

# **Essentials of Oral Biology**

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**David Adams**



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# Preface

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The aim of this little book is to guide the dental undergraduate student to those aspects of the basic sciences which are of direct relevance to his clinical work. It is assumed that he will already have had instruction in the general aspects of these subjects. The book is, therefore, unequivocally vocational in its treatment of the subject. It is not meant to replace the more comprehensive texts, to which the student will need to refer for details of some aspects that are only dealt with in outline here. I have not attempted to include the very latest information in dental research, as the book is not intended for the postgraduate research worker. However, the graduate studying for the Primary Fellowship examination of the Royal Colleges may find it useful for revision.

There is no differentiation between anatomy, physiology and biochemistry because I believe that these subjects should be integrated at this stage of the course. In a sense this book is meant to be the lowest common denominator of the various patterns of the teaching, in dental schools, of the biology of the mouth.

Cardiff, 1980

D. A.

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1981

D. A.

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## Terminology

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When embarking on a new subject terminology is one of the first difficulties a student encounters. The working language in the dental clinic will be foreign to the new student until he has acquired the basic vocabulary. To add to the confusion there is a tendency nowadays to communicate in a 'shorthand' style. Abbreviations are rife and it is not uncommon to hear and see sentences which are almost totally in initial letters. For example: 'RCT without ABC for a patient with CV disease may result in SBE' when translated reads, 'Root canal therapy without antibiotic cover for a patient with cardio-vascular disease may result in sub-acute bacterial endocarditis'.

Glossaries are usually placed at the end of textbooks but as I believe that the sooner the vocabulary is learnt the better the understanding the student will have of the subject, I have placed it at the beginning. Some of the terms presented here will be defined again later and in a more specific manner, but my aim is to provide a working vocabulary that will be enlarged as time goes on and more knowledge is gained. Thus, the terms selected for presentation are those which are in common usage in the field of oral biology.

### The mouth and teeth

*Oral* is an adjective which is almost synonymous with the mouth. It should not be confused with *aural* which relates to the ear. Oral Biology means the study of the structure and functions of the tissues within and around the oral cavity. Another word denoting the mouth is *stoma*. It is the stem from which the word stomatology comes. Stomatitis is also from this stem and means inflammation of the mucosa of the mouth.

*Buccal* refers to the cheeks and this word like oral is an adjective. Buccinator muscle or cheek muscle obviously has the same source. The adjective is used to describe position, i.e., the buccal aspect or buccal side of a tooth is the side facing the cheeks. The buccal sulcus is the trough between the teeth and the cheeks.

*Labial* refers to the lips in the same way as buccal refers to the

cheeks. We talk of the labial side of the anterior teeth as that side which is towards the lips.

*Lingual* means pertaining to the tongue and again the word is often used to describe position, e.g., the lingual side of the tooth faces towards the tongue as opposed to the buccal side. It is used when referring to structures of the lower jaw since when we refer to the structures of the upper jaw the word *palatal* denotes the inner surface. The other term related to the tongue '*glosso*' is a Greek word and appears as a prefix to some words, e.g., the 9th cranial nerve is the glosso-pharyngeal, meaning nerve to the tongue and to the pharynx. Glossodynia means pain in the tongue.

*Vestibule*, 'the entrance', means that part of the mouth between the lips and the cheek on the outside and the teeth on the inside.

*Gingiva* (plural *gingivae*) is a term used to describe the tissue surrounding the teeth. It is roughly equivalent to the lay term 'gum'.

*Rugae* are transverse ridges of the mucous membrane which run across the anterior part of the hard palate.

*Deciduous teeth* are the first of the two sets of teeth that develop in man. They are also known as milk, baby, first and primary teeth.

*Permanent teeth* are the second of the two sets of teeth and are also called adult and secondary teeth.

The teeth are divided into four groups, incisors, canines, premolars and molars. The morphology of the teeth will be dealt with in Chapter 3 but it is worthwhile to note that there are considerable variations in size, shape and colour of the teeth between persons.

The *occlusal surfaces* of the teeth meet when the upper and lower jaws are brought together. *Occlusion* is the term for this bringing together of the jaws from a Latin word meaning 'to hide'. The occlusal surfaces are therefore hidden by occlusion. The front or anterior teeth have edges rather than surfaces and so it is more usual to speak of the *incisal edges* of the front teeth.

Each tooth has a *crown*, the part that is visible in the mouth when a tooth has erupted, and a root or roots which are implanted in the jaw bone. The junction between the crown and the root is known as the cervical or neck region and the end of the root is called the apex. At the apex there is a small opening or foramen through which blood vessels and nerves pass to supply the pulp or soft tissue within the tooth. The apical foramen is frequently divided up so that there are several small foramina.

A *cusp* is a conical elevation on a tooth surface, usually the occlusal surface. All teeth except the incisors have one or more cusps. The region between cusps often carries grooves of varying depth called *fissures*. These are important as often decay starts in a fissure. A *fossa* is



used to describe a depression on the tooth surface which may have a pit in its depth. The *bifurcation* of the roots indicates the point at which the roots divide, where there are more than one root.

The *mesial* surface of the tooth is that surface of the tooth which is nearest the midline at the front of the jaws. Thus it is the medial surface of the anterior teeth and the anterior surface of the posterior teeth. The *distal* surface is that surface which is furthest from the midline in the jaws, i.e., the side opposite to the mesial surface (Fig. 1.1). The use of the word mesial is confusing as it is so near the word medial which the student will probably have learnt as a descriptive term in general anatomy. The use of medial in the present context would not be appropriate however in referring to the contact surfaces of the posterior teeth. These contacting surfaces are known as the *approximal* surfaces and the area between the teeth as the *approximal area*.

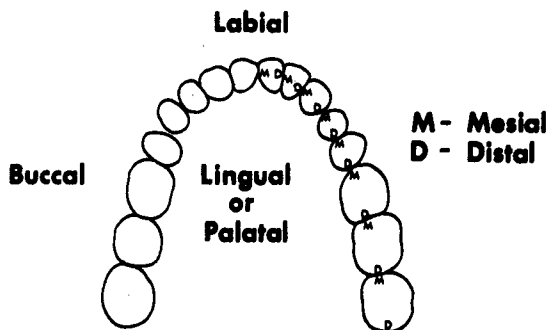


Fig. 1.1 Diagram of the teeth to illustrate the descriptive terms of position

*Enamel* is the hard mineralised covering on the crown of a tooth. *Ameloblasts* are the cells responsible for enamel formation, ((en)ameloblast).

*Dentine* is the mineralised tissue which makes up the bulk of the tooth, covered in the crown by enamel and in the root by *cementum*. *Odontoblasts* are dentine forming cells. The *amelodentinal junction* (ADJ), the boundary between enamel and dentine, is an interesting junction as it is sensitive and pain is first felt when a dental surgeon drilling a tooth reaches it. The *pulp* is the soft tissue which is contained within the dentine of the tooth. It consists of nerves, blood vessels and several types of cells.

The *root canal* is the central canal of the root which is continuous with the pulp chamber above and with the soft tissues outside the tooth at the apical foramen or foramina.

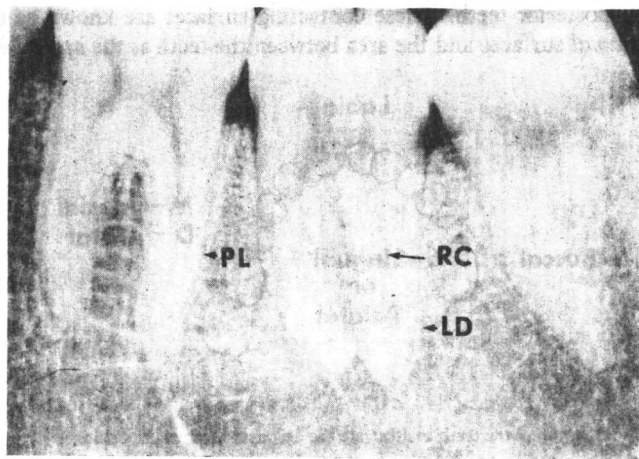
*Cementum* is a mineralised, bone-like tissue which surrounds the

root of the tooth and through which attachment to the jaw bone is effected. Sometimes it is loosely termed cement.

*Hydroxyapatite* is the main basic calcium phosphate crystalline material which is found in mineralising enamel, dentine and bone.

The *periodontal ligament* is the fibro cellular layer attaching the root of the tooth to the socket. It is also known as the periodontal membrane and may sometimes be seen as 'paradental' in the American literature.

The *lamina dura* means 'hard sheet' and is a term used for the radioopaque line which is seen on radiographs around the root of a tooth corresponding to the bony boundary of a socket (Fig. 1.2).



**Fig. 1.2** Radiograph of lower molars. LD=lamina dura; PL=periodontal ligament. RC=root canal

*Eruption* is the movement of the tooth towards or into the oral cavity. *Attrition* is a term used to describe the wearing down of teeth by other teeth. *Abrasion* is the wearing down of the tooth by an agent other than the teeth.

### **Mastication**

*Ingestion* is a term meaning the taking of food into the oral cavity. *Bolus* is the mass of food which has been masticated and is ready to be swallowed. *TMJ* is the *temporomandibular joint* between the mandible and the temporal bone. *Gnathostomatic system* is a sophisticated embracing term referring to all the chewing apparatus and includes teeth, muscles, bones, TMJ and all the nervous elements associated

with it. *Articulation* is used in relation to the contacts that individual teeth make on opposing teeth. *Bite* is an old term meaning the position of the jaws when the teeth are in occlusion or in edentulous subjects the position the jaws would take up if teeth were present. This is an important position to establish when making dentures and is better described as an occlusal record. *Edentulous* is the state of being without teeth. The act of swallowing is called *deglutition*.

### The jaw bones

An *alveolus* is the socket for the tooth root and hence alveolar bone refers to the part of the jaw bone which carries the teeth. *Alveolar mucosa* is the mucosa which covers the jaw bone lying below the line of the attached gingiva. A *crypt* is the cavity or space within the bone in which resides a developing tooth. The term *ossification* means formation of bone and must not be confused with calcification which is the term for the laying down of calcium salts. The most commonly formed calcium salt is calcium phosphate which has several forms and which is found in bone, dentine, enamel and cementum, but calcification also occurs in some sites which do not become one of these recognised tissues, e.g., there may be calcification in cartilage or in ligaments or perhaps even in such sites as the kidney tubules in the form of renal calculi. The term *mineralisation* is roughly equivalent to calcification and is in fact more accurate in that other minerals in addition to calcium are often laid down during the process of 'calcification'.

### General

*Calculus* is a term used to describe tartar or hard formations that occur on teeth. *Plaque* is a soft material which accumulates on teeth and is mostly made up of bacteria. *Pellicle* is the thin film which forms on teeth almost immediately after brushing, and is present on all surfaces within the mouth. *Trauma* is the term used to describe any form of wounding of the tissues. *Lesion* is a term describing a wound caused either by trauma or by disease processes. *X-ray* is often used as a shorthand way of referring to a radiograph and in this case means the picture rather than the radiation.

It may be helpful for the student to know the names of disciplines within dentistry. *Conservation* deals with restoration of tooth substance which has been lost by *caries* (tooth decay) or by trauma. *Restorative Dentistry* is the discipline which deals with the replacement of teeth, which have been lost, by a prosthesis and hence is sometimes known as prosthetic dentistry. *Periodontology* is the study of diseases of the gums. *Orthodontics* is the study and treatment of abnormal

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occlusal relationships, i.e., the straightening of teeth which are misplaced or malpositioned. *Paedodontics* is dentistry for children. Other branches of dentistry such as Oral Surgery, Oral Medicine and Oral Pathology are self explanatory.

Other more specialised terms will be defined as they arise in the text but the student will find it useful to refer back to this chapter from time to time.

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## The mouth

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The mouth, or oral cavity, is bounded by the lips, cheeks, palate and the floor of the mouth. Posteriorly it is in continuity with the nasopharynx above and the oropharynx below.

Except for the teeth the mouth is lined by mucous membrane which is similar in its epithelial covering to that of skin. It differs however from skin in being moist, in its degree of keratinisation and its appendages.

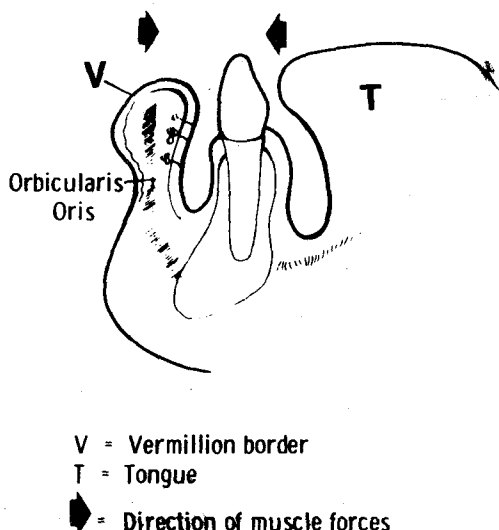
### The lips

The junction between skin and mucous membrane is a sharp line known as the vermillion border. Here the keratin layer of the epithelium abruptly decreases in thickness so that the epithelium becomes more translucent and appears red. The lips are very sensitive and in infants they are the main exploratory areas before they learn to use their hands for this purpose.

The lip contains the orbicularis oris muscle and bundles of muscle fibres radiate from it to the bones round about. These muscles, especially the orbicularis, can exert considerable force, a characteristic of great importance from the orthodontists' viewpoint. By counteracting the thrust of the tongue the muscles help to maintain the anterior teeth in their proper relationships (Fig. 2.1). The muscles of the lips can sometimes be troublesome to the dental surgeon operating in the lower incisor region as they push the lip up and obscure his field of vision. The attachment of the radiating muscle fibres to the mandible and to the maxilla results in bands of mucosa-covered muscle crossing the vestibular sulcus in the midline and in the canine to premolar regions. In denture construction the base of the denture is cut back to permit free movement of the muscles in these areas otherwise dislodgement of the denture may occur with movement of the lips and cheeks.

The lips also contain on the oral aspect of the muscles, numerous minor salivary glands which can be felt by running a finger lightly over the surface. These glands often reflect disease processes in the

major salivary glands and as they are easily accessible they are sometimes biopsied to help in the diagnosis of disease.



**Fig. 2.1** Diagram of the forces on the anterior teeth. The position of the teeth is related to the balance between the thrust of the tongue and the pull of the lips

### The cheeks

The cheeks are similar in general structure to the lips but in the infant contain an appreciable amount of fat. This fat is said to be important in suckling as it lends substance and some rigidity to the side walls of the mouth. The cheek contains the buccinator muscle which acts in mastication to clear the vestibular sulcus and to squeeze food into the space between the occluding teeth. Teeth may alter position in the bone if forces are applied to them. The bucco-lingual position of the cheek teeth is partly determined by the balance of forces between the tongue on one side and the buccinator muscle on the other, just as the balance between the tongue and the lips governs the position of the anterior teeth. The mucous membrane of the cheek is similar to that of the lips having a covering of nonkeratinising epithelium and minor salivary glands with numerous ducts piercing the lamina propria. The surface layers of the epithelium desquamate into the saliva and cells from the surface can be readily collected by rubbing a finger or a spatula across the surface and smearing onto a microscope slide. The study of cells by this technique is known as exfoliative cytology. It has the advantage of not creating a wound nor does the technique require

any anaesthetic. Normally the replacement of these desquamated cells occurs by proliferation in the basal layer of the epithelium which in the mouth generally has a higher turnover rate than in the epidermis.

### The gingivae

The oral mucosa covering the alveolar bone, also known as gum or gingivae, is tightly bound to the underlying bone. It is pink and has a stippled appearance in health. Round the necks of the teeth the gingiva forms a shallow groove about 1–2 mm in depth with the tooth as the inner wall. This is the gingival sulcus or crevice and deepening of this sulcus producing a pocket is an early stage in the development of periodontal disease. Measurement of the depth is therefore an important procedure in the examination of a patient. On the oral surface of the gum a linear shallow depression following the line of the crest of the gingiva and approximately 2 mm below it, indicates the limit of the 'free gingiva'. The gingiva more apically is attached firmly to the bone and hence is called attached gingiva. The attached gingiva ends abruptly at the mucogingival line by meeting the alveolar mucosa, a much looser tissue which is darker in colour and which is continuous across the vestibular sulcus with the labial or buccal mucosa (Fig. 2.2).

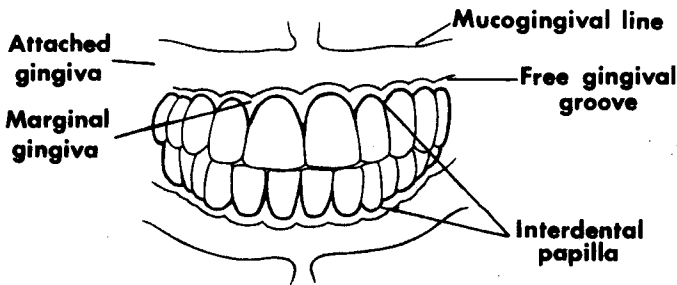


Fig. 2.2 Diagram of the anterior teeth and gums

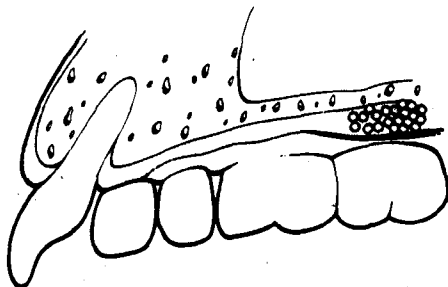
### The palate

On the palatal side of the upper teeth the attached gingiva is continuous with the mucoperiosteum covering the hard palate. In the incisor region the mucosa is tightly bound to the bone and injections to anaesthetise the nerves which enter the palate from the incisive foramen, can be painful. Posterior to the first premolar tooth there is a looser tissue at the sides of the palate, and injection of local anaesthetic solution here does not cause quite so much pain (Fig. 2.3).

A variable number of ridges run transversely across the palate.

They are known as rugae and have a core of dense connective tissue. There is considerable individual variation in the pattern of rugae and they have been called the finger prints of the mouth. In the infant they provide a rough surface to grasp the nipple and in the adult they assist in mastication providing a rough surface against which the tongue can press the food. They are highly developed in many animals and are richly provided with tactile sensory organs. They may also contain taste buds.

#### Section through the palate



**Fig. 2.3** Parasagittal section through the upper canines. Anteriorly the palatal mucosa is tightly bound down. Posteriorly glands and looser tissue separate the mucosa from the bone

Behind the hard palate and continuous with it is the soft palate, which has a core of muscles and minor salivary glands. The soft palate has a free posterior border elongated centrally to form the uvula. It can be raised or lowered during speech to create a variation of the sound emitted from the larynx. During swallowing it is raised to prevent solid and liquid foods from entering the nose. These movements are made possible by the levator palati muscle which is inserted into the lateral part of its upper surface, the palato-glossus muscle which runs from its undersurface down laterally to the tongue and the palato-pharyngeous muscle which runs downwards from the palate to the side walls of the pharynx. The core of the soft palate is strengthened by the tendon of the tensor palati muscle which uses the lower end of the medial pterygoid plate (the hamulus) as a pulley to enter the soft palate from the side. To complete the musculature picture a rather weak muscle runs from front to back in the central area of the soft palate, the uvular muscle. Apart from tensor palati which is supplied by the trigeminal nerve the muscles are innervated by the vagus and cranial accessory nerves. The tensor palati is attached to the lower part of the Eustachian tube and when it contracts this tube is made patent. Thus the pressure of air in the pharynx and



the middle ear is equilibrated. Thus swallowing while the air pressure in the environment is changing restores the ability of the tympanic membrane to respond to sounds. This explains why discomfort in the ears produced when climbing a mountain or flying may be relieved by swallowing.

The two muscles which run from the undersurface of the soft palate, the palato-glossus and the palato-pharyngeus raise vertical folds of mucous membrane on the side walls of the posterior part of the oral cavity. On each side between the folds, which converge above, is the tonsil, a mass of lymphoid tissue lying under the epithelium. This tonsil is part of a ring of tonsillar or lymphoid tissue encircling the opening into the oropharynx. The ring is completed by the adenoids a similar mass of lymphoid tissue on the posterior wall of the pharynx, and the lingual tonsil lying under the epithelium on the back of the tongue. The function of the tonsillar ring is not completely understood. Medical opinion is divided on the need for removal of the tonsils when infection occurs during childhood. The masses of lymphoid tissue tend to regress in middle and old age, but it is not uncommon for young adults to suffer from tonsillitis with tonsillar enlargement and consequent restriction of the width of the oropharynx.

### **The tongue**

The tongue is a strong muscular organ which almost fills the space bounded by the teeth when the mouth is closed. The surface at the sides is often marked by the teeth in contact with it at rest. Over the dorsal or upper surface the epithelium bears two types of papillae known as filiform (wire like) and fungiform (mushroom shaped) respectively (Fig. 2.4). The latter appear as small red dots which are very numerous near the tip and along the sides. Taste buds are associated with these papillae. The filiform papillae are much more numerous and have a greyish colour due to the cap of keratin which surmounts them. They give the tongue its rough surface and are much more developed in some animals, for example the cat, which uses its rough surfaced tongue to lap up milk. In the human, illnesses which affect the alimentary canal cause the papillae to become long and coated with bacteria. An experienced medical practitioner can gain a lot of information from the condition of his patient's tongue.

Dividing off the anterior two thirds from the posterior third of the tongue is a V shaped line of small circular structures similar in shape, but larger than the fungiform papillae. These are known as circumvallate papillae and they also carry taste buds. They are described in more detail in Chapter 7. Behind this the tongue has a pebble stone