As practitioners and patients continue to seek new ways to address age-related changes, dorsal hand rejuvenation is gaining popularity in the field. However, despite the high demand for this procedure, there has been little discussion on dorsal hand anatomy in the literature, with a prominent focus on the inner workings of the palmar hand. In this article, the authors will explore the dorsal hand in depth and outline safety considerations for aesthetic practitioners who are providing rejuvenation.

Signs of dorsal hand ageing
A youthful dorsal hand is characterised by a supple, smooth skin texture and contour, with minimal or absent prominence of the dorsal veins (Jakubietz et al, 2008). Over time, extrinsic (e.g. sun damage and smoking) and intrinsic (bone remodelling and soft tissue volume changes owing to ageing and disease processes such as arthritis) factors promote ageing, resulting in textural changes, dermal atrophy, prominence of the dorsal veins, visibility of the tendons, soft tissue volume loss, and bone and joint changes (which can cause deformities). These changes are all part of a dynamic process and have been evaluated chronologically (Jakubietz et al, 2008).

To address the problem of hand ageing, a variety of rejuvenation procedures have been proposed. These include fat grafting (Coleman, 2002), the administration of dermal fillers (Dallara, 2012), chemical peeling procedures (Butterwick 2005) and vein resection (Sadick and Schecter, 2004).

Anatomical considerations in dorsal hand rejuvenation
To date, the anatomy of the dorsal hand has not been discussed in any great depth in the literature. However, several anatomical considerations have to be taken into account when rejuvenating the dorsal hand. An in-depth understanding of the anatomy will enable practitioners to place products accurately and safely, minimising the risk of any complications (e.g. bruising). Essential components to consider include the skin, soft tissues (areolar tissue/dorsal laminae), and intrinsic muscle activity and wasting. It is also crucial that any veins and tendons are identified as precisely as possible, and that a palmar assessment, including sensory and motor activity of the ulnar, radial and median nerves, is undertaken.

Abstract
The hands are frequently exposed to an assortment of chemicals and ultraviolet (UV) radiation, which over time can be characterised by loss of dermal elasticity and atrophy of the subcutaneous tissue. Whereas extrinsic changes may present, such as solar purpura, solar lentigines and actinic keratoses, intrinsic changes can be significantly improved with the aid of a volumising agents such as calcium hydroxylapatite or hyaluronic acid dermal fillers. Administering these products can reduce the appearance of dorsal veins, tendons and boney prominences, restoring a smooth and youthful contour. It is vital that practitioners are up to date on their anatomical knowledge before treating the hands with any injectable products. Awareness of the dorsal hand anatomy and vascular system will ultimately increase the degree of accuracy in product placement, and decrease the risk of complications.

Key words
- Dorsal hand anatomy
- Hand rejuvenation
- Injectables
- Complications

The arterial supply to the hand should also be documented by aesthetic practitioners, with a patency assessment of the radial and ulnar arteries, by performing the Allen Test (Cable et al, 1999). This test involves getting the patient to make a fist for about 5 seconds and then applying pressure over the radial and ulnar arteries to occlude them. The hand is then opened; it should appear pale as the pressure over the ulnar artery is released and the colour should return in the palm and fingers within 5 seconds. This result will verify that the ulnar artery is patent. The test is also repeated with release of pressure over the radial artery to assess patency of this artery.

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Dissecting the dorsal laminae

The dorsal laminae, or the fat planes, are of critical importance to any practitioner who is injecting products into the dorsal part of the hand. This is because accurate placement of a product can be particularly difficult if the practitioner does not appreciate the variations that may exist in the ageing hand.

In his early description of the dorsal space, Kanavel (1925) described the fascial layers in the dorsal hand as being separated into a superficial and deep lamellae, through which infection could and did spread. This is something that aesthetic practitioners should be particularly mindful of while performing dorsal hand rejuvenation, and consideration should be given to skin preparation and the use of aseptic techniques.

Kanavel (1925) reported that there was a superficial fascia overlying the extensor tendons, with a deep fascia over the interosseous muscles and metacarpals. However, the area superficial to the extensor tendon was not described. Twenty years later, following cadaveric dissections, Anson et al (1945) described the dorsal hand fascia as being composed of four distinct layers: a superficial fascia divided into superficial and deep fascial layers by an areolar plane, and a deep fascia divided into a superficial and deep layer by another areolar plane. The deep fascia was said to be a continuation of the antebrachial fascia of the arm, or the deep fascia.

While the superficial layer of the deep fascia covered the extensor tendon compartment, the deeper layer overlies the interosseous muscles and metacarpals.

Recent studies on the dorsal laminae

Bidec et al (2010) carried out a histological analysis and duplex ultrasound imaging of cadaveric hands to study the dorsal lamellae further. As a result of these investigations, the authors identified three dorsal layers of fat, separated by three fascial layers (Figure 1). The first is the superficial layer, which lies between the dermis and the dorsal superficial fascia. It contains no structures and, in the aged hand, is often adherent to the deep dermis and lacks any fat. It was found that cadavers with a body mass index of >30 had more fat in this superficial layer compared to those with a BMI <20, which resulted in the veins and underlying volume changes being masked by the superficial fat layer in the obese hands.

Next is the intermediate fatty layer, which is sandwiched between the dorsal superficial fascia and the dorsal intermediate fascia, which is a continuation of the antebrachial fascia of the forearm. This intermediate layer contains the dorsal veins and sensory nerves.

The final layer is the deepest fat plane is between the dorsal intermediate fascia and the dorsal deep fascia. The extensor tendons are located in this layer; the dorsal deep fascia covers the interosseous muscles and the metacarpal bones.

Vertically arranged fibres between the layers

Bidec et al (2010) also highlighted that there are vertically arranged fibres traversing between the layers from the deep compartments to the dermis (palmar to dorsal). The authors reported that these fibres contain the perforating vessels that supply the subdermal plexus from the deep dorsal vessels; therefore, when disrupted, they may be the source of bleeding and bruising. This explanation may also explain the lumpy appearance (cellulite) that is occasionally observed following volumetric dorsal hand rejuvenation.

Safety considerations

Although, in general, the superficial layer would be safe to inject into, in the aged hand it is too close to the dermis to separate. Moreover, the superficial layer would not be suitable for the injection of hyaluronic acid or calcium-based dermal fillers, as these products would be visible through thin skin. Having said that, fat grafting would be an acceptable alternative treatment in this layer.

The complex anatomical arrangement of the dorsal hand highlights that, when the practitioner tents the dorsal skin before injecting with a dermal filler, the product is often placed in the intermediate fatty layer. Placing product in this layer prevents both damage to the extensor tendon complex and palmar migration of the injected product.
The dorsal vascular system

Arterial system

The dorsal arterial system was explored in detail by Salmon et al (1988), who highlighted the arrangement of vessels as complex and variable. The dorsal carpal arch is formed by the carpal branches of the ulnar and radial arteries at the level of the wrist, lying on the carpus. It sends dorsal metacarpal arteries distally in the intermetacarpal spaces, with further anastomosis with the dorsal and palmar interosseous arteries through the interosseous spaces. The dorsal metacarpal arteries lie deep to the tendons (Figure 2); the first artery is a direct continuation of the radial artery and is not part of the dorsal carpal arch. All of the dorsal metacarpal arteries lie deep to the extensor tendon, which is close to the metacarpal bones, interosseous ligaments and muscles.

The proximal two-thirds of the second to fourth dorsal metacarpal arteries are covered by the extensor digitorum communis tendon. In the distal third of the hand and webspaces, the dorsal metacarpal arteries supply two or three perforator branches, which travel between the tendons and tendon sheaths of the back of the hand to reach the skin, where they divide into two or more short branches (Salmon, 1988). These branches travel proximally (recurrent), forming longitudinally orientated plexuses.

Safety considerations

Insertion of a needle and product proximally (at the level of the dorsal wrist) is unlikely to damage the dorsal arteries; however, distal injections to the extensor digitorum communis could damage the perforator vessels, and it is possible for a product to be injected into these vessels, as they have a communication with the palmar and end artery digital vessels.

Venous network

The dorsal venous network forms large veins that drain from the palm; this means that the pressure of gripping does not have an impact on venous return. The venous
network lies superficial to the extensor tendons (in the intermediate fat plane) and drains on the radial side to the cephalic vein, and on the ulnar side into the basilic vein.

Safety considerations
As vessels enlarge in a distal to proximal direction, they are more visible proximally. Vessels may be avoided readily with regards to any proximal injection points.

Sensory supply
Innervation occurs through the terminal branches of the radial and dorsal ulnar nerve. Branches are distributed in the hand and digits 3½ to 1½; although, occasionally, a 2½ to 2½ distribution is seen. The ends of the nerves do not reach the nail beds; these are supplied 3½ to 1½ by nerves on the flexor side, the median and superficial branch of the ulnar nerves (Figure 3).

Practical advice for aesthetic practitioners injecting the hands
Having an in-depth knowledge of dorsal hand anatomy ultimately enables practitioners to fully understand treatment outcomes and avoid any complications that may occur. Moreover, those who know the compartmental spaces of the dorsal hand in detail will be able to explain how minor infections may rapidly spread to involve the hand. However, in all cases, practising in line with strict aseptic technique will ensure that any risk of potentially harmful conditions is reduced.

Awareness of the dorsal vascular system
An appreciation of the vascular system will keep practitioners alert to the presence of arteries, veins and perforator vessels in relation to injection points and product placement. The hand has potential communications between palmar and dorsal vessels, which lead into the end arteries in the digits. Although not reported in the literature, there can be serious consequences following products being injected into the end arteries.

Avoiding vessel damage
As there are vertically arranged perforator fibres (Bidec et al, 2010), cannulae dissection is best performed in a palmar-dorsal direction, rather than radial-ulnar, to any reduce damage to these vessels. Dorsal vessels are more visible proximally and may be easily avoided.

Inducing reflex sympathetic dystrophy
An additional consideration to bear in mind when rejuvenating the hands is the possibility of inducing reflex sympathetic dystrophy (RSD). RSD is a complex pathophysiological problem that is particularly difficult to manage owing to its causation, treatment and even definition. There is a variety of treatment-inducing events reported in the literature, ranging from a paper cut to spinal cord injury (Merritt, 2006). However, this problem is also frequently reported in common hand operations such as carpal tunnel release, with 2–5% with minor trauma responsible for 10–14% of cases.

As RSD is a complex problem, an interaction of CNS physiology and hand function and should not be disregarded. Any practitioner treating the hand should be aware of this potentially disabling condition.

Conclusion
When performing dorsal hand rejuvenation the practitioner should be aware of the detailed anatomy of this region. The ageing hand has dynamic age related changes that need to be addressed for successful hand rejuvenation, including anatomical changes in the dermis, soft tissues, muscles and joints. During invasive procedures the position of arteries veins and fat planes should be appreciated as well as the changes associated with age. Knowledge of the perforating vessels and how the dermis is vascularised will allow practitioners to minimise problems such as bleeding and bruising.

References

Key points
- The ageing hand undergoes multiple changes with respect to the underlying structures
- There are three fat planes: the superficial changes with age and weight, dorsal veins and nerves are in the middle plane, and the extensor tendons reside in the deep plane
- The vascular system has communications between the palmar and dorsal systems and perforating vessels are in a palmar-dorsal orientation. Nerve supply to the dorsum is through the radial and ulnar nerve branches
- Knowledge of the anatomy of the dorsal hand will allow accurate product placement and minimise risks