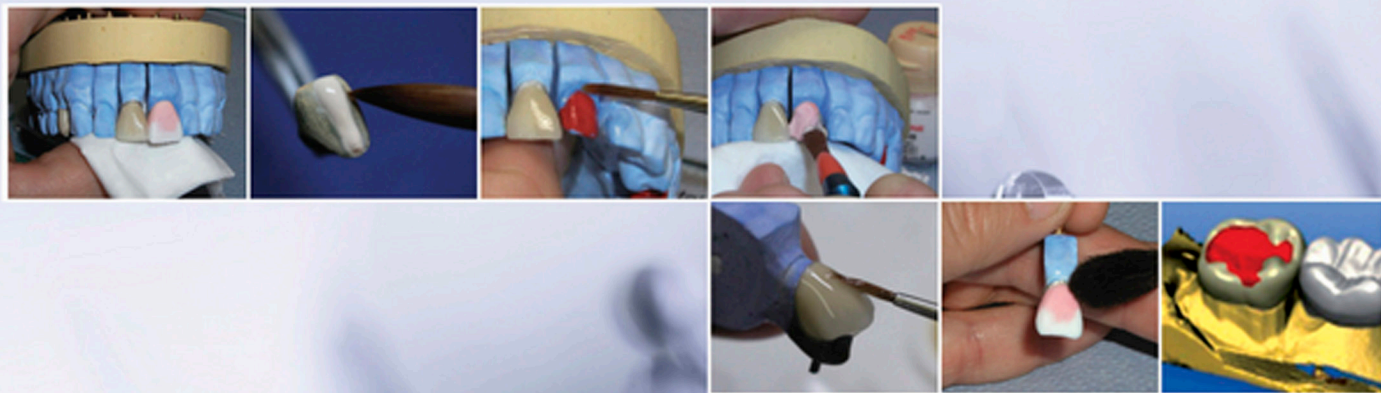


# BASICS OF DENTAL TECHNOLOGY

A STEP BY STEP APPROACH | 2ND EDITION



Tony Johnson | David G. Patrick | Christopher W. Stokes  
David G. Wildgoose | Duncan J. Wood



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Basics of

Dental

Technology



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A Step by Step Approach

**Second edition**

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# About the companion website

*Basics of Dental Technology* is accompanied by a companion website:

**[www.wiley.com/go/johnson/basicsdentaltechnology](http://www.wiley.com/go/johnson/basicsdentaltechnology)**

The website includes:

- Multiple choice questions
- Downloadable images



# Chapter 1 INTRODUCTION

## 1.1 Introduction

This book has been designed for use in the dental laboratory as a guide for the novice dental technician. Described in the manner of a 'cook book', the procedures in this handbook have been designed to be followed step by step. Presented in sections ordered by specialty, each procedure has been completed in a dental laboratory, with photographs illustrating all the important steps of each procedure. The work shown in this book has not been edited or tweaked, but is presented as the instructions given in this book were followed, to ensure that the outcomes are achievable by anyone following the guides (perhaps with a little practice!).

## 1.2 How to use this book

Working  
impression

Casting  
working  
model

Sectioning

This book is designed for the student of dental technology for use on the bench in the dental laboratory. The construction of many dental prostheses and appliances requires progression through a series of stages, often from impression through to the finished product. You can use this book to work through each procedure step by step.

The graphic at the beginning of the sections will help you to see where any given procedure fits into the production process. An example of this is shown on the right.

For each procedure you will find a brief **introduction**, a list of the tools and **equipment required**, guidance on **working safely** and an illustrated step-by-step **basic procedure**.

In addition, the **hints and tips** sections give techniques to expand or refine the process, and the **extended information** sections give an insight into the scientific and clinical aspects that can enhance your understanding of the topic.

## 1.3 Equipment and instruments

The equipment listed below is commonly found in a dental laboratory, and with which any technician should be familiar.

### Plaster bowl, spatula and knife (Figure 1.3.1)

Common to all plaster rooms, these items are used for mixing, shaping and trimming plaster of Paris, Kaffir and die stone materials. Cleanliness of these items is important to prevent rapid setting of materials.



Figure 1.3.1

## Wax knives and carvers

These instruments are commonly used in the laboratory for a number of procedures. You should purchase your own good-quality knives and carvers.

**Small wax knife:** Most commonly used in the fabrication of crowns for placing and carving inlay wax. You may see technicians using two, a cold and a hot knife, to save time (Figure 1.3.2, instrument on the left).

**Large wax knife:** Used for melting, placing and carving modelling wax in the production of dentures. Again, it is common to see two knives being used, a cold and a hot knife (Figure 1.3.2, instrument on the right).

**LeCron carver:** This carver is popular for the carving of inlay wax in the production of crowns. It is used cold, but some techniques use it slightly warm, but not hot (Figure 1.3.3, instrument on the far right).

**Ash 5:** This carver is used cold to shape modelling wax in the production of dentures (Figure 1.3.3, instrument in the centre).

**Hylin carver:** This carver is popular for the carving of inlay wax in the production of crowns. It is used cold (Figure 1.3.3, instrument on the far left).

**PKT (PK Thomas):** A set of instruments (examples of two shown) designed to aid the precise positioning of molten wax in the production of crowns (Figure 1.3.4).



Figure 1.3.2



Figure 1.3.3



Figure 1.3.4



Figure 1.3.5



Figure 1.3.6



Figure 1.3.7

## Other hand instruments

**Ceramic brushes:** Available in a range of sizes similarly to artists' brushes (Figure 1.3.5), with sizes from 0 to 20 with 0 being the smallest and 20 the largest. These brushes are made from sable and should be treated with care. A size 6 brush is popular for the placement of ceramics in the production of crowns. Smaller brushes are useful for staining, and a larger brush for condensing ceramic.

**Ceramic spatulas:** These instruments (Figure 1.3.6) are used for mixing, placing and carving of ceramic powders. They are produced from a material that will not contaminate the ceramic with metal particles that may cause discoloration.

**Micromotors:** Modern micromotors (Figure 1.3.7) are very advanced in terms of engineering, control and quality. They are powered by low voltage electricity and usually controlled via a foot or knee controller, allowing the speed to be set anywhere between 5000 and 40 000 rpm. The chuck is opened and closed by twisting the handpiece to secure or remove a bur.

## Burs

There is a huge range of burs currently on the market and manufacturers devote several pages of their catalogues to them. Below is a brief outline of the main types.

**Tungsten carbide (TC):** These are very popular burs used for many applications within the laboratory from trimming plaster to acrylic and metal. They are available in a large selection of shapes and sizes (Figure 1.3.8). The most useful are the plaster trimmers, flame-shaped for trimming acrylic and small round (often called rosehead) burs for accessing small areas.



Figure 1.3.8

**Steel burs:** As above, but not as hard wearing (and cheaper).

**Stone burs:** Abrasive stone burs are available in different grades, shapes, sizes and materials. The shapes range from cones to points to discs (Figure 1.3.9) and the different materials are indicated (often by colour) for different applications, that is, for the trimming and finishing of ceramics, acrylics or alloys.



Figure 1.3.9

**Diamond discs and burs:** Increasingly popular over the past decade, these tools are used for the shaping of ceramics and composites. They are available in many shapes and sizes (Figure 1.3.10).



Figure 1.3.10

**Rubber abrasives for metals:** These are available as wheels, cones or points and are used mainly in the finishing of metal surfaces (Figure 1.3.11).



Figure 1.3.11

**Abrasives for acrylics:** The simplest is a mandrel that holds a small piece of sandpaper, but rubber-bonded abrasives are now popular (Figure 1.3.12).

**Brushes and mops:** The main application of these is the polishing of metal surfaces in combination with wax-based polishing compounds (Figure 1.3.13).



Figure 1.3.12

## Pliers and cutters

For orthodontic appliance manufacture (or for any other occasion where a wire may need to be bent or cut) the technician will have a selection of tools.

**Adams 65:** Square-ended pliers used in the bending of orthodontic stainless steel wire (Figure 1.3.14).



Figure 1.3.13

**Adams 64:** Square- and round-ended pliers used in the forming of springs and curves in orthodontic wires (Figure 1.3.15). (Sometimes referred to as 'half-round'.)

**Maun cutters:** Used for the cutting of orthodontic stainless steel wires (Figure 1.3.16).

**Parallel pliers:** Used for firmly gripping a variety of items (Figure 1.3.17).

## Large laboratory equipment

Most laboratories will have most or all of the following (illustrations of some of the following equipment will appear later in the book).

**Model grinder:** A bench-mounted, water-lubricated, tungsten carbide wheel used to grind plaster products (Figure 1.3.18).



Figure 1.3.14

**Polishing lathe:** Used with brushes and pumice, or mops and polishing wax in the polishing of acrylics and alloys (Figure 1.3.19). Modern lathes have integrated dust extraction and lighting and have two speeds: 1500 or 3000 rpm. The polishing



Figure 1.3.15



Figure 1.3.16



Figure 1.3.17



Figure 1.3.18



Figure 1.3.19



Figure 1.3.20



Figure 1.3.21



Figure 1.3.22

lathe can be fitted with a variety of brushes and mops, for example, a bristle brush for applying abrasive pumice to acrylics (Figure 1.3.20) or a cotton mop for polishing acrylics or alloys (Figure 1.3.21).

**Steam cleaner:** Used extensively in the dental laboratory for cleaning models and restorations.

**Pressure bath:** These use compressed air to keep self-curing acrylics under pressure during curing. They also have the facility to keep water warm to aid the process.

**Hydroflask:** Used full of water for putting self-curing acrylic under pressure whilst curing, in the repair of dentures, for example (Figure 1.3.22).

**Vibrating table:** Used during the mixing and pouring of plaster materials to help avoid air bubbles.

**Vacuum mixer:** Essential in the production of models for fixed prosthodontics and for mixing investment materials. This machine mixes plaster materials mechanically in a sealed pot whilst sucking the air out of the plaster mix.

**Boiling out machine:** This machine keeps water hot enough to remove wax from moulds (e.g. in the production of complete dentures). It has a compartment in which moulds can be placed and automatically sprayed, or often there is a hand-operated shower for manual spraying.

**Presses:** Presses are usually bench mounted and used to close denture flask (moulds). Hydraulic presses are also available for the same purpose. These work in the same way as a hydraulic car jack and require less force than manual presses.

**Clamps:** Denture flask clamps are used to keep flasks under pressure during the curing process required for heat-cured acrylics.

**Denture flasks:** Brass flasks used to create two-part moulds of wax trial dentures in the conversion to acrylic dentures.

**Curing bath (dry heat or water):** Used for the curing of heat-curing acrylic. Large enough to accept the mould and spring clamp, these machines have an automatic heating cycle to ensure optimum curing of the acrylic.

**Porcelain furnace:** These small, automated vacuum furnaces are specifically for the firing of ceramics (Figure 1.3.23). They are computerised and programmable, and can store the data for the various firing cycles required for different ceramics.

**Burnout furnace:** Relatively large for a dental technology laboratory, these furnaces are used in the heating of moulds and crucibles prior to casting. Modern furnaces are programmable to allow for preheating and the holding of high temperature during the heating cycle.

**Casting machines:** There are several types of casting machines combining the different casting forces (centrifugal, air pressure/vacuum) and different heating methods (induction, electrical resistance, gas torch, oxyacetylene).

**High-speed grinder:** Bench-mounted motor used with a cut-off disc or grinding wheel, for removing sprues and finishing cobalt–chromium alloy denture frameworks.



**Spot welder:** Used to weld stainless steel wire or components in the production of orthodontic appliances.

**Ultrasonic bath:** Used extensively for cleaning restorations or components of restorations in conjunction with different cleaning solutions.

**Drying oven:** A low temperature oven used for gently warming and drying refractory models used in the production of cobalt–chromium denture frameworks.

**Electrolytic bath:** Used in the ‘polishing’ of cobalt–chromium alloy frameworks.

**Technician’s workbench:** The workbench is often fitted with drawers, a gas supply for Bunsen burners, electrical sockets, a micromotor, dust extraction and colour-balanced lighting.

**Lighting:** Lighting is an important feature of the dental laboratory in terms of long-term well-being for eyes working under demanding conditions. It is also essential to allow correct assessment of colour when producing aesthetic restorations. Tungsten or fluorescent lights can alter the perception of the shade being matched.

**Shot-blaster:** There are several types of shot-blaster using different sizes of abrasives (such as aluminium oxide or glass beads) for different purposes. Non-recirculating blasters are used in conjunction with extraction in the preparation and finishing of metal surfaces, for example, in the production of metal-ceramic restorations. Recirculating blasters are used with larger grit materials in the removal of investment materials from cobalt–chromium frameworks.



Figure 1.3.23

## 1.4 Health and safety in the dental laboratory

There are many hazards in the dental laboratory and many procedures that have an element of risk attached to them; however, if we take time to assess the risks and hazards, hopefully we will be able to minimise, or in some cases eliminate, the potential for harm.

It is the responsibility of all who work in the dental laboratory to ensure that we work safely and that we minimise the risk of injury to ourselves and others. It can be said that the effect of our use or misuse of equipment and materials can affect the degree of risk from known health hazards in the laboratory. In order to make sure that the working environment is a safe one there are some simple steps that can be taken, such as carrying out a ‘risk assessment’ and identifying any hazards present.

### What are hazards?

A hazard is anything that could possibly be damaging.

### What are risks?

How something might be damaging to you or others.

## Risk assessment

A risk assessment is an examination of what could cause harm to people. A risk assessment is done so that one can decide whether enough precautions have been taken to prevent accidents or injury.

Workers and others have a right to be protected from harm caused by a failure to take reasonable control measures.

## How to assess the risks in your workplace

The easiest and most effective way that you can assess the risks and put in place measures to minimise the risks in your workplace is to follow the five-step plan given below.

### 1. Identify all hazards

Walk around your workplace to see what may cause harm, check manufacturer's instructions on chemicals and think about long-term harm such as noise and dust.

### 2. Decide who might be harmed and how

Everyone does not have to be named, but specific groups of people have to be considered, such as plaster room workers or acrylic room workers; members of the public also need consideration if they have access.

### 3. Evaluate the risks and decide on the precautions

Once the risks have been identified, it has to be decided what can be done to minimise or eliminate the risk. This can be done by some simple means such as limiting access to hazardous chemicals or using less harmful chemicals and substances. Use protective clothing and organise work so that exposure is minimised.

### 4. Record all your findings and make sure to put them in practice

If proper notes are made it will be easier to implement safe working practices; also, remember to involve all staff so that a cohesive plan can be adopted by all to ensure the continued safety of all staff.

### 5. Regularly review your assessment and update when needed

All things are subject to change – number of employees, chemicals, working practices, etc. – so it is a good idea to review any risk assessment on at least a yearly basis so that any changes that have to be made can be done with relatively little disruption.

Assessing risks need not be an onerous task and if 'Risk Assessment' records are kept up to date, they can be carried out quickly and effectively with little hindrance to daily working practices.

Before starting to follow any procedure in this book, you should carry out a risk assessment. To help you, the **Working safely** section for each procedure outlines the main hazards.

## 1.5 Sterilisation and impression handling

### Cross-infection in the dental laboratory

Cross-infection is a very real risk in the dental laboratory and one that should be taken seriously by all staff. Although it is the responsibility of the dentist to ensure that all items that are sent to the dental laboratory are sterilised, it is wise to treat

everything with caution and not assume that we need not take basic precautions to minimise cross-infection.

The greatest risk to all members of the dental team is the patient and impressions that carry saliva; mucus and blood can pass disease on very easily. Workers in the dental laboratory do not usually see patients and in many cases are far away from the surgeries for which they carry out work. Being removed from the patient interface can lead to a feeling of not being directly involved with the clinical aspects of dentistry, but the impressions that we receive are a direct link with the patient and the clinic, and therefore must be treated accordingly.

Often the dentist will not know whether a patient has a communicable disease. Furthermore, the patient may not even know if they have a condition such as human immunodeficiency virus (HIV) infection or hepatitis so we have to make sure that we put into operation a cross-infection control procedure. Not only are we at risk from the patient but the patient also can be put at risk from the things that we do in the laboratory.

### Cross-infection control procedure and policy

All laboratory staff should understand the cross-infection control procedure required in the dental laboratory and follow good practice.

- (1) All staff involved in the production and preparation of dental models from impressions must be immunised against tetanus, hepatitis B, poliomyelitis, rubella, tuberculosis and diphtheria, and a record of their hepatitis B sero-conversion must be held by the laboratory owner.
- (2) The dental laboratory must provide personal protective equipment (PPE) for each laboratory worker, such as protective clothing, gloves, eyewear and masks that must be worn during all production procedures.
- (3) All impressions and other items that have been in the patient's mouth or in contact with the patient/clinician/nurse, in any way, should have been sterilised and show evidence that they have been sterilised by the clinic sending them. They should be enclosed in a sealable plastic bag and have a sticker on them stating the date and time the sterilisation procedure was carried out.
- (4) All areas handling impressions and dental casts must be cleaned with the appropriate disinfectant.
- (5) In the event of a needlestick-type injury, the wound should be made to bleed, washed thoroughly under running water and covered with a waterproof dressing. The accident should be recorded in the accident book, and immediately advice sought from a qualified first aider as to whether any further action may be required.
- (6) All potentially infected waste must be put in the correct bag. Appliances that are returned to the dental practice should be disinfected in a 1% solution of sodium hypochlorite for 10 minutes, rinsed under running water, and then packaged in a clean, single-use container within a 'clean area' of the laboratory.
- (7) Eating and drinking is only permitted in designated areas.
- (8) It is not the responsibility of the technician to sterilise any items of work leaving the dental laboratory. However, this should always be made clear to the clinic receiving the work, whose responsibility it is to sterilise any items of work before they enter the patient's mouth.

For further information contact the Dental Laboratories Association (DLA), British Dental Association (BDA), British Dental Trade Association (BDTA) or the Health & Safety Executive.



Figure 1.6.1



Figure 1.6.2



Figure 1.6.3

## 1.6 Introduction to model making

Most procedures in the dental laboratory are carried out on some form of plaster model, which is produced from an impression. There are several different model types that are produced for different applications.

In common to all is that care and attention to detail is required to produce an accurate, flaw-free model, which in turn will allow an accurate appliance, restoration, prosthesis or analysis to be made.

The types of model that will be discussed are the following:

- Models for prosthodontics (Figure 1.6.1)
- Orthodontic study models (Figure 1.6.2)
- Sectional models for indirect restorations (Figure 1.6.3).

### Materials considerations

Dental models are almost always made from a plaster-based material. Before using these materials, it is important to have an understanding of their composition and handling characteristics.

#### Plaster of Paris

This is a type of building material based on calcium sulphate hemihydrate, and is often referred to as the 'beta form'. It is created by heating gypsum (the raw mineral) to about 150°C, which drives off the water to make the powder that is used in the dental laboratory. This powder is then mixed with water (typically 50 ml of water to 100 g of powder) to make a thick creamy mix suitable for dental applications.

Plaster of Paris is recognised in the dental laboratory as a white powder (other dental model materials are often coloured to differentiate them from it). The working time is about 3–4 minutes, and the initial set occurs after about 10 minutes. There is a slight expansion on setting in the order of 0.2–0.3%. The setting reaction is exothermic, so plaster of Paris models feel warm to the touch as they set. A rule of thumb to gauge if a model has set sufficiently to be handled is to check that it is cool to the touch (indicating that the setting reaction has completed).

#### Kaffir D

A more expensive gypsum-based, model-making material (and referred to as the 'alpha-form'), Kaffir D, has been heated in an autoclave (a sealed pressurised container) at around 130°C. The outcome is that more water is driven off and the powder produced is more regular in shape, finer and less porous. Less water is required to produce a mix suitable for dental model making (typically 20 ml of water to 100 g of powder), and the product is a significantly harder and stronger material.