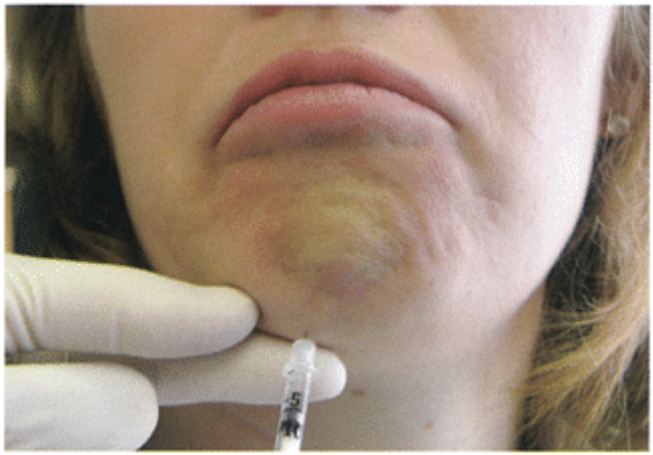


Figure 82

Injection technique for mentalis—stay low at the point of the mentum and avoid the depressor labii.

MENTAL CREASE

ANATOMICAL CONSIDERATIONS

In some individuals with an active mentalis a deep semi-lunar groove is interposed between the perioral area and the prominence of the chin. This can be softened by injecting mentalis. As indicated previously, it is important to inject mentalis from under

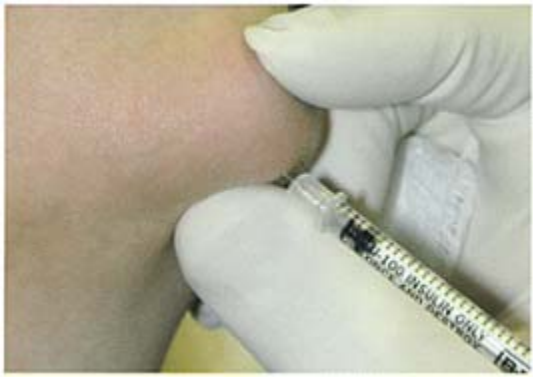


Figure 83

Semiprofile view to indicate the correct location for mentalis injection.

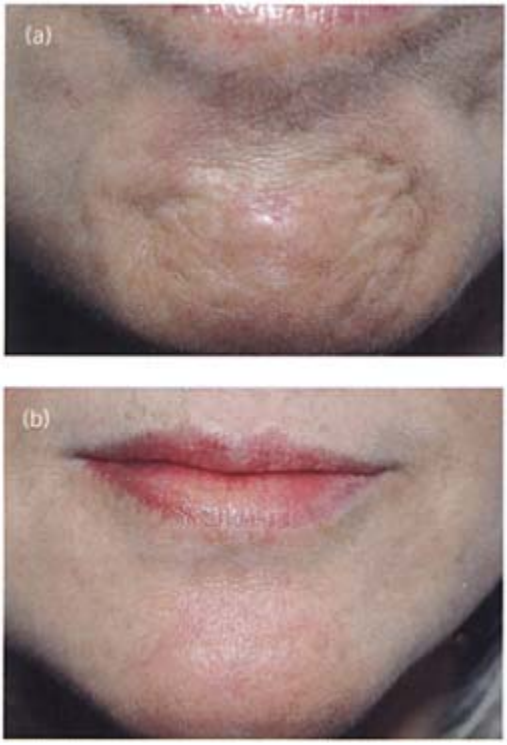


Figure 84

Before and after treatment of mentalis for ‘apple dumpling’ chin.

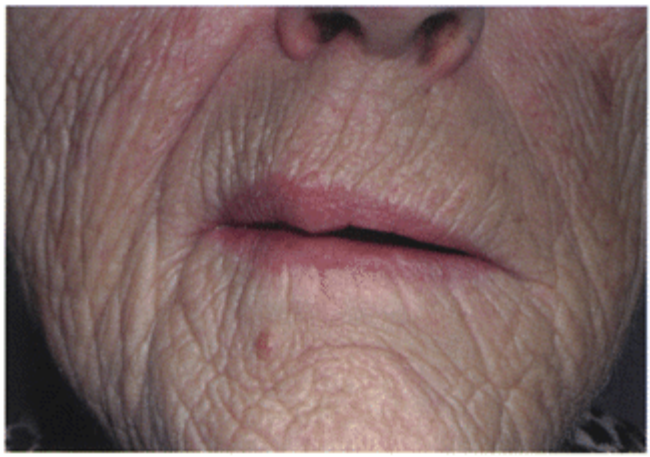


Figure 85

Hyperdynamic asymmetry of hemifacial spasm. Injection of sygomaticus, risorius and masseter on the overacting side can help to restore facial asymmetry.

the point of the chin, just anterior to the tip of the mandible, with an inferior approach. 3–5 U of BOTOX is injected into each side of the chin. Injection too high in mentalis can involve the lip depressor muscles with consequent difficulty in pulling down the lower lip when laughing, eating or talking.

LOWER FACIAL ASYMMETRY

ANATOMICAL CONSIDERATIONS

Lower facial asymmetry due to damage to the seventh cranial nerve or to the muscles of facial expression on one side can lead to pulling the mouth over to the normal powered side. BOTOX chemodernervation of the over dynamic risorius lateral to the lateral corner of the mouth in the mid-papillary line will allow the mouth to centre when the face is in repose. In addition, some individuals who have a weakness of the depressor anguli oris muscle on one side can have symmetry restored with a 2–5 U injection into the contralateral depressor anguli oris. It can be quite difficult to balance the face with unilateral injections and we commonly inject both sides in order to achieve even greater symmetry (Figure 85).

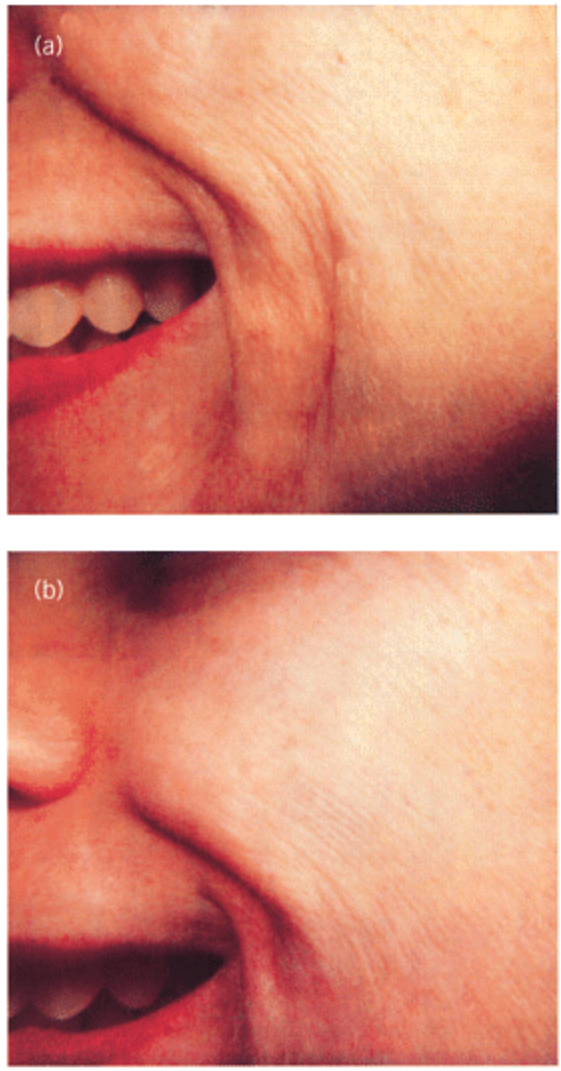


Figure 86

Zygomaticus smile lines. Injecting 1 U of BOTOX in the origin of zygomaticus and into risorius can soften these lines. Soft tissue augmentation and laser resurfacing are important adjunctive treatments in this area.

ZYGOMATICUS LINES

ANATOMICAL CONSIDERATIONS

Zygomaticus major attaches to the inferior zygoma in line with the lateral canthus of the eye. Often in individuals who have lost facial fat or collagen the crow's feet will establish continuity with zygomaticus lines. Injecting BOTOX into the zygomaticus in these individuals is not safe because it will drop the corner of the mouth for 6 months. These lines should not be treated except by individuals very familiar with the anatomy and when the patient understands there may be a change in the height of the corner of the mouth. In our opinion it is better to treat these lines by tightening the fabric of the skin of the cheek inferior to the zygomaticus origin using non-ablative laser resurfacing or supporting the facial envelope with soft tissue augmentation (Figure 86).

8
CERVICAL INJECTIONS

HORIZONTAL ‘NECKLACE’ LINES

ANATOMICAL CONSIDERATIONS

The platysmal muscle is a large muscle, which inserts into the pectoralis major and minor along the thoracic inlet and extends vertically up the neck to interdigitate with the lower muscles of facial expression. In the slightly chubbier neck two to three horizontal ‘necklace’ lines of skin indentation may appear because of the subcutaneous muscular aponeurotic system attachments from platysma to the overlying skin.

INJECTION SITES AND DOSING

The simplest approach is to inject 1–2 U of BOTOX approximately 1 cm apart along each ‘necklace’ line with some massage. Raising a wheal as in a deep dermal injection is preferable as this is an area that does tend to bruise easily. We tend to inject no more than 10–20 U per treatment session because of the close proximity of the muscles of deglutition and speech (Figures 87 and 88).

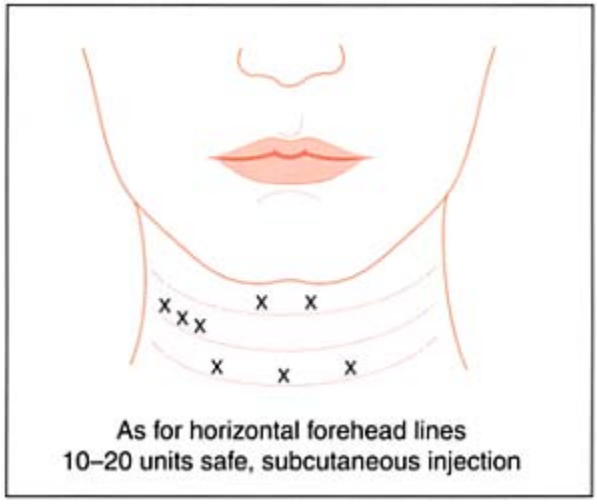


Figure 87

Injection diagram for horizontal necklace lines.

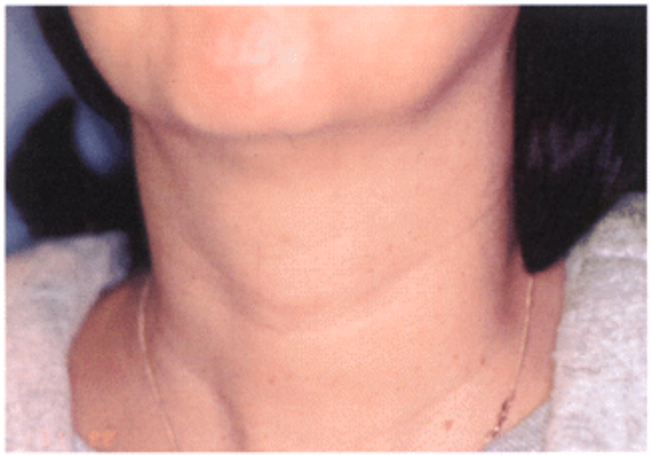


Figure 88

Pretreatment horizontal necklace lines.

VERTICAL PLATYSMAL BANDS

ANATOMICAL CONSIDERATIONS

Separation and vertical banding of the platysma occurs over time. BOTOX has been used for many years to treat this problem in individuals who do not have jowl formation and bone reabsorpion. In individuals who have marked dermatocholasis and fat prolapse in the neck, more traditional face lifting surgery may be the treatment of choice. BOTOX chemodenervation can also be used as a rehearsal so that individuals who are not ready to undergo traditional face-lift surgery may have an aesthetic enhancement with no downtime using BOTOX.

As with horizontal ‘necklace’ lines, the vertical platysmal bands are external to the muscles of deglutition, speech and neck flexion. We have previously reported one individual treated with only 60 U of BOTOX in the neck who had such severe failure to swallow that she had to be fed with a nasogastric tube for approximately 6 weeks. Other authors have reported up to 200 U of BOTOX in the neck in the past but we feel that this in fact interferes not only with speech and deglutition but also with neck flexion, and we do not recommend such high doses.

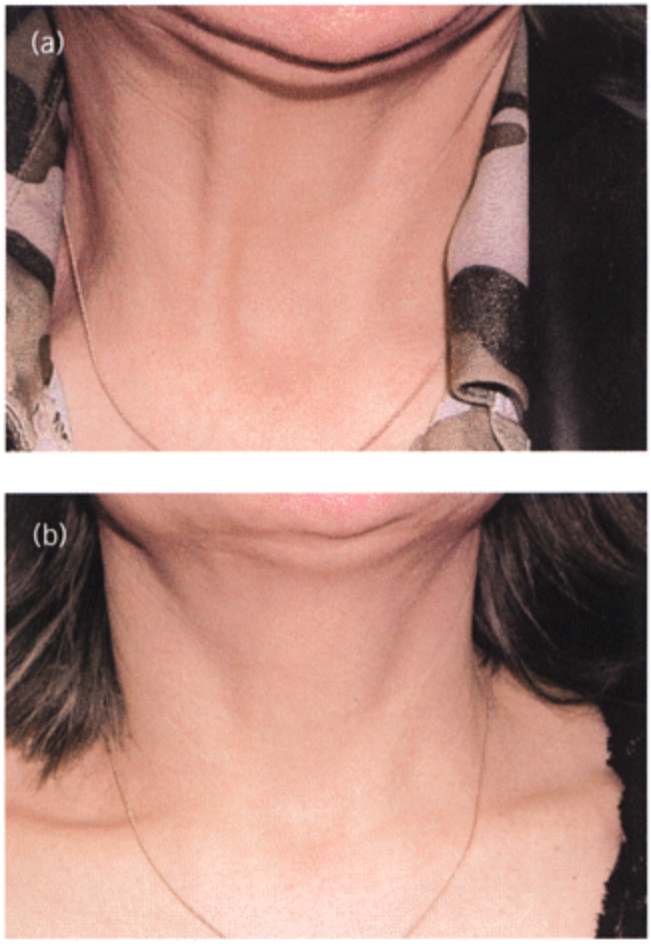


Figure 89

Vertical platysmal bands before and after treatment.

Two techniques are used in this area. The commonest is to grasp the band and to inject approximately 15 U divided into three injection sites along each band. Alternatively, a 1.5 inch 27 gauge EMG needle can be used and passed across the width of the muscle, listening to the EMG signal to ensure that the needle remains in the muscle. Proponents of this technique argue that it is more accurate with a better response from a lower dose and a lower likelihood of complications. However, it is more uncomfortable for the patient and requires special equipment. Both techniques are reasonable and effective (Figure 89).[24–27]

9
ADJUNCTIVE USE

Botulinum toxin injections are easily combined with other cosmetic procedures, producing a more polished and refined result, and also prolonging the effect of the other procedures. In some clinical situations for example the repeated action of the brow depressor muscles after brow lift surgery can pull the brow down, as can the repeated action of the platysma in face lift surgery. Botulinum toxin can also be used to reduce the tension exerted on a wound or surgical incision by the underlying muscles, allowing for better healing and less scar formation.

WITH SURGICAL BROW LIFT

As mentioned above, botulinum toxin can be used on its own to create a mild brow lift. However, surgery is indicated when brow ptosis is moderate to severe. Preoperative and postoperative relaxation of the brow depressors with botulinum toxin A may allow for greater stability of brow elevation, particularly in the first 3 months after surgery when the brow skin is binding to its new position (Figure 90).[5,28,29]

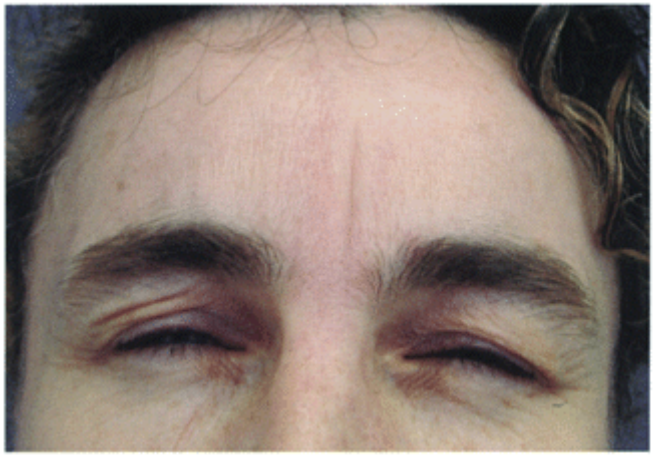


Figure 90

After brow lift surgery, a significant number of subjects experience a recurrence of the brow depressor muscle activity as in this individual.

WITH UPPER AND LOWER EYELID BLEPHAROPLASTY

Prior to upper lid blepharoplasty it is important to use botulinum toxin to achieve a minor brow lift and also to attempt to equalize brow height. Over-resection of upper eyelid skin on the side with the lower brow could otherwise occur producing a permanent angry and hostile expression. This is only appropriate for individuals with mild asymmetry and those individuals having more marked asymmetry may require a coexisting brow lift. With lower eyelid blepharoplasty, treatment of the crow's feet can relax the skin, allowing for a more accurate assessment of the amount of skin to be resected during surgery and better placement of the incision, so it is concealed within the orbital margin (Figures 91 and 92).[30,31]

WITH LOWER EYELID ECTROPION AND 'ROUND EYE' REPAIR

After these procedures dehiscence of the temporal incision in repair of lower eyelid ectropion can often occur, and weakening of the area over orbicularis that is pulling against the incision can allow it to heal with no complications (Figure 93).[32,33]

WITH ABLATIVE AND NON-ABLATIVE LASER RESURFACING

The habitual use of the muscles of facial expression will eventually refold the new dermal collagen created by the laser treatment, producing a more sausage-like appearance to the crow's feet and a thicker and more clumsy look to the glabellar frown line. Regular postoperative injections every 6 months prolong and expand and refine the laser resurfacing procedures (Figures 94–98).[34–36]

WITH REPAIR OF FACIAL WOUNDS

Some wounds have a tendency to widen, even when orientated properly along the relaxed skin tension lines. A good example is horizontal forehead incisions that should heal well but can often show a degree of widening. Botulinum treatment of the brow depressors will reduce the pull on the incision during the time needed to attain strength in the healing wound and will optimize the final result. Similar examples will occur to the active surgeon.[37]

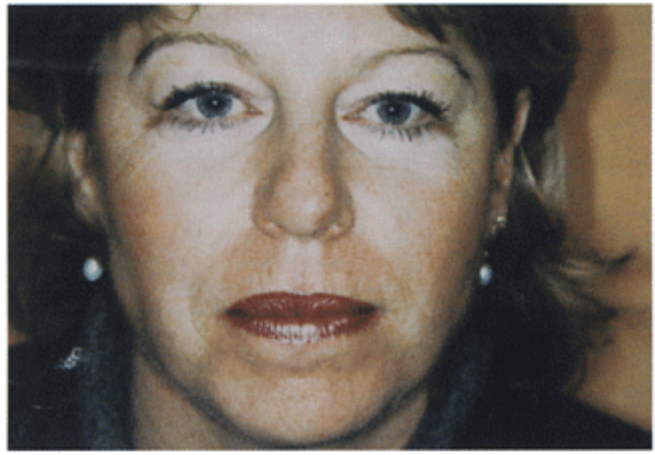


Figure 91

BOTOX polishes the surgical blepharoplasty result by stabilizing the brows during the healing phase. Pretreatment photograph.

Figure 92

Post BOTOX and cosmetic CO_2 laser-assisted upper eyelid blepharoplasty, the eyes appear more open and alert and there is an associated mild brow lift.

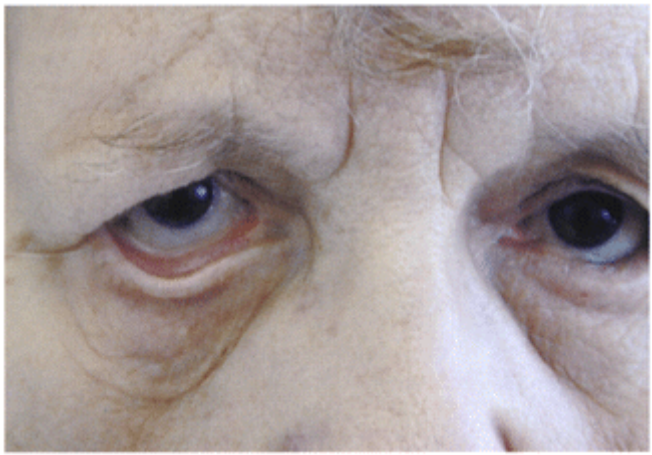


Figure 93

BOTOX can be used in the surgical repair of ectropion of the lower eyelid by weakening the distracting force of the horizontal fibres of the orbicularis on the vertical tarsal incision.

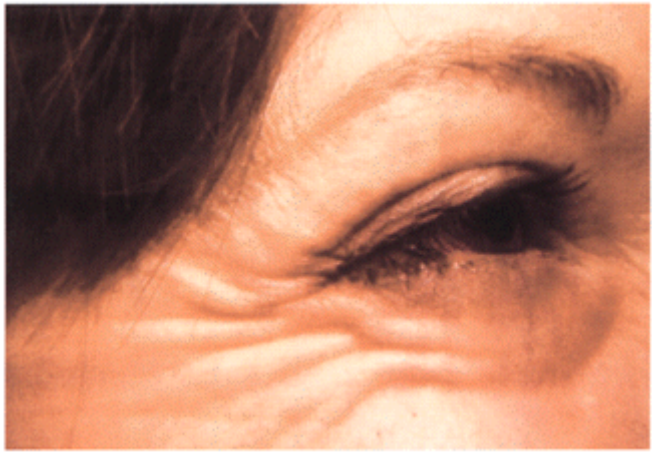


Figure 94

BOTOX is a prerequisite for maintenance of post ablative and nonablative laser resurfacing results. In this individual, the crow’s feet are much thicker than before laser resurfacing because of the newly generated dermal collagen.

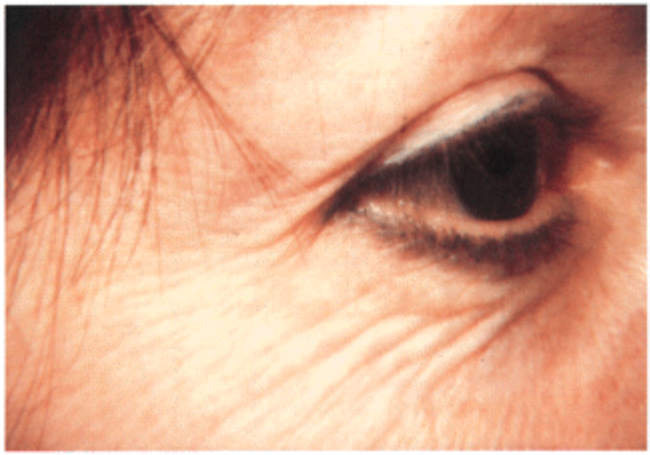


Figure 95

Resting crow's feet before resurfacing and BOTOX.

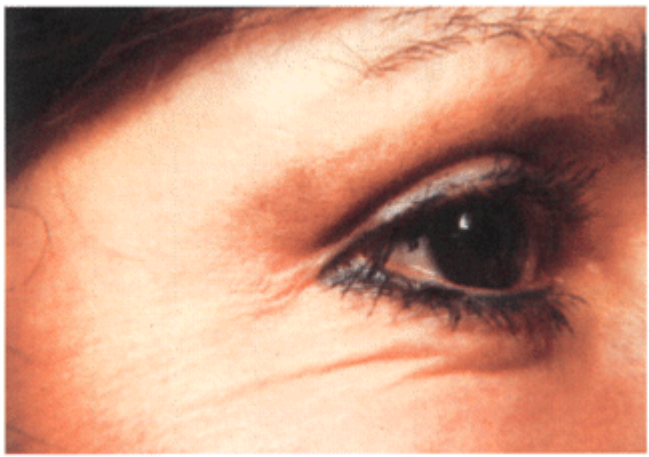


Figure 96

Resting crow's feet after both modalities. Note the polished appearance in comparison to the tissues in Figure 94.

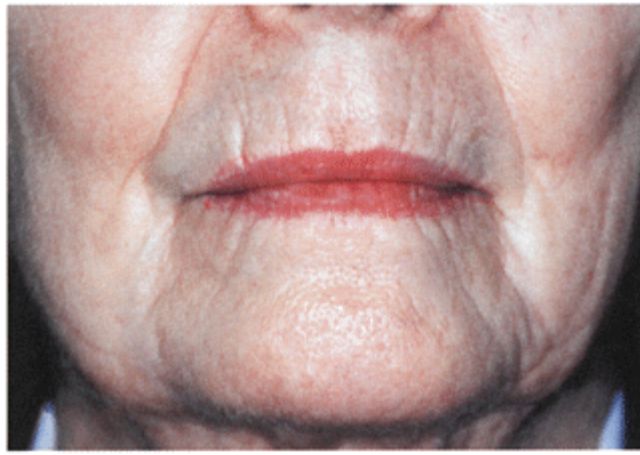


Figure 97

Perioral rhytides also benefit from combined therapies. In this 78– year-old subject, CO_2 ablative resurfacing was combined with perioral BOTOX injections.

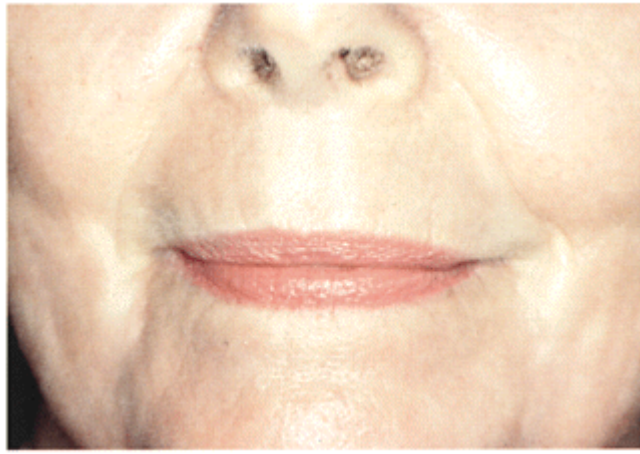


Figure 98

Post treatment improvement in rhytides seen with combined treatment with laser and BOTOX.

RHYTIDECTOMY (FACE-LIFT)

In some face-lift techniques the separated vertical platysmal bands are sutured together in the mid-line in order to refine the cervical mental angle. A simpler approach is to use chemodenervation with BOTOX to achieve the same result. In some individuals who have had a platysmal plication the muscle may eventually pull out of the plication and instead of another surgical procedure the bands can be treated with BOTOX. Another problem that can occur after platysmal plication is ‘bow-stringing’ of platysma actively reducing the cervico-mental angle improvement desired. Botulinum toxin treatment can be a simple way of preventing this complication from occurring during the healing phase, and can improve it if it develops.

10
SUMMARY

Botulinum toxin therapy is now accepted throughout the world as a safe, rapid, effective, desirable treatment of upper and now lower facial and cervical rhytides. It can be used on its own or in combination with other modalities to produce an improved result. Its versatility makes it a natural leader in the cosmetic world.

New injectors are encouraged to re-learn the facial muscular anatomy, as well as modern concepts of aesthetics, and to understand the individual's desires for facial enhancement. A learned sophisticated approach to cosmetic botulinum injections in the face and neck will ensure positive aesthetic results with avoidance of complications.[38,39] In essence, the botulinum toxin injector becomes an artist and sculptor as well as a physician and surgeon.

REFERENCES

1 Alarm M, Dover J, On beauty. Evolution, psychosocial considerations and surgical enhancement, *Arch Dermatol* (2001) **137:** 795–807.

2 Lamanna C, The most poisonous poison, *Science* (1959) **130:** 763–772.

3 Carruthers JA, Carruthers JDA, BOTOX treatment of glabellar frown lines and other facial wrinkles, *J Dermatol Surg Oncol* (1990) **10:** 370 (abst).

4 Carruthers JDA, Carruthers JA, Treatment of glabellar frown lines with *C.botulinum* A exotoxin, *J Derm Surg Oncol* (1992) **18:** 17–21.

5 Carruthers JDA, Carruthers JA, The adjunctive use of BOTOX, *Dermatol Surg* (1998) **24:** 1244–1247.

6 US Bureau of the Census, 78 million people born: 1946–1964 (Bernan Press: Lanham, 2001).

7 Larrabee WF, Makielski KH, *Surgical Anatomy of the Face* (Raven Press: New York, 1993).

8 Klein AW, Dilution and storage of botulinum toxin, *Dermatol Surg* (1998) **24:** 1179–1180.

9 Lowe NJ, Maxwell J, Double blind, vehicle controlled study with an electromyographic injection technique, *J Am Acad Dermatol* (1996) **35:** 569–572.

10 Blitzer A, Brin MF, Keen MS, Botulinum toxin for treatment of hyperfunctional lines of the face, *Arch Otolaryngol Head Neck Surg* (1993) **119:** 1018–1022.

11 Carruthers J, Carruthers A, Klein A, Flynn T, Multicenter dose ranging study of botulinum toxin type B (MYOBLOC from Elan Pharmaceuticals), in progress 2002.

12 Callaway JE, Arezzo JC, Grethlein AJ, Botulinum toxin type B: an overview of its biochemistry and preclinical pharmacology, *Semin Cutan Med and Surg* (2001) **20:** 127–136.

13 Matarasso A, Endoscopic surgical correction of glabellar creases, *Dermatol Surg* (1995) **6:** 695.

14 Huilgol S, Carruthers JA, Carruthers JDA, Raising eyebrows with botulinum toxin, *Dermatol Surg* (1999) **25:** 373–376.

15 Frankel AS, Kamer FM, Chemical browlift, *Arch Otolaryngol Head Neck Surg* (1998) **124:** 321–323.

16 Huang W, Rogachefsky A, Foster JA, Browlift with botulinum toxin, *Dermatol Surg* (2000) **26:** 55–60.

17 Ahn MS, Catten M, Maas CS, Temporal brow lift using botulinum toxin, *Adv Ophthal Plast Reconstr Surg* (2000) **105:** 1129–1135.

18 Carruthers A, Carruthers J, Botulinum toxin type A: history and current cosmetic use in the upper face, *Semin Cutan Med Surg* (2001) **20:** 71–84.

19 Flynn TC, Carruthers JA, Carruthers JDA, Botulinum A exotoxin treatment of the lower eyelid improves infraorbital rhytides and widens the eye, *Dermatol Surg* (2001) **27:** 703–708.

20 Flynn TC, Carruthers JA, Carruthers JDA, The use of the ultrafine II short needle 0.3 cc insulin syringe for botulinum toxin injections, *J Am Acad Dermatol* (2000) **46:** 931–933.

21 Carruthers J, Carruthers A, BOTOX use in the mid and lower face and neck, *Semin Cutan Med Surg* (2001) **20:** 85–92.
22 Carruthers A, Carruthers JDA, Clinical indications and injection technique for the cosmetic use of botulinum A exotoxin, *Dermatol Surg* (1998) **24:** 1189–1194.
23 Carruthers JDA, Carruthers A, Practical techniques in cosmetic BOTOX, *J Cutan Med Surg* (1999) **3:** 49–52.
24 Matarasso A, Matarasso SI, Brandt FS, Botulinum A exotoxin for the management of platysmal bands, *Plast Reconstr Surg* (1999) **103:** 645–652.
25 Kane MAC, Nonsurgical treatment of platysmal bands with injection of botulinum toxin A, *Plast Reconstr Surg* (1999) **103:** 656–663.
26 Hoefflin SM, The platysma aponeurosis, *Plast Reconstr Surg* (1996) **97:** 1080.
27 Blitzer A, Binder W, Aviv JE, The management of hyperfunctional facial lines with botulinum toxin, *Arch Otolaryngol Head Neck Surg* (1997) **123:** 389–392.
28 Stasior OG, Lemke BN, The posterior eyebrow fixation, *Adv Ophthal Plastic Reconstr Surg* (1983) **2:** 193–197.
29 Knize D, An anatomically based study of the mechanism of eyebrow ptosis, *Plast Reconstr Surg* (1996) **97:** 1321–1333.
30 Remington K, Carruthers JDA, Laser blepharoplasty, *J Cutan Med Surg* (1999) **3:** 21–26.
31 Carruthers JDA, Carruthers JA, *Blepharoplasty and Brow Lifts. Dermatologic Clinics* (WB Saunders: Philadelphia, 2001).
32 Fagien S, BOTOX for the treatment of dynamic and hyperkinetic facial lines and furrows: adjunctive use in facial aesthetic surgery, *Plast Reconstr Surg* (1999) **103:** 710–713.
33 Fagien S, Botulinum toxin can remove/eradicate rhytides, improve overall results, *Ophthalmology Times International* (1998) Jan/Feb: 20–22.
34 Carruthers J, Carruthers A, Combining botulinum toxin injection and laser for facial rhytides. In: Coleman WP, Lawrence N, eds, *Skin Resurfacing* (Williams and Wilkins: Baltimore, 1998), 235–243.
35 West TB, Alster TS, Effect of botulinum toxin type A on movement associated rhytides following CO_2 laser resurfacing, *Dermatol Surg* (1999) **25:** 259–261.
36 Carruthers J, Carruthers A, Zelichowska A, The power of combined therapies: BOTOX and ablative laser resurfacing, *Am J Cosm Surg* (2000) **17:** 129–131.
37 Gassner HG, Sherris DA, Otley CC, Treatment of facial wounds with botulinum toxin A improves cosmetic outcome in primates, *Plast Reconstr Surg* (2000) **105:** 1948–1955.
38 Klein AW, Complications and adverse reactions with the use of botulinum toxin, *Semin Cutan Med Surg* (2001) **20:** 109–120.
39 Glogau RG, Cosmetic dermatology: no apologies, a few regrets, *Arch Dermatol* (1998) **134:** 1204–1206.

INDEX

Page numbers in *italics* refer to figures.