Pictorial Atlas 
of Botulinum Toxin Injection

Dosage · Localization · Application
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1.1 Treatment with Botulinum Toxin

Within the last 20 years, the use of local injection with botulinum toxin has proven to be effective in the treatment of increased tonicity in both skeletal and smooth muscle, as well as in illnesses presenting with increased secretion from glands.

Following local injection, the botulinum toxin reduces muscle tone effectively for several months and also reduces secretion from sweat, lacrimal and salivary glands.

The prerequisite for therapeutic success, of course, is the proper application of the drug. The required information for its successful use concerning topography, dosage, muscle action, localization and injection technique is presented clearly in this atlas.

In Germany, at the time of print, four botulinum toxin products have been licensed for use.

- Botox® (Serotyp A-Toxin)
- Dysport® (Serotyp A-Toxin)
- Xeomin® (Serotyp A-Toxin)
- Neurobloc® (Serotyp B-Toxin)

There are various ways of designating the types of toxins, e.g. with reference to the non-toxic protein content, the advantages and disadvantages of which have not yet been clearly defined.

For determination of the dosage, the biological activity of the serotype is the determining factor. This is determined using a mouse lethal assay and is designated in biological units (so-called mouse units: MU). One MU corresponds to the amount of toxin needed to kill half of a population of treated mice injected intraperitoneally with the toxin (LD 50).

1.2 Licensed Medication and Clinical Indications

The following products have been licensed for use (Wissel et al. Der Nervenarzt, 2011, 82: 481-495; DGN guideline "dystonia", 2008; DGN guideline "spasticity", 2008) in Germany for treatment of various clinical indications by the BfArM.

- Botox® for clinical indication of hemifacial spasm, blepharospasm, idiopathic rotary cervical dystonia (spasmodic torticollis), focal spasticity in connection with dynamic toe drop (pes equinus) with patients presenting with infantile spastic paralysis (Little’s disease), who are two years of age or older, and for treatment of wrist and hand in adults suffering from stroke. In addition, it is indicated in clinical manifestation of “intense progressive primary hyperhidrosis of the axilla, where patients are severely hampered in their daily routine and cannot be adequately controlled by topical treatment.”

- Dysport® in clinical manifestation of hemifacial spasm, blepharospasm, rotary spasmodic torticollis, arm spastic following stroke and for treatment of glabellar wrinkles in adults

- Xeomin® for the clinical indication of symptomatic treatment of blepharospasm, cervical dystonia of a predominantly rotational form (spasmodic torticollis) and of post-stroke spasticity of the upper limb presenting with flexed wrist and clenched fist in adults.

The products licensed under the names of Botox® and Xeomin® are available under the trade names Vistabel® and Bocouture® for cosmetic treatment of wrinkles.

1.3 Off-Label Application

There are a number of illnesses for which the treatment with botulinum toxin is not officially permitted in Germany, although scientific proof for the efficacy of the drug in these cases has been given and has been patented in other European countries. The jurisdiction for the so-called off-label regulation is at best contradictory. For a series of indications, the Arbeitskreis Botulinumtoxin e. V. as member of the Deutsche Gesellschaft für Neurologie e. V., acting as the expertise specialists in consensus with medical literature, has declared that the prerequisite for the use of the botulinum toxin has been fulfilled for a whole series of clinical indications. This is substantiated by the adjudication and assessment by respected circles of experts that the toxin indeed plays an important role in pertinent clinical indications.
**Dystonia**

In analogy with accredited cases of focal dystonia, the local injection of the toxin in all other cases of dystonia not yet licensed, appears as the treatment of choice for symptomatic treatment. The proven efficacy in those licensed indications should in analogy be sufficient evidence for its approval. Moreover, controlled scientific studies as well as case studies add credence to its efficacy. In the guideline “dystonia” of the Deutsche Gesellschaft für Neurologie e. V. the treatment of focal dystonia is strongly recommended being supported by convincing evidence (DGN, guideline “dystonia”, 2008). The dystonias belonging to this group are:

- oro-mandibular or lingual dystonia (Tan et al., 1999)
- laryngeal dystonia (spasmogenic dystonia, Bosten et al. 2002; Benninger et al. 2001)
- limb dystonia of leg/foot and arm/hand, specifically task-oriented movement (e.g. writer’s cramp, musicians dystonia; Cole et al. 1995; Tsui et al., 1993; Wissel et al., 1996)
- Trunk dystonia (e.g. camptosperm; Reichel et al., 2001; Cornella et al., 1998)

In cases of multifocal, one-sided or general dystonia, emphasis is placed on injection and is equivalent to the above-mentioned indicated conditions (†).

**Spasticity**

In analogy to its proven efficacy in the treatment of arm and hand spasticity as a result of stroke or pes equinus following infantile spastic paralysis, the positive effect of botulinum toxin in the treatment of arm and hand spasticity of different origin as well as leg spastic not connected with infantile spastic paralysis can be assumed. Other causes for these maladies include cranial trauma, encephalitis, multiple sclerosis, brain tumor or injury and illness of brain and spinal cord. Its use in such cases is scientifically founded in controlled studies and case studies (Moore, 2002; Burbaud et al., 1996; Hyman et al., 2000; Pavesi et al., 1998; Reichel, 2002; Smith et al., 2000; Simpson, 1997; Yablon et al., 1996; Brashear et al., 2002; Kanovsky et al., 2009; Barnes et al., 2010).

In the guideline “spasticity” of the Deutsche Gesellschaft für Neurologie e. V., the treatment of focal spasticity is strongly recommended by virtue of its high grade of efficacy (†) (DGN, guideline “spasticity”, 2008). In other European countries, treatment under the synonym Spastic Syndrome regardless of etiology is permitted.

**Hyperactivity of the Detrusor Muscle (Muscles of the Bladder)**

Botulinum toxin has been proven and tested in two clinical indications in urology: in increased sphincter contraction or detrusor sphincter dysynergia and in hyperactive bladder (Jost and Naumann, 2004).

Treatment with botulinum toxin in increased sphincter activity is employed when conventional therapy has proven ineffective and before an operative sphincterotomy becomes done (Jost and Naumann, 2004). Sphincterotomy can lead to irreversible injury of the sphincter muscle and to eventual incontinence. Treatment of hyperactive bladder belongs to the domain of anticholinergic medication. In many cases, these drugs are inadequate and can lead to undesirable side effects. In these cases, injection of the botulinum toxin into the detrusor muscle is recommended for successful therapy. Numerous clinical studies corroborate the use of the botulinum toxin in such clinical indications (Schurch et al., 2005).

**Glandular Secretion**

Excessive secretion of various glands (sweat glands = hyperhidrosis; salivary glands = hypersalivation; lacrimal gland = hyperlacrimation) can lead to considerable discomfort of pathological dimension. The botulinum toxin blocks hypersecretion effectively and reliably (Heckmann et al., 2001; Naumann et al., 2001; Palmar Saadia et al., 2001; Giess et al., 2002; Pal et al., 2000). Considering the clinical indication and the gravity of the illness when other therapies have failed, injection of the botulinum toxin has proven to be cost-effective and advantageous. In Germany, botulinum toxin has been authorized in cases of intense and progressive axillary hyperhidrosis and when topical treatment has proven ineffective. The following degree of statistical evidence exists for:

- Axillary hyperhidrosis  ††
- Frey syndrome  ††
- Palmar hyperhidrosis  ††
- Hypersalivation  ††
- Hyperlacrimation  †
Pectoralis major

**Nerve supply**
Medial pectoral nerve, C8–T1

**Origin**
Clavicular attachment: anterior surface of the medial half of clavicula
Sternocostal attachment: anterior surface of sternum, cartilage of 6th to 7th ribs, aponeurosis of the external oblique muscle of the abdomen
Abdominal attachment: anterior lamina of the rectus sheath

**Insertion**
Greater tubercle of humerus and lateral lip of intertubercular groove of humerus

**Dosage/Needle size**

- Xeomin®: 20–100 MU (rarely higher)
- Botox®: 20–100 MU (rarely higher)
- Dysport®: 80–400 MU (rarely higher)

Injection sites: 1–3
Needle length: 40 mm

Follow instructions for each prescription drug, the off-label therapy (see p. 4) as well as pertinent product information.
Muscles of the Shoulder Joint

Clinical application
The muscle forms the anterior axillary fold and the sternocostal fibers form the anterior border of the axilla, whereas the clavicular fibers define the border of the infraclavicular fossa.
The pectoralis major can function as an accessory muscle of inspiration.
The sternocostal fibers are important for walking on crutches.

Action
The inferior and middle parts of the pectoralis (abdominal and sternocostal attachments) adduct and medially rotate the arm.
In addition to this, the isolated contraction of the clavicular fibers flexes at the shoulder joint (anteversion).

Topographical indication
Injecting too deeply bears the risk of pneumothorax.
By injecting too deeply the coracobrachialis can be punctured. By injecting too deeply and too far superiorly the brachial plexus as well as the vessels running through the axilla can be damaged.
Injection too far medially can pierce the biceps brachii.

Injection protocol
Number of puncture sites: 1–3

Localization
The muscle is easily palpable laterally and superiorly to the nipple.
Grasp the muscle and inject in the area of the anterior axillary line.

Injection technique
Injection site: in the area of the anterior axillary fold
Injection direction: medially, in the direction of the fibers
Patient position: sitting or supine, with the arm abducted to about 45–90°
Biceps brachii

Nerve supply
Musculocutaneous nerve, C5–C6

Origin
Long head: supraglenoid tubercle of scapula
Short head: coracoid process of scapula

Insertion
Radial tuberosity and into the fascia of the forearm via the bicipital aponeurosis

Dosage/Needle size

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dosage/MU (rarely higher)</th>
<th>Needle length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xeomin®</td>
<td>20–100 MU</td>
<td>40 mm</td>
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<tr>
<td>Botox®</td>
<td>20–100 MU</td>
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</tr>
<tr>
<td>Dysport®</td>
<td>60–400 MU</td>
<td></td>
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</table>

Follow instructions for each prescription drug, the off-label therapy (see p. 4) as well as pertinent product information.
Muscles of the Elbow Joint

Clinical application
It should be kept in mind that the biceps is not only a flexor at the elbow joint but also has further action as supinator at the proximal and distal joints of the forearm. It therefore always has to be considered in synergy with the other flexors.

Action
The biceps flexes and supinates the forearm at the elbow joint. Both actions regarding the elbow joint are most powerful with the elbow at 90°. An extension of the elbow leads to a loss of supinating power. The biceps brachii also flexes at the shoulder joint and its long head abducts the shoulder, especially in a laterally rotated position. The long head also stabilizes the shoulder joint together with the muscles of the rotator cuff.

Topographical indication
The muscle is easily palpable and distinguishable. By injecting too deeply, the brachialis (1) can be pierced.

Injection protocol
Number of puncture sites: 2–4, depending on dosage and indication; mostly 2 sites

Injection technique
Injection site: in the center of the muscle belly with the injection depth dependent on the thickness of the muscle
Injection direction: vertically or oriented to the direction of the fibers
Patient position: sitting or supine with the elbow flexed and supinated

The biceps loses most of its power in a pronation position. An injection into the biceps always influences the function of the other muscles of the arm. An exclusive injection into biceps is rarely necessary or called for. The dosage indicated is too high in most cases.
Iliopsoas

**Nerve supply**
Branches of the lumbar plexus
- Iliacus: femoral nerve L2–L3
- Psoas major: ventral rami L2–L4

**Origin**
- Iliacus: iliac fossa, anterior inferior iliac spine, iliolumbal ligament, anterior sacroiliac ligament
- Psoas major: vertebral bodies of 12th thoracic – 4th lumbar vertebrae, intervertebral discs, costal processes 1st – 5th lumbar vertebrae

**Insertion**
Lesser trochanter

**Dosage/Needle size**
- Xeomin®: 25–200 MU (rarely higher)
- Botox®: 25–200 MU (rarely higher)
- Dysport®: 100–700 MU (rarely higher)

Injection sites: 1–3
Needle length: at least 40 mm

⚠️ Follow instructions for each prescription drug, the off-label therapy (see p. 4) as well as pertinent product information.
Muscles of the Hip

3.1

Clinical application
An injection into the psoas should only be carried out by experienced users. A contracture of the iliopsoas lastingly intensifies the lumbar lordosis, whereby intervertebral disks in this region can be damaged.

Action
The main action of the iliopsoas is to balance the hip on the head of the femur, especially in the fixed femur. It flexes the free leg at the hip joint. It intensifies the lumbar lordosis. By one-sided contraction, it causes lateral flexion of the vertebral column.

Topographical indication
The psoas major can be injected distal to the inguinal ligament, whereby the medially positioned bundle of nerves and vessels (femoral nerve, artery and vein) must be taken into consideration.

By injecting too far laterally, the sartorius can be impregnated.

Injection protocol
Number of puncture sites: one site for psoas major, two for iliacus.

Localization
An injection into the iliacus under ultrasound control transperitoneally from anterior or alternatively retroperitoneally under CT control (not illustrated here); for distal injection, EMG is reasonable; injection to the psoas major is more effective from posterior, but must be undertaken under CT control.

Clinical application
An injection into the psoas should only be carried out by experienced users. A contracture of the iliopsoas lastingly intensifies the lumbar lordosis, whereby intervertebral disks in this region can be damaged.

Injection technique
Injection site: two fingers’ width (3–4 cm) lateral to the femoral artery and one fingers’ width (1–2 cm) distal to the inguinal ligament (1).

Injection depth: 2–4 cm depending on the thickness of the muscle.

Patient position: supine, the right leg slightly flexed.
Lower Limb

Soleus

**Nerve supply**
Tibial nerve, S1–S2

**Origin**
Posterior surface of the tibia (soleal line), upper third of posterior surface of fibula, fibrous arch between tibia and fibula

**Insertion**
Calcaneal tuberosity via calcaneal tendon (Achilles tendon)

**Dosage/Needle size**

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dosage (MU)</th>
<th>Needle length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xeomin</td>
<td>20–80 MU</td>
<td>40 mm</td>
</tr>
<tr>
<td>Botox</td>
<td>20–80 MU</td>
<td>40 mm</td>
</tr>
<tr>
<td>Dysport</td>
<td>80–300 MU</td>
<td>40 mm</td>
</tr>
</tbody>
</table>

Follow instructions for each prescription drug, the off-label therapy (see p. 4) as well as pertinent product information.
Muscles of the Ankle Joints

Action
The soleus is an important flexor at the ankle joint and inverts (supinates) at the talotarsal joint. It is especially important for maintaining the upright position and resisting collapse at the ankle joint from the force of body weight, in so doing it balances the body over the ankle joint.

Topographical indication
By injecting too superficially or proximally, the gastrocnemius (1) and not the soleus will be infiltrated with toxin. The tibial nerve and posterior tibial artery and vein (2) run beneath the soleus. By a medial injection undertaken too deeply, there is danger of infiltrating the flexor digitorum longus (3) or tibialis posterior (4).

Injection protocol
Number of puncture sites: 2–4; usually at 1–2 sites

Injection technique
Injection site: below the heads of the gastrocnemius, lateral and medial to the calcaneal tendon
Injection depth: 2–4 cm, depending on the thickness of the muscle
Patient position: prone; feet should hang over the end of the examining cot or be supported with a rolled cushion
Transversus abdominis

**Nerve supply**
- Intercostal nerves, T5–T11
- Subcostal nerve, T12
- Iliohypogastric nerve, T12–L1
- Ilioinguinal nerve, L1

**Origin**
- Inner surface of costal cartilage of 6th to 12th ribs
- Inner surface of iliac crest and inguinal ligament
- Costal processes of lumbar vertebrae via thoracolumbar fascia

**Insertion**
- Linea alba via the rectus sheath

**Dosage/Needle size**
- Xeomin®: 5–10 MU/injection site (rarely higher)
- Botox®: 5–10 MU/injection site (rarely higher)
- Dysport®: 20–40 MU/injection site (rarely higher)

**Injection sites:** up to 5 per side

**Needle length:** 20–40 mm

Follow instructions for each prescription drug, the off-label therapy (see p. 4) as well as pertinent product information.
Anterior Muscles of Abdominal Wall

4.1

**Clinical application**
Because the muscle is quite thin and difficult to palpate, it cannot be injected with certainty.

The transverse abdominal is involved in the formation of the anterior and posterior layers of the rectus sheath.
The differentiation between the transverse abdominal and the internal oblique is difficult.

**Action**
The transverse abdominal rotates the torso to the ipsilateral side. In synergy with the other abdominal muscles, it is also strongly involved in abdominal compression, e.g., during defecation and labor.
During contraction it can produce very high intra-abdominal pressure. Its superior part can also constrict the lower thoracic aperture, and thereby is involved in expiration.

**Topographical indication**
The transverse abdominal is very thin, thus it is easily penetrated, which bears the risk of transperitoneal puncture. Palpation of the muscle is extremely difficult in adiposed patients.

**Injection protocol**
Number of puncture sites: 1–5; under EMG control

**Injection technique**
Injection site: between the costal arch and the iliac crest at the medioclavicular line (MCL)
Injection depth: depends on the thickness of the muscle and subcutaneous fat
Patient position: supine

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**Injection depth:** depends on the thickness of the muscle and subcutaneous fat
**Patient position:** supine

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**Topographical indication**
The transverse abdominal is very thin, thus it is easily penetrated, which bears the risk of transperitoneal puncture. Palpation of the muscle is extremely difficult in adiposed patients.

**Injection protocol**
Number of puncture sites: 1–5; under EMG control

**Injection technique**
Injection site: between the costal arch and the iliac crest at the medioclavicular line (MCL)
Injection depth: depends on the thickness of the muscle and subcutaneous fat
Patient position: supine

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**Clinical application**
Because the muscle is quite thin and difficult to palpate, it cannot be injected with certainty.

The transverse abdominal is involved in the formation of the anterior and posterior layers of the rectus sheath.
The differentiation between the transverse abdominal and the internal oblique is difficult.
Platysma

Nerve supply
Cervical branch of facial nerve

Origin
Subcutaneous fascia, base of mandible, parotid fascia

Insertion
Skin below clavicle, pectoral fascia

Dosage/Needle size

<table>
<thead>
<tr>
<th>Product</th>
<th>Dosage</th>
<th>Needle length</th>
</tr>
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<tbody>
<tr>
<td>Xeomin®</td>
<td>1.25–5 MU/injection site</td>
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</tr>
<tr>
<td>Botox®</td>
<td>1.25–5 MU/injection site</td>
<td>10–20 mm</td>
</tr>
<tr>
<td>Dysport®</td>
<td>4–20 MU/injection site</td>
<td>10–20 mm</td>
</tr>
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</table>

Follow instructions for each prescription drug, the off-label therapy (see p. 4) as well as pertinent product information.
Anterior Muscles

Clinical application
The platysma extends into the lower regions of the face and makes contact with the risorius, the depressor anguli oris, the depressor labii inferioris. Injection into this region is especially difficult. The muscle often inserts well below the clavicle.

It stretches the skin of the neck in the front from the lower jaw to the clavicle. When it is taut, individual cords of fibers can be seen.

Additionally, the muscle can cause the corner of the mouth to be drawn down. It is especially important in hemifacial spasm and treatment of wrinkles. Many patients cannot voluntarily contract this muscle. In this case it is recommended to pull the skin taut over the clavicle.

Action
As cutaneous muscle of the neck it stretches the skin from mandible over the clavicle. Individual cords of fibers can be seen when it is taut. It depresses the lower lip and draws down the corners of the mouth.

Topographical indication
The platysma is relatively thin. Thus, when injecting too deeply, the toxin can diffuse to muscles beneath this muscle (for ex. the strap muscles) and by higher dosages can cause difficulty in swallowing. Anteriorly, there is a space between the two platysmas. Attention must be given to nerves and vessels running beneath the muscle. The supraclavicular nerves can be found at the site of insertion below the clavicle.

Injection protocol
Number of puncture sites: 4–8
When symptoms occur on one side such as with hemifacial spasm, it is only necessary to inject on the affected side.

Injection technique
Injection site: in the main fibers of the muscle; 2-3 injections per platysma
Injection manoeuvre: ask the patient to tense the platysma. Since it is a cutaneous muscle, injection can be made subcutaneously (for ex. into horizontal skin creases)
Patient position: in sitting or supine

Additionally, the muscle can cause the corner of the mouth to be drawn down. It is especially important in hemifacial spasm and treatment of wrinkles. Many patients cannot voluntarily contract this muscle. In this case it is recommended to pull the skin taut over the clavicle.
Epicranius, Frontal Belly

Nerve supply
Occipital belly: posterior auricular branch of facial nerve
Frontal belly: temporal branches of facial nerve

Origin
Occipital belly: lateral two-thirds of highest and superior nuchal line of occipital bone, mastoid process of temporal bone
Frontal belly: skin of the forehead together with the procerus (middle fibers), corrugator supercilii, and orbicularis oculi (lateral fibers)
Temporoparietalis: skin of the temples, temporal fascia

Insertion
Occipital belly: galea aponeurotica
Frontal belly: galea aponeurotica
Temporoparietalis: galea aponeurotica

Dosage/Needle size
Xeomin®: 1.25–5 MU/injection site
Botox®/Vistabel®: 1.25–5 MU/injection site
Dysport®: 5–20 MU/injection site
Injection sites: 4–8
Needle length: 20 mm (27–30 gauge)

Follow instructions for each prescription drug, the off-label therapy (see p. 4) as well as pertinent product information.
Action
These muscles form transverse folds (forehead wrinkles) on the forehead and raise the eyebrows. It is a major antagonist of the orbicularis oculi and together with the levator palpebrae opens the palpebral fissure. This action is dependent on the action of the occipital belly.

Topographical indication
Both functional as well as cosmetic (asymmetric) aspects must be taken into consideration when treating these muscles. An injection into the levator palpebrae must be avoided at all costs since this can lead to ptosis (inject at least 3 cm distant to this muscle).

Injection protocol
Number of puncture sites: 4–8
The site of injection varies according to the indication, for example, treatment of wrinkles, headaches, blepharospasm. The illustration demonstrates injection into the transverse wrinkle of the forehead.

Injection technique
The orientation for injection is dependent on the clinical diagnosis and the desired effects. For treatment of wrinkles attention is given to symmetry and to retain some function. The injection is performed subcutaneously. Due to the varying width of the gap amongst patients between the two middle portions of the frontal bellies of both sides, do not inject at the middle point of the hairline.

Clinical application
In such conditions as hemifacial spasm, facial synkinesis and blepharospasm, the frontal belly is rarely involved and thus is seldom or not treated at all.
By hemifacial spasm, the unaffected side can be treated in a cosmetic attempt to reduce the asymmetry rendering the paresis of the affected side less evident.
The middle fibers vary greatly among patients and must be diagnosed clinically in individual cases.

When treating wrinkles of the forehead, the effect on the eyebrows must always be taken into consideration. In patients who have undergone previous cosmetic operations, the injections must be carried out with great care.
Because the epicranius raises the eyebrows it causes deep transverse wrinkles in the forehead.
The temporoparietalis is irregular and rudimentary.
Clinical application
The angle of the mandible is covered on its inner surface by the pterygoideus medialis and externally by the masseter in a muscle sling. The pterygoid medialis can move the lower jaw sideways. It also closes the jaw. Because it is only the third most powerful muscle with this action it does not have to be treated in cases of OMD lock jaw. It runs approximately perpendicular to the pterygoideus lateralis and can protract the jaw.

Dosage/Needle size
- Xeomin®: 5–20 MU (rarely higher)
- Botox®: 5–20 MU (rarely higher)
- Dysport®: 20–80 MU (rarely higher)

Injection sites: 1 per muscle
Needle length: 40 mm

Nerve supply: medial pterygoid branch of the mandibular nerve from the trigeminal nerve (V/3)
Origin: medial surface of lateral pterygoid plate of spheroid bone, pyramidal process of palatine bone
Insertion: medial surface of ramus and angle of mandible, pterygoid tuberosity

Action
The pterygoideus medialis forcefully closes the jaw and has a slight protraction component.

Topographical indication
Both pterygoidei are difficult to inject. Improper treatment is frequent in the hands of the inexperienced user.

Injection protocol
Number of puncture sites: one per muscle

Injection technique
Direction of injection: it is expedient to control a pre-auricular injection with an EMG. The injection is undertaken at right angles to and behind the angle of the mandible.
Patient position: supine or sitting

Follow instructions for each prescription drug, the off-label therapy (see p. 4) as well as pertinent product information.
Clinical application
The pterygoideus lateralis participates in all movements of the jaw and can be seen as the guide muscle for the jaw joint. It is often involved in oromandibular dystonia.

Dosage/Needle size
- Xeomin®: 5–25 MU (rarely higher)
- Botox®: 5–25 MU (rarely higher)
- Dysport®: 20–100 MU (rarely higher)
- Injection sites: 1 per muscle
- Needle length: 40 mm

Nerve supply:
- lateral pterygoid branch of the mandibular nerve from the trigeminal nerve (V/3)

Origin:
- superior (upper) head: lateral surface of greater wing of sphenoid, maxillary tuberosity; inferior (lower) head: lateral surface of lateral pterygoid plate

Insertion:
- superior (upper) head: medial surface of condylar process of mandible, anterior margin of articular disc; inferior (lower) head: pterygoid fossa of condylaris process; temporomandibular joint

Action
The pterygoideus lateralis runs from anterior toward the lower jaw and can protract not only the lower jaw (lower head) but also pull the articular disc forward.

Topographical indication
Both pterygoidei are difficult to inject. Improper treatment is frequent in the hands of the inexperienced user.

Injection protocol
- Number of puncture sites: one per muscle

Injection technique
- Direction of injection: inject in front of the tragus on an imaginary line from the tragus to infraorbital margin approximately 3 cm anteriorly.
- Patient position: sitting or supine

Clinical application
The pterygoideus lateralis participates in all movements of the jaw and can be seen as the guide muscle for the jaw joint. It is often involved in oromandibular dystonia.
Tongue – Intrinsic Muscles

Nerve supply
Hypoglossal nerve (XII)

Origin
Superior longitudinal muscle: tip of tongue
Inferior longitudinal muscle: tip of tongue
Transverse muscle: margin of the tongue
Vertical muscle: continuation of the genioglossus

Insertion
Superior longitudinal muscle: root of tongue
Inferior longitudinal muscle: root of tongue
Transverse muscle: lingual septum
Vertical muscle: lingual aponeurosis

Injection protocol
Number of puncture sites: 1–2
The sites of injection are selected according to clinical indication. It may be important to differentiate which side is affected. According to dosage and indication up to four sites can be chosen, whereas usually one to two sites per side suffice.

Injection technique
The picture illustrates injection of the intrinsic muscles of the tongue. Based on the clinical diagnosis, the injection is made into the lower margin of the tongue whereby the patient should protrude the tongue which can be held between two fingers with a swab.

Injection technique
By this alternative method, the head is stretched forward. The site of injection of choice is approximately 3 cm lateral to the tip of the chin on the lower margin of the mandible. Alternative to this, the injection can be made in the middle of the underside of the chin. The needle passes through the mylohyoid and geniohyoid to reach the genioglossus. Usually, a low dose is chosen to avoid undesirable side effects.

Clinical application
It is generally difficult to differentiate between the different components of the intrinsic muscles of the tongue and to select one muscle individually. A paralysis of the tongue can evoke potential dangers for the patient such as swallowing the tongue during sleep. Injury to the hypoglossus nerve causes deviation of the tip of the tongue to the affected side. The mobility of the tongue can be affected adversely by swelling and shortening of the frenulum of the tongue making it difficult to diagnose. Some of the movements shown can be difficult for the patient to perform and these should not be over interpreted or falsely interpreted as being pathologic.

Dosage/Needle size
Xeomin®: 2.5–10 MU
Botox®: 2.5–10 MU
Dysport®: 10–40 MU
Injection sites: 1–2
Needle length: 40 mm (27–30 gauge)

Follow instructions for each prescription drug, the off-label therapy (see p. 4) as well as pertinent product information.
Clinical application
The so-called intrinsic muscles of the tongue can alter the shape of the tongue. Action of one muscle is dependent on the simultaneous contraction of the other intrinsic muscles. The remainder of the lingual tissue acts as antagonist working according to the principle of a hyrdostatic cushion.

Tongue – Intrinsic Muscles – Action

- **Superior longitudinal muscle**: shortening and broadening of the tongue, raising the tongue
- **Inferior longitudinal muscle**: shortening and broadening of the tongue, lowering of tip of tongue
- **Transverse muscle**: rolling the sides of the tongue thereby narrowing and elongating it
- **Vertical muscle**: flattening of the tongue and thereby broadening the tongue