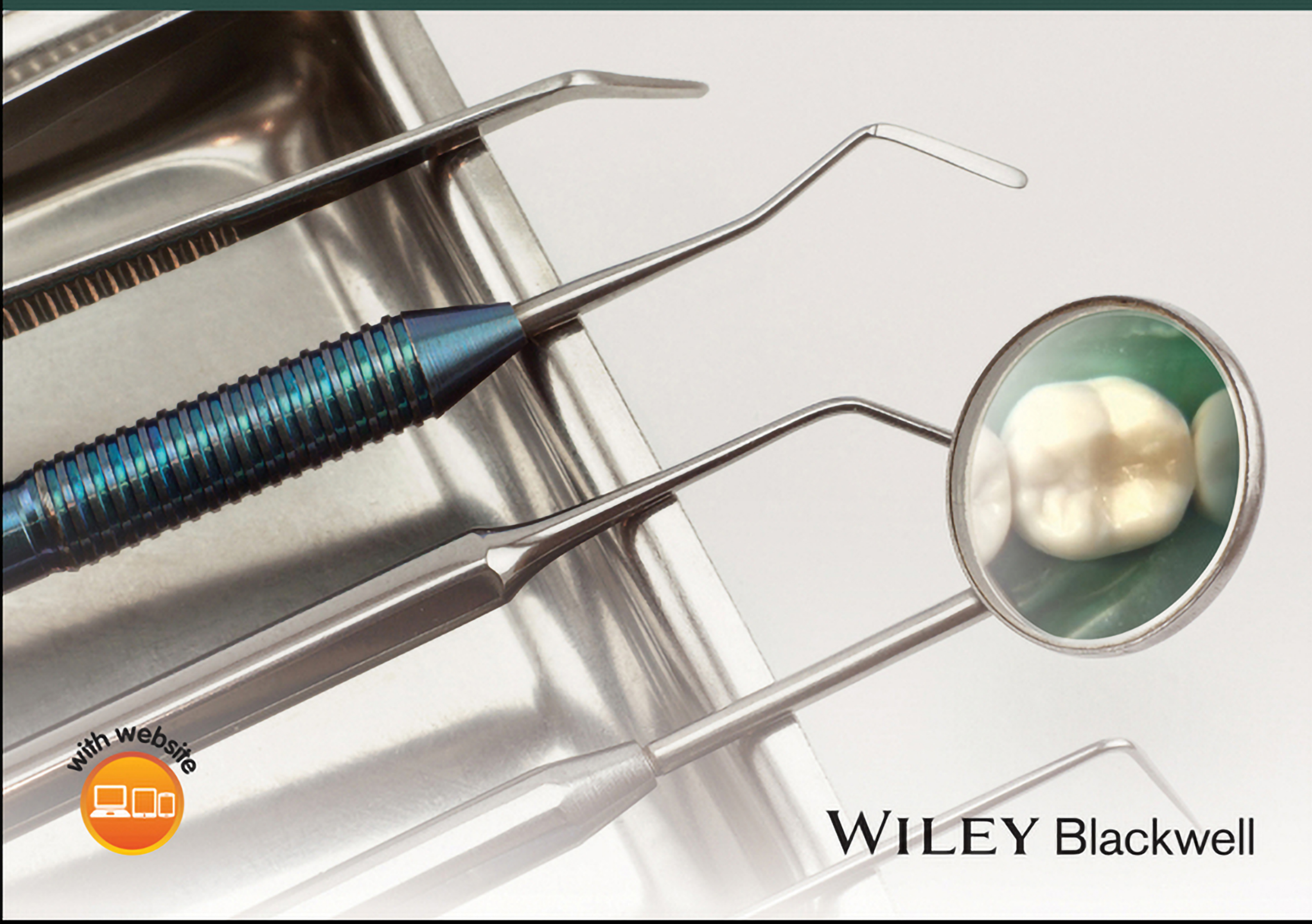
# A PRACTICAL APPROACH TO OPERATIVE DENTISTRY

GORDON B. GRAY
ALAA H. DAUD

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*Gordon B. Gray*
*BDS, MSc, DDS, PGCertEd*
*Senior Clinical Lecturer in Restorative Dentistry (Retired)*
*Dental Clinical Dean*
*Bristol Dental School*
*Bristol, United Kingdom*

*Alaa H. Daud*
*BDS, LDS RCS (Eng.), MFDS RCS (Edin.), MFDS RCS (Eng.), FDTFEd, MSc, PGCertEd, FHEA*
*Senior Clinical Lecturer in Restorative Dentistry*
*Bristol Dental School*
*Bristol, United Kingdom*

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# Preface

Problem solving and minimal invasive dentistry must be developed as an innate art, since it is used routinely by clinicians. This art needs to be developed as an undergraduate student, for both clinical practice and diagnostic purposes.

The purpose of this book is to help students reorganise factual knowledge in their mind. Rather than compartmentalising preclinical sciences into subject matter e.g. anatomy, oral biology, biochemistry, pathology and material science, this book aims to integrate knowledge and produce some links between them that can be used in a practical setting.

While this book acts as a core text for teaching clinical skills to dental undergraduate students, it may also be useful for those practicing or teaching dentistry or in preparation for practical professional registration examinations such as Overseas Registration Examination and License in Dental Surgery.

We would like to thank those who have contributed pictures for this book and have reviewed the manuscript and made useful suggestions.

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The time involved in writing this book would not have been possible without the understanding and support of family and friends.

Images of any products presented in this book represent examples of dental materials that could be used. The authors declare no conflict of interest or funding from any dental companies.

## About the Companion Website

Don't forget to visit the companion website for this book:

**www.wiley.com/go/gray/operative-dentistry**

There you will find valuable material designed to enhance your learning, including:

- Videos of clinical procedures
- Self-assessment questions

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# Section I

# Restorative Dentistry

# 1

# Instruments

The instruments contained in an operative tray are concerned with the diagnosis of disease and operative management of carious cavities. The dental mirror, straight, and Briault probe are used for diagnosis of cavities. Some kits will also contain periodontal probes.

## Diagnosis

Dental mirrors have a number of functions that include not only indirect vision but reflecting light onto tooth surfaces and retracting soft tissues to protect them from sharp burs.

Probes are used for the exploration of tooth surfaces or, more usually, for the exploration of a prepared cavity. This will provide the operator with knowledge of the surface texture and hardness of the dentine surface within a cavity. It should be noted, however, that the use of sharp probes in fissures can break down the surface and accelerate the progress of a carious lesion. The Briault probe is a double ended instrument that is very useful to exploring for cavitation between teeth and under restoration margins. It should be used lightly to avoid iatrogenic damage.

Periodontal probes are used to measure attachment loss, furcation involvement, and bleeding on probing. The WHO probe has coloured bands that correspond to the Basic Periodontal Examination grading system, and this probe has a small ball end to avoid trauma. The Williams probe has markings at 1 mm intervals and is used to make pocket depth measurements around each tooth when completing a periodontal charting.

## Operative Management

These instruments include those used in removing carious dentine and refining the margins of a cavity. Excavators come in a variety of shapes and sizes and should be used carefully for paring away soft dentine. Marginal trimmers are excellent in removing unsupported enamel. The instruments have sharp cutting edges and must be kept sharp to be effective. Some marginal trimmers have a tip of tungsten carbide so that they can maintain their sharpness.

A double ended PF10 instrument is used to transfer dental cements to the cavity floor where it can spread the material smoothly and evenly. An amalgam gun is used to transfer the mixed filling material into the cavity, where it can be condensed using a variety of double ended amalgam condensers. Composite resin is used increasingly frequently in the restoration of teeth. Composite

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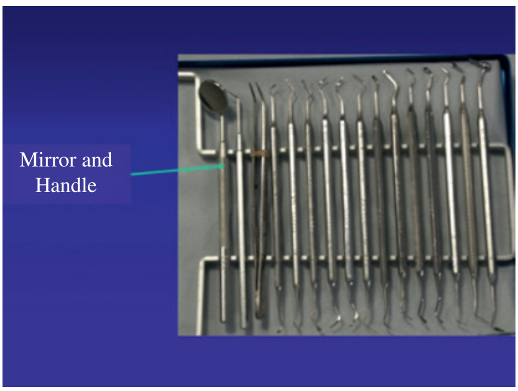
resin sticks to the surface of stainless steel instruments. A range of gold plated stainless steel instruments is available for transferring and shaping this restorative material.

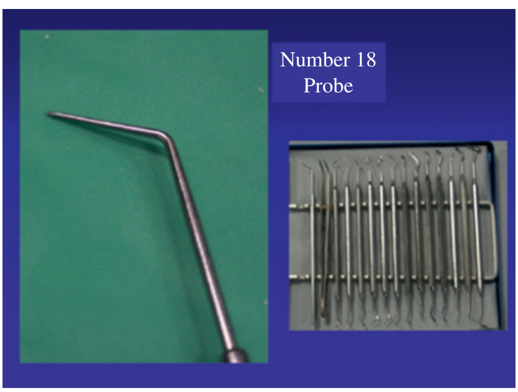
The final shaping of restorations can be achieved using carvers. These double ended instruments have a leaf shaped blade that can be rested on the surrounding tooth structure to help guide the final shape of the restoration.

## Instrument Tray

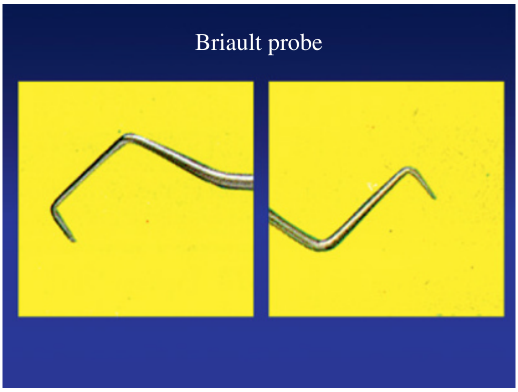

In the accompanying slide a range of diagnostic and operative instruments is shown. There is also a range of matrices for the restoration of class II cavities.
It is important that students learn where each instrument is kept in the tray and that they ensure when an instrument is used it is cleaned on a gauze square before replacing it into its original position.



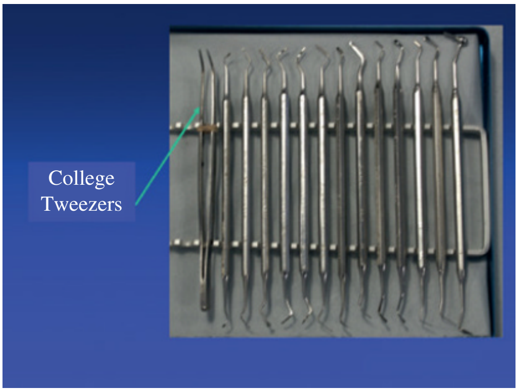

It is important to ensure the dental mirror is securely attached to its handle because these can unscrew for replacement heads to be fitted.
Front and rear reflecting mirrors are available as well as magnifying versions.
A front reflecting mirror should be used for endodontic procedures to avoid a double image with close work.




This is a single ended straight probe that should be used to inspect the quality of dentine in cavities. These instruments should be sharp, otherwise they will not accurately convey the information to the operator.
Probes should not be used with force on tooth surfaces because they may break down any demineralised surface zone and enhance the progression of the lesion.



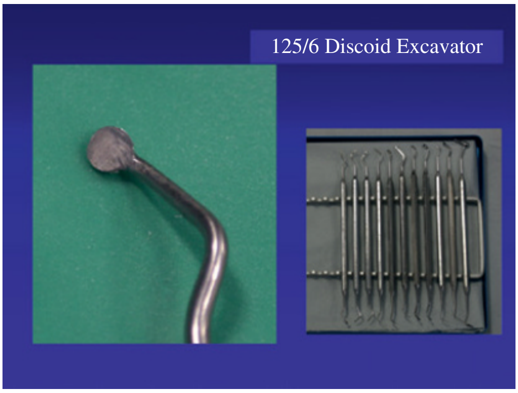

The Briault probe is a double ended instrument that is particularly useful in diagnosing the presence of cavitation or roughness on interproximal tooth surfaces.
It should be used only with light pressure to avoid breaking down any remineralising front to carious lesions and to avoid introducing cariogenic bacteria into lesions.



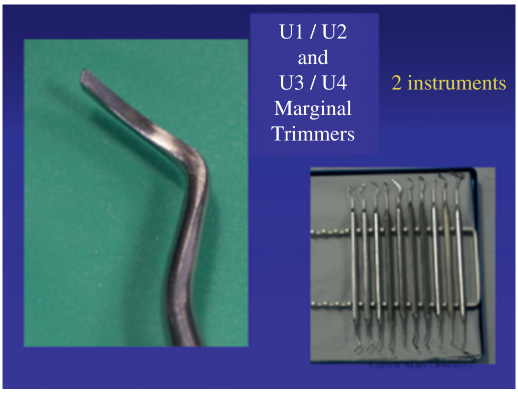

College Tweezers can be used to transfer cotton pellets and cotton wool rolls, etc. to the cavity or mouth.
This instrument is also useful in placing paper points into root canals during endodontic therapy.
A locking version is available that is particularly useful for root canal therapy.


This small excavator has a short neck that can limit the depth to which it can reach into cavities. It is the leading edge of the instrument that is sharp and can cleave carious dentine to allow it to pare away tooth structure.
The instrument shown is a spoon excavator, and its name is derived from the concave upper surface and not from the shape of the overall outline.

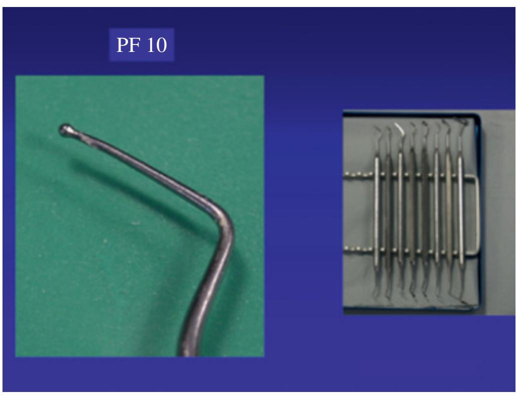

This medium sized excavator has a long neck and allows the instrument to be used into the depth of the cavity.
The instrument shown is a discoid excavator, and its name is derived from the flat upper surface and not from its circular outline.




This large excavator is very useful in large carious lesions. It has a sharp leading edge around its outline.
Excavators can be used as an alternative to a round bur for caries removal. They should always be used from a more central area in the cavity towards the periphery, which should have been cleared of caries in an earlier stage of the principles of cavity design.



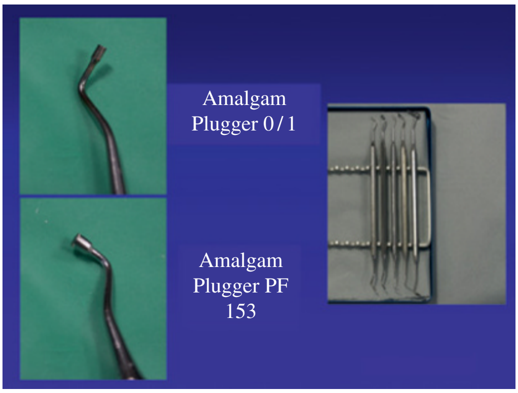

This gingival margin trimmer can be used to pare away unsupported enamel from the floor and walls of a class II box.
The instrument is double ended so that the curved blade can be used to sweep to either the buccal or the lingual aspect of the box.
The sharp leading edge is obliquely cut to remove unsupported tooth structure along the gingival floor of a box preparation or to round internal line angles.
Two of these instruments are required to cover mesial and distal boxes. The difference between the two is the direction of the oblique leading edge.




The double ended PF10 instrument is ball ended to collect mixed dental lining cement and smooth it over the cavity floor.
The small size of the ball end allows the material to spread with accuracy.


This is a double ended stainless steel instrument that can be used to transfer mixed dental cements into the cavity while still in their putty-like state. One end of the instrument has its blade aligned with the handle, whereas the other end is placed perpendicularly. This  allows the base to be applied to the axial wall of a class II cavity.


This instrument is similar to the previous one, but the working ends are larger. This makes it particularly useful in transferring a temporary dressing in bulk to the cavity.

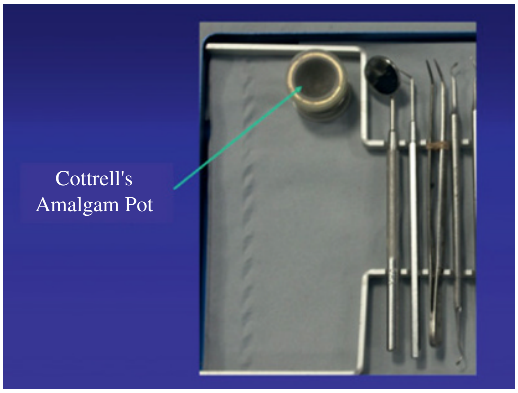



There are a couple of double ended amalgam pluggers in the tray, offering a total of four diameters to condense the filling material into the cavity. The size used will depend on the cavity width.
Smaller instruments will exert greater pressure on the amalgam during the condensation phase and bring a mercury rich layer to the surface.

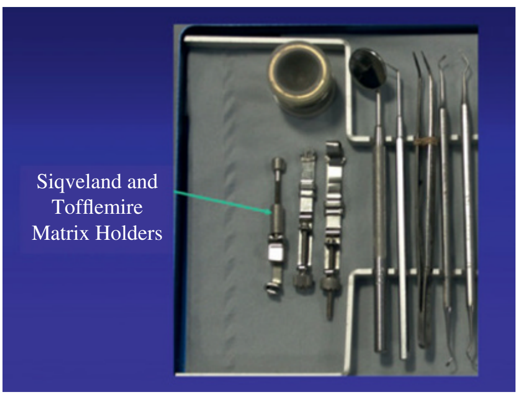

The first of the two carving instruments is the half Hollenbach carver. The leaf shaped blades on either end of the instrument are placed perpendicularly to each other. Part of the blade can be rested on the surrounding cusp slope while the tip of the instrument is held in the mid-line of the tooth. In this way, when the instrument is dragged along the cusp slopes, it carves the correct degree of slope and fissure pattern.


The Ward's carver is similar to the previous carver, but the blade that is in line with the handle is not sharp and can be used to transfer a temporary dressing to the cavity.

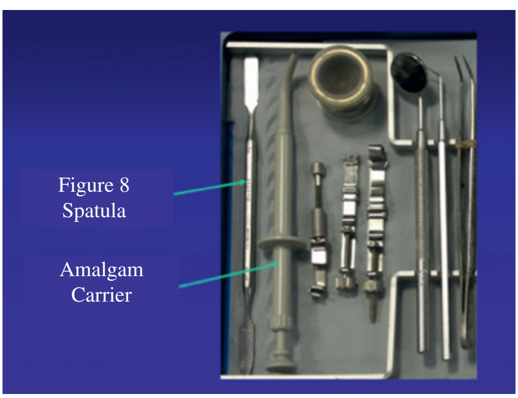

The P1 instrument is one of a range of instruments that can be used to place and shape composite resin. Many similar instruments are gold plated or have tips made from Teflon so the filling material does not adhere.
The cone ends can be used to shape cusp slopes of composite resin, whereas the point makes a fissure pattern.




The amalgam pot is dish shaped and receives the mixed or triturated amalgam from a capsule.
The shape of the pot allows the amalgam carrier to be loaded with fresh material.
It is important that the dish is emptied according to Health and Safety recommendations after each use.
The metal ring is autoclavable, and the plastic insert can be replaced.




The tray also contains a Tofflemire and two Siqveland matrix bands and holders.
The matrices are used to replace the missing wall of a tooth while filling material is inserted. A matrix allows the filling material to be condensed against it while providing a smooth surface finish.
Single use matrix holders with attached bands can also be used. However, the correct size and shape should be carefully selected.




The operative tray also contains a figure 8 spatula with which lining and base cements can be mixed. This instrument must be cleaned with a gauze square after each use to prevent the dental cement setting on its surface.
The amalgam carrier or gun has an open end into which the amalgam is forced when the tip is pushed into the mixed amalgam mass. The syringe plunger at the other end allows the operator to control the dispensing of the material into the cavity. The gun must be emptied after each use because material left in situ will harden and render the gun unusable.

# Handpieces and Burs

## Air Turbine

The air turbine or air rotor handpiece is often referred to as the high-speed drill because it rotates at around 400 000–450 000 rpm (see Figure 1.1). This is known as the free-running speed, but when the dentist is actually cutting tooth structure it slows down to 250 000–300 000 rpm, and this is known as the cutting speed.

It operates using compressed air, which turns the turbine containing the bur. The first handpiece was designed by John Walsh and first produced commercially by Dr John Borden in the USA in 1950. The handpiece has two main parts:

- The body through which the compressed air and water are channelled
- The turbine that is contained within the head of the handpiece

The turbine is precision made and converts the compressed air into rotational energy. The fins arranged around its periphery are caught by the flow of compressed air and rotate the turbine within the head of the instrument. A bur is held within the central axis of the turbine, and this is then rotated as the turbine turns. The burs inserted into air turbines are known as friction grip burs. Many handpieces now have a fibre optic facility to shine light directly at the tooth being prepared.

Water is also channelled through the handpiece and sprays a mist onto the rotating bur. This has the effect of cooling the bur and the tooth being cut as well as flushing away the cut debris. It is vital that routine maintenance is performed on all handpieces to ensure they are free from abrasive particles that can cause wear in the turbine and allow it to vibrate. Nowadays cleaning and lubrication can be performed in automated machines. The use of a regular maintenance programme will greatly extend the life of these expensive handpieces.

Video 1.1

## Contra-Angled Handpiece

These are often referred to as slow-speed handpieces and are used for removing caries or refining the margins of a cavity. These handpieces require a motor to drive them. This can be an air driven

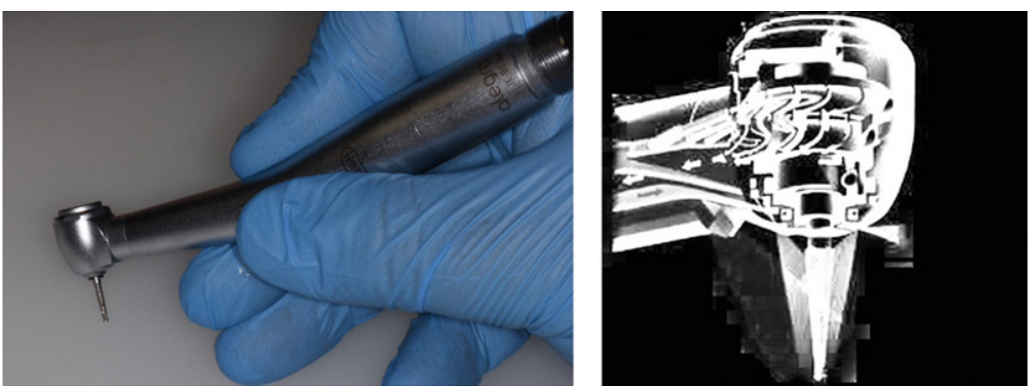


**Figure 1.1** The air turbine handpiece is well balanced and operates in excess of 400 000 rpm. It is driven by compressed air that passes over the blades of the turbine and rotates them.

Figure 1.2 An air driven or electric motor can be used to drive the slower-speed handpieces. These can be either straight or contra-angled, and both are designed to be easily held by the operator.

motor or an electric version. The resultant speed of rotation differs between the two with an air motor providing a rotational speed of about 6000 rpm, whereas an electric version can rotate at speeds up to 40 000 rpm. The speed of electric motors can be controlled by rotating a ring at their lower end (see Figure 1.2).

The handpiece connects over the motor shaft and is held in place with a locking device. Both straight and contra-angled handpieces are available. A handpiece with one of more bends in the body allows the bur to lie at an angle to the shaft and is known as a contra-angled handpiece. This allows the bur access to less accessible areas of the mouth. The burs are held within the head of the handpiece by mechanical means and are known as latch grip burs. The body of the handpiece contains a series of gears and is available in a number of versions: speed reducing (4 : 1), speed increasing (1 : 10), and direct (1 : 1).

The torque available with a motor driven handpiece is greater than that of an air turbine, but the speed is lower. In some countries, there is a preference for using a speed increasing handpiece on an electric micromotor because this can produce a speed of nearly 400 000 rpm but with much greater torque than is available with an air turbine. The disadvantage is that there is greater vibration experienced by the patient and a greater potential for rises in pulpal temperature.

## Burs

A dental bur is a type of bur or rotary cutter used in a dental handpiece (see Figures 1.3 and 1.4). The burs can be made from steel or tungsten carbide or may be diamond coated. The three parts to a bur are the head, the neck, and the shank.

The heads of steel and tungsten carbide burs contain the cutting blades that remove material. These blades may be positioned at different angles to change the property of the bur. More obtuse angles improve the strength and longevity of the bur, whereas more acute angles produce a sharper blade. Additional cuts across the blades of burs were added to improve their cutting efficiency, but their benefit has been minimised with the advent of high-speed handpieces. These extra cuts are called crosscuts.

The heads of other commonly used burs are covered in a fine diamond grit, which has a similar cutting function to blades but actually abrades the tooth structure and generates more heat.

There are various shapes of burs that include round, inverted cone, straight fissure, tapered fissure, and pear shaped burs.


**Figure 1.3** A range of steel single use burs for intra-coronal use are shown. In addition, a range of stones and impregnated rubber points are present to smooth and polish restorations.

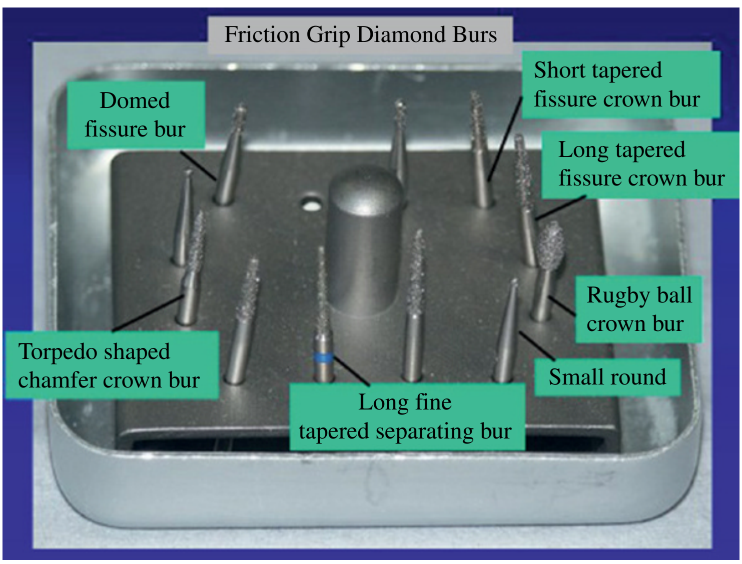
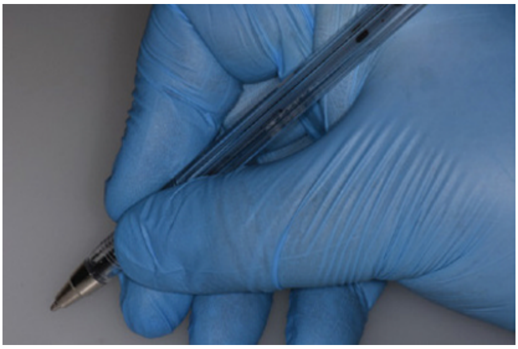



**Figure 1.4** A range of friction grip burs for intra-coronal and extra-coronal use. The examples shown are all coated with industrial diamond to make the surface rough and abrade the tooth structure. Similar designs are available made from tungsten carbide that will cut the tooth structure.

Due to the wide array of different burs, numbering systems to categorise them are used and include a US numbering system and a numbering system used by the International Organisation for Standardisation (ISO).

The speed at which these burs operate makes them behave very differently. A bur in an air turbine handpiece will produce a smooth cut with ease, but there will be a high pitched whine while it is operating. A slow-speed bur may be quieter but will produce a courser cut with a lot more



The way in which a person holds a pen gives a great deal of control over the movement of the writing instrument.

**Figure 1.5** Handpieces are held using the pen grip to exert maximum control of the instrument.

If the pen is replaced with a dental handpiece, a similar level of control can be exerted over the manoeuvrability of the dental instrument. This means that minute movements in a lateral direction can be exerted by small movements of the thumb against the handpiece balanced against the forefinger.

Video 1.2

**Figure 1.6** When a handpiece is substituted for the pen, maximum control of the instrument can be used.

vibration experienced by the patient. It is important to check that the bur is running in a clockwise direction, otherwise the flutes will not engage the tooth structure.

It is important that the operator learns to control the handpieces to prevent hard and soft tissue trauma (see Figures 1.5 and 1.6). This can be prevented by mastering

- Grip on the handpiece
- Finger rest positioning on hard non-movable tissues

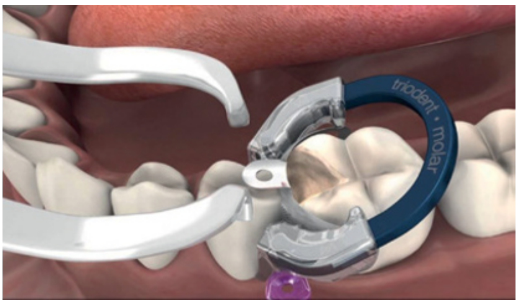
The fine control of the handpiece using the pen grip requires that a stable finger rest is obtained onto immovable tissue such as adjacent or contralateral teeth or hard tissues. It is really important that a finger rest is never placed on mobile soft tissues (see Figure 1.7).

## Matrix Systems

When placing restorative material in a cavity where the proximal wall has been lost due to caries or fracture, the subsequent aim is to restore the contact area and marginal ridge area to prevent food packing. In addition, it is important to have a smooth junction cervically between the restorative material and the tooth surface. However, the cavity does not have walls surrounding it on all sides, and it is necessary to provide one so that the restorative material can be placed. This is done

The third or fourth finger is used to rest firmly on adjacent or contralateral teeth to ensure a stable position from which to move the handpiece.

**Figure 1.7** It is important that a finger rest is employed when a handpiece is used in the mouth. The finger should be rested on an immovable object, such as adjacent teeth.




A sectional matrix in place on the mesial aspect of tooth 2.6. The lateral sides of the matrix are adapted to the tooth by the metal ring, and a wedge ensures adaptation to the cervical margin.

**Figure 1.8** A modern version of a sectional matrix band that is held in place with a spring ring.

using a matrix band: a clear polyether band anteriorly or a stainless steel band posteriorly. The functions of this matrix band are:

- To retain the filling material in the cavity during placement
- To provide a smooth and close adaptation of the filling material to the surrounding tooth
- To re-establish the contact point and contour of the tooth

There are three types of matrices:

1) Where the band encircles the tooth and is retained by a holder on the buccal or lingual side. The bands held in these holders or retainers can be straight, curved, or contoured. This design allows a firm adaptation to the tooth, e.g. Siqveland or Tofflemire.
2) Where the band encircles only three-quarters of the tooth and the retainer has sharp jaws that impinge into the other tooth embrasure. This type of matrix system is useful when contact points are very tight and resist placement of a matrix bond through the contact, e.g. Ivory or sectional matrix.

   A modern version of this matrix is the newer sectional matrix systems (see Figure 1.8) where a shaped band is inserted and held in place with a metal ring whose sides press against the band and tooth structure to ensure its close adaptation, e.g. Palodent System.
3) In the third type of matrix, there is no retainer. The matrix is held in position using a wedge or may consist of a spring mechanism. The latter has the advantage that no retainer is required and can be used on badly broken down teeth, e.g. AutoMatrix System (see Figures 1.9–1.12).