

## Management of Forehead Wrinkles

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Botulinum toxin is widely known to be an excellent treatment for smoothing out both vertical and horizontal forehead lines. Patients often ask for it to be used to treat their vertical (glabellar) frown or their horizontal lines or put in a general request for improvement. It is important to find out at an early stage whether they are looking for total immobility of the forehead (this is often not possible—as explained below) or simply for a natural-looking effect with some residual forehead expression and greatly reduced wrinkles.

Forehead wrinkles are due to a combination of genetic and environmental factors, especially damage ultraviolet light. The contributions of both must be analysed when patients attend for treatment. Make sure too that they do not expect the ablation of furrows as this requires carbon dioxide laser resurfacing for maximum effect.

Older patients tend to develop deep forehead furrows from subconsciously lifting their upper lid skin and brows off the eyelids. Ptosis or blepharoplasty surgery is often accompanied by relaxation of the frontalis and elimination of such rhytids.

Botulinum toxin to the mid-forehead can lead to permanent atrophy of the muscle fibres, with an excellent long-lasting result. This usually occurs after five or six treatments at 14-week intervals. The glabellar muscles always seem to recover after treatment but can, with time, diminish in size and function. Most patients continue to return for glabellar and crow's feet treatment, with an annual 'top-up' to the mid-frontalis.

Treatment of the frontalis will inevitably affect the shape of the brow. This must be assessed carefully and discussed with the patient. The treatment of horizontal lines alone may avoid changes to the brow, but once the glabella has been treated, the frontalis must be balanced with the treatment.

Remember that the shape of the brow is subject to fashion. I prefer the current trend for a female brow to have a slight arch at the junction of the medial two thirds to the lateral third. More modern trends include a horizontal brow that elevates laterally. It is essential to avoid a 'Dr Spock' effect with a peak to the brow, usually achieved by the unopposed action of the frontalis on the mid-brow, and most likely to occur when the glabellar muscles are treated independently.

Tell your patients what to expect from botulinum toxin at this stage, and discuss how their foreheads might alter with age. Let them know that with regular treatments, they will begin to lose their "reactive" frowning, as the central signaling area in the brain diminishes in size in response to their Botulinum toxin treatments.

Select patients as described in Chapter 6, and take great care to avoid treating the forehead of a patient with the rare neuromuscular disorder known as chronic progressive external ophthalmoplegia (CPEO). Remember that such patients may not yet have been diagnosed. Examine the eyes and eyelids of every new patient for signs of asymmetry or abnormal muscle function. If in doubt, refer to an ophthalmologist for examination before any treatment is attempted.

### Chronic Progressive External Ophthalmoplegia

CPEO is a rare neuromuscular disorder that causes total immobility of all the external ocular muscles and of the levator muscles of the eyelids. Patients eventually need an operation to attach their frontalis muscles to their eyelids (by a subcutaneous sling) so that they can open their eyes and see. The initial presentation is often a symmetrical ptosis with brow elevation.

### Anatomy of Frown Muscles

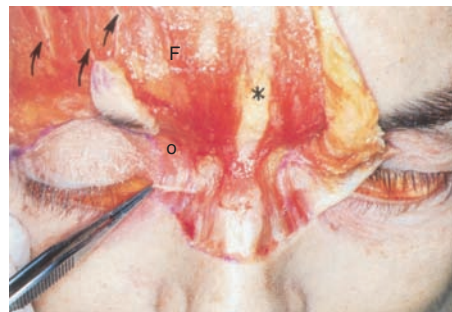
An intimate knowledge of the anatomy of the forehead is essential for successful treatment. There will always be a few patients with variations on the normal anatomy, but the typical muscle attachments are shown in Fig. 9.1. In particular, note the following:

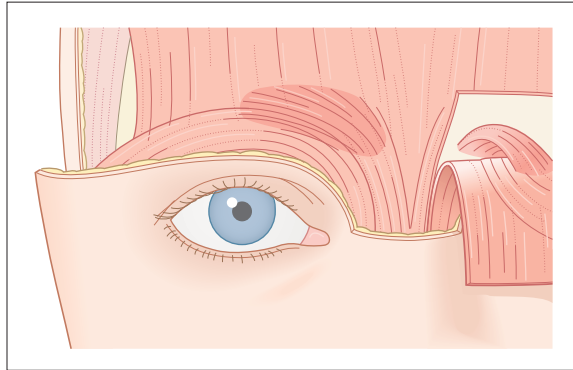
- The frontalis muscle originates from the galea aponeurosis (near the hair line) and stretches to an insertion into the skin and the orbicularis oculi at the level of the eyebrows.
- The frontalis does not cross the midline and is separated by a central muscle-free zone at the base of the nose (Figs 9.2 and 9.3). Movements of the galea aponeurosis unaccompanied by movement of the frontalis will cause wrinkling of the forehead skin, especially in patients who can voluntarily ‘wiggle their ears’ or ‘move their scalp’.

**Fig. 9.1** Anatomy of the forehead. The vertical fibres of the frontalis muscle (F) insert into the skin and orbicularis oculi at the level of the eyebrow. The frontalis muscle, innervated by a branch of the seventh cranial nerve, originates from the galeal aponeurosis (G). The red arrow tip is inserted below the galea. The black arrow tip lies beneath the periosteum of the frontal bone. Note the sensory nerve (\*), a branch of the supraorbital nerve coursing over the muscle. The frontalis muscle usually does not cross the midline. (From Zide, B. M., & Jelks, G. W. (1985). *Surgical anatomy of the orbit*. New York: Raven Press Books, Ltd. With permission of Barry Zide.)



**Fig. 9.2** Note that the frontalis fibres do not cross the midline. Note the paired frontalis muscles (F) with their central muscle-free zone (\*). The supraorbital nerves are noted coursing upwards (small arrows). The forceps grasp the anterior portion of the medial canthal tendon. Note the orbicularis oculi fibres (o), some of which originate from this tendon. (From Zide, B. M., & Jelks, G. W. (1985). *Surgical anatomy of the orbit*. New York: Raven Press Books, Ltd. With permission of Barry Zide.)





**Fig. 9.3** The glabella complex. (From Zide, B. M., & Jelks, G. W. (1985). *Surgical anatomy of the orbit*. New York: Raven Press Books, Ltd. With permission of Barry Zide.)

- The bone at the base of the nose is covered by the procerus muscle (skin attachments only), blending into the corrugator muscle at the level of the eyebrows, and the medial fibres of the orbicularis oculi below the medial part of the brow.
- The corrugator muscle arises from the nasal process of the frontal bone. It is responsible for drawing the eyebrows together, creating the vertical glabellar rhytid. The corrugator lies deep to the frontalis, the procerus and the supraorbital nerves and arteries. It attaches to the skin above the medial aspect of the eyebrow.

The vertical fibres of the orbicularis oculi, which run superomedial to the medial canthal tendon, attach to the medial brow and are known as the depressor (corrugator) supercilii. The angular veins are embedded in this muscle.

## Examination of Brow/Forehead Rhytids

General appraisal

Specific glabella (vertical frown) examination

Specific forehead (horizontal frown) examination

### GENERAL APPRAISAL

Brows

Hairstyle

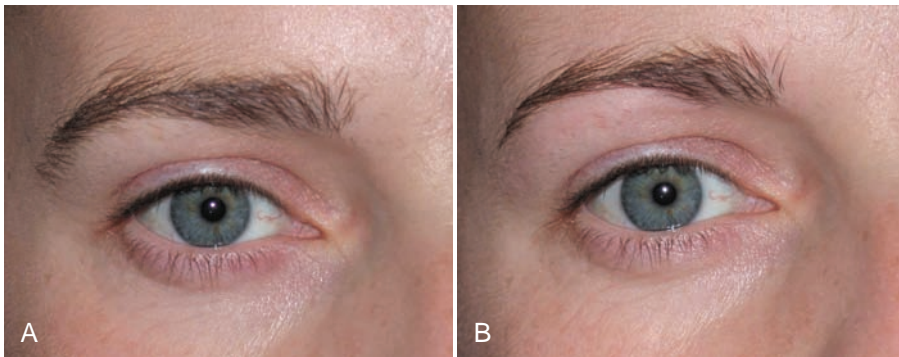
Ptosis

Dermatochalasis

First, examine your patient carefully and decide what botulinum toxin can do for his or her particular type of lines. Decide at this stage whether or not botulinum toxin treatment will eliminate the wrinkles. Will laser resurfacing be needed? Will the vertical lines also require a filler (Chapter 11)?

### Eyebrows

Examine the eyebrows. Are they heavy or groomed? Some brows look as if they have descended because of their excessive growth of hair. Simple contouring of the brow with tweezers can give the illusion of a lift and instantly take years off the eyes (Fig. 9.4A and B). A visit to a reputable beautician may be recommended to acquire a professional shape, which the patient can easily maintain thereafter.



**Fig. 9.4** (A) Before and (B) after eyebrow contouring.

### Hairstyle

Discuss this with the patient. If a fringe (bangs) is being worn, will the effects of botulinum toxin be noticeable? Is the patient happy to have botulinum toxin to prevent further ageing of the forehead, regardless of whether or not it can be seen? Is the patient getting a receding hairline with widow's peaks? This can be ageing. Full forehead and scalp botulinum toxin treatment will lengthen the forehead further. They may be advised to modify their hairstyle to hide the receding areas. Has the patient seborrheic dermatitis, acne rosacea or psoriasis? In the author's experience, this usually disappears in the zones treated with botulinum toxin, to the delight of the patients. Inform them of this possible bonus.

### Ptosis

Always examine the patient for signs of ptosis (a droopy eyelid). This is common in patients over 60 years old and is usually unilateral or asymmetrical. The levator aponeurosis, which opens the eyelid, and which is also responsible for the 'lid crease' by its superficial insertion into the orbicularis muscle and skin, slips up under the orbital rim (and eyebrow) with age or trauma, including eye rubbing. This causes a slight drooping of the eyelid that worsens on looking down and when the patient is tired (Fig. 9.5A and B). Patients then compensate by tensing the frontalis muscle,



**Fig. 9.5** (A) Before and (B) after left levator aponeurosis reinsertion. Note high lid crease and ptosis preoperatively.

developing high arched eyebrows, deep frontalis furrows and deep upper lids, which droop sleepily. The lid crease is often noticeably higher on the affected side (normal 7 to 10 millimeters, symmetrical).

In these patients, botulinum toxin to the frontalis muscle results in an immediately obvious ptosis (even though it was already present). Patients will also complain of the appearance of swollen upper lids as their brow descends. The ptosis is often asymmetrical, sometimes unilateral, and sometimes occurs in young people following trauma. It will be hard to convince these patients that the botulinum toxin did not cause the initial ptosis. Examine carefully before treating!

### Basic Ptosis Examination

- Observe the patient in the primary position (looking straight ahead).
- Measure the palpebral aperture (P.A.)—the distance from the lower lash margin to the upper lash margin at the midpoint of the pupil.
- Place a finger over the patient's brow to stop it from moving.
- Ask the patient to look down. Place the zero point on a fine ruler over the upper lid lashes before immediately asking the patient to look up. Now measure the point on the ruler where the lash margin has risen to.
- The result is the levator muscle function (normal is 15 to 18 mms).

### Dermatochalasis (Eyelid Bags)

The term dermatochalasis refers to age-related wrinkling and sagging of the skin over the eyelids. Examine carefully for brow elevation with overaction of the frontalis compensating for the 'heavy skin' and subconsciously lifting it off the lids (Fig. 9.6). Botulinum treatment to the frontalis may unmask the dermatochalasis and give the illusion of 'swelling' of the upper lid skin (Fig. 9.7A and B).

## EXAMINATION OF THE GLABELLAR FROWN

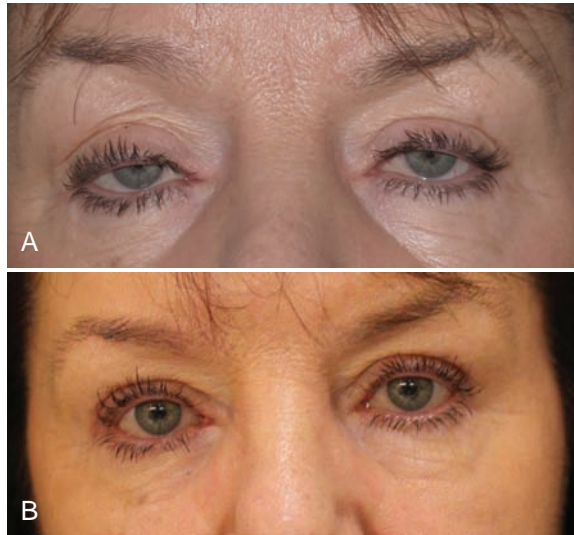
The glabella is the area between the eyebrows. A deep rhytid, the glabellar crease, may occur in isolation (Fig. 9.8); with a parallel but usually shorter rhytid (Fig. 9.9); or with curved rhytids under the medial brows (Fig. 9.10). A vertical glabellar crease is usually associated with hypertrophy of the medial corrugator fibres.

Horizontal glabellar rhytids ('Bunny Lines') are due both to dynamic and static factors. The dynamic cause is contraction of the procerus muscle (there is no frontalis here). The static cause is sagging of the forehead skin and muscle with age, overhanging the base of the nose (Fig. 9.11).

The medial fibres of the frontalis elevate the brow but overlies the brow depressor and the corrugator. Treatment of the corrugator should avoid the brow elevator fibres.



**Fig. 9.6** High raised eyebrows with forehead wrinkles and upper eyelid bags, and 'bag' weight induced ptosis.



**Fig. 9.7** (A) Before and (B) after upper eyelid surgery for dermatochalasis, unmasked by botulinum toxin to the forehead.



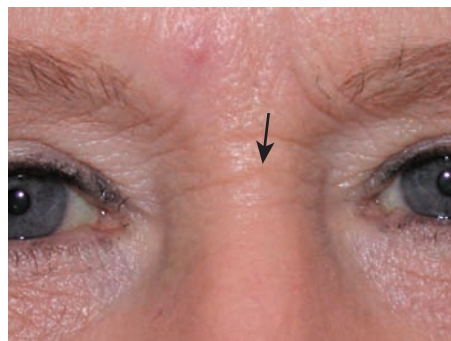
**Fig. 9.8** Single vertical frown in a 40-year-old woman.



**Fig. 9.9** Parallel vertical frown lines.



**Fig. 9.10** Curved vertical frown lines.



**Fig. 9.11** Bunny line.



**Fig. 9.12** Ask the patient to close both eyes (allowing eyebrows to drop), then to open eyes slowly while looking in a mirror. This demonstrates the probable resting position of the brows after botulinum toxin A to the frontalis muscle.

## EXAMINATION OF THE HORIZONTAL FROWN

Examine the brows carefully. First, demonstrate the effect that botulinum toxin to the forehead would have if brow tone were to be weakened. To do this, ask the patient to close both eyes and then to open them very slowly while looking in the mirror. This may require repeated attempts, but show the result to the patient in the mirror (Fig. 9.12)

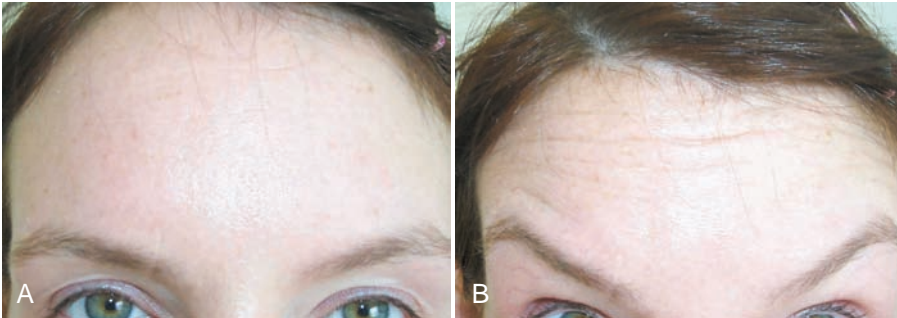
Examine the upper lid crease once this has been achieved. If the lid crease is unaltered by their resting brow, then the patient is suitable for full botulinum toxin treatment. If the lid crease has become full due to dermatochalasis or mild brow ptosis, recommend a limited botulinum toxin treatment to the upper forehead and advise the patient that some movement of the forehead will remain.

## Brow Examination

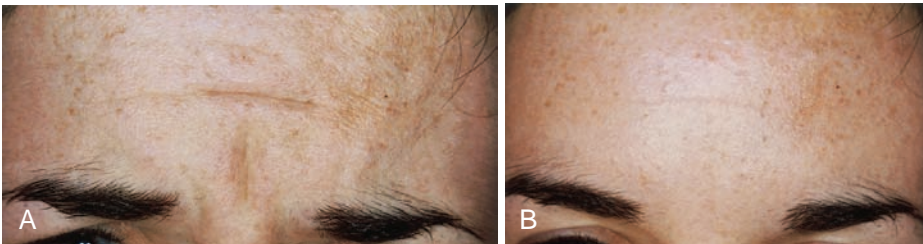
1. Observe where the horizontal and vertical forehead rhytids lie. Are they due to excessive brow elevation? Is the patient holding an excess of upper lid skin off their lids? Explain to the patient that botulinum toxin may make them look too 'tired' or 'heavy lidded'. They will be open to a partial effect or surgical alternatives.
2. Tug on the skin below the brow to check for laxity. Does the brow droop at the sides? Tell patients that they might get a temporary elevation of the lateral brows after treatment (Fig. 9.13) but that this is not always repeatable as some frontalis fibres eventually atrophy.
3. Ask patients to elevate their brows. Are they symmetrical? (Most are not.) Point out any asymmetry.
4. When the brows are elevated, do they 'peak' at any point? Some patients have naturally pointed brows which, if unmasked with botulinum toxin, look unattractive (Fig. 9.14A and B). The currently fashionable arch lies at the junction of the medial two thirds and the outer third of the eyebrow—but fashions change.
5. Ask the patient to frown (Fig. 9.15A and B). Which fibres contract? Some patients actually elevate their medial brow by contracting the corrugator, raising the brow superomedially. Others tend to drag the brow down.
6. Decide whether or not the patient would benefit from an endoscopic brow lift or blepharoplasties (Fig. 9.16A and B). Discuss this with them and refer if necessary. Explain the



**Fig. 9.13** Temporary elevation of lateral brow, creating a pleasing arch after Botox to the glabella. Note post-laser resurfacing erythema (10 days post-laser).

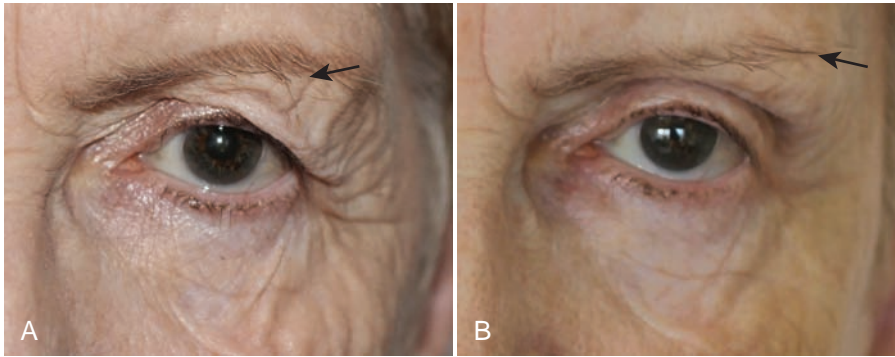


**Fig. 9.14** Natural brow peaking: (A) at rest and (B) when asked to elevate brows, before receiving any botulinum toxin treatment.



**Fig. 9.15** (A) Before and (B) after Botox for frowning. Patient is trying to frown in (B).





**Fig. 9.16** (A) Before and (B) after endoscopic brow lift for brow ptosis. Note that the eyebrow in (A) has been 'drawn in' at a higher level than the real brow hairs, shown post operatively (arrow) in (B).

improvements possible from botulinum toxin without surgery (use your hands to stabilise the medial brow, for example, while the patient raises the brow).

- On the follow-up visit, before the next treatment, ask patients to place their fingers over their brow muscles and feel the contraction as they frown. They will often notice that the lateral fibres of the frontalis have strengthened, squeezing the corrugator toward the glabellar area. Some patients may tolerate botulinum toxin to this lateral area, but most will look tired, with total inaction of their frontalis if treated. Of significance is that these fibres can strengthen with successive glabellar treatments, 'pushing' in the frown again despite atrophied corrugators. The edge of a diffusion circle of treatment may be used to weaken these fibres.

### Principles of Forehead Rhytid Treatment (See Fig. 9.26)

The mid-frontalis may eventually atrophy, requiring less treatment.

The glabellar complex rarely atrophies.

Treatment changes with time as the muscle response alters.

Untreated muscle can hypertrophy with time, for example the lateral frontalis.

Treatment depends on brow position and the presence or absence of blepharochalasis.

Avoid ptosis by not injecting beneath the superior orbital rim.

Avoid peaked brows by lightly treating the frontalis 2 cm above the possible peak.

Avoid intramuscular injections close to or in the brow.

Discuss brow movement at length with the patient.

### Recommended Treatment of Forehead Wrinkles (See Tables 3.4 and 3.5)

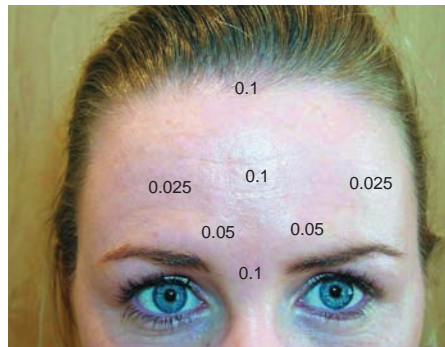
#### Dose Box

Botox: 2.5 mL to 100 units = 4 units per 0.1 mL

Xeomin: 2.5 mL to 100 units = 4 units per 0.1 mL

Dysport: 3.5 mL to 500 units = 14.3 units per 0.1 mL

Azzalure: 0.63 mL to 125 units = 10 units per 0.05 mL



**Fig. 9.17** Suggestion for glabellar treatment in inexperienced hands. Forehead complex and scalp must be balanced to avoid peaking.

The forehead is best treated as a single zone to achieve a balanced effect. Consider the optimal glabellar treatment and then treat the frontalis accordingly.

### Basic Glabellar Treatment (Fig. 9.17)

Treatment of a glabellar rhytid:

The essence of treatment is to paralyse the contraction of the corrugator muscle while allowing acceptable brow movement **WITHOUT** descent of the medial brow or ascent of the lateral brow! The author rarely treats the glabella alone, because most patient examinations reveal probable diversion of signalling to the frontalis over a peaked brow. This is usually avoided by giving 0.025 mL to the point of peaking.

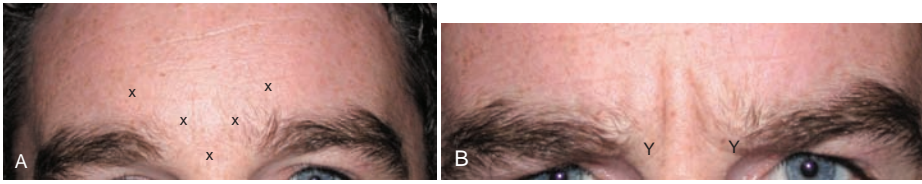
Visualise diffusion circles as in Fig. 9.26. Inject 0.05 mL to 0.1 mL, depending on muscle bulk, 1.5 to 3 cm above medial brow (line of medial canthus). **ALWAYS** aspirate first to avoid the supraorbital complex. Inject 0.1 mL at the base of nose below brow level (to diffuse across 3 cm to procerus and brow depressors). Note that the procerus often resembles a pentagon when contracted. Inject 0.025 mL 1 cm above the base of corrugator muscle, aiming not to depress the natural brow arch.

#### USER TIP

Use palpation to augment observation when assessing the location of maximum muscle contraction during frowning.

### Advanced Glabellar Treatment

With experience and finesse, it is possible to inject smaller volumes of higher concentrations of botulinum toxin. Injections can then be placed below the brow, up towards the corrugator muscle and above the trochlear tendon towards the medial brow depressor fibres. Until then, inject allowing for a wider diffusion zone to avoid unwanted diffusion. Great caution must be taken not to enter a blood vessel in the very vascular area of the superomedial orbit. Inaccurate dosage may cause toxin to diffuse towards the levator muscle, causing ptosis, and toward the superior oblique muscle, causing diplopia. Outstanding results may be achieved with low volumes of high concentrations, with subtle elevation of the brows and smoothing of all furrows. However, this technique should be undertaken only by those completely familiar with anatomical variations in this area who are experienced enough to assess the degree of diffusion of the different concentrations accurately (Fig. 9.18A and B).



**Fig. 9.18** Suggested injection sites (X) for optimal glabellar treatment in inexperienced hands. (A) Before and (B) after frowning. Site Y is at high concentration and low volume to avoid ptosis. Do not try unless comfortable with diffusion distances.

## Important Considerations for Glabellar Treatment

Injecting botulinum toxin below the orbital rim greatly increases the risks of true ptosis (a droopy eyelid) due to diffusion of toxin towards the levator muscle of the lid.

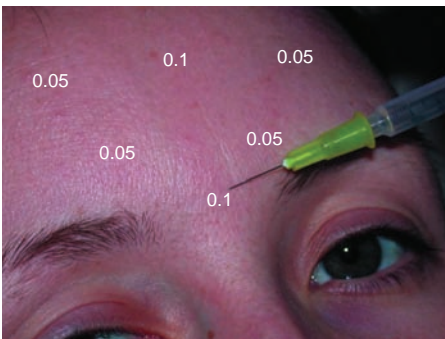
The corrugator may be approached from below the medial brow by an expert, thereby avoiding the elevating frontalis fibres. Lower doses at higher concentrations are recommended—but only in experienced hands.

The supraorbital artery, vein and nerve lie on the corrugator muscle and must be avoided. Palpate the supraorbital notch (not always present) in the bone just medial to the medial brow. This is the line of the supraorbital complex (2.7 cm from midline).

The angular vein traverses the area below the medial brow, the site of the depressor supercilia.

## Basic Frontalis Treatment

Examine the frontalis region by asking the patient to frown repeatedly, allowing identification of the strong points of the frontalis. Inject the bulk of the muscle adjacent to the rhytid. Inject 0.01 mL intramuscularly in the central zone as shown (Fig. 9.19) and then inject 0.05 mL to the other areas to give symmetry. An injection of 0.025 mL subcutaneously above the mid-lateral brow can soften rhytids whilst retaining frontalis action. On follow-up visits, inject 0.1 mL into the scalp aponeurosis to discourage hypertrophy and an overaction of aponeurotic fibres, which would result in excessive scalp movement relative to the atrophic frontalis muscle (Fig. 9.20).



**Fig. 9.19** Basic frontalis treatment.



**Fig. 9.20** Injection to scalp aponeurosis.

**USER TIP**

Tell the patient that the treatment sites will be different each time because the muscles will recover differently.

### Different Types of Rhytids May Be Treated as Follows:

#### **Fig. 9.21A: Simple forehead lines in motion, none at rest (20 to 30 years).**

If the brows are firm, then treat the complete frontalis. Expect a semi-permanent effect within 2 years as the frontalis muscle atrophies.

Young patients with firm brow attachments are easy. Inject the glabellar area as shown in Fig. 9.18, along the line of the corrugator. Treat the frontalis as shown to prevent peaking of the brows. Injection sites are chosen to allow for diffusion of the toxin within 1 to 3 cm of the site. This allows treatment of the procerus medially, sometimes incorporating some overlying frontalis fibres with diffusion towards the brow depressor, counteracting brow depression medially at the most nasal aspect of the brow. Fig. 9.21B shows the same patient as in Fig. 9.21A, 15 years later!

#### **Fig. 9.22: Simple forehead lines in motion, none at rest (20 to 30 years).**

Short brow lash distance with slightly mobile brows. Avoid lateral frontalis and treat superolateral frontalis instead. Treat medial brow depressors.

#### **Fig. 9.23: Forehead lines at rest and in motion.**

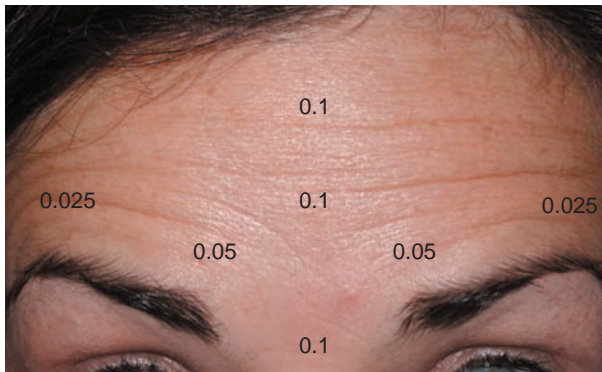
Treat as above but classify rhytids. If severe, advise about CO<sub>2</sub> resurfacing.



**Fig. 9.21** (A) Before simple forehead lines in motion, none at rest (20 to 30 years), and (B) after treatment, 15 years later.



**Fig. 9.22** Wrinkles in motion with suggested injection sites (X) in a 20-year-old woman with short lash-brow distance and mobile brows.



**Fig. 9.23** Suggested injection sites with suggested doses in a patient over 40 with high arched brows and wrinkled forehead, note the sites are NOT symmetrical, in keeping with the asymmetrical frontalis mass.



**Fig. 9.24** Suggested doses and injection sites in a patient over 35 with high arched brows and wrinkled forehead. Retain brow height, if desired, by avoiding botulinum toxin to brow area (i.e. lower half of forehead).

**Fig. 9.24: High arched brows with furrowed horizontal lines in patient over 35.**

Take great care. This patient is typical of those who can become extremely distressed if they lose the deep appearance of their upper eyelids as the frontalis becomes paralysed with botulinum toxin. The heavy brow can sometimes weigh upon the upper lid simulating ptosis; but when the brow is gently lifted by the examiner's finger, the lid will return to its normal position.

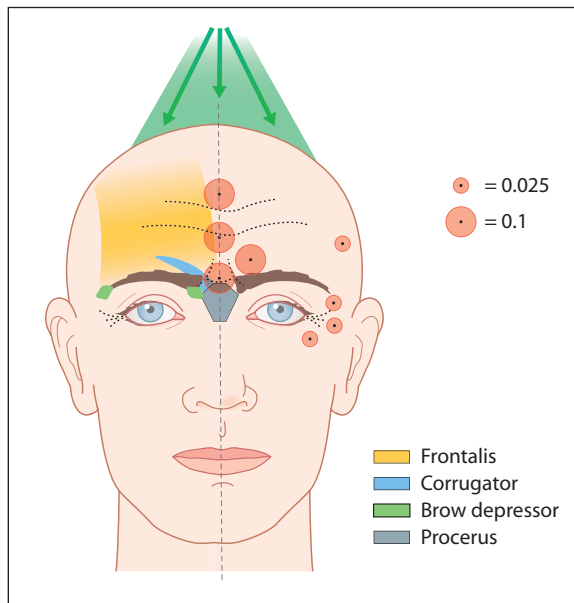
Discuss surgical correction at length (Chapter 11). Consider botulinum toxin treatment to the upper rhytids, retaining the elevating action of the lower frontalis fibres. Offer filler to the glabellar crease and the fine lines over the lateral brow.

**Fig. 9.25: The male forehead.**

The male brow tends to be horizontal with a short lash brow distance. The muscles may be bulkier than those of the female forehead and sometimes need greater doses. Treatment of the glabellar area *per se* can lead to a feminising arch and must be avoided unless requested. The male forehead is also prone to a receding hairline. Such patients may require extensive volumes of botulinum toxin to treat the occipito-frontal portion of the frontalis; otherwise, they will return with frontal furrows.



**Fig. 9.25** Typical heavy male forehead.



**Fig. 9.26** Low heavy brows. Note the signal to raise brows is equal across the forehead (*green rays overhead*) before treatment. The pink circles of diffusion are used to overlap the corrugator (*blue*) and the procerus (*grey pentagon*) and the brow depressors (*pale green stripes*). Note the space between the circles (*pale green stripes* on forehead) are left to allow lift and shape.