Introduction
The use of IV access is very common in hospital practice. It is a very effective way of administering fluids and medications. While gaining IV access in patients is a skill seldom used by most dental practitioners, as it is not a requirement of the medical emergencies and resuscitation guidelines, it is relatively easy, once mastered. Dentists should familiarise themselves with this skill, as it is invaluable in administering IV medications such as antibiotics. Dentists who carry out sedation routinely should have received training in the techniques for placing IV cannulae; others may not have received any training in these techniques. The lack of sufficient training may not become apparent until IV access is necessary, such as in the administration of IV antibiotics before transfer to a hospital environment.

The following is a brief explanation of the basic principles, techniques used and complications involved in gaining successful IV access.

Basic principles
IV access is most readily achieved with a peripheral IV cannula. This consists of a slender plastic tube approximately 2.5 cm long. This houses a metal inducer needle, which is used for insertion into a vein, usually in the back of the hand or the antecubital fossa of the arm. At the end is a plastic hub, through which fluids and drugs are administered. This is then secured with an adhesive dressing.

An important point to note is that flow rate through the catheter is proportional to the diameter to the power of four. This is according to Poiseuille’s law. Poiseuille discovered that increase in flow is proportional to the fourth power of the diameter. Therefore, doubling the diameter of the cannula will increase the flow rate by a factor of 16.

In emergency situations, a needle and syringe technique may be used to inject medications; however, this is a less safe and less stable arrangement than using a secured IV cannula.

Relevant anatomy of the forearm and hand
The veins of the forearm and hand are commonly used in IV access. There is variability in these veins, but common patterns are found.

The veins that drain the fingers unite on the dorsum (back) of the hand to form three large veins, known as the metacarpal veins (Figure 1). These drain into the lateral cephalic vein (which is on the thumb side) and medial basilic vein (which is on the little finger side), and can be identified at the hand and wrist.

Of note, the cephalic vein lies in close proximity to the radial artery. This is of little significance in most patients; however, a more superficial position of the radial artery has been reported in up to 1% of cases. This group may be at higher risk of radial artery damage during cannulation.

In the antecubital fossa, the cephalic vein (located laterally) and basilic vein (located medially) are located at the skin fold between the forearm and upper arm (Figure 2). Here, both veins are connected by the median cubital vein, which is often visible. There are several important structures in the antecubital fossa, including the brachial artery, median nerve and cutaneous nerves of the forearm. While these are further below...
the surface of the skin than superficial veins, the brachial artery can be
displaced to a more superficial position in up to 9.4% of the
population. Since these structures are located more medially, the risk
of damage is reduced by selecting veins that lie more laterally in the
antecubital fossa.

Relevant physiology
Normal arterial blood pressure is 120/80mmHg. The higher figure
represents systolic pressure (pressure generated when the heart
contracts) and the lower figure represents diastolic pressure (the
lowest pressure that occurs between heart contractions). Pressure in
the veins is significantly lower (approximately 10mmHg) than arterial
pressure, but this varies with position of the limb.

Tourniquets are used to make veins dilate and make it easier to inject
into, or cannulate, the vein. The force applied by the tourniquet
should be sufficient to block the vein (but not the artery) and stop
blood flowing back through the vein to the heart. This will cause
dilation of the vein and allow for easier identification of the vein and
placement of the cannula.

The ‘triple response’ refers to the vascular changes in the skin in
response to mild mechanical injury. In practice, this means that mild
tapping on the skin with the flat of the hand causes dilation of the
veins, which will improve access. Mechanical activity, such as asking
the patient to repeatedly form a fist, will cause further engorgement
of the veins. This is due to increased activity and a build-up of
metabolites locally in the blood vessel. Finally, the application of heat,
in the form of a warm, damp cloth, or by placing the patient’s hand
in warm water (care must be taken to ensure that the temperature is
not so high as to cause burns or skin damage), will cause dilation of
the vein. Blood vessels dilate in the presence of heat in an attempt to
cool the body.

Indications for IV line placement
1. IV sedation.
2. Administration of drugs, e.g., antibiotics.
3. Administration of fluids.
4. Emergency situations – IV access should be obtained early since it
   will become more difficult if the patient deteriorates.

Complications of IV access
1. Failure of cannulation.
2. Extravasation (entry into the surrounding tissue) of drugs or fluids.
3. Damage to local structures.
4. Bleeding and haematoma formation.
5. Inflammation of the vein or surrounding skin.
6. Fracture of needle or shearing of the cannula.

Preparation for IV access
Preparation is the key to good IV access. It is important that you have
all the necessary supplies with you when you place an IV line. In
general practice, it is wise to have a kit ready (in case of emergency),
including the following:
1. Gloves and protective equipment.
2. Tourniquet.
3. Cannulas of appropriate size (14- to 25-gauge).
4. Alcohol swabs.
FIGURE 6: Application of tourniquet.

FIGURE 7: The veins are distended on the dorsum (back) of the hand. They have been highlighted with a marker for the purpose of this demonstration.

FIGURES 10 and 11: Insertion of the cannula into the vein. Note the “flashback” of blood into the chamber.

FIGURES 12 and 13: The cannula is further advanced after the inducer needle is released. The tourniquet is released.

FIGURES 14 and 15: The arm is raised above the level of the heart. The blood can be seen in the chamber.

FIGURES 16: The cap is placed before the arm is lowered. Blood can be collected from the cannula at this stage.

FIGURES 8 and 9: Pre-injection alcohol wipes are used to clean the skin.
5. Sharps disposal box.
6. Adhesive dressing to secure the cannula in place.
7. Saline flush.
8. Sterile gauze.

Technique
1. Ensure that you have all of the necessary equipment.
2. Examine the patient’s veins.
3. Put on gloves.
4. Apply the tourniquet to the patient’s arm with a finger inside to prevent excessive tightness and/or trapping of the skin. The dorsum (back) of the hand is commonly used since the veins are easily accessible, it is easy to support and the risk of damaging important structures is very low.
5. Re-examine the veins.
6. The veins in Figure 7 have been highlighted with a marker pen. Remember, veins that you can see and feel are always better than veins that you can see.
7. Select a vein that is easy to access. Clean the skin overlying the vein with the alcohol swab and allow it to dry (reduces pain) (Figures 8 and 9).
8. Remove the needle cover and orientate the needle to the vein. Stabilise the vein by stretching the skin near the vein (but not over the vein) with the thumb of your non-dominant hand. This prevents movement of the vein/skin during insertion of the catheter. Skin and vein movement can make IV access more difficult.
9. Approach the vein from a low angle with the needle bevel facing up, advancing through the skin firmly but slowly.
10. At the end of the hub, there is a small see-through chamber. This is where you observe for flashback. Flashback is when the needle enters the vein, and blood is seen to enter this chamber. At this stage, you will know if you have successfully entered the vein (Figures 10 and 11).
11. Advance the catheter slowly, 3mm into the vein.
12. At this stage, hold the cannula between your thumb and index finger. With your middle finger, hold the inducer needle steady while sliding the cannula off the inducer needle through the skin and into the vein. The stabilisation of the inducer needle will help to prevent perforation of the vein, which would cause the needle and cannula to enter the tissue outside the vein (extravasation).
13. Remember at this stage to keep the tension on the skin and vein. Continue advancing the catheter slowly into the vein (Figure 12).
14. Release the tourniquet at this stage (Figure 13).
15. Ask the patient to raise their arm above the level of the heart, as shown in Figures 14 and 15. This prevents leaking of blood when the inducer is removed.
16. The inducer needle can now be removed further out of the cannula. As this is done, blood should be visible in the plastic line section of the cannula and will drain into the vein via the line. Air does not enter the vein, since the vein collapses.
17. Gently advance the cannula fully into the vein and place the cap on the end (Figure 16). Fully remove the inducer needle and dispose of it safely in the sharps box.
18. Secure the hub with adhesive dressing. Drugs can be given and bloods can be taken from the line at this stage if necessary (Figures 17 and 18).
19. Flush the IV with a 0.9% saline solution to ensure that it is running properly and has not infiltrated. Signs of infiltration include pain and rapid swelling. If this happens, the IV will need to be replaced in another vein (Figures 19 and 20).
20. Drugs and fluids can be administered through the cannula at this stage.
Removal of IV cannula
1. Remove all adhesive dressings.
2. Raise the hand above the level of the head. This will cause the blood to drain out of the veins (Figure 21).
3. Hold a piece of sterile cotton wool in the non-dominant hand. Remove the cannula slowly with the dominant hand (Figure 22). It will not bleed.
4. Place the sterile cotton wool over the wound and secure in place with medical adhesive tape. This will control any minor bleeding once the arm is lowered.
5. Ensure that the IV cannula is safely disposed of in a sharps disposal container (Figure 23).

Conclusion
While IV access is a procedure that is seldom used in general dental practice, it is a potentially useful one. As with any procedure, practice makes perfect. Opportunities to practise are few and far between unless the practice undertakes IV sedation. The authors recommend that dental practitioners seek training in IV access, either as part of a medical emergencies course, phlebotomy course or sedation course.

References