



**Pre-course reading for the Interface Aesthetics Advanced
Course in Botulinum Toxin & Dermal Filler**

Principles of Dermal Filler Use in Aesthetic Medicine

1.1 - 1.9: Explain the mechanism of action of dermal fillers

Dermal filler is a broad term used to describe a wide range of materials used in an injectable form to volumise tissue. They can act in the form of temporary occupiers of space, or as stimulatory fillers acting on native fibroblasts. The temporary space-occupiers yield temporary results and must be re-injected regularly. The stimulators induce a foreign-body inflammatory reaction which promotes fibroblast proliferation and activity, leading to autologous collagen production. Neocollagenesis results in improvements in both volume and quality of the connective tissue, and as such is believed to yield better long-term effects.

Dermal fillers can be divided into permanent, semi-permanent, and temporary fillers.

Permanent dermal fillers

- Man-made polymers that are not degradable
- These fillers yield longer lasting results, but are less forgiving and are associated with higher rates of granuloma formation. The effects are also irreversible, which is highly undesirable in the event of an emergency .
- Permanent fillers will also not adapt to changes in the face that occur naturally over time, possibly resulting in unfavourable outcomes
- Example 1: Bellafill
 - bovine collagen combined with PMMA (polymethylmethacrylate)
 - used to treat acne scars with results lasting up to 5 years
 - PMMA beads (microspheres), when injected under the skin, are not absorbed, metabolised nor excreted by the body
 - There is an increased risk of inflammatory reactions with this filler type
- Example 2: Silicone
 - Used to volumise lips and treat scarring from acne
 - Long history of use

Semi-permanent dermal fillers

- Example 1: Sculptra
 - Contains Poly-L Lactic Acid (PLLA) which is biodegradable and immune inert
 - Sculptra works as a dermal stimulant, resulting in the production of lactic acid monomers which are incorporated into glucose.
 - The result after injection is neo-collagenosis, leading to volumisation of 3-9 months and lasting up to 2 years.
 - NOT RECOMMENDED in temporal or galeal areas (as intravascular injection risk)
 - NOT RECOMMENDED for mid dermal or superficial injections, or lips (risk of nodule formation)
- Example 2: Autologous fat transfer
 - where fat is taken from one part of the body and placed in another part to volumise.
 - Requires harvesting, and therefore intervention elsewhere in the body

- Example 3: Radiesse

- Calcium hydroxylapatite (CaHA)
- An inert, biocompatible filler
- Used for deep injections, jaw augmentation at pre-periosteal level
- Microsphere which stimulates fibroblasts inducing neo-collagenesis
- Effect of around 1-2 years with lower granuloma risk than Sculptra.
- Not recommended for superficial placement in view of stimulatory effect
- Is a stimulatory filler, but also provides an initial volumising effect

Temporary dermal fillers

- Hyaluronic acid (HA) is a biodegradable gel-like substance which is found naturally in connective tissue
- It is a replacement filler, providing volume
- It is an energetically stable mucopolysaccharide, which is broken down over 6-12 months
- It is hydrophilic, contributing to tissue hydration
- It promotes fibroblast proliferation and collagen production
- In its natural form, HA is vulnerable to free-radical degradation and the enzyme hyaluronidase (hyalase), resulting in it being broken down in around 12-48 hours
- The HA used in aesthetics is cross-linked, making it resistant to this rapid breakdown
- HA based fillers are classed as medical devices, and therefore do not require a prescription
- There are many different brands, and a variety of fillers within brands with varying consistencies, for use in different areas and for different purposes.
- Unlike botulinum toxin, dermal fillers which are HA based are reversible with the use of hyaluronidase (enzyme) which immediately starts to break down the product.
- HA-based fillers can last from 6-24 months, depending on the individual product

1.10: Compare and contrast the use of dermal fillers with and without the use of local anaesthetic

Local anaesthetic is an important consideration when providing aesthetic treatments with dermal filler. Topical anaesthetics have been discussed previously. Many products now incorporate lidocaine into the dermal filler itself, to provide anaesthesia upon injection. The advantages of such formulations include the greater patient comfort both during and directly after the procedure. This is of particular benefit for sensitive treatment areas such as in the temples or lips. Disadvantages include greater cost and allergy risk. It is important for patients to be aware that the anaesthetic will wear off within hours, and some discomfort may then ensue. Clear instructions regarding when to contact the practitioner post procedure must be given in the context of the patient being anaesthetised for 1-2 hours post procedure.

2.1 Explain the facial blood vessels of relevance to the use of dermal fillers

Knowledge of facial anatomy is a pre-requisite for any practitioner injecting dermal filler. There are certain 'danger zones' which must be appreciated and accounted for on planning and executing treatments. Furthermore, knowledge of arterial supply is especially important in consideration of the occurrence of blanching or purple discolouration of areas of skin following treatment with filler, as this could represent arterial compromise. End arteries may provide the sole vascular supply to some areas of the face, and any occlusion or compromise of these will result in pain and blanching, leading to tissue necrosis if not treated.

Arteries

Branches from the **External Carotid Artery (ECA)**

- **FACIAL ARTERY**

- Crosses the lower border of the mandible travelling superomedially - can be palpated at this point
- Gives off **INFERIOR LABIAL** branch 1cm lateral to oral commissure
- Gives off **SUPERIOR LABIAL** branch slightly cranial to the Inferior Labial branch
- Ascends towards the nasal ala where it gives off the **LATERAL NASAL** branch
- Continues (in the majority of people) as the **ANGULAR** artery

- **ANGULAR ARTERY**

- Terminal branch of the facial artery
- Ascends to medial canthus along with the angular vein.
- Anastomoses with branches of infraorbital artery on cheek
- Ends by anastomosing with dorsal nasal branch of the ophthalmic artery

- **INFRAORBITAL ARTERY**

- Terminal branch of the **MAXILLARY ARTERY**
- Supplies the cheek and anastomoses with the Angular artery

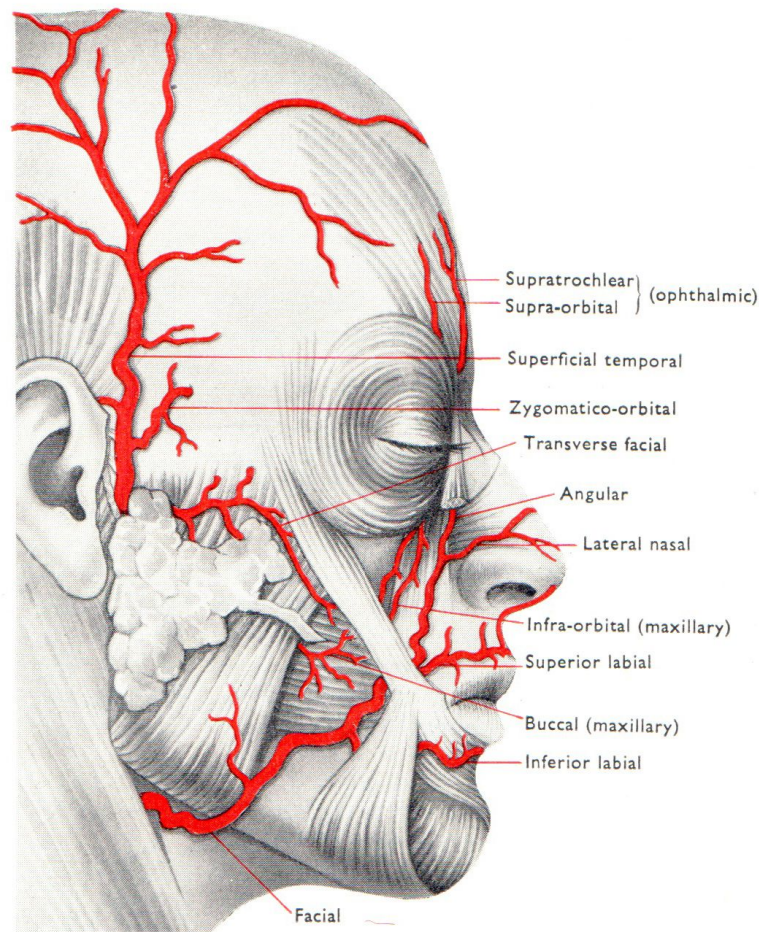
- **SUPERFICIAL TEMPORAL ARTERY**

- Terminal branch of the **ECA**
- Supplies upper and lateral parts of the scalp

Branches from the **INTERNAL CAROTID ARTERY (ICA)**

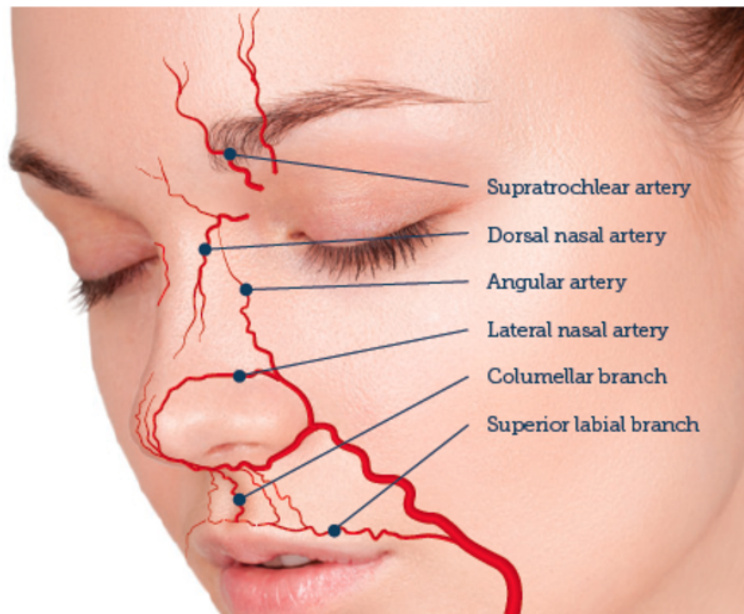
- **SUPRATROCHLEAR ARTERY**

- One of the terminal branches of the **OPHTHALMIC ARTERY**, itself a branch of the Internal carotid artery (ICA)



Danger areas

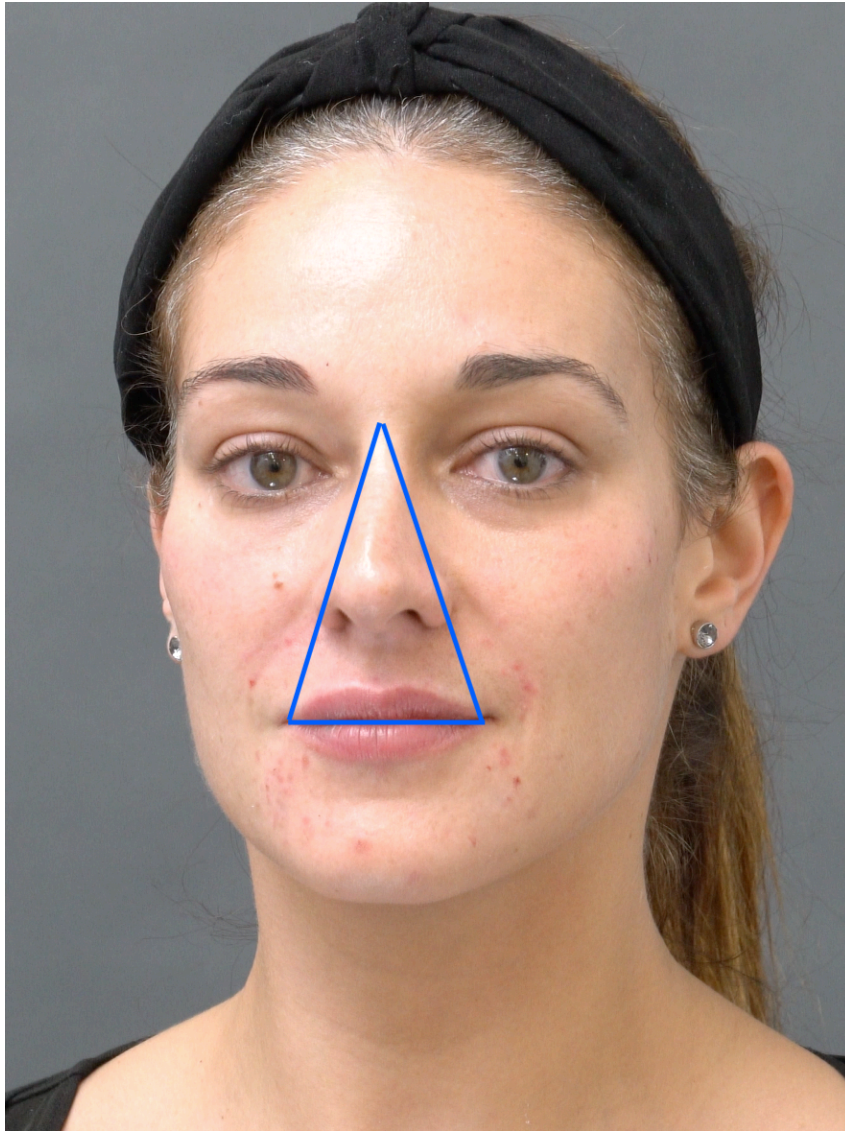
- *where the facial artery crosses the lower border of the mandible*
 - Avoid deep injections at the bone level at this area
 - Facial artery can be palpated just anterior to anterior border of the masseter muscle (ask patient to clench jaw to feel this muscle)
 - Intravascular injection here will affect the facial artery supply which is large
- *where the facial artery ascends superomedially by the nasal ala and becomes the angular artery*
 - The angular artery is the end artery of the facial artery
 - Occlusion results in blanching, necrosis and scarring of the lateral cheek, nasal septum and has the potential to cause blindness through embolisation
 - The angular artery may also be affected when injecting the tear trough medially
 - Occlusion may also affect the nasal ala where it affects the facial artery (more proximally)
- *In the glabella region where the supra-trochlear artery may be affected*
 - The supra-trochlear artery is an end vessel of the ophthalmic artery
 - Injecting the glabella with dermal filler is high risk for vascular occlusion
 - Occlusion can cause ischaemia and necrosis of the forehead, while retrograde embolisation can affect the ophthalmic artery itself, resulting in blindness and loss of normal ocular movements.



Veins

Venous drainage largely follows arterial supply, with corresponding veins to match the facial, angular, supratrochlear and supraorbital arteries. The facial vein is formed at the medial canthus of the eye from the supraorbital and supratrochlear veins, descending the face alongside and deep to the facial artery. This facial vein then passes the lower border of mandible and moves posteriorly, where it joins with the retromandibular vein to form the common facial vein, which drains into the internal jugular vein. The infraorbital vein drains the mid-cheek area which is supplied by the infraorbital artery, also passing via the infraorbital foramen.

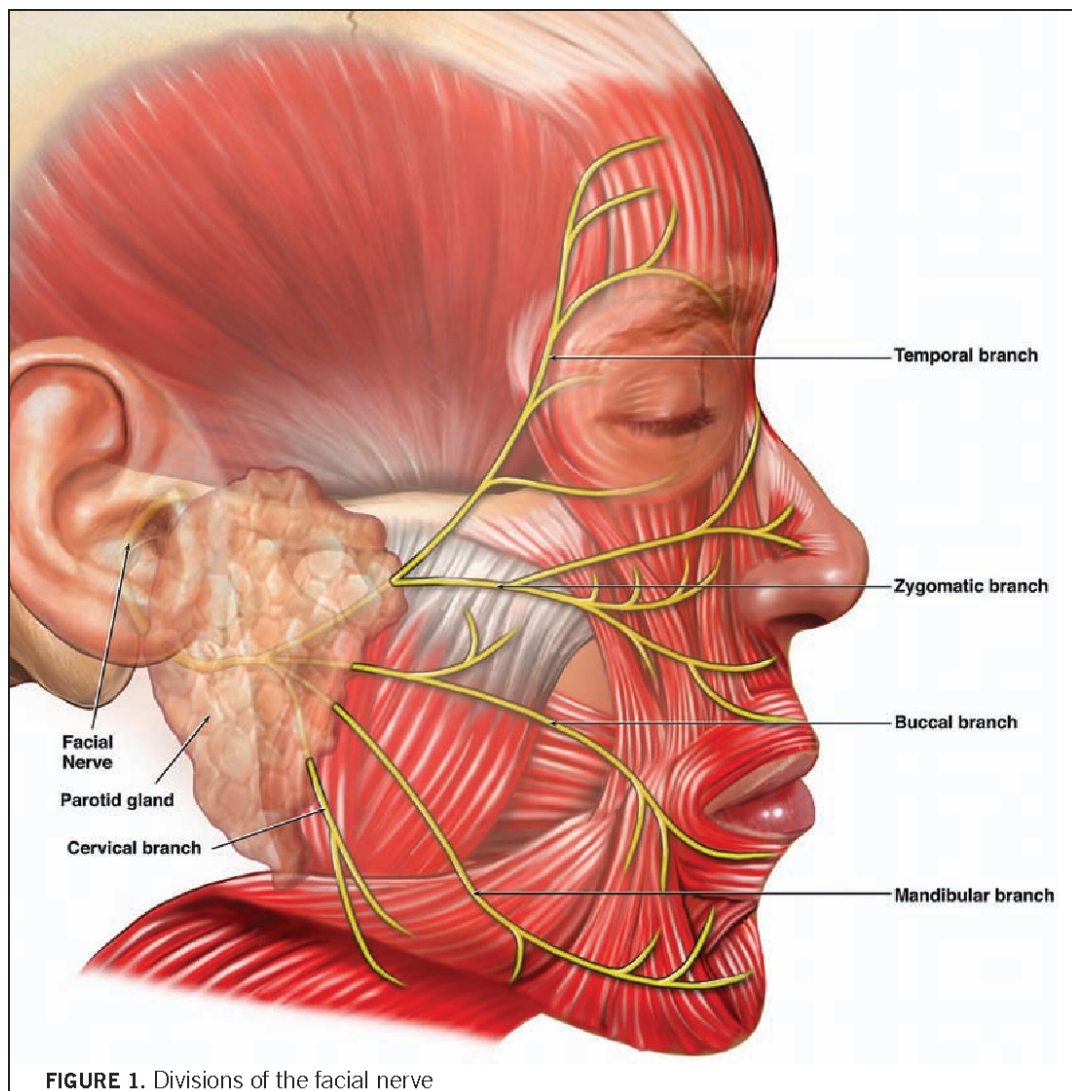
Danger triangle of the face – the area of the face from the nasal bridge, to the corners of the mouth. Superficial venous drainage here is via the facial vein, which has connections deep into the cavernous sinus via ophthalmic veins. This communication poses the risk of superficial injections in this area moving deep intracranially and causing encephalitis, venous, sinus thrombosis, meningitis or an abscess. (see diagram below)



There are areas with rich venous plexuses which are prone to bleed and bruise, and these include the under-eye region, which is high risk for bruising after any treatment. Another high risk area is the temple, where the superficial temporal veins can be prone to trauma. Always look out for superficial veins overlying an injection site, taking care not to cause unnecessary trauma that could cause bruising.

2.2 Explain the facial nerves of relevance to the use of dermal fillers

The facial nerve is the motor nerve of the face, and it supplies the muscles of facial expression. There are five main branches to the facial nerve: Temporal, Zygomatic, Buccal, Mandibular, Cervical.



The actions of each of the five branches can be seen, along with the relevant vascular anatomy also demonstrated:

- **Temporal – raises eyebrows**



- **Zygomatic – closes eyes, frowns**



- **Buccal – puffs out cheeks**



- **Mandibular – sad face, turns down corners of mouth**

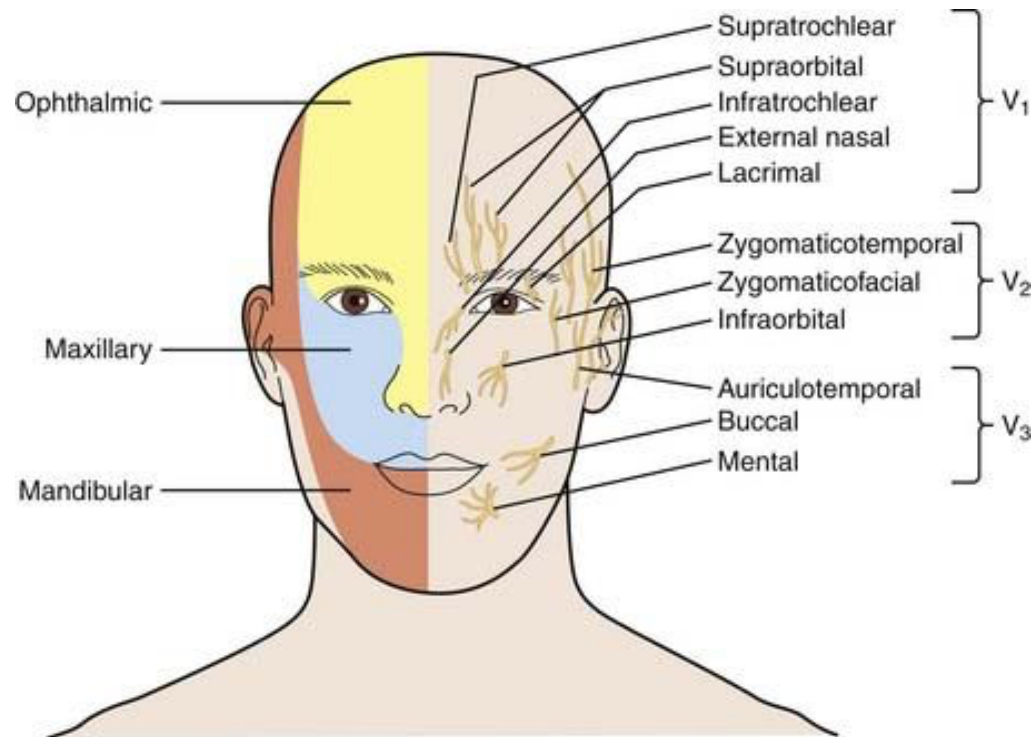


Cervical – grimaces, activation of platysma (neck)



The sensory nerve of the face is the Trigeminal nerve (CN V). This nerve has three main divisions - ophthalmic, maxillary and mandibular. Important nerves within these divisions include:

- **Supratrochlear nerve (V1)**
 - Branch of the frontal nerve <- Ophthalmic division of Trigeminal nerve.
 - Supplies skin of medial lower forehead, conjunctiva and skin of the upper eyelid
- **Supraorbital nerve (V1)**
 - Branch of the frontal nerve <- Ophthalmic division of Trigeminal nerve.
 - Emerges from supraorbital foramen and is lateral to the Supratrochlear nerve
 - Supplies frontal sinus and skin of forehead more lateral to midline and up to the scalp
- **Infraorbital nerve (V2)**
 - Terminal branch of the maxillary division of the trigemini nerve
 - Supplies sensation to the lower eyelid, upper lip and part of the nasal vestibule
 - Exits through infraorbital foramen of maxilla
 - Divides into 4 terminal branches: superior labial, internal nasal, external nasal, inferior palpebral



2.3 Explain the facial fat pads of relevance to the use of dermal fillers

Cheek

- FOUR Superficial fat compartments
 - Nasolabial
 - Medial
 - Middle
 - Lateral-temporal

Deep Cheek

- THREE deep fat compartments
 - SOOF (Sub-ocularis oculi fat)
 - Deep medial cheek
 - Buccal

Forehead

- THREE compartments
 - Central
 - Two lateral

Orbital

- THREE inferior intraorbital compartments
 - Medial
 - Central

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- Temporal (Lateral)
- TWO superior intraorbital compartments
 - Medial
 - Central

Subcutaneous periorbital area

- THREE subcutaneous fat compartments
 - Superior
 - Inferior
 - Lateral

Figure – superficial fat compartments eye

Superficial Fat Compartments

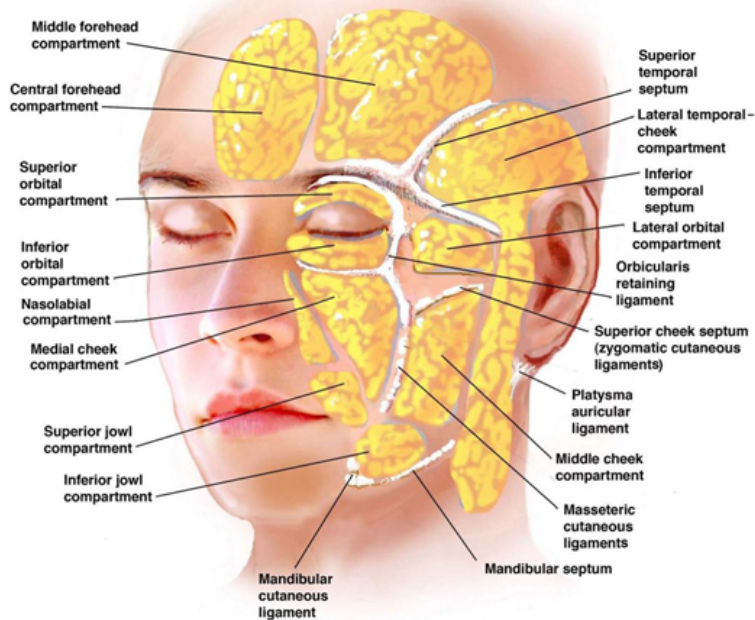


Figure – fat compartments of the eye

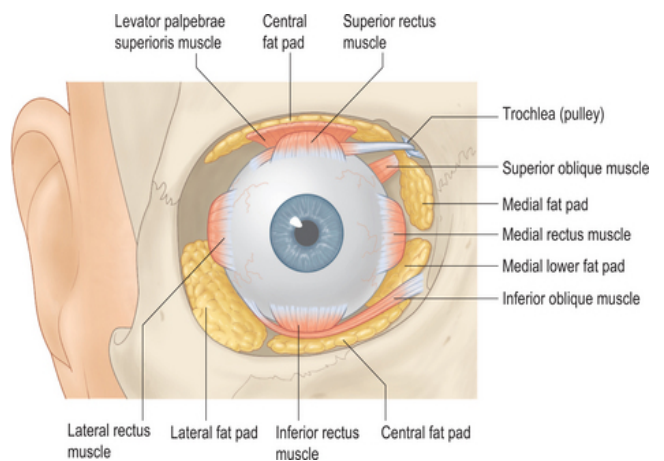
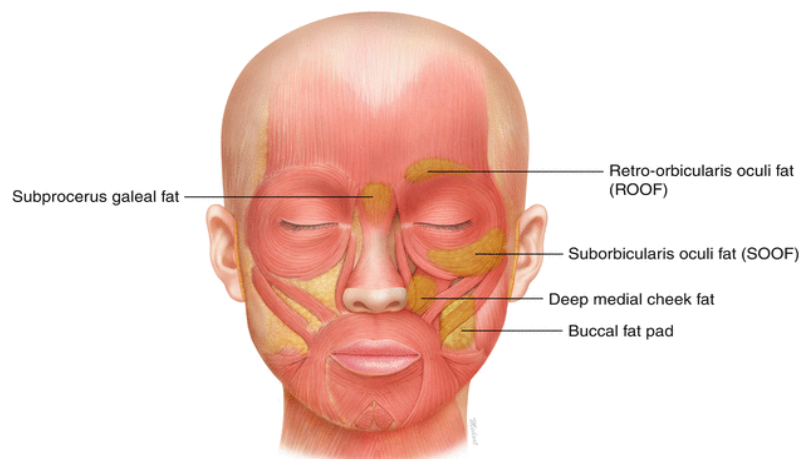


Figure – Deep fat compartments



2.4 Explain the impact of age related anatomical and physiological changes upon dermal filler administration

The morphology of ageing dictates where product should be placed. In the first instance, a thorough assessment must be undertaken to account for individual changes resulting from both genetic and environmental factors. The problem areas identified or suggested by the patient will guide product selection, volume used, depth of placement and use of other modalities such as botulinum toxin. Common areas that need to be addressed as part of the ageing process include:

- *Midface volume loss*
 - Zygomatic bone loss
 - Midface fat volume loss
 - Temporal volume loss
 - Downward migration of fat causing increased lower face volume

The above is addressed with mid face dermal filler placed pre-periostally on the cheekbone in the first instance. A volumising filler should be used.

- *Perioral/lip volume loss*
 - Loss of volume of both lips, upper more than lower
 - Loss of perioral volume creating fine lines and a sunken appearance
 - Increased distance between subnasale and upper lip

The above is addressed with dermal fillers in the lip body/border/periorally, using an appropriate filler.

- *Deep creases*
 - Deep crease development over areas of dynamic movement
 - Creases from descent of tissue and subcutaneous volume loss
 - May be exacerbated by environmental factors and facial shape

The above is addressed with tailored placement of an appropriate product to soften line appearance, while addressing any underlying cause such as mid face volume loss. Placement should be at the depth appropriate for the severity/depth of the crease.

3.1 Explain a range of injection techniques

See video “Dermal Fillers”

Linear Threading

- A retrograde slow injection while withdrawing a needle
- Measure the needle against the area to be injected, visualising where the entry point should be
- Determine the injection angle, stretch the skin and insert the needle until it is at the desired depth, and then flatten the needle
- Maintain the needle bevel up, and with the needle now flat advance to where is required
- At this point, you must ASPIRATE - looking for any blood which may indicate intra-arterial positioning. If blood is aspirated, WITHDRAW IMMEDIATELY WITHOUT INJECTING
- Once happy with position and safety, start injecting the product slowly as you withdraw

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- Avoid injecting until withdrawal as this will waste product (inject until 3/4 of needle has been withdrawn)
- Aim to inject small amounts at a time - 0.1ml at each pass.

Bolus

- An injection of a determined amount of product in a single point
- Used commonly at the bone (pre-periosteal) depth
- The deep anatomical landmark should be identified and marked, accounting for any movement of overlying tissues
- Injection is usually perpendicular to the skin (eg: onto the cheek bone) and when the desired level is reached, aspiration should be performed
- When satisfied with the site and safety, injection is carried out slowly, delivering the desired amount of product in a single location, before withdrawing

Fanning

- the initial stages of lining up and inserting the needle here are identical to the linear threading technique
- This is often used in conjunction with linear threading
- The difference to linear threading regards needle direction and movement
- Whilst inserted, the needle orientation is changed before being withdrawn
- At each new position, aspiration must take place
- This change in orientation can take place multiple times to cover a larger area through a single entry point
- Injecting the product is linear retrograde (as with linear threading)
- This fan effect can provide greater support to certain areas (eg in the nasolabial area)

Cross-hatching

- injections take place at right angles
- This can provide support and volume
- Useful in the marionette region
- Linear threads are placed at 90 degree angles to each other

3.2- 3.4 Explain the use of needles and cannula referring to dermal fillers, and compare the advantages and disadvantages

Needle

Injecting with a needle is the more traditional method of product placement, and can take the form of any of the injection methods listed in the previous section. An aseptic non-touch technique (ANTT) must be used throughout.

Advantages:

When used appropriately, this method is accurate, and it is also often the method in which practitioners are most confident, which can lead to better outcomes.

Disadvantages:

By nature of the sharpness of the needle it can cause more trauma, resulting in a higher risk of bruising or swelling. In addition, for covering large areas, a needle may require multiple puncture sites leading to greater discomfort for the patient. There may be less depth control resulting in unevenness, and importantly, there will be an increased of arterial puncture and vascular compromise.

Cannula

This is the more recent method used for filler placement, and is becoming more popular with time. It is particularly suited to certain treatments where minimal trauma and placement over a large area is preferable. A cannula is a round ended tube which is inserted into the subcutaneous layers via puncture site made with a small needle. The cannula is progressed through the tissues in a plane using minimal pressure to find a path of low resistance. Cannulas come in varying gauges and lengths.

Advantages:

Less traumatic, and as such can pose a lower risk of bruising, swelling or arterial puncture/injection. The lower bruising risk and reduced downtime makes the cannula especially useful for patients with externally facing roles, while the safety aspect makes it very appropriate for using around the eyes. There are also fewer administration/injection points which is good for patient comfort. Depth controls is good as injecting is in a horizontal plane, thus resulting in better evenness of distribution.

Disadvantages:

The cannula itself is more costly and must be bought separately. There is also a significant learning curve associated with use, with some increased complexity and greater training requirements involved. Most of the advantages of using a cannula are dependent on the practitioner developing and having the necessary skills, and reaching this level of competency takes time.

4.1 Explain the contraindications for the use of dermal fillers.

Contraindications:

- known hypersensitivity/allergy to product (including local anaesthetic if contained, or to gram positive bacterial proteins)
- Pregnancy
- Breast feeding
- Infection at injection site

Cautions

- Patient mental health concerns
- Anticoagulant Medications - Warfarin, aspirin, clopidogrel
- Vitamin E high dose, omega 3 oil high dose, and aspirin (if permitted to stop) should be stopped 7 days pre-treatments

4.2 Explain the high risk treatment areas

- Nasolabial folds: injecting deep into this area poses a risk of intravascular injection into the facial/angular artery, causing vascular occlusion with associated ischaemia and necrosis of facial tissues if untreated

- Tear trough - small vessels around eye plus the proximity of the angular artery when treating medially make this a high risk area of intravascular injection which, in the worst scenario, can lead to tissue necrosis or involvement of the ophthalmic artery and the eye itself.
- Glabella - using filler to fill fine lines in this region can lead to intravascular occlusion affecting the supratrochlear or supraorbital vessels. Retrograde embolisation can even result in involvement of the eye and visual disturbance.

4.3-4.4: Describe the potential adverse effects associated with dermal filler administration. Describe the management options for each adverse effect.

Adverse effects associated with dermal filler administration are more common than they ought to be, and the media regularly has stories of poorly performed filler procedures with often disastrous outcomes. It should be highlighted that despite not being a prescription-product, dermal filler can cause catastrophic damage to patients when it is not delivered by suitably trained healthcare professionals. Even when practitioners are suitably trained and experienced, adverse outcomes can still occur and it is crucial that practitioners understand how to recognise and deal with these.

When we refer to dermal filler here, we are talking about hyaluronic acid (HA). Other fillers exist in the current aesthetic market, but for reasons which will be elaborated on, currently we recommend that only HA is used for the purposes of your Level 7 training. HA is found naturally in our connective tissues, however it's quantity diminishes with age. It is a glycosaminoglycan which is turned over on a daily basis in the body. HA is also a component of the group A streptococcal extracellular capsule; it is from this bacteria that HA is produced for use in aesthetics. Importantly, HA can be dissolved by the enzyme hyaluronidase (hyalase) in the event of an emergency.

Adverse effects associated with dermal filler application include:

- Bruising
- Bleeding
- Swelling
- Vascular compromise
- Vascular occlusion/embolization
- Pain
- Headache
- Hypersensitivity/Allergy
- Granuloma/biofilm/nodules
- Suppuration/abscess/infection

Regarding bleeding and bruising, simple measures such as patient selection, avoiding aspirin/Vitamin E pre-treatment and pressure over areas during the procedure can help reduce this risk. Swelling can be especially evident with certain areas (eg; under eyes), but simple advice such as ice packs and sitting upright can ameliorate this. Allergy to HA is unlikely, while pain can be managed with paracetamol, however **patients must be made aware that severe or worsening pain is a RED FLAG and must be reported to the practitioner immediately in the first 48 hours as a possible manifestation of vascular compromise.** The use of aseptic non-touch technique and effective skin cleansing with alcohol or chlorhexidine is important to avoid contamination of the needle/cannula or

implantation of bacteria or debris during injection. The result can be a biofilm and granuloma formation in the tissues. The single most important measures to avoid this are maintaining sterile conditions of the cannula/needle and adequate skin preparation. If a frank infection with suppuration is suspected, this must be managed rapidly and with appropriate steps to involve antibiotics and other healthcare professionals. Drainage may be required in certain circumstances, and at all times involvement of important structures as well as spread must be accounted for.

To elaborate on some of the most important adverse effects, we must turn to vascular compromise and vascular occlusion/embolization. When dermal filler is injected into an artery, it can either block the artery at the site or it can embolize to a more distant site. Both of these outcomes are catastrophic and can lead to tissue necrosis and/or blindness. To avoid this occurring, it is important to aspirate every time a needle is placed in a different site, and while cannulas do not remove the risk, they are significantly safer and less likely to pierce a vessel. Special care must be taken when treating 'danger zones' such as the nasolabial fold region, where there are vessels leading to an increased risk of arterial involvement. Other measures to reduce risk include injecting small volumes at each time (max 0.1ml), and linear threading is preferable to large boluses in the subcutaneous tissue. Where arterial compromise is suspected, the single most important measure is to inject hyaluronidase into the tissues to break up the filler. This must be done as a matter of emergency. Other important measures include massage, warm compress, oral sildenafil and topical GTN cream to promote vasodilatation.

4.5, 4.6, 4.7 Identify the indications for, effects of and possible adverse effects associated with hyaluronidase application.

See video "Vascular compromise & Hyalase"

Hyaluronidase (shortened to hyalase) is an enzyme that breaks down hyaluronic acid, starting to work instantly. It can be used to break down/dissolve HA-based dermal filler in both emergency and non-emergency situations.

Emergency Indication

- suspected vascular occlusion leading to necrosis of tissue or ocular complications

Non-emergency Indications

- Excessive product present
- Nodules
- Poor aesthetic outcome
- Patient wishes to reverse treatment

Hyaluronidase comes in vials of 1500 units. Once opened, the contents must be mixed with bacteriostatic normal saline as per requirements/dilution required and either used or discarded immediately. There is a risk of allergy/anaphylaxis with hyalase, and as such for non-emergency indications there should be a patch test on the patient with a small amount injected sub-dermally onto an area of skin (eg: the arm) followed by 30 minutes observation. When hyalase is injected it will dissolve product and remove nodules. It should be explained to the patient that hyalase can also affect native connective tissue. There can also be unintended dissolution of other filler treatments, and it is notoriously difficult to use hyalase as an accurate way to treat specific areas. Since hyalase is delivered by injection, there are associated risks of bruising, bleeding and swelling, and the patients should be warned that the injection can sting.

There is debate regarding patch testing in the emergency situation. As long as adrenaline and oxygen is readily available (as should be the case) then the emergency situation requires that hyalase is injected as soon as possible to halt ongoing vascular compromise and impending tissue necrosis. Hyalase should be used to flood the area in emergencies, following along the area of injected filler as well as the course of the suspected vessel involved. Treatment should be repeated at frequent (1-3 hourly intervals) until capillary refill and symptoms are resolving. The patient should stay with you throughout this time for observation. Involvement of a more experienced professional/mentor should be considered as the progression and recovery can be challenging and unpredictable. Scarring can occur if this complication is not recognised or appropriately treated. In the worst scenario sight can be lost and permanent facial disfigurement can occur.