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2. Basic Considerations

Physical basis

Relevant anatomy of the denture-bearing area and its environment

The oral cavity extends from the lips anteriorly, via the cheeks and retromolar segments laterally and the anterior pillar of fauces posteriorly, to the oropharynx. Superiorly the vestibules, edentulous ridges and hard and soft palates are important anatomical landmarks, while the vestibules, ridges, floor of mouth and tongue are of significance inferiorly.

The denture-bearing area is contained within the oral cavity, which is of variable dimension and shape depending on the activity of its muscular environment. Complete dentures must be contained within this environment.

External aspects of the oral cavity

Lips

The lips are muscular valves of the oral cavity which are covered on the facial surface by skin and on the internal surface by mucous membrane; these two components meet at the vermilion border. The latter is an anatomical feature peculiar to man. The extent of border shown may have a bearing on aesthetic aspects of any prosthesis and is critically dependent on the support provided to the lips by the incisor teeth, as is the restoration of an acceptable profile. A feature of the restored upper lip is the philtrum, the vertical lateral borders of which may be associated, inferiorly, with the distal margins of the upper central incisors. The philtrum is often not seen in complete denture wearers whose appliances do not adequately restore the labial facial curtain, with consequent reduction in the aesthetic quality of the dentures.

The muscular skeleton of the lips is, inter alia, orbicularis oris which, in normal circumstances, serves as an effective oral sphincter and participates in a wide range of other movements such as speech, mastication and social behaviour. The diverse range of lip movements is made possible via the complex integration of muscle groups inserted into orbicularis oris either superficially or deep (1).

Lips which are not in apposition without voluntary muscular contraction are termed incompetent in the dentate patient, and this could have implications in the treatment of edentulous patients.

The angle of the mouth contains a muscular junction box termed the modiolus, the activity of which may have a strong influence on the form of the lower complete denture.

Muscular form can affect the nature of three surface grooves; the right and left nasolabial grooves, which serve as boundaries between the cheeks and the upper lip, and the labiomental groove which lies between lower lip and chin and is especially prominent in patients with Angle’s Class 2 Division II incisor relations. In older patients, wrinkles tend to develop, as do vertical grooves separating the lower lip from the cheeks.
Internal aspects of the edentulous oral cavity

Edentulous ridges

These comprise residual alveolar bone (although this may appear to be absent in patients with severe atrophy) and the maxillary tuberosities. All of these are covered with mucoperiosteum. Studies have demonstrated that, following tooth extraction, resorption of the alveolar ridge occurs. This resorption is of multifactorial origin and is discussed on page 16. Post-extraction bone loss is irrevocable and the rate of bone loss, following the rapid post-extraction phase which lasts approximately three months, varies between patients.

In general, data from several investigations would suggest that the pattern of bone loss within the first two post-extraction years is maintained over a five-year period.

Longitudinal post-extraction studies have mapped out trends of resorption in both arches and some workers have indicated differential amounts of resorption between incisor, pre-molar and molar areas of the maxilla. These findings have enabled the replacement teeth to be placed in a position analogous to that of natural teeth, hence the term ‘biometric design’. In addition to intra-arch variation in resorption, Tallgren reported that, on average, the ratio of bone loss in the anterior mandible compared to the anterior maxilla was 4:1.

In addition to atrophic changes in the residual ridges, an often unquantifiable atrophy of the soft tissues overlying these ridges also occurs. While many classifications of ridge form exist, no such classification exists for the mucosa of the ridges, yet these soft tissues share the load of mastication with the underlying bone. The alveolar mucosa is not considered to have appropriate properties per se to carry such loads and the loss of periodontal membrane following tooth extraction results in a deficiency in support which is both qualitative and quantitative (2). Furthermore, the mucosa overlying the residual ridges may initially be attached gingiva. This is keratinised stratified squamous epithelium which, concomitant with resorptive changes over a period of time, may be replaced by the thinner non-keratinised alveolar mucosa. The mucosa overlying the residual ridges also varies in thickness in various parts of the mouth and tends to become thinner with age and is thus less tolerant to applied forces.

Vestibules

These potential spaces exist between the lips and cheeks and the alveolar ridges. They are interrupted by folds of mucous membrane, connecting lips and cheeks to the ridges, called frenae. Other folds contain muscle fibres and these muscle attachments connect lips and cheeks to ridges (3). The presence of these folds may pose problems in denture production. When correctly prescribed dentures are in occlusion, the vestibules are, effectively, obliterated spaces and communication with the remainder of the oral cavity can only occur posteriorly at the retromolar segments.
**Cheeks**

These muscular lateral borders of the oral cavity extend from the modioli anteriorly to the mucosa overlying the ascending rami of the mandible posteriorly. They are continuous with the upper and lower vestibules. As with the lips, the cheeks are lined externally by skin and internally by mucosa, some of which may be keratinised at about the level of the occlusal plane.

The parotid duct opens into the oral cavity in the region of the upper second molar and Fordyce’s spots (ectopic sebaceous glands) may be present as discrete yellow areas. Mucous glands may be present in both lips and cheeks. As the cheeks extend postero-medially to the anterior pillar of fauces, they are ridged by the pterygomandibular raphe, the inferior end of which terminates in the thick, fibrous retromolar pad.

**Lingual sulci and the floor of the mouth**

The lingual vestibules have the tongue as a medial border while the floor of the mouth has the mylohyoid muscle as an inferior border and the ventral surface of the tongue as a superior border (4). In the midline the lingual frenum is seen and this may be attached to the lingual aspect of the resorbed ridge. In extensively resorbed ridges the superior genial tubercles may be evident (5). The submandibular ducts open via the lingual papillae at the base of the tongue. Lateral to these papillae are the sublingual folds containing the sublingual glands and ducts.

In older patients, the ventral surface of the tongue often contains lingual varicosities (6). Where there is severe mandibular atrophy, care should be taken when recording lower impressions, as the submandibular gland may cause some bulging of the tissues of the floor of the mouth and should be displaced appropriately (7).
**Dorsal surface of the tongue**

This is separated anatomically into anterior and posterior segments by the v-shaped sulcus terminalis which lies distal to the circumvallate papillae (8). These papillae are viewed more easily by edentulous patients who often express concern at their presence.

Filiform and fungiform papillae are present on the anterior aspect of the tongue; the former are keratinised while the latter are non-keratinised and may contain taste buds.

![Dorsal surface of the tongue](image)

8 Junction of anterior two-thirds and posterior aspects of the tongue.

**Hard and soft palate**

These combine to form the roof of the oral cavity.

The **hard palate** This has, as its bony base, the palatal processes of the maxillae and the horizontal plates of the palatine bones. The midline region of the palate is considered to be free of post-extraction bony changes. The hard palate exhibits prominences, namely the rugae and the incisive papilla, the latter being of importance in biometric positioning of upper incisor teeth of complete upper dentures (9).

Bony prominences (tori) may be present on the hard palate and their presence may require that relief be provided in an upper complete denture.

Mucosa covering the hard palate is keratinised stratified squamous epithelium and anteriorly this is tightly bound to the periosteum. The same is true in the middle of the posterior border of the hard palate but the underlying connective tissue increases laterally. Mucous glands and the palatine vessels and nerves are found here.

The palatal mucosa is prone to soft tissue pathology which must be treated prior to the provision of complete dentures. In some patients, a palatal fissure is present and this may compromise retention of a complete upper denture unless obliterated by the denture base (10).

![Hard and soft palate](image)

9 Relationship between incisive papilla and replacement incisors.

10 Midline palatal fissure.
The soft palate This is the posterior continuation of the hard palate. It has a muscular skeleton comprising five paired muscles: tensor palati, levator palati, palatoglossus, palatopharyngeus and muscularis uvulae. The first four pairs are conjointly associated with mastication, respiration, deglutition and speech.

The tensor palati is particularly relevant to the upper complete denture as this muscle is attached to the posterior border of the horizontal plates of the palatine bones via a fibrous aponeurosis. This structure should be displaced by the post dam of the denture. The remainder of the post dam is extended laterally, via the pterygoid notch to the attached mucosa on the buccal aspects of the tuberosities (11).

The mucosa of the soft palate tends to be non-keratinised and more vascular than that of the hard palate. In the region of the junction of the hard and soft palate (the vibrating line) are the fovea palatini. Laterally the soft palate sweeps inferiorly via two folds, the anterior and posterior pillars of fauces; the former is formed by the palatoglossus while the latter is formed by the vertical fibres of palatopharyngeus. The posterior aspect of the soft palate has the horizontal fibres of palatopharyngeus muscles and, in the midline, muscularis uvulae (12).

Applied anatomy of the posterior border seal of the upper denture

The labial and buccal borders of the upper denture should fill the functional depth and width of the sulci in order to restrict access of air and saliva to the fitting surface of the appliance and thereby improve retentive forces. The exposed posterior border of the denture cannot be enfolded by soft tissue and thus must displace the mucosa of the palate if a similarly functioning seal is to be produced.

For maximum effectiveness, the post dam must be sited at the junction of the fixed and mobile tissues of the palate (13). The largest possible area of denture-supporting tissue is thereby covered and suitable displaceable tissue more readily found. A method for forming a post dam for a denture under construction is as follows:

1. In the mouth, observe the line beyond which the soft palate begins movement by asking the patient to say ‘aah’. This ‘vibrating line’ may be sited just beyond, at, or anterior to the palatine fovea. The position of the line may also be visualised relative to any existing denture or record rim or trial appliance.
Physiological basis

Aging

The homeostatic efficiency of the body is at its maximum during adolescence and gradually declines during maturity. The decline accelerates during senescence. Age changes result in:

- Local alterations in constituents of tissues.
- Increased susceptibility to disease (prevalence and severity of disease increases with age).
- Changes in metabolism due to deterioration in endocrine, circulatory, digestive and respiratory systems; indeed menopause results in acceleration of aging.

The oral mucosa, for example, shows the following: it becomes atrophied, relatively dry and easily abraded; the number of ectopic sebaceous glands (Fordyce spots) apparently increases; keratinization of the palatal and masticatory mucosa decreases, that of the tongue and buccal mucosa increases; healing is slower and there is an increased tendency for malignant change.

Disturbances of oxygen transport mechanisms (iron deficiency, vitamin deficiency, cardiac insufficiency) result in decreased cell proliferation and replacement, causing, for example, loss of tongue papillae.

In the absence of age-associated disease, there is only modest impairment of bodily function, being insufficient to cause serious problems for people living in the protected environment of developed nations, but sufficient to reduce their physiological capacity and ability to meet challenges (thermal, chemical, infective, traumatic, mental). Physiological deterioration tends to be progressive.
**Immune system**

This protects the body in a highly specific manner against assault by viruses, bacteria, fungi and host cells that have undergone neoplastic change. This system is therefore very important in the preservation of health.

The number of lymphocytes in the circulation decreases as age advances, and those present have decreased functional capacity. In the presence of poor nutritional status (to which inadequate dentures may contribute) and/or metabolic illness, there may be failure of this system with consequent opportunistic infections (e.g. candidiasis).

However, it is known that autoimmune antibodies increase with age. This may be due to loss of control within the immune system or to its appropriate reaction to alterations in the molecular structure of the body.
Calcium and phosphorus metabolism

The presence of sufficient alveolar bone contributes greatly to the successful wearing of complete dentures.

The main factors involved in calcium and phosphorus metabolism are outlined in 20. It is apparent that:

- Adequate dietary intake of calcium, phosphorus and vitamin D is necessary (deficient calcium intake is common in elderly females).
- Normally functioning kidneys and digestive tract are required.
- Regular exposure to sunlight is desirable (difficult for housebound).

Overall calcium balance:
- Is maintained up to approximately 50 years of age.

- Commonly becomes negative after menopause (oestrogen protects bone from effects of parathyroid hormone).
- Males may develop negative balance at 60 years of age (lack of vitamin D, decrease in sensitivity of bone cells to this vitamin and parathyroid hormone).

Osteoporosis results in:
- Fragile bone (care necessary when working with elderly; 1 in 4 white women over 60 has spinal compression fractures).
- Hastened skeletal and associated alveolar resorption (systemic factors are of greater importance than local factors in this respect).

Subclinical malnutrition of many dietary factors is not uncommon. Calcium and vitamin D supplements and oestrogen replacement therapy probably reduce rate of alveolar resorption.

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**Outline of calcium and phosphorus metabolism (adapted from G.N. Jenkins, 1978).**
Nutrition

Nutrition affects the aging process. Mental and physical disability may be related to subnutrition. The latter may be difficult to detect but is liable to become true malnutrition if illness occurs.

Many factors influence the nutritional status of an individual:

1. Food itself – its quality and quantity. These can vary widely, e.g. habits (alcoholism, faddism), availability of money or of suitable food and of storage, ability to prepare appetising meals, and the ability to appreciate the aesthetic and sensual pleasure of eating food.

Vitamin C deficiency is not uncommon, perhaps because of lack of appreciation of its importance. Sufficient intake of dietary fibre is important in combating obesity, diabetes, diverticulitis and some cancers.

2. Ingestion of food depends on mastication and swallowing; the following are therefore important:

- Stable, pain-free dentures (choking on food is a cause of accidental death in patients of denture-wearing age).
- Adequate quantities of saliva; sufficient appreciation of taste and smell.
- Adequate neuromuscular coordination. May be deficient, particularly in victims of Bell’s palsy, stroke, generalised neuromuscular disease and advanced age. Breathlessness, due to, e.g. anxiety, cardiac insufficiency, asthma and anaemia may hinder swallowing. Severe arthritis causes difficulty in handling food.

Inability to eat sufficiently rapidly may result in food becoming cold and unappetising.

3. Efficiency of secretion, mobility and absorption in stomach and intestine, e.g. absorption of fat required to ingest vitamin D.

- Protein and iron may be lost because of bleeding, e.g. gastritis (possibly resulting from aspirin taken for arthritis), haemorrhoids.
- Food combinations eaten may reduce absorption, e.g. dietary fibre binds iron, calcium and magnesium.

4. Requirements of body tissues decline with age (especially for energy compared with protein) although this is not so marked if physical activity is maintained.

Illness may reduce the desire to eat while increasing the need for nutritional intake, especially of protein. Surgery around the oral cavity has a particularly dramatic effect.

Dental surgeons should be prepared to counsel the elderly regarding the following:

- The requirements for a good diet, including its preparation. Many books are available that consider the problems associated with declining income and decreasing neuromuscular coordination. It must be appreciated that adequate fluid intake is important as the sensation of thirst declines.
- The provision of aids for eating, including the modification of, for example, plates and cutlery (21), the supply of efficient comfortable dentures and a patient recall service.

Dental surgeons should also be prepared to alert the patient’s physician to problems (e.g. drugs producing hyposalivation) and/or suspected nutritional deficiencies, and to cooperate with other agencies in contact with the elderly (e.g. community nurses, meal providers, chiropodists).

21 Modified cutlery.
Mastication

The active components of the masticatory (stomatognathic) system are the reflexly controlled, coordinated muscles that move the passive components (the mandible, temporomandibular joint and the teeth).

Denture wearers:

- Exert only one sixth of the biting force developed by people with good occlusion on natural teeth. The force is limited by pain (mucosa is pinched between denture and bone) and by the fear of denture movement.
- Have less delicate control of mastication owing to the loss of periodontal receptors (touch receptors in the oral mucosa have a higher threshold).
- Can, like people with natural teeth, develop the capacity to guide the mandible to an habitual occlusal position. Overriding these habits when recording the jaw relationship or when new dentures are fitted may be difficult.

Thorough mastication is not essential for abstraction of nutrients from food but it increases enjoyment of food and thus encourages a varied diet.

There is no apparent link between inefficient mastication and disturbances of the digestive tract (e.g. epigastric distress). However, indigestion is a cause of concern for many elderly people who commonly relate this to loss of their natural teeth.

Saliva

**Salivary glands**

- Secretory elements (acini) produce protein, fluid and electrolyte components.
- Innervation:
  - Sympathetic – increases protein content.
  - Parasympathetic – copious watery secretion.
- Initial secretion is isotonic. Passage down glandular ducts renders it hypotonic.

The functions of saliva in edentulous subjects are listed in **Table 2.1**.

- Saliva removes debris and damaging factors by transportation to oropharynx. Coats dentures and soft tissues with film 0.1 mm thick (therefore, to maximise physical retentive factors, any space between complete dentures and supporting tissues should not exceed this value). The rate of debris clearance depends on velocity of movement of film (0.8–8.0 mm/min, depending on salivary flow rate and environmental muscle activity). Irritants within oral cavity (e.g. new dentures) stimulate secretion.
- Antimicrobial action most effective against non-commensal organisms. It is thus a determinant of the bacterial composition of denture plaque which itself may be associated with denture-related stomatitis.
- Hydrophilic components lubricate, moisten and protect moving tissues in contact, aided by pellicle formation. Especially important for denture wearers. Secretions of minor salivary glands are critical, since ducts open onto all mucosal surfaces (except anterior region of hard palate).

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**Table 2.1** Functions of saliva in edentulous subjects.

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<td>Removal of debris</td>
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<td>Antibacterial, antifungal, antiviral</td>
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<td>Initiation of digestion</td>
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<tr>
<td>Assistance with taste</td>
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<tr>
<td>Lubrication</td>
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<tr>
<td>Protection</td>
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<tr>
<td>Assistance with retention of dentures</td>
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Calculus

This is formed by precipitation of calcium salts in matrix of protein and bacteria in denture plaque (23). Patients who form calculus rapidly need special instructions in how to keep their dentures clean.

Output of saliva

The circadian rhythm in unstimulated flow rate is shown in 24; the minimum flow rate is during sleep and the consequent diminution in the protective functions of saliva indicates that the wearing of dentures throughout the night should be avoided. Age has little effect on salivary flow rate (unless subject is receiving medication).

Dry mouth

A patient with this complaint may not have a low flow rate; conversely a low flow rate may not evoke a complaint of a dry mouth.

A progressive change in an individual’s secretion rate is indicative of pathological processes; simple clinical testing of flow rate is possible (25). Stimulated flow may be obtained by regularly swabbing the tongue with 5% citric acid solution (pure lemon juice).

True salivary hypofunction must be distinguished from sensory or cognitive disorders.

Ask:

- Do you sip liquid when eating dry food?
- Is your mouth dry when eating?
- Is swallowing difficult?
- Have you too little saliva in your mouth?

Positive answers to all questions suggest salivary hypofunction. An examining finger may also stick to the dry mucosa (26).
True xerostomia

True xerostomia (27) occurs with a resting flow rate of 0.1 ml/min or less.

The causes are:
- Lack of or diseases of salivary glands (e.g. ectodermal dysplasia, Sjögren’s syndrome).
- Irradiation of head and neck.
- Medication by many commonly prescribed drugs (Table 2.2) is a potent cause of xerostomia in the elderly.

It produces:
- Intolerance and lack of retention of dentures.
- Problems in mastication, swallowing, speaking.
- This predisposes to nutritional deficiency.

Amelioration is by:
- Absolute deficiency of glandular tissue – artificial saliva containing a lubricant (some brands contain porcine protein and may be unacceptable on religious grounds).
- Some functioning glandular tissue exists (test with citric acid) – stimulate secretion with a bulky diet, chewing gum, sugar-free acidic sweets.

Approximately one-third of the adult population has symptoms suggestive of dry mouth. It is important to appreciate that the complaint is not a normal consequence of aging.

The collection of unstimulated saliva

Ideally, body water content and posture, lighting conditions, olfactory stimulation and time of day should be controlled. The subject is comfortably seated holding a small tube and in sight of a clock (see 25). The subject swallows, lowers their head and allows their saliva to drain into the tube for 5 minutes. Mouth breathing and swallowing must be avoided. After 5 minutes, any saliva remaining in the mouth is expectorated into the tube. The quantity of saliva collected is measured by volume or weight. Privacy is essential; rehearsal is desirable. Progressive decrease in saliva output can indicate pathological change and thus the need for further investigations. The effect of secretion stimulants or change in systemic medication can also be ascertained.

Taste

Gustation

This is the sense evoked by the stimulation of taste receptors in the oral cavity.

Taste buds

- In fungiform and circumvallate papillae of tongue, also folate papillae on the posterolateral aspect of this organ. Also at junction of hard and soft palates, in uvula, epiglottis, lips and cheeks. These are therefore not covered by a denture.
- Not on underside of tongue or hard palate.

Taste sensation results from interaction between:
- Gustation.
- Sensations emanating from olfactory receptors.
- Tactile, thermal and pain sensations from trigeminal nerve endings in mouth and nose (28).

Hence texture appreciation is also important in determination of ‘flavour’ and requires motor func-
tion to move food round the oral cavity and teeth to divide food.

The visual appearance of food, its temperature and emotional reaction (pleasant, unpleasant, past experiences and associations) is important in the enjoyment of mastication.

Taste contributes to reflex salivation, and some gastric and pancreatic secretion. Thus it aids digestion. Poor diet results in deficient taste sensation (peripheral and central effect).

Age affects taste. With increasing age, the sensitivity of taste declines. Thus the threshold of detection of sour, bitter and salt is raised. The sweet threshold is possibly unaltered.

Increased salt intake can result in fluid retention and hypertension. If sugar intake increases, it can result in obesity, diabetes, and qualitative and quantitative changes in plaque.

Wearing dentures:

- Affects appreciation of texture of food which may be interpreted as alteration to taste.
- May require adaptation. Patients can learn to move food to more sensitive areas of mouth.
- May increase salivary flow when first worn; this results in dilution of sapid substances.

28 Oral sensory pathways.

**Dysgeusia (altered taste)**

This has many causes (Table 2.3):

- Often wrongly regarded as not serious by health workers.
- May be a component of burning mouth syndrome.
- Reduces quality of life for sufferer.

<table>
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<td>Wearing of upper dentures</td>
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<td>Infected tongue</td>
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<td>Thermal or chemical injury of tongue or palate</td>
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<td>Radiation therapy</td>
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<td>Middle ear surgery</td>
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<td>Sjögren’s syndrome</td>
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<td>Bell’s palsy</td>
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<tr>
<td>Head injury, fractures of petrous bone</td>
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<tr>
<td>Multiple sclerosis</td>
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<td>Cirrhosis of the liver</td>
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<td>Nicotinic acid (B3) deficiency</td>
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<td>Pernicious anaemia (B12 and folic acid deficiency)</td>
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<td>Zinc and copper deficiency</td>
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<td>Increased female sex hormones</td>
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<td>Hypothyroidism</td>
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<td>Diabetes mellitus</td>
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<td>Wide spectrum of common drugs</td>
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Smell

Olfactory epithelium
Sniffing is required to divert inspired air to flow directly over the olfactory epithelium, which occupies 1% of the total nasal mucosal area. There is a rapid adaptation to odours. (The dentist may not notice a smell; a new patient almost certainly will.) By neuronal interconnections within the brain, smells can influence salivary flow and behaviour which may, as far as the dentist is concerned, be adverse. Lack of smell can contribute to development of nutritional deficiency by its effect on appetite.

Disturbances of smell
- Interruption in airflow, e.g. excess mucus (common cold, allergies).
- Replacement of specialised epithelium by non-sensory nasal epithelium, e.g. increasing age.
- Interruption of neuronal pathway, e.g. fracture of cribriform plate.
- Hormones – increased sensitivity as oestrogen level rises, decreased sensitivity during menstruation and following menopause.
- Deficiency in smell may be interpreted as deterioration in taste.

Deglutition

The decision to swallow depends on:
- Fineness of food comminution.
- Intensity of taste experienced.
- State of lubrication of bolus.

Some individuals comminute thoroughly, others ‘balt’ food (thus there is variation in the total load applied to tissues beneath dentures).

Teeth usually occlude during deglutition and lips meet (teeth on dentures must readily permit these actions). The tongue rapidly sweeps food into the pharynx:
- The posterior border of the upper denture should be undetectable.
- The tip of the tongue is placed behind incisors (thin palate desirable).

Swallowing is frequently performed and thus pressures exerted on dentures are important (lingual placement of teeth may produce sore tongue). Senescence may prolong swallowing time.

Pressure and touch

The most sensitive areas in the body are around and in the oral cavity:
- Tip of tongue the most sensitive. Lips aid monitoring of substances entering mouth.
- Anterior hard palate aids monitoring of texture and temperature (lost in denture wearers).

Touch receptors:
- Monitor masticatory and appliance movements in denture wearers.
- Have higher threshold than periodontal receptors.
- Hence less precise control of mastication in denture wearers, especially with respect to control of appliances, texture discrimination of food, load applied during mastication and detection of foreign hard particles in food. (The advantages of retaining prepared tooth roots as overdenture abutments are apparent.)
- Sensitivity decreases with increasing age.

Swallowing reflex:
- Stimulation of anterior pillar of fauces most likely to initiate swallowing reflex.
- Great variation in sensitivity between individuals.
- Stimulation of a wide variety of areas can result in nausea.

Retching

- Multifactorial origin.
- Physical stimulation from within oral cavity (somatogenic).
- Association with real or imaginary fears (psychogenic).
- Gastric conditions, catarrh, smoking and alcohol can predispose.

Speech

Speech is produced by sounds from the larynx (phonation) which are then modified by resonance in spaces between the larynx and the lips (articulation). Vocal cords are flaps containing the thyroarytenoid muscles and elastic tissue. The force of expired air causes the ‘cords’ to vibrate horizontally and touch during part of this movement. The expired air is thus interrupted and emerges in a series of rapid bursts. Increasing the tension within the cords raises the pitch. Louder sounds result from increasing pressure of expired air.
Vowel sounds are produced by variation in pitch and pressure. Air flow is not interrupted but sounds are modified by resonance in cavities whose size is varied by dorsum and tip of tongue, palates, teeth and lips.

Consonants are produced by interruption of the air stream by the tongue, teeth and/or lips. There are several classification systems for consonants, one being:

1. Bilabials [b], [p], [m]
   Lip contact required (labiolingual positioning of anterior teeth and occlusal vertical dimension are important).

2. Labiodental [f], [v]
   Contact between lower lip and upper incisors (incisal edge of upper anterior should come to lie on wet/dry junction of vermilion border of lower lip. Support for lower lip by lower anterior is also important).

3. Lingual dental [d], [t]
   Tip of tongue contacts cingulum area of upper anterior teeth and adjacent mucosa (labiolingual positioning of incisors important, as is occlusal vertical dimension and thickness of artificial palate).

4. Lingual palatal [g], [k]
   Dorsum of tongue humped up to touch posterior or palate (beware posterior overextension, over-thick palate, or lack of retention of denture).

With [ch] and [t] sounds, the greater part of the tongue is in contact with the hard palate (the denture should not be too thick). For sibilants [s], [sh], and [z], the air stream passes through a narrow space between the tip of the tongue and the anterior portion of the hard palate.

If lisping occurs ([s] and [z] substituted by [th]), the space has been occluded by too palatal positioning of the anterior teeth, too thick an artificial palate overlying nasal area, or narrow arch width of artificial teeth which forces the tongue into a more forward position.

In addition, lisping may result from too wide an arch width, since the latter permits escape of air lateral to the tongue. Whistling during speech results from the converse of the above factors.

Providing the optimum occlusal vertical dimension is important for speech, since it governs the size of space within which the tongue works. Too little space results in distortion of [s], [sh], [th] and [t] sounds.

The [s] sound may be helpful in determining the occlusal vertical dimension, since during its production the mandible is in its most forward speech position, when the upper and lower incisors should just not touch. The lips should also touch easily when producing bilabial sounds.

There is usually a slight distortion of speech (unless it is intrinsic to the patient) following the fitting of new dentures. This gradually resolves as the muscles adapt to working with the new conditions, the time taken depending on the degree of change in the dentures and the adaptive potential of the patient. If the latter is considered to be low (because of, for example, advancing age or poor health), and the old dentures enable the production of satisfactory speech, consideration should be given to reproducing the positioning of the teeth and the contours of the palate by utilising a template replacement denture technique.

Physiological rest jaw position is adopted by the mandible without conscious control when mouth movements cease. The effect of gravity on the mandible is counteracted by:

- The passive elastic components of the elevating muscles and connective tissue of the face.
- The active contractile components of the elevating muscles controlled by reflexes originating in the muscle spindles and receptors in the temporomandibular joint.

The interocclusal rest space:

* Increases
  - When the head is tilted backwards (increases the tension in the submandibular tissues).
  - During inspiration.

* Decreases
  - When the head is tilted forward.
  - During exertion, stress or pain (muscle tone increases).
  - With arthritis of the temporomandibular joint.
  - If teeth have to be occluded to keep loose dentures in place.
  - With increasing age.

**Bruxism**

This is the orofacial manifestation of rapid eye movement (REM) sleep and, if the dentures are worn at night, will result in the overloading of the denture-supporting tissues. Clenching and grinding the teeth during the day also causes trauma to these tissues.

Bruxism, clenching and grinding increases with rise in psychological and physical stress, whether from financial, family, health, employment or independence causes. Pain within the oral cavity can also be an initiating factor.

Instruction in coping strategies and relaxation techniques may be helpful, as is the provision of comfortable dentures.
Psychological basis

All forms of removable prosthodontic treatment require clinical skills that are well supported by adequate technical services. Equally important is good rapport and mutual understanding between the patient and dentist.

Communication is thus a key factor in the management of patients. Successful communication has as one of its aims an accurate assessment of the patient's personality. This will guide the operator to the likely reaction to, and acceptance of, treatment.

No other form of treatment has such a profound influence on body image, or the ability to undertake the normal range of oral functions, as does complete denture treatment. This treatment often takes place at a time in the life of a patient when emotional overtones considerably influence the personality—the loss of someone close; the realisation of advancing age; one who is at the peak of a demanding career, or who recognises unfulfillable ambitions; lifestyle changes resulting from the retirement of the patient or spouse, and so on.

Thus the process of examination must include an evaluation of the patient in the broadest sense—medical status, dental condition and personality—so that a realistic basis for the formulation of a treatment plan, the likely outcome of treatment, and thus the ability to generate effective interpersonal communication, is possible.

**Personality**

Most dentists will be familiar with the attempt by House to classify the personality of individual patients into one of four types - philosophical, exacting, hysterical, or indifferent. This classification may have been developed from the 'Four Temperaments' of Hippocrates, which are equally unhelpful in considering the personality of an individual patient. However, the application of factor analysis to the 'four temperaments' is useful when considering the interrelationships between various traits (29).

Of course, no single person can be considered to be a perfect example of any of these descriptive terms although one trait may be dominant in a given situation. In this context a *trait* refers to consistent differences between the behaviour or characteristics of two or more people. Thus, a trait is any distinguishable relatively enduring way in which one individual varies from another, and, as a consequence, is used by some as a basis for explaining or predicting behaviour.

The judgements to be exercised in respect of labelling a particular patient as likely to respond in a particular way to a given stimulus, are complex.

Examples of responses which result from a given stimulus are shown in Table 2.4.

**Table 2.4 Personality stimulus response**

<table>
<thead>
<tr>
<th>Stimulus</th>
<th>Possible response by:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Criticism of dental</td>
<td>Dentist:</td>
</tr>
<tr>
<td>treatment by a patient</td>
<td>Excuses</td>
</tr>
<tr>
<td></td>
<td>Guilt</td>
</tr>
<tr>
<td></td>
<td>Anger</td>
</tr>
<tr>
<td></td>
<td>Acceptance</td>
</tr>
<tr>
<td>Poor fear control by a patient</td>
<td>Patient:</td>
</tr>
<tr>
<td></td>
<td>Uncommunicative</td>
</tr>
<tr>
<td></td>
<td>Overreactive</td>
</tr>
<tr>
<td></td>
<td>Talkative</td>
</tr>
<tr>
<td></td>
<td>Aggressive</td>
</tr>
<tr>
<td></td>
<td>Discourteous</td>
</tr>
</tbody>
</table>

Despite the fact that most patients are neither neurotic nor psychologically abnormal, they may still respond to dental treatment with tension and anxiety responses such as avoidance, excessive reactions to perceived pain, irritability or gagging. It must be appreciated that reactions such as these are directed at the 'oral attack' and not personally at the dentist. As the first step in understanding the reactions of patients to a given situation, the dentist must have his or her own emotional needs under control. In
particular, the operator must guard against the development of frustrations such as those which might result from repeated awkward episodes with a particular patient, or a lack of confidence in the outcome of a clinical activity where postgraduate clinical experience might be lacking.

Thus, the emotional needs of the dentist may be gratified through a deep sense of satisfaction from the role being played in the excellence of the service provided.

Initial contact with a patient

The attitude of the patient to the dental practice is moulded by the initial visit. The clinical skills of the dentist are unlikely to be in doubt as the patient will usually have arrived as a result of free choice. It is the attitude and understanding of the receptionist and the surroundings within the practice which will set the scene for the first contact with the dentist and the degree of rapport which might be achieved.

In the first interview with the patient, the opportunity to obtain a general overview of the patient’s opinions, feelings and attitude is presented. The patient must be given time to present these. The process may be time-consuming, but it is essential to successful prosthodontic treatment.

While conversing with the patient, awareness of the non-verbal (‘body language’) clues provided, such as eye contact (or its absence), body posture, covering the mouth with a hand, tension habits, and so on is important. These are well known and easily learned signs relating to personality which will be helpful in overall assessment of the patient.

The process of communication is a two-way one. It is equally essential for the dentist to have a clear understanding of the patient’s perception as it is for the dentist to communicate the possibilities in respect of attempting to satisfy the patient’s dental needs.

It is at the conclusion of this initial assessment that the dentist should be in a position to decide whether or not the patient can be helped. Given that the decision is to proceed, then a complete medical and dental history is obtained, as, by now, the full extent of the concerns that motivated the patient to attend will have been identified.

Medical basis

The purpose of obtaining a medical history is to be able to record pertinent health information which is necessary to arrive at a rational and safe treatment plan. This may play a fundamental part in satisfaction of the patient’s denture needs.

Having greeted the patient and engaged briefly in neutral conversation in order to reduce the level of anxiety, questions concerning general health may be a suitable way to continue the interview.

For the purpose of this text it is not intended to present the format of a routine medical history. It should, however, be borne in mind for patients in the age group under consideration that fears about serious illness, or concerns about appearance, are often not expressed without careful questioning. This includes reference to the sometimes substantial pharmacotherapy – much of which is of dental relevance – that older patients may have prescribed for them.

Accurate observation of the patient can often provide valuable clues as to the nature of the questions that might be posed. Some examples of observations from which aspects of health status relevant to denture provision might be inferred, are listed in Table 2.5.

The medical history is equally important for the removable denture patient as for the patient about to undergo surgery. Do not be misled by the generally non-invasive nature of prosthodontic treatment. The literature is replete with warnings and examples of conditions, many of which do not have overt presenting signs, but which may result in extreme discomfort for the denture patient. If a new denture is produced before the detection of low level deficiency states, anaemia, etc., the value of the clinical service provided may (rightly) be called into question.
<table>
<thead>
<tr>
<th>Observation</th>
<th>Selected health implications</th>
<th>Relevance to complete denture treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abnormal gait</td>
<td>Arthritis</td>
<td>Postural problems during treatment</td>
</tr>
<tr>
<td></td>
<td>Stroke</td>
<td>Osteoporosis</td>
</tr>
<tr>
<td></td>
<td>Generalised neuromuscular disease</td>
<td>Diminished neuromuscular control</td>
</tr>
<tr>
<td>Overweight</td>
<td>Compensatory eating – stress; depression</td>
<td>Difficulties in assessing requirements for satisfaction</td>
</tr>
<tr>
<td></td>
<td>Drug therapy</td>
<td>Consult general medical practitioner (GMP)</td>
</tr>
<tr>
<td></td>
<td>Hypertension</td>
<td>Fluctuation of tissue form</td>
</tr>
<tr>
<td></td>
<td>Mature onset diabetes mellitus</td>
<td>Fluctuation of tissue form and denture tolerance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intolerance of supine position</td>
</tr>
<tr>
<td>Underweight</td>
<td>Stress</td>
<td>Communication and tolerance difficulties</td>
</tr>
<tr>
<td></td>
<td>Anorexia</td>
<td>Rapid changes in tissue form</td>
</tr>
<tr>
<td></td>
<td>Carcinoma</td>
<td>Poor tissue tolerance</td>
</tr>
<tr>
<td></td>
<td>Diabetes mellitus</td>
<td>Fluctuation of tissue form and tolerance</td>
</tr>
<tr>
<td>Handshake weakness</td>
<td>Stroke</td>
<td>Poor neuromuscular control</td>
</tr>
<tr>
<td></td>
<td>Neuropathies: Anaemic</td>
<td>Poor denture tolerance, abnormal oral sensations</td>
</tr>
<tr>
<td></td>
<td>Alcoholic</td>
<td>Poor neuromuscular control</td>
</tr>
<tr>
<td></td>
<td>Myxoedema</td>
<td>Poor neuromuscular control</td>
</tr>
<tr>
<td></td>
<td>Multiple sclerosis</td>
<td>Poor neuromuscular control</td>
</tr>
<tr>
<td>Breathlessness</td>
<td>Anxiety</td>
<td>Difficulty in assessment of real needs</td>
</tr>
<tr>
<td></td>
<td>Heart condition</td>
<td>Care in management</td>
</tr>
<tr>
<td></td>
<td>Asthma or other allergy</td>
<td>Possible reaction to dental treatment or materials</td>
</tr>
<tr>
<td></td>
<td>Psychoneuroses</td>
<td>Difficulties in achieving patient satisfaction</td>
</tr>
<tr>
<td></td>
<td>Anaemia</td>
<td>Poor tissue response</td>
</tr>
<tr>
<td>Premature aged appearance</td>
<td>Psychological; depression, inability to cope with daily problems</td>
<td>Intolerance of supine position</td>
</tr>
<tr>
<td></td>
<td>Endocrine disorders</td>
<td>Postural hypotension</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dry mouth</td>
</tr>
<tr>
<td>Swollen ankles</td>
<td>Cardiac failure</td>
<td>Care in management. Consult GMP</td>
</tr>
<tr>
<td></td>
<td>Renal oedema</td>
<td>Variations in tissue form</td>
</tr>
<tr>
<td>Kyphosis/scoliosis: Wearing surgical collar</td>
<td>Osteoporosis</td>
<td>Intolerance of supine position</td>
</tr>
<tr>
<td></td>
<td>Ankylosing spondylitis</td>
<td>Postural hypotension</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Postural difficulties</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chair positioning</td>
</tr>
<tr>
<td>Facial asymmetry</td>
<td>Angioneurotic oedema</td>
<td>Possible reaction to dental treatment or materials</td>
</tr>
<tr>
<td></td>
<td>Developmental</td>
<td>Searching history</td>
</tr>
<tr>
<td></td>
<td>Infective</td>
<td>Preliminary treatment</td>
</tr>
</tbody>
</table>
### Table 2.5 continued  Health status and dental provision.

<table>
<thead>
<tr>
<th>Observation</th>
<th>Selected health implications</th>
<th>Relevance to complete denture treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unusual pattern of hair loss</td>
<td>Alopecia, shock, psychological disturbance&lt;br&gt; Ectodermal dysplasia</td>
<td>Care with assessment of expectations&lt;br&gt; Friable tissues</td>
</tr>
<tr>
<td>Ptosis</td>
<td>Aging, Horner’s syndrome</td>
<td>Difficulty with neuromuscular control</td>
</tr>
<tr>
<td>Eyes: Red</td>
<td>Allergic conjunctivitis</td>
<td>Possible reaction to treatment materials</td>
</tr>
<tr>
<td>Black</td>
<td>Trauma and prone to falling</td>
<td>Tissue relations</td>
</tr>
<tr>
<td>Prominent</td>
<td>Thyrotoxicosis</td>
<td>Management difficulties</td>
</tr>
<tr>
<td>Dry</td>
<td>Sjögren’s syndrome</td>
<td>Difficulty with neuromuscular control&lt;br&gt; Abnormal mucosal reaction</td>
</tr>
<tr>
<td>Nasal drip</td>
<td>Allergy, hay fever</td>
<td>Possible reaction to treatment materials&lt;br&gt; Possible uncontrolled movements&lt;br&gt; Abnormal taste sensation (dysgeusia)</td>
</tr>
<tr>
<td>Lips: Blue</td>
<td>Mitral stenosis</td>
<td>Care in management. Consult GMP</td>
</tr>
<tr>
<td>Pale</td>
<td>Heart failure</td>
<td>Reduced tissue resistance. Consult GMP&lt;br&gt; Abnormal mucosal reactions</td>
</tr>
<tr>
<td>Functional abnormality</td>
<td>General malaise</td>
<td>Care in tooth positioning</td>
</tr>
<tr>
<td></td>
<td>Anaemia</td>
<td>Maintain patient airway during treatment&lt;br&gt; Special care with aesthetics</td>
</tr>
<tr>
<td>Pigmented</td>
<td>Incompetent lips</td>
<td>Careful history&lt;br&gt; May be associated gastrointestinal problems&lt;br&gt; Access difficulties. Cross-infection</td>
</tr>
<tr>
<td>Herpes</td>
<td>Mouth breather</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hyper-oral consciousness</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Developmental abnormality</td>
<td></td>
</tr>
<tr>
<td>Abnormal speech</td>
<td>Ill-designed dentures</td>
<td>Care with assessment of need. Refer to existing faults&lt;br&gt; Difficulty with neuromuscular control</td>
</tr>
<tr>
<td></td>
<td>Cerebrovascular disease: Stroke&lt;br&gt; Motor neurone disease&lt;br&gt; Multiple sclerosis</td>
<td></td>
</tr>
<tr>
<td>Irritability</td>
<td>Anxiety</td>
<td>Assessment of needs and expectations&lt;br&gt; Communication and tolerance difficulties</td>
</tr>
<tr>
<td></td>
<td>Stress</td>
<td>Care with management&lt;br&gt; Variation in tissue form</td>
</tr>
<tr>
<td></td>
<td>Irrational fear</td>
<td>Care in treatment</td>
</tr>
<tr>
<td></td>
<td>Hypertension</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Perfectionism</td>
<td></td>
</tr>
<tr>
<td>Fingers:</td>
<td>Rheumatoid arthritis</td>
<td>Chronic medical conditions&lt;br&gt; Possible management implications</td>
</tr>
<tr>
<td>Clubbing</td>
<td></td>
<td></td>
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<tr>
<td>Swollen joints</td>
<td></td>
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<tr>
<td>Deviation</td>
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</tbody>
</table>
3. Information Gathering

Introduction

Careful observation and a comprehensive examination combine to secure the trust of the patient, while at the same time providing the information which is essential to the provision of successful treatment.

It is not the intention of this chapter to detail the steps in patient assessment that should be familiar to all practitioners, but rather to provide an outline of those aspects of the examination stage which experience has shown to be of value.

History

Medical history

As outlined on page 25, the purpose of obtaining detailed information on a patient's medical status is to give an indication, in physiological terms, of his or her ability to wear and use dentures.

Providing the patient with a questionnaire to complete while in the waiting room, and then subsequently scanning this at the chairside as a check on accuracy, is helpful. A suitable aide-memoire for obtaining health information appears in Table 3.1.

Dental history

This must include the approximate dates of extraction of the teeth. These may serve as a guide to resorption rates and also give an indication of the stability of the denture-bearing tissues. The reasons for the loss of the natural teeth will also help in this estimation, whether because of caries, periodontal disease, trauma, etc.

Denture history

The denture-wearing history is of great importance in evaluating the likelihood of success. It should be ascertained whether the dentures were:

- Never satisfactory.
- Previously satisfactory, and now unsatisfactory.
- Previous denture satisfactory but new denture unsatisfactory.

This information will give valuable information concerning the design of the previous dentures, especially in respect of successful features which might be usefully reproduced in replacement dentures.

While taking these histories, the importance of listening carefully to the patient cannot be over-emphasised. This stage commonly provides the most important clues with respect of faults present in the existing dentures. For example:

- Masticatory difficulties usually have their basis in faulty occlusion.
- Looseness may also relate to occlusal faults, or to extension or other border faults.
- Any speech difficulties apparent while listening to the patient, or complained of, could indicate vertical height error, neutral zone mis-assessment, poor retention or errors in anterior tooth position.

Other observations

During the examination stage, it is useful to observe the relaxed patient with the mouth closed, then with the mouth wide open, and also with the mouth partly open. Some of the information to be gleaned from this is:

- Mouth closed:
  - Skeletal relationship.
  - Lip support.
  - Labiomental groove prominence.
  - Habitual clenching.
  - Dyskinesia.
- Mouth wide open:
  - Assessment of temporomandibular joint activity.
  - Influence of circum-oral muscles on the dentures.
  - Access to the mouth.
  - Neuromuscular control.
- Mouth partly open:
  - Tongue position relative to the occlusal plane.
  - Tooth position relative to the neutral zone.
  - Depth/width of sulci.
  - Tongue control of dentures (have patient bite on your finger using their anterior teeth).

Other aspects of the clinical examination should compare the patient's assessment of their existing
Table 3.1 Health information.

*Health*
1. Are you in good health?
2. Are you under the care of a doctor at the present time?
3. Have you ever had any serious illness or operation at any time?
4. Have you ever been in hospital, especially within the past year?

*Illness*
Do you suffer from, or have you had, any of the following:
- Rheumatic fever?
- Rheumatic heart disease?
- Chorea (St Vitus’ dance)?
- Congenital heart disease (blue baby)?
- Heart murmur or valvular disease of the heart?
- Anaemia?
- Heart trouble, heart attack?
- Stroke, paralysis or thrombosis?
- Tuberculosis?
- Bronchitis?
- Chest pains?
- Persistent cough or shortness of breath?
- Fainting spells?
- Blackouts?
- Epilepsy or low blood pressure?
- Asthma?
- Hay fever (summer colds)?
- Blocked nose?
- Eczema or hives (urticaria)?
- Diabetes?
- Jaundice (yellowing of the skin) especially after operation?
- Arthritis (rheumatism)?
- Kidney trouble?

*Medicines*
1. Are you taking, or have you taken, any of the following medicines, tablets or drugs during the past year?
   (a) Antibiotics (penicillin, etc.);
   (b) tablets for high blood pressure;
   (c) nerve tablets for depression;
   (d) insulin or others for diabetes;
   (e) anticoagulants (to thin the blood);
   (f) cortisone (steroids);
   (g) tranquillisers (sedatives);
   (h) digitalis, etc. for the heart.
2. Do you habitually take alcohol?

*Bad reactions*
Are you, or have you been allergic, sensitive or hypersensitive to any drug, medicine or anything else such as:
- (a) Local anaesthetic;
- (b) penicillin or other antibiotic;
- (c) sleeping pills;
- (d) aspirin or similar pain-killing drugs;
- (e) sticking plaster;
- (f) iodine;
- (g) any other drug;
- (h) any type of food;
- (i) ointments.

*Dental complications*
1. Have you been to the dentist during the past six months?
2. Have you needed treatment for bleeding following dental extractions, operation or injury?
3. Do you bruise easily?
4. Are you employed in any situation which regularly exposes you to X-rays or other ionising radiation?
5. Have you had any bad reactions to any form of dental treatment?
6. Have you or your relatives had any bad reactions to a general anaesthetic (going to sleep for an operation)?

*For women*
Are you pregnant or taking the contraceptive pill?

*For patients of African or Mediterranean descent*
1. Have you or members of your close family suffered with sickle-cell anaemia or Cooley’s anaemia?
2. Have you had a blood test for these diseases?
dentures with that of the dentist, including an evaluation of the patient’s complaints compared to the observations made by the operator.

Existing dentures do provide valuable information for the planning of replacement dentures and they should be examined carefully following a routine in which no aspect is overlooked. A suitable approach to this is the completion of a checklist such as the example shown in Table 3.2. All the aspects listed should be carefully considered to enable a proper evaluation of the existing dentures to be carried out.

In the examination of the oral cavity, the following must be included and noted in the patient’s clinical record where any variation from normal is seen:

- Mucosa of the ridges, palates, lips, checks and floor of the mouth.
- Displaceability of all the tissues in contact with the dentures.
- Tongue size, colour, position and habits.
- Saliva – quality and quantity.
- Sublingual flange area.
- Palatal form.
- Muscle and frenum attachments.
- Border tissue form and activity.
- Palatal sensitivity.
- Mandibular movements.
- Radiographic appearance of the relevant tissues.

Where uncommon presenting symptoms are disclosed these will require careful evaluation usually involving special tests. Among the most frequent problems in this category are gagging associated with dentures and 'burning mouth' syndrome. The management of special problems is considered in Chapter 4.

<table>
<thead>
<tr>
<th>Age of patient</th>
<th>Length of time edentulous</th>
<th>Age of present c/c</th>
<th>Relationship of c/c</th>
<th>Incorrect</th>
<th>Alteration proposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient’s assessment</td>
<td>C/–</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Condition of</td>
<td>Upper ridge</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>Palate</td>
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4. Problem Solving

Mouth preparation

Denture treatment should not be undertaken unless the mouth is in a healthy state. In general terms, a denture made for a patient where untreated pathology is present in the mouth cannot be said to be either therapeutically or ethically acceptable.

Common problems relating to dentures which have been worn for a prolonged period include:

- Soft tissue displacement.
- Fibrous degeneration of the residual ridge.
- Border faults.
- Hyperplasia of the border tissues.
- Denture-related stomatitis (possibly associated with angular cheilosis).

Some of these conditions may be present concurrently.

Soft-tissue displacement

Where displacable tissue is present over the residual alveolar ridge, uneven forces on the mucoperiosteum cause the unbound tissue fluid to be driven from its normal resting position. This results in distortion of the form of the surface contours of the residual ridges. Such uneven forces result from continuing resorption or tooth wear, or a combination of both.

A new denture produced from an impression of the tissues in their distorted state will result in an appliance which fits the tissues no better than did the denture it replaces.

The distorted tissues must be allowed to recover before any impressions are made. Recovery is time dependent, and a minimum period of 90 minutes after removal of the old dentures should be allowed to elapse before the working impressions are made (30, 31). Where severe tissue distortion has been caused by inappropriate treatment, recovery of the resting tissue form may take much longer than this (32, 33).

30, 31 Surface contours in the sagittal and coronal planes showing progressive recovery of tissue form after removal of an ill-fitting upper denture. Recovery was complete at 90 minutes.
32, 33 Tissue distortion resulting from an unsuccessful attempt to obtain retention of a ‘horseshoe’ form of denture.

34 A fibrous and mobile anterior residual ridge.

35 Control of viscosity of a tissue conditioner by varying the liquid:powder ratio. Curves 4, 5 and 6 represent a ratio that is too low for practical use—the material would be too stiff to be effective.

Fibrous degeneration of the residual ridge

In its extreme form, the condition just described results in a hypermobile, readily displaceable (‘flabby’) ridge form (34). In addition to the need for a prolonged period of recovery from distortion prior to the impression stage of treatment, special impression procedures are required. These impression methods are considered in Chapter 5.

Tissue conditioners

In the above cases—and also in those situations where the effects of other forms of tissue abuse are evident in the denture-supporting tissues—the use of a tissue conditioning material should be considered as a part of the treatment required to prepare the mouth for impressions.

These materials behave visco-elastically, i.e. they flow under slowly applied forces, and behave elastically under more rapidly applied dynamic loading. Thus, when applied to the impression surface of a denture, they adapt to the underlying tissues during function allowing a more even distribution of force. To provide an effective layer of tissue conditioner in a denture, the liquid:powder ratio needs to be controlled. As the reaction between the powder and liquid is not a chemical one, the viscosity of the tissue conditioner can be adjusted to the requirements of the clinician (35). In addition, as they remain soft and resilient in the short term, some of the applied force is absorbed during functional activity. The correct application of the mixed conditioning material is essential for its effective use (36). It is all too easy to misuse these materials (37–39). However, tissue conditioners do not completely eliminate the tissue distortion referred to above, nor can they be used to correct denture faults other than an ill-fitting denture on a temporary basis. Serious damage to the patients tissues and/or the denture can result from inappropriate use of tissue conditioners (40).
36 Tissue conditioner of the desired viscosity should be spread evenly over the fitting surface of the denture.

37 Example 1 of the misuse of tissue conditioners. Excess of high viscosity material applied to palate only.

38 Example 2 of the misuse of tissue conditioners. Material applied to ridge area only.

39 Example 3 of the misuse of tissue conditioners. Excess material on buccal flange.

40 A further example of the misuse of tissue conditioners in that, after placement, no follow-up treatment was provided.
Border faults

A denture which has been worn for a considerable period of time will have demonstrable border faults. Over-extension will be present if the denture was correctly extended when first inserted, or, if the border extensions were inaccurate at insertion, then some regions will demonstrate under- and some over-extension.

Over-extension will result in trauma to the tissues producing tenderness, swelling, possibly ulceration and other associated effects of inflammation (41). Such regions must be relieved and the denture returned to the patient. After one week, the patient should be recalled, and, if the region concerned has not recovered, the procedure is repeated until such time as the tissues have completely healed. Only then may the impression stage of treatment begin.

Hyperplasia of the border tissues

In some cases, where over-extension is present, the border tissues may respond by becoming hyperplastic. Patients are often unaware of the presence of hyperplastic tissue, since it is frequently painless (42). When, however, the mass of abnormal tissue becomes large, patient concern ('cancer phobia') may be evident.

Treatment requires the removal of the source of irritation. The denture flange in the vicinity must be reduced to clear the hyperplastic tissue by a minimum of 1 mm. In severe and extensive cases the whole denture flange may require removal. Preferably, the denture should not be worn at all.

The patient is also advised to massage the area of abnormal tissue with the ball of the finger. A warning that the denture will feel loose should also be given.

Quite large masses of hyperplastic tissue will resolve over a period of 4–6 weeks using these simple measures. If, however, resolution does not occur, or is incomplete, surgery may be indicated. In all cases, however, the conservative procedures referred to above are required before surgery is contemplated.

Only when the hyperplastic tissue has been controlled and the mouth considered to be in a state of good health, should new denture treatment be commenced.

41 Ulceration resulting from border inaccuracy.

42 Denture-induced hyperplasia.
Denture-related stomatitis

In this condition, chronic irritation of the mucosa contacted by the denture base produces an observable inflammatory response. It may appear as discrete areas of pin-point inflammation often associated with the ducts of the palatal mucous glands (43), or, more commonly, as a vivid inflammation of an area coincident with that covered by the upper denture. Inflammation of varying extent may be present between these extremes (44). A further form described as papillary hyperplasia may also occur, in which a nodular hyperaemic mucosal surface is seen, usually in the central palatal region (45).

43 An early form of denture-related stomatitis together with denture-induced hyperplasia.

44 Denture-related stomatitis where the pin-point areas of inflammation are becoming confluent.

45 Progression of denture-related stomatitis towards the production of tissue nodules.
The condition is generally painless and the patient is often unaware of its presence. A large number of causative factors have been implicated including denture-related trauma, antibiotic therapy, deficiency states, endocrine disturbance, association with xerostomia, and others.

Denture-related trauma is the most common cause. The trauma may arise from occlusal and articulation faults, poor fit of the denture base, roughness of the base because of entry into palatal fissures, poor denture hygiene, incorrect vertical dimension of occlusion, and others. All of these factors may be present in a denture which has been in use for a prolonged period. The inflammation is often associated with *Candida albicans*—invasion of which appears to be stimulated by trauma and the nature of the denture base, particularly when worn continuously and in the presence of poor oral hygiene.

When denture-related stomatitis is accompanied by angular cheilitis, *Candida albicans* is almost certainly implicated. The use of suitable fungicides on the mucosa and the denture will be required as part of the treatment. It is important that assumptions are not made on superficial evidence where easily recognised signs are present, as angular cheilitis and generalised forms of oral inflammation may require a more detailed investigation (46).

Denture-induced trauma is best eliminated by the patient not wearing the denture. This is often not practical on social grounds so other measures are required. The use of tissue conditioners will improve adaptation of the denture to the tissues and this, together with the patient being instructed not to wear the denture overnight, will be adequate where poor fit is the cause. Where dentures have been in use for a long time, occlusal faults are also likely to be present. In this case, the use of occlusal pivots will be required. For these and other factors related to occlusal faults, the reader is referred to Chapter 6. In all cases, instruction in oral hygiene will need to be reinforced. Where fungicides are indicated, the denture is also a source of infection, and it must be placed in a suitable antifungal agent overnight (e.g. a dilute hypochlorite solution).

Denture-related stomatitis must be controlled prior to impressions being obtained. Such control may require some 6 weeks of treatment as described above.

Other aspects of mouth preparation are considered in Chapter 5.
Looseness of dentures

This complaint is more commonly associated with the lower rather than the upper appliance.

Common symptoms

- Looseness during speech will alter sounds (resonance chamber alters in size) and affect fluency (tongue has to replace denture or teeth have to be occluded for the same purpose).
- Looseness during eating affects ability to masticate anything but soft food and permits debris to collect beneath the dentures.
- Looseness when opening mouth wide (e.g. when laughing) is socially embarrassing.
- Moving dentures can also cause pain if they abrade the mucosa or are not accurately reseated on their supporting tissues.

Synonyms

Instead of looseness, patients may complain of dentures rocking or shifting, of the upper denture falling, or of the lower denture rising or lifting. They may also say the dentures are too big; this may imply that they do not fit the residual ridge and are therefore loose, that the dentures are bulky and occupy too much space in the mouth, or that the vertical dimension of occlusion is too great. Patients must therefore be questioned to discover the implication of the adjective.

Causes

There are numerous causes of apparently loose dentures, any or many of which may result in the above symptoms. Accurate diagnosis of the cause of looseness is therefore essential otherwise the problem is unlikely to be overcome when modifying existing dentures or avoided when constructing new appliances. Since the diagnosis is not always obvious, time is well spent listening to what patients say is wrong with their dentures and their response to leading questions; in careful observation of the dentures inside and outside the mouth, of the lips, cheeks and tongue when static and in function, and of the denture supporting tissues; and in palpation of both hard and soft tissues. Use of a proforma like that shown in Table 3.2 is a helpful aide-mémoire as are the following equations:

When teeth are apart,

STABLE DENTURES result from RETENTIVE FORCES being greater than DISPLACING FORCES

When teeth are occluded or when masticating, high displacing forces are generated through the occlusal surfaces and the supporting tissues enter the equation thus:

STABLE FORCES result from GOOD SUPPORT plus RETENTIVE FORCES being greater than DISPLACING FORCES

Utilising these components of stability, lists of the most frequent causes for common symptoms and signs follow (Table 4.1). To further aid diagnosis, a general exposition of the causes of looseness and their recognition is then presented together with suggestions as to how the problems may be overcome by modifying existing dentures and avoided when constructing new ones (Table 4.2).
<table>
<thead>
<tr>
<th>Cause</th>
<th>On initial delivery</th>
<th>Soon after delivery of dentures</th>
<th>After adjustment</th>
<th>After some months of satisfactory wear</th>
<th>Recently constructed denture, previously satisfactory, loose during/immediately following illness</th>
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<td>When speaking</td>
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<td>When opening wide</td>
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Table 4.1 continued  Causes of loose dentures: relationship to common symptoms and signs.

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<td>PAIN AVOIDANCE MECHANISMS</td>
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</tr>
</tbody>
</table>
### Table 4.2 Causes of loose dentures: their recognition, overcoming and avoidance.

<table>
<thead>
<tr>
<th>Cause</th>
<th>Recognising</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper denture must possess a seal to prevent easy access of air and saliva to impression surface. Seal has two components: (1) buccal and labial flanges should fill functional depth and width of sulci (47, 48); (2) seal across posterior border of denture should be effective. May be possible to develop similar seal around lower denture.</td>
<td><em>Upper:</em> pull down on anterior teeth—tests seal on labial and buccal borders. Pull out on incisors—tests seal of post dam. Pull out on canines—tests seal around contralateral tuberosity and distobuccal sulcus. <em>Lower:</em> lift with tip of probe placed in anterior interdental area.</td>
</tr>
<tr>
<td>Border under-extension in depth.</td>
<td>Direct vision in mouth on gentle retraction of lips and cheeks—e.g. round fraena, up to retromolar pads. Use mirror to examine extension of upper denture around distobuccal aspect of tuberosities and into hamular notches. Distolinguial of lower denture examined by retraction of tongue by mirror and by palpation. Diagnostic additions of soft tracing compound will remain extended beyond border unless latter correct/overextended (49). Denture may rotate horizontally with appropriate finger manipulation unless tuberosities enclosed/retromolar pads covered; such movement liable to break border seal.</td>
</tr>
</tbody>
</table>

47 The functional depth and width of sulci should be utilised to provide seal and assist in optimal positioning of the teeth.

48 Diagrammatic representation of the situation shown in 47.

49 Diagnostic addition of impression compound.
Overcoming

Simple relining/rebasing of denture without active correction of border under- or over-extension unlikely to dramatically improve retentive forces.

Avoiding

Primary impressions should encompass entire denture supporting area and fill sulci in depth (and width).

Secondary (working) impressions need customised trays with carefully adjusted borders using, *inter alia*, soft tracing compound or similar material. Impression material should cover these borders.

Impressions should be cast carefully to avoid distortion of material and preserve recorded depth (and width) of sulci. Latter should also be preserved when trimming cast (51).

Borders of record rims and trial dentures should fill sulci on cast so that extensions can be checked in mouth. If borders found to be under-extended, impressions must be retaken.

Add adequately softened tracing compound to relevant border, mould in mouth by digital manipulation of lips and cheeks, and functional movements by patient. Trim off any excess and send denture to laboratory for compound to be replaced by acrylic resin.

For semi-permanent addition, modify borders in similar manner at chairside using butylmethacrylate resin. Provision must be made for butt joint between old and new resin to prevent peel-away (50).

50 Butt joints are required for border additions.

51 Sulcus form preserved on the cast.
**Cause**

**Decreased retentive forces continued**

**Lack of seal continued**

Border under-extension in width.

**Recognising**

Direct vision of denture in situ in mouth.

Compare available width of sulci (when cheeks/ lips gently retracted while mouth half open) with width of denture borders.

Diagnostic additions of tracing compound.

Under-extension in width of upper buccal flanges often accompanied by premolar/molar teeth being sited over crest of residual ridge (47, 48). (Upper ridge resorbs more on buccal side, thus neutral zone comes to lie buccal to crest of ridge.)

Lower molar teeth may be sited lingual to crest of residual ridge (often as result of upper teeth being too palatally placed); this often results in no contact between checks and polished surface of denture (52).

Posterior border of upper denture:

This may be over-extended on to mobile tissue of soft palate (seal broken when palate elevates during speech), or under-extended, making it difficult to achieve seal in presence of relatively undisplaceable soft tissue.

Observe soft palate movement when patient says ‘aah’.

Note junction line between mobile and immobile tissue; posterior border of denture should be sited just anterior to this line.

May be correctly sited but post dam of insufficient depth or lateral extent.

If denture has been worn for several hours, see if palatal tissues have been displaced by an effective post dam.

Insert and seat freshly wetted denture; site of egress of air bubbles indicates deficient seal.

---

52 Optimum flange extension aids optimal tooth positioning.

53 Control of impression material in the post dam area.
### Overcoming

As above.

In many patients coronoid process reduces width of upper distobuccal sulcus as mouth opens; beware over-extension in width of border. During moulding procedure, ask patient to open mouth and move mandible from side to side. Lack of contact between polished surface of denture and cheek when mouth partly open has to be accepted.

---

### Avoiding

As above. *See immediately left regarding border moulding in upper distobuccal sulcus.*

---

**Over-extension:** reduce border until sited correctly, then add post dam as below.

**Under-extension:** extend border with tracing compound and refine fit against tissues with wash impression (*see ridge resorption*). Cut groove for post dam in master cast (*see right*) before acrylic resin added.

---

**Impression tray must reach junction of hard and soft palates. Wax dam across rear of tray will stop dragging of impression material away from tissues (53). Clinically determine displaceability of tissue at post dam site (54 shows inadequate post dam relative to displaceability of tissues); cut groove in master cast to appropriate depth and width (groove should extend through hamular notches into buccal sulci). Ensure that record rim and trial denture enter this groove so that accurate assessment of seal can be made.

---

Trace thin string of softened compound along impression surface of posterior border and seat denture firmly in mouth. Send modified denture (55) to laboratory for compound to be replaced by acrylic resin.

For semi-permanent addition, add butyl/methacrylate resin using same clinical technique.

---

*54 Clinical determination of tissue displaceability.*

*55 Post dam area modified with impression compound.*
### Cause

**Decreased retentive forces continued**

<table>
<thead>
<tr>
<th>Cause</th>
<th>Recognising</th>
</tr>
</thead>
<tbody>
<tr>
<td>Torus where post cam should be sited.</td>
<td>Note junction line between mobile and immobile palatal tissue; palpate to</td>
</tr>
<tr>
<td></td>
<td>determine size of torus and displaceability of tissues anterior and posterior</td>
</tr>
<tr>
<td></td>
<td>to it.</td>
</tr>
<tr>
<td>Resorption of residual ridge.</td>
<td>Lapse of time since denture constructed. Denture may rock with appropriate</td>
</tr>
<tr>
<td></td>
<td>finger pressure.</td>
</tr>
<tr>
<td></td>
<td>Borders of denture may have become over-extended and fibrous hyperplasia</td>
</tr>
<tr>
<td></td>
<td>may be evident in sulci.</td>
</tr>
<tr>
<td></td>
<td>May be possible to see gap between flange and side of residual ridge or</td>
</tr>
<tr>
<td></td>
<td>between posterior border and lateral aspect of palate (may see these</td>
</tr>
<tr>
<td></td>
<td>phenomena with poorly constructed new denture).</td>
</tr>
<tr>
<td>Inelasticity of cheeks due to, for example,</td>
<td>Patient’s medical history.</td>
</tr>
<tr>
<td>aging, scleroderma, submucous fibrosis.</td>
<td>Observation of mobility of soft tissues.</td>
</tr>
<tr>
<td></td>
<td>Palpation of displaceability of cheeks and lips.</td>
</tr>
</tbody>
</table>

### AIR BENEATH IMPRESSION SURFACE

Trapped air expands as denture moves away from supporting tissues until air bubble reaches border and seal broken.

**Poor fit to supporting tissues:**
- Deficient impression.
- Damaged cast.
- Warped denture.
- Over-adjustment of impression surface.

Denture may rock under finger pressure. May be possible to see gap between flange and side of residual ridge or between posterior border and lateral aspect of palate. Occlusion against opposing appliance deteriorated if denture has warped since last inspected. Apply thin layer of low-viscosity disclosing material to impression surface of denture; seat appliance firmly in mouth. Remove and inspect for non-uniformity of thickness (56).

---

56 Pressure-indicating paste applied to the fitting surface.
<table>
<thead>
<tr>
<th><strong>Overcoming</strong></th>
<th><strong>Avoiding</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Following determination of displaceability/mobility of tissues, adjust border of denture until judged to be sited where optimal seal can be obtained. Replace post dam (see above).</td>
<td>As above.</td>
</tr>
<tr>
<td>If shape of polished surfaces of denture correct, teeth sited in neutral zone, free-way space not greater than 6 mm, and occlusion satisfactory, then reline denture (see Chapter 7). Or temporarily reline denture with tissue conditioner (after removing undercuts), patient wears for no longer than 3-6 hours. If stability restored, reline/rebase denture to functional impression so obtained.</td>
<td>Prolong wearable life of immediate dentures by repeated relining with tissue conditioner (each increment being removed before adding new material; maximum time between renewals, 3 weeks). Construct new dentures when most rapid phase of ridge resorption complete (3-6 months post-extraction). Review complete denture patients yearly to determine if relinel/ remake necessary.</td>
</tr>
<tr>
<td>Slightly under-extend peripheries of dentures in both depth and width. Using adequately softened tracing compound, border mould a small section of periphery by asking patient to perform functional movements. Continue to adjust compound until adequate retention achieved. Send denture to laboratory for replacement of compound by acrylic resin. Process may need to be repeated after suitable time interval if soft tissue inelasticity increasing.</td>
<td>Accurate border moulding of customised impression tray using technique described at left. Provide optimum post dam on upper record rim and trial denture (see above); check that borders not over- or under-extended in depth and width on both dentures.</td>
</tr>
</tbody>
</table>
| If shape of polished surfaces of denture correct, teeth sited in neutral zone, free-way space not greater than 6 mm, and occlusion satisfactory, then reline/rebase denture (see Chapter 7). Before taking impression, relieve heavy contact between denture and supporting tissues revealed by disclosing material (see left). Relining is correct procedure to undertake if temporary addition of tissue conditioning material restores retentive forces. | When taking secondary (working) impression, ensure:  
• Uniform thickness of impression material achieved.  
• No pressure from tray on to denture-supporting tissues.  
• Borders formed from impression material are adequately supported by the tray.  
• Impression poured before distortion occurs. Resultant cast must not be overtrimmed or damaged (57).  
Optimum curing cycle for acrylic resin must be used.  
Denture must not be heated when trimming and polishing; patient must be warned against using hot water when cleaning appliances.  

57 Cast damaged by careless laboratory handling.
<table>
<thead>
<tr>
<th>Cause</th>
<th>Recognising</th>
</tr>
</thead>
</table>
| **Decreased retentive forces continued**  
**AIR BENEATH IMPRESSION SURFACE continued** |  |
| Resorption of residual ridge. | As above and lapse of time since denture constructed. |
| Change in fluid content of supporting tissues. This may result from:  
- Lack of recovery of tissues from pressure of old dentures (latter should not be worn for at least 90 minutes prior to taking impressions).  
- Effect of medication (e.g. diuretics).  
- Effect of change in posture of patient with high volume of tissue fluid (e.g. heart failure). | Enquire whether old denture was left out prior to taking secondary (working) impressions.  
Medical history of patient.  
Patient’s comments and observation as to whether ankles/legs swell on assuming upright posture.  
Close firmly on cotton rolls between posterior teeth for 5 minutes to aid adaptation of tissues to dentures (58).  
Improved retention only results if borders optimally extended in depth and width and post dam effective. |
| Undercut residual ridge, e.g. buccal of tuberosities (59), labial of upper and lower anterior ridge, lingual to lower anterior ridge.  
If impression surface of denture not closely adapted to ridge, air and saliva will occupy the space. | Inspect contours of residual ridge and compare impression surface of denture. Roughened areas may indicate that impression surface had to be adjusted to insert denture. |

58 Cotton rolls between the posterior teeth.  
59 Undercut maxillary residual ridge.
<table>
<thead>
<tr>
<th>Overcoming</th>
<th>Avoiding</th>
</tr>
</thead>
<tbody>
<tr>
<td>As above.</td>
<td>See Resorption of residual ridge, page 46.</td>
</tr>
<tr>
<td>Elicit cooperation of patient’s physician to stabilise, as far as possible, fluid content of tissues.</td>
<td>Stabilise fluid content of tissues, see left.</td>
</tr>
<tr>
<td>If prolonged seating pressure from cotton rolls (see left) restores retention, rel ine/rebase dentures using minimum pressure technique (see Chapters 5 and 7). Note comments under ‘Deficient impression’ above. Ensure old dentures not worn for 90 minutes prior to taking impressions.</td>
<td>See left for comments on not wearing old dentures. When taking secondary (working) impression, ensure that uniform thickness of impression material achieved and that no pressure from tray on to denture supporting tissues.</td>
</tr>
<tr>
<td>Determine displaceability of tissues at maximum contour of residual ridge:</td>
<td>Determine displaceability of tissues at maximum contour of residual ridge during examination stage:</td>
</tr>
<tr>
<td>High displaceability – add softened tracing compound to occupy space between impression surface and ridge. If denture can be painlessly removed and reinserted, replace compound with acrylic resin.</td>
<td>High displaceability – request laboratory to process acrylic resin into undercut.</td>
</tr>
<tr>
<td>Low displaceability – assess if angled or rotational path of insertion will permit denture to enter undercut area (60). If this considered possible, add tracing compound (as above) to test. If successful, replace compound with acrylic resin.</td>
<td>Low displaceability – assess if angled or rotational path of insertion will permit denture to enter undercut area. If considered possible, acrylic resin processed into undercut. If not considered possible, request laboratory to block out undercut on cast prior to processing acrylic resin. Reduced retentive force has to be accepted, so design and construct denture to maximise other retentive forces and minimise displacing forces.</td>
</tr>
</tbody>
</table>

60 Planned path of insertion for a maxillary denture.
<table>
<thead>
<tr>
<th>Cause</th>
<th>Recognising</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Decreased retentive forces continued</strong></td>
<td>Palpate relevant area to determine extent and displaceability; compare with relief provided on impression surface of denture. Disclosing material on impression surface of denture (as above); inspect material for excessive thickness by probing with explorer.</td>
</tr>
<tr>
<td><strong>AIR BENEATH IMPRESSION SURFACE continued</strong></td>
<td></td>
</tr>
<tr>
<td>Excessive relief over areas of reduced tissue displaceability.</td>
<td></td>
</tr>
<tr>
<td><strong>XEROSTOMIA</strong></td>
<td>Reduced retention of optimally designed and constructed dentures. Patient may complain of a dry mouth (27), but questioning of patient without this complaint may reveal relative deficiency of saliva (see Physiology, page 20). May be symptoms and signs of other manifestations of xerostomia, e.g. sore residual ridges where rubbed by dentures, reduced taste sensation.</td>
</tr>
<tr>
<td>Reduces ability to form seal along borders and polished surfaces of dentures.</td>
<td></td>
</tr>
<tr>
<td><strong>NEUROMUSCULAR CONTROL</strong></td>
<td>Difficulties with neuromuscular control often evident during speech and eating (problems with eating alone usually result from occlusal errors).</td>
</tr>
<tr>
<td>This is of vital importance for successful denture wearing, since forces generated during mastication are sufficient to destabilise appliances with optimum retention.</td>
<td></td>
</tr>
<tr>
<td>Overcoming</td>
<td>Avoiding</td>
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<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>Reline/rebase denture (see Chapter 7). Once impression poured and master cast available, outline area on cast to be relieved and indicate to laboratory thickness of relief required (61). Or outline area on impression with indelible pencil (mark will transfer to cast [62]).</td>
<td>Outline area on master cast to be relieved and indicate to laboratory thickness of relief required prior to processing of denture.</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Swab tongue with lemon juice to test if any functioning glandular tissue remains. If so, continue stimulation with bulky diet, chewing gum, sugar-free acidic sweets. Patient may require supplementation with artificial saliva, as do all subjects with an absolute deficiency of glandular tissue. Modify dentures where necessary to maximise retentive forces and minimise displacing forces. | Design and construct dentures to maximise retentive forces and minimise displacing forces.  
Prescribe artificial saliva where appropriate.  
Warn patient of potential problem.                                                                                                                                 |
|                                                                                                                                                                                                            |                                                                                                                                                                                                           |
| Correct any faults in dentures hindering neuromuscular control. Temporary use of fixative may help patient learn necessary skills.                                                                          | Maximise retaining forces and minimise displacing forces with new dentures to aid development of neuromuscular control.                                                                                       |

61 Area where relief is required outlined on the cast.

62 Area where relief is required outlined on impression material.
### Cause

**Decreased retentive forces continued**

**NEUROMUSCULAR CONTROL continued**

<table>
<thead>
<tr>
<th>Cause</th>
<th>Recognising</th>
</tr>
</thead>
</table>
| Basic shape of denture incorrect: in posterior regions, cross-section of dentures should have inherent triangular shape; occlusal surface being sited within confines of borders and polished surfaces being slightly concave (63). | Common departures from triangular shape:  
- Lower molar teeth too lingually placed (often the result of placing upper molars over crest of residual ridge [64, 65, compare 63]).  
- Lingual polished surface convex (66).  
Both the above reduce space for tongue and enable this organ to exert direct lifting force on denture.  
- Upper buccal flange insufficiently wide to accommodate molar teeth placed buccal to crest of ridge (67). Pressure from cheek exerts downward force on denture. |
Overcoming

- May be possible to narrow lower posterior teeth from lingual aspect (e.g. by removing lingual cusps) to restore correct shape. If not successful, teeth on both upper and lower dentures may have to be reset more buccally or dentures remade.
- Adjust lingual polished surface until flat from occlusal surface to periphery. If this results in loss of optimum triangular shape (teeth too lingually placed), teeth must be reset or dentures remade.
- Add softened tracing compound to buccal of peripheries and mould in mouth to fill optimum width of sulci. If correct shape of polished surfaces obtained, send to laboratory for compound to be replaced with acrylic resin. If correct shape not obtained, teeth must be reset or dentures remade.

Avoiding

Careful impression technique to record functional depth and width of sulci.

Midline of lower posterior teeth should be set over crest of residual ridge. This will usually necessitate placing upper teeth slightly buccal to crest of residual ridge (unless great disparity in basal bone relationship between jaws).

Use narrow posterior teeth to maximise space for tongue and aid development of optimum cross-sectional shape.

Check (and if necessary, adjust) contours of wax trial dentures.

Minor discrepancies between old and new dentures: modify new dentures until virtually identical to old ones. Major discrepancies: remake dentures copying desirable features of old appliances and incorporating selected modifications (e.g., better fit to supporting tissues, improved border extension, minor change in vertical dimension of occlusion).

If history of successful wearing of old dentures, use template technique (see Chapter 7) to copy desirable features of old dentures and incorporate selected modifications (see left) in new appliances.

66 Overcontouring of the lingual surface.

67 Poor denture form in the maxillary buccal region.

68 Gauge to aid comparison of tooth position.
<table>
<thead>
<tr>
<th>Cause</th>
<th>Recognising</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Decreased retentive forces continued</strong>&lt;br&gt;<strong>NEUROMUSCULAR control continued</strong>&lt;br&gt;High occlusal plane on lower denture: tongue unable to control appliance.</td>
<td>When lips just parted, observe tongue in its normal resting position: lateral borders should overlie lingual cusps of lower posterior teeth (69).&lt;br&gt;Posterior portion of lower occlusal plane approximately at level of midpoint of retromolar pad (70).&lt;br&gt;High occlusal plane on lower usually associated with excessive vertical dimension of occlusion if incisal level of upper denture correct.</td>
</tr>
<tr>
<td>Upper or lower motor-neurone disorder: e.g. Bell’s palsy, cerebrovascular accident, tardive dyskinesia.</td>
<td>Observation of patient.&lt;br&gt;Medical history.</td>
</tr>
<tr>
<td>Lack of appreciation by patient of need to actively control dentures.</td>
<td>Ask patient to close incisor teeth on to operator's finger; observe if dorsum of tongue elevates to hold posterior border of upper denture in place and tip of tongue presses against lower incisors to prevent posterior displacement of appliance (71).&lt;br&gt;Lack of such active control must not be used to excuse poor retention if dentures of suboptimal design and construction.</td>
</tr>
</tbody>
</table>

69  Lateral border of tongue in relation to lower denture.<br>70  Pencil line outlines the lingual aspect of the retromolar pad.
**Overcoming**

If incisal level and occlusal plane of upper denture also too high, reset teeth on both dentures or remake appliances.

If incisal level and occlusal plane of upper denture correct and excess in vertical dimension of occlusion not greater than 1.5 mm, use transfer facebow record to mount upper denture on anatomical articulator and interocclusal record (taken in retruded jaw relationship) to mount lower denture. Selectively grind lower teeth only to reduce height of occlusal plane. Note this will shorten lower incisors—beware effect on aesthetics. If excess in vertical dimension of occlusion is greater than 1.5 mm, reset teeth on lower denture or remake appliance.

Optimise retentive forces and minimise displacing forces on existing dentures (see sections above and below). If dentures still unsatisfactory, may need to be remade to optimal design.

**Avoiding**

When recording jaw relationship, ensure that occlusal rims prescribe to the laboratory, *inter alia*, the correct incisal level, occlusal plane and vertical dimension of occlusion.

Utilise information from any dentures that were worn successfully prior to onset of motor-neurone disorder via template denture technique (see Chapter 7); modifications should be minor and restricted to, for example, improving fit to supporting tissues.

In absence of previously satisfactory dentures, construct optimally designed upper denture and then determine best shape for lower appliance (see Chapter 5).

Incorporate metal lingual bar or cobalt–chromium base in lower denture to increase its mass.

Explanation to patient of range of denture movement liable to occur during mastication and of need for active control of appliances. Place small bead of acrylic resin in midline of posterior border of upper denture and lingual to lower incisors to indicate desirable positions of tongue.

Maximise retentive forces and minimise displacing forces to provide stable dentures while new neuromuscular reflex arcs become established. Temporary use of fixative may be appropriate.

Explanation and instruction of patient as left if examination of old dentures reveals this problem; patient can practise skills with old dentures while new appliances being constructed.

Maximise retaining forces and minimise displacing forces with new dentures to aid development of neuromuscular control.

---

71 Tongue control of the upper and lower dentures.
<table>
<thead>
<tr>
<th>Cause</th>
<th>Recognising</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Increased displacing forces</strong></td>
<td></td>
</tr>
<tr>
<td><strong>DENTURE BORDERS</strong></td>
<td></td>
</tr>
<tr>
<td>Over-extension in depth.</td>
<td>Direct vision in mouth on gentle retraction of lips and cheeks (e.g. displacement of sulcal tissues and fraenae). Observe if denture displaced on digital manipulation of cheeks and lips, and tongue movements performed by patient, as when moulding borders of impression (see Border under-extension, page 42). Slow elevation of lower denture when mouth half open and cheeks and lips immobile (latter important to avoid confusion with non-coincidence of denture with neutral zone, see below). Slow fall of upper denture not diagnostic of over-extension since lack of seal may produce same effect. Remove denture and look for red line of inflammation at reflection of sulcal tissues (72).</td>
</tr>
</tbody>
</table>
| Over-extension in width. | Upper and lower buccal flanges: width not usually a problem unless patient complains of bulk or of food entrapment between flange and depth of sulcus. (Placing alginate on outside of dentate arch and contracting cheek demonstrates potential space in sulci and area of maximum muscle contraction close to occlusal plane [73].) Problem areas:  
  - Buccal to tuberosities: coronoid process moves anteriorly on opening mouth and medially in lateral excursion; overextension in width may produce soreness in cheek or displacement of denture.  
  - Lingual flange: thick border may enable denture to be lifted by tongue.  
  - Lower labial flange: thick border may enable mentalis muscle to lift denture (digital pressure in labiomental groove will simulate muscle action).  
  - Upper labial flange: thick border increases displacing force exerted by upper lip. (May also produce anaesthetic bulge in lip profile.) |

72 The red line indicates the effect of over-extension of the denture border.
<table>
<thead>
<tr>
<th>Overcoming</th>
<th>Avoiding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce over-extension, using disclosing material if necessary. Repolish denture border.</td>
<td>Slightly under-extend borders of custom impression tray and accurately mould using adequately softened tracing compound (see Border under-extension, page 42). Beware patients with large variation in sulcus depth between resting and functional positions; adapt border to latter. Check borders of record rims and trial dentures for over-extension. Reduce borders if necessary and draw pencil line on cast to new extension; instruct laboratory to finish denture to this line.</td>
</tr>
</tbody>
</table>

| Reduce over-extension, using disclosing material if necessary. Repolish denture border. | When moulding borders of impression, ask patient to open mouth and move mandible from side to side. Ensure that borders of record rims/trial dentures fill sulci on cast and check for displacement of appliances during mandibular movements, mimicked border moulding, and simulated mentalis muscle action. Observe profile of upper lip. Thin flange on record rim/trial denture. If effective, instruct laboratory to preserve new thickness of flange. |

73 Demonstration of the functional form of the sulci.
<table>
<thead>
<tr>
<th>Cause</th>
<th>Recognising</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Increased displacing forces continued</strong></td>
<td>Newly inserted denture: patient may complain of pain in region of post dam when denture firmly seated by finger pressure. Denture worn for variable time span: patient may complain of pain as above. Deep groove in palatal tissues with inflammation ranging from hyperaemia to ulceration.</td>
</tr>
<tr>
<td><strong>DENTURE BORDERS continued</strong></td>
<td>(Recoil of displaced tissues pushes denture downwards).</td>
</tr>
<tr>
<td>Deep post dam on upper denture:</td>
<td></td>
</tr>
<tr>
<td><strong>POOR FIT TO SUPPORTING TISSUES</strong></td>
<td>Displaceable tissue on residual ridge/in palate. Enquire whether old denture was left out prior to taking impressions. History of impression taking with high viscosity material or reline impression in denture without vent holes. Denture falls/rises when teeth not in contact (beware confusion with border over-extension or denture not sited in optimal space).</td>
</tr>
<tr>
<td>(Recoil of displaced tissues lifts dentures).</td>
<td></td>
</tr>
<tr>
<td><strong>DENTURE NOT SITED IN OPTIMAL SPACE</strong></td>
<td>Observe relationship of lower teeth to residual ridge when denture viewed from posterior aspect (100). Note comment on Neuromuscular control, page 52, regarding position of upper teeth. Use impression material to detect interference with normal muscle activity (see Chapter 5).</td>
</tr>
<tr>
<td>Posterior regions: Molars on lower denture lingual to residual ridge: optimum triangular shape of dentures not present (see Neuromuscular control, page 52).</td>
<td></td>
</tr>
<tr>
<td>Large posterior occlusal table: reduces space available for tongue; thus large laterally directed displacing forces on denture. Especially relevant where patient has been without natural or artificial posterior teeth for several months (tongue adapts to increased available space).</td>
<td>Wide posterior teeth. Long occlusal table (prevents tongue spreading laterally over posterior aspect of lower denture base and exerting retaining force on lower appliance, [75]). History of lack of posterior teeth, see left.</td>
</tr>
<tr>
<td>Overcoming</td>
<td>Avoiding</td>
</tr>
<tr>
<td>------------</td>
<td>----------</td>
</tr>
<tr>
<td>Reduce depth of post dam using pressure indicating cream if necessary. Beware over-reduction; as inflammation subsides, deficient seal may develop. Request patient to wear denture as little as possible until inflammation subsided.</td>
<td>Groove on master cast cut by operator to optimal position, depth and width (see Deficient posterior border seal, page 44).</td>
</tr>
</tbody>
</table>

If shape of polished surface of denture correct, teeth situated in neutral zone, freeway space not greater than 6 mm, and occlusion satisfactory, then reline/rebase denture using minimum pressure technique (see Chapter 7). Before taking impression, relieve heavy contact between denture and supporting tissues revealed by disclosing material. Ensure old dentures not worn for 90 minutes prior to taking impressions. | See left for comments on not wearing old dentures. When taking secondary (working) impression, ensure that uniform thickness of low viscosity impression material achieved and no pressure from tray on to denture-supporting tissues. |

Remove lingual cusps and lingual surface from relevant teeth and reshape polished surface until flat from occlusal surface to periphery (74). If this does not restore optimum triangular shape, teeth must be reset or, preferably, denture(s) remade. (Latter essential if upper posterior teeth insufficiently buccal to crest of residual ridge.) | For skeletal Class I jaw relationship, ensure midline of lower posterior teeth set up over, and upper teeth slightly buccal to crest of residual ridge. Adjust record rims until indicate desired buccal-lingual position of teeth. (Rims should be stable once all adjustments completed.) Instruct laboratory to copy contours of rims when setting up wax trial dentures. Check positioning of teeth on wax trial dentures. If major discrepancy in jaw relationship (e.g. gross Class II or III, or following trauma or surgery), determine size and shape of available space for denture (see Chapter 5). |

Narrow posterior teeth and reshape lingual flanges as above. Remove most distal teeth from dentures. If large tongue (e.g. Down’s syndrome), may require remake of dentures following determination of available space for denture (see Chapter 5). | Routinely use narrow posterior teeth. Leave off most distal tooth if would prevent provision of space for lateral spread of tongue. If large tongue, see left. |

74 The lingual cusps have been modified.
75 Diagram to illustrate the appropriate form of the distal aspect of the lower denture.
<table>
<thead>
<tr>
<th><strong>Cause</strong></th>
<th><strong>Recognising</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Increased displacing forces continued</em></td>
<td></td>
</tr>
<tr>
<td><strong>Denture not sited in optimal space continued</strong></td>
<td></td>
</tr>
<tr>
<td>Thick lingual flanges: reduces space available for tongue (see comments above).</td>
<td>Observe thickness of lingual flanges. Except where ridges greatly resorbed, lingual flanges should be thin (76).</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Anterior regions:</td>
<td></td>
</tr>
<tr>
<td>Excess pressure from lower lip on to lower denture.</td>
<td>Lower denture lifted vertically in anterior region and/or displaced posteriorly when muscles in lip contracted. Digital pressure in labio-mental groove (77) to simulate action of mentalis muscle displaces denture. Teeth anterior to residual ridge. Thick periphery to labial flange. If latter two factors grossly adverse, denture will lift on passive opening of mouth.</td>
</tr>
</tbody>
</table>

76 Lingual flanges of the lower denture should not be bulky.

77 Digital pressure on the labio-mental groove.
**Overcoming**

Reshape lingual polished surface until (a) border thin (approximately 1.5 mm) and (b) flat from occlusal surface to periphery. If optimum triangular shape of denture now lost and cannot be restored by narrowing posterior teeth, remake appliance.

Thin lower labial flange.

Grind labial surfaces of lower anterior teeth.

Aim of these two procedures is to produce concave polished surface profile with deepest concavity opposite site of maximum mentalis muscle activity (approximately labio-mental groove, [78]). Such adjustment may produce unacceptable aesthetics or be insufficient to prevent displacement, necessitating replacement of teeth or remake of denture. If latter, consider functional determination of optimum lower incisor position (see Chapter 5).

Ensure optimum posterior extension to retromolar pads to resist displacement of appliance (see Border underextension, page 42).

**Avoiding**

Adjust record rims until indicate desirable shape and thickness of lingual flange; instruct laboratory to copy in wax trial dentures.

Check, and if necessary adjust, lingual flange on trial denture.

Assess muscular activity in lower lip during examination of oral cavity. Beware displacement of lip by handle on custom impression tray, thus preventing true record of functional depth and width of labial sulcus (79). For similar reasons, carefully adjust border of impression tray.

Ensure optimum distal extension of tray. Carve labial surface of record rim until remains stable during functional movements of lower lip/pressure in labio-mental groove. Request laboratory to reproduce contour on trial denture.

Check, and if necessary adjust, trial denture until stability achieved.

Consider functional determination of optimum lower incisor position (see Chapter 5).

---

78 Denture form in the incisor region.

79 The tray handle should not interfere with muscle function.
<table>
<thead>
<tr>
<th><strong>Cause</strong></th>
<th><strong>Recognising</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Increased displacing forces continued</strong>&lt;br&gt;<strong>DENTURE NOT SITED IN OPTIMAL SPACE continued</strong>&lt;br&gt;Excess pressure from upper lip on to upper denture.</td>
<td>Denture displacement reduced when upper lip gently held out of contact with labial surface of appliance.&lt;br&gt;Upper anterior teeth too labially placed: gingival margin and incisal edge of central incisors approximately 6 mm and 10 mm respectively in front of posterior border of incisive papilla (80).&lt;br&gt;Acute naso-labial angle (optimum approximately 90°, [81]).&lt;br&gt;May result from inadequate seating of denture during reline/rebase impression; appliance now downwards and forwards relative to optimal position on supporting tissues. Occlusion will also be affected.</td>
</tr>
</tbody>
</table>

**OCCLUSION**<br>Uneven initial contact: causes dentures to tilt on supporting tissues, thus disrupting retentive seal. Also prevents even seating of loosening dentures on supporting tissues when teeth occluded.<br>Relax patient.<br>If dentures likely to move on supporting tissues, gently hold in place with fingers. Obtain retruded jaw relationship. Ask patient to close slowly (not 'bite'; this implies jaw protrusion) until teeth just touch. Any pressure via contacting teeth liable to alter relationship between dentures and supporting tissues (displacement of underlying mucosa (1) and/or tilting of dentures (2) [82]), thus masking occlusal error.<br>Intercuspal (TCP) and retruded contact positions (RCP) not coincident: causes dentures to shift on supporting tissues, thus disrupting seal and preventing reseating as above.<br>Utilise procedure outlined above. Any pressure via contacting teeth liable to move dentures over supporting tissues or to cause mandible to deviate from retruded path of closure, thus masking occlusal error.

80 Relationship between denture tooth and the incisive papilla.<br>81 The nasolabial angle is observed from the patient's profile.
Overcoming

Usually irredeemable; denture has to be remade.

If result of reline, generous removal of impression surface may enable denture to resume correct relationship to supporting tissues and restore occlusion. Take new impression for reline observing precautions outlined in Resorption of residual ridge (page 46) and Chapter 7.

Avoiding

When relining dentures, observe precautions outlined in Resorption of residual ridge (page 46) and in Chapter 7. Ensure optimum border extension in depth and width/provide post dam on record rim/trial denture to permit assessment of retaining forces; these may be insuffi- cient to resist displacing forces from upper lip on to anterior teeth positioned for ideal aesthetics. Compromi se between aesthetics and retention has to be achieved.

Adjust occlusion until even at initial contact in retruded jaw relationship:

At chairside: use thin articulating paper or other aid and remove inappropriate contacts (see Chapter 6). Difficult; dentures move on supporting tissues producing inaccurate markings.

In laboratory (more accurate): use transfer facebow to mount upper denture on adjustable articulator and pretooth contact interocclusal record of retruded jaw relationship to mount lower denture, then adjust occlusal contacts (see Chapter 6).

Gaps between teeth of 1.5 mm or more require teeth to be reset or dentures remade.

Adjust occlusion until ICP and RCP coincide (see Chapter 6). Undertake selective occlusal adjustment on existing denture teeth provided error between present ICP and RCP not exceed half width of a cusp (83); errors greater than this require all teeth on at least one denture to be reset. (All teeth must be reset since error of this magnitude significantly alters vertical and horizontal relationships of anterior teeth.)

See above for comments on chairside versus laboratory adjustment of occlusal contacts.

Ensure record rims are stable and retentive (check fit and border extension, add post dam). Gently hold in place on supporting tissues.

Patient must close slowly in retruded jaw relationship until rims just touch. Rims adjusted to even contact at optimum vertical dimension.

Relationship between rims in lightest possible contact recorded with registration paste or silicone material. Occlusal contacts between trial dentures carefully checked using similar precautions.

Remount processed dentures using new transfer facebow record and new precontact interocclusal record; adjust occlusal contacts on articulator until even (see Chapter 6).

Accurate recording of retruded jaw relationship, see above.

Remount processed dentures on articulator, see above.

82 Inappropriate pressure via contacting teeth may mask occlusal errors by displacement of underlying mucosa (1) and/or by tilting of dentures (2).

83 Occlusal error less than half a cusp in the anteroposterior plane.
<table>
<thead>
<tr>
<th><strong>Cause</strong></th>
<th><strong>Recognising</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Increased displacing forces continued</strong></td>
<td></td>
</tr>
<tr>
<td><strong>OCCLUSION continued</strong></td>
<td></td>
</tr>
<tr>
<td>Lack of freedom in ICP: patients with inaccurate control of mandibular</td>
<td>Age/observation/medical history of patient. Patient has difficulty in achieving</td>
</tr>
<tr>
<td>movement may not adapt to precise cusp/fossa relationship between</td>
<td>reproducible occlusal relationship. Patient able to eat using old dentures</td>
</tr>
<tr>
<td>occluding teeth causing dentures to shift on supporting tissues and</td>
<td>with flattened, worn teeth.</td>
</tr>
<tr>
<td>disrupting retentive seal.</td>
<td></td>
</tr>
<tr>
<td>Lack of occlusal balance in lateral and protrusive mandibular excursions:</td>
<td>Gently hold both dentures in place on supporting tissues. Request patient to</td>
</tr>
<tr>
<td>causes dentures to tilt on supporting tissues, thus disrupting retentive</td>
<td>close until teeth just touch, then to ‘rub’ teeth from side to side and</td>
</tr>
<tr>
<td>seal. Many patients successfully wear dentures without occlusal balance;</td>
<td>forwards. By observation and palpation, note if teeth slide easily over each</td>
</tr>
<tr>
<td>however, as retentive factors decrease (e.g. as supporting tissues resorb),</td>
<td>other without causing dentures to move relative to supporting tissues.</td>
</tr>
<tr>
<td>displacing forces generated by lack of balance assume greater significance.</td>
<td></td>
</tr>
<tr>
<td>Excessive vertical overlap of anterior teeth. Large vertical overlap</td>
<td>Detection of lack of occlusal balance; see above.</td>
</tr>
<tr>
<td>common with natural teeth. Does not cause problems as roots individually</td>
<td>Detection of interference during speech: request patient to produce [s] sound</td>
</tr>
<tr>
<td>anchored in alveolar bone. Patients frequently request to show more of</td>
<td>(e.g. count from 60 to 70); upper and lower incisors should just not touch.</td>
</tr>
<tr>
<td>their artificial lower teeth; compliance may result in lack of occlusal</td>
<td>Beware confusion with excess vertical dimension of occlusion/lack of freeway</td>
</tr>
<tr>
<td>balance (see above), or anterior tooth contact during speech (see left);</td>
<td>space. (See also Physiology of speech, page 23.)</td>
</tr>
<tr>
<td>both may cause dentures to tilt and break retentive seal.</td>
<td></td>
</tr>
<tr>
<td>Last lower tooth too posteriorly placed: teeth overlie crest of residual</td>
<td>Observe relationship of teeth to residual ridge. Apply finger pressure to most</td>
</tr>
<tr>
<td>ridge as latter rises towards retromolar pad; pressure on these teeth</td>
<td>posterior teeth; observe if denture moves.</td>
</tr>
<tr>
<td>therefore causes denture to slip forward (84).</td>
<td></td>
</tr>
</tbody>
</table>

84 Too long an occlusal plane causes denture instability.
<table>
<thead>
<tr>
<th>Overcoming</th>
<th>Avoiding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remount dentures on adjustable articulator and alter teeth to produce area of occlusal contact. If adjustment results in loss of occlusal balance, reset teeth/remake dentures using cuspidless teeth.</td>
<td>Always allow 1–1.5 mm of easy anterior movement of mandible from retruded contact position. Consider use of cuspidless (non-anatomical) teeth set in occlusal balance during lateral and protrusive mandibular excursions. This produces no vertical incisor overlap; beware effect on aesthetics.</td>
</tr>
<tr>
<td>Adjust occlusal contacts until balance obtained (see Chapter 6). Difficult to achieve at chairside because of denture movement on supporting tissues, thus remount dentures on adjustable articulator to facilitate correction. If achievement of balance would necessitate mutilation of teeth (e.g. excessive shortening of lower incisors, see Chapter 6), reset teeth or remake dentures.</td>
<td>Working casts mounted on adjustable articulator. Teeth set up in occlusal balance. Verify presence of occlusal balance at trial insertion of waxed-up dentures. Remount processed dentures on articulator (see above) and adjust occlusal contacts until balance obtained (see Chapter 6). Large tuberosities may prevent placement of teeth in correct compensating curve; may require reduction in length of occlusal table, lowering of occlusal plane, or surgical reduction of tuberosities.</td>
</tr>
<tr>
<td>Reduce height of lower incisors, see above. May result in incision/aesthetic problems necessitating resetting of teeth/remaking of dentures. If up to 1.5 mm of extra freeway space is required, use transfer facebow to aid mounting of dentures on adjustable articulator; selectively alter occlusal contacts to reduce vertical dimension of occlusion. If extra freeway space required exceeds 1.5 mm, remove teeth from denture with incorrect occlusal plane and re-record retruded jaw relationship at correct vertical dimension of occlusion then reset/remake denture.</td>
<td>Ensure teeth set up in occlusal balance to prescription supplied by optimally adjusted occlusal rims. At trial insertion, check waxed-up dentures for occlusal balance/absence of anterior tooth contact during speech/presence of optimal freeway space. Remount processed dentures (see above).</td>
</tr>
<tr>
<td>Remove most posterior teeth from dentures.</td>
<td>Site lower first molar over most concave aspect of residual ridge; pressure on this tooth thus stabilises denture. Fill in anterior space with appropriate number and size of teeth; similarly for posterior space provided rearmost tooth does not overlie steeply sloping portion of residual ridge.</td>
</tr>
</tbody>
</table>
### Cause

**Increased displacing forces continued**

**OCCLUSION continued**

Orientation of occlusal plane not parallel to ridge: mastication produces moments of force tending to move dentures over supporting tissues (85).

<table>
<thead>
<tr>
<th>Recognising</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observe relationship of occlusal plane to residual ridge. Problem liable to occur with large tuberosities; these can depress occlusal plane posteriorly producing forward moment of force on lower denture.</td>
</tr>
</tbody>
</table>

### Support problems

**LACK OF RIDGE**

Little resistance to forces in lateral and anteroposterior directions; dentures liable to move, thus disrupting retentive seal (86).

<table>
<thead>
<tr>
<th>Recognising</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observation of residual ridge. May be associated with shallow palate. Denture may easily move in lateral and anteroposterior directions with appropriate finger pressure.</td>
</tr>
</tbody>
</table>

### FIBROUS DISPLACEABLE RIDGE

Forces of mastication cause denture to sink into and tilt on supporting tissues, thus disrupting retentive seal.

<table>
<thead>
<tr>
<th>Recognising</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palpation of residual ridge to determine displacability (87). Denture may sink into displaceable supporting tissue with finger pressure on occlusal surfaces or incisal edges. Presence or history of presence of opposing natural teeth (commonly lower anteriors). Teeth may appear to contact evenly when forcefully occluded; if dentures stabilised with fingers and patient closes until teeth just meet, incorrect occlusion often seen (see Uneven initial contact, page 62).</td>
</tr>
</tbody>
</table>

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85

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86
### Overcoming

- Usually irredeemable; teeth must be reset or dentures remade (see right).

### Avoiding

- Adjust record rims to indicate desired orientation of occlusal plane.
- If large tuberosities: reduce length of posterior occlusal table if most distal tooth cannot be accommodated without disorientating occlusal plane, lower occlusal plane (aesthetics permitting) to provide space for posterior teeth, or surgically reduce large tuberosities.

<table>
<thead>
<tr>
<th>Maximise retentive forces and minimise displacing forces, see above.</th>
<th>Maximise retentive forces and minimise displacing forces, see above.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimal border extension in depth and width particularly important.</td>
<td>Consider endosseous implants: careful assessment necessary since may be insufficient bone volume or compromising medical history.</td>
</tr>
<tr>
<td></td>
<td>Mandibular implants more successful than maxillary.</td>
</tr>
<tr>
<td></td>
<td>Consider surgical deepening of sulcus: if insufficient bone volume for implants, unlikely to be adequate height of mandible for this operation to be successful (see Chapter 5).</td>
</tr>
</tbody>
</table>

Reline/rebase dentures (see Chapter 7). Additional precautions:

1. Remove acrylic from impression surface until no contact with displaceable tissue (confirm with disclosing material).
2. Additional vent holes in labial/buccal/lingual flanges of denture.
3. Low-viscosity impression material must be used.
4. Provide best possible posterior border seal on completed denture.

Optimise occlusal balance in lateral and protrusive mandibular excursions, see above.

If opposing jaw semi-dentate, provide well-supported partial denture to give best possible contact with complete denture in all positions of occlusion. Endodontic treatment and conversion of selected teeth to abutments and construction of overdenture may aid provision of optimal occlusal configuration.

---

85 Incorrect orientation of the occlusal plane will result in instability.

86 Atrophic maxillary ridge.

87 Displaceable maxillary tissue.
<table>
<thead>
<tr>
<th>Cause</th>
<th>Recognising</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Support problems continued</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Bony prominence covered by thin mucosa</strong>&lt;br&gt;(e.g. tori [88], prominent maxillary midline suture, anterior nasal spine): denture rocks about fulcrum provided by area of reduced tissue displaceability thus disrupting retentive seal.</td>
<td>Denture rocks when finger pressure applied alternately to occlusal surfaces on either side of fulcrum. Inflammation of thin mucosa overlying bony prominence. Palpate supporting tissues to determine extent and displaceability of fulcrum area.</td>
</tr>
<tr>
<td><strong>Non-resilient soft tissue</strong>&lt;br&gt;covering denture-support area: does not adapt to impression surface of denture, thus supporting and retentive factors reduced.</td>
<td>Determine displaceability of supporting tissues by palpation. May be associated with: - Endocrine deficiencies, e.g. oestrogen (post-menopause), diabetes. - Nutritional deficiencies, e.g. iron, folate.</td>
</tr>
<tr>
<td><strong>Pain avoidance mechanisms</strong>&lt;br&gt;To relieve pain produced by denture, tongue/cheeks lift appliance away from supporting tissues, and/or patient lines impression surface with cotton wool (89), excess fixative, or self-applied proprietary reline material.</td>
<td>History of pain from denture; question how controlled. Observation of patient’s coping mechanisms. Examination of dentures.</td>
</tr>
<tr>
<td><strong>Denture collectors</strong>&lt;br&gt;May be difficult to satisfy; dentures that appear stable to operator seem loose to patient.</td>
<td>History of repeated adjustments to, and remaking of, appliances without resolution of patient’s problem. May bring bag full of unsatisfactory dentures. Listen attentively to patient’s description of problem. Examine mouth and dentures carefully to diagnose correctly probable cause of problem.</td>
</tr>
</tbody>
</table>

88 Thin mucosal coverage of bony prominences.
### Overcoming

Remove acrylic from impression surface where disclosing material shows excessive loading of supporting tissues. Ideally should be even pressure over entire support area when teeth firmly occluded. Beware:

- Creation of excessive space between denture and tissues *(see Excessive relief, page 50).*
- Over-thinning of denture base, increasing possibility of fracture (polished surface may require compensatory addition of material).

Provide optimum occlusal contacts in intercuspal position and lateral and protrusive mandibular excursions thus reducing tendency to rock about fulcrum *(see Chapter 6).*

---

### Avoiding

Palpate anticipated fulcrum area to determine extent and displaceability; outline area on master cast to be relieved and indicate to laboratory thickness of relief required prior to processing of denture.

Provide optimum occlusal contacts, *see left.*

---

<table>
<thead>
<tr>
<th>Reline/rebase dentures <em>(see Chapter 7)</em> taking care to:</th>
<th>Maximise retentive forces and minimise displacing forces, <em>see above.</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>- Achieve optimal border extensions in depth and width.</td>
<td></td>
</tr>
<tr>
<td>- Use low-viscosity impression material.</td>
<td></td>
</tr>
</tbody>
</table>

Provide optimum occlusal contacts in intercuspal position and lateral and protrusive mandibular excursions to minimise displacing forces.

---

<table>
<thead>
<tr>
<th>Eliminate cause of pain.</th>
<th>Careful construction of optimum appliances thus avoiding tissue trauma that may cause pain.</th>
</tr>
</thead>
</table>

---

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient may be wearing dentures that he/she finds barely tolerable. Any adjustment (including temporary) may render the appliance totally unwearable. It is therefore advisable to make exact copies of the dentures using the template technique <em>(see Chapter 7)</em>; tooth-coloured self-curing acrylic is utilised instead of wax to form the dental arch prior to pouring in pink resin to produce the base plate. The temporary copies are then modified until patient satisfaction achieved; the normal template technique is then utilised to produce the definitive appliances.</td>
<td>If cause not obvious, aid diagnosis by modifying temporary copies of old dentures, <em>see left.</em></td>
</tr>
</tbody>
</table>

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89 A 'pain avoidance' strategy!
Discomfort with dentures

Although some discomfort may be anticipated in the days following delivery of replacement complete dentures, it is sound prostodontic practice to identify potential problem areas at the time of examination, in addition to diagnosing possible causative agents at the time of insertion of complete dentures. Discomfort is most frequently associated with the lower denture-supporting area, although it may also relate to the upper denture.

Synonyms

Patients may complain of a range of symptoms which may vary from an alteration of form (‘a newness’), pain, altered sensation (‘can’t taste food’, ‘burning sensation’) to difficulty in swallowing.

Causes

There are many causes of discomfort associated with complete dentures (Tables 4.3 and 4.4). As a consequence, the importance of listening to the patient, observing denture-bearing areas and the dentures themselves closely, in addition to palpating the oral tissues and impression surfaces of the dentures is central to diagnosis of the cause of a patient’s discomfort.

Sometimes the cause of oral pain may not be directly attributable to dentures but the symptoms are aggravated by the presence of dentures, for example with trigeminal and glossopharyngeal neuralgias, temporomandibular pain dysfunction syndrome and, rarely, angina. The treatment of these, and other medically related disorders, is outside the scope of this textbook.

<table>
<thead>
<tr>
<th>Table 4.3 Causes of discomfort: relationship to common symptoms and signs.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cause</strong>&lt;br&gt;(L) = localised discomfort&lt;br&gt;(G) = generalised discomfort</td>
</tr>
<tr>
<td><strong>Related to impression surfaces</strong>&lt;br&gt;Pearls of acrylic or sharp ridges on impression surface of denture (L or G)</td>
</tr>
<tr>
<td>When speaking</td>
</tr>
<tr>
<td>Related to impression surfaces</td>
</tr>
</tbody>
</table>

- Faulty impressions
- Damage to working cast
- Warpage of base during processing
- Immersing in too hot water (L or G)
- Lack of or inappropriate relief over tori, atrophic mucosa or undiagnosed hard tissue undercuts (L or G)
- Lower denture over-extended and pressing on mylohyoid ridge(s) (L)
- Insufficient coverage of denture supporting area or overadjustment of denture (G or L)
Table 4.3 continued Causes of discomfort: relationship to common symptoms and signs.

<table>
<thead>
<tr>
<th>Cause</th>
<th>On initial delivery</th>
<th>Soon after delivery of dentures</th>
<th>After some months of satisfactory wear</th>
<th>When dentures out of mouth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>When speaking</td>
<td>When eating</td>
<td>When opening wide</td>
<td>As day progresses</td>
</tr>
<tr>
<td>Over-extension of periphery: discomfort because of:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>● Unrelieved frena or muscle attachments</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>● Pinching of tissue between denture base and tuberosity/retromolar pad (L)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post dam too deep (L)</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Atrophic mucosa/spiky ridge</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Related to polished surfaces</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper denture constraining coronoid process (L)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Related to occlusal surfaces</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of occlusal balance (L or G)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slide from retruded contact position to intercuspal: pain and/or ulceration lingual to lower anterior ridge</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of incisor overjet: pain and/or ulceration labial to lower anterior ridge</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of appropriate freeway space (G)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cheek/hip/tongue biting (L)</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Related to miscellaneous causes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discomfort arising from instability of denture (L or G)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Burning mouth syndrome (G)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Herpetic ulceration (L or G)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin B&lt;sub&gt;12&lt;/sub&gt;/folate deficiency (G)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Xerostomia (G)</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Nausea (G)</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Temporomandibular joint pain-dysfunction syndrome</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parafunctional habits, e.g. tongue thrusting (G)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Allergy (G)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 4.4 Causes of discomfort: their recognition, overcoming and avoidance.

<table>
<thead>
<tr>
<th>Cause</th>
<th>Recognition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Related to impression surface</td>
<td></td>
</tr>
<tr>
<td>Pearls of acrylic or sharp ridges on fitting surface of denture.</td>
<td>Close scrutiny of impression surface for surface irregularities which may be felt with finger or recognised by snagging of cotton wool fibres on the acrylic surfaces (90).</td>
</tr>
<tr>
<td>Denture base not relieved in region of undercuts.</td>
<td>Look for undercuts and/or erythematous or ulcerated areas on sides of ridges. Patient usually complains of pain when dentures are inserted and/or removed.</td>
</tr>
<tr>
<td>Pressure areas arising as a result of:</td>
<td></td>
</tr>
<tr>
<td>• Faulty impressions.</td>
<td>Check impression surface of denture to ensure it accords with ridge form and contour. Check that denture does not rock when seated.</td>
</tr>
<tr>
<td>• Damage to working cast.</td>
<td></td>
</tr>
<tr>
<td>• Warpage of denture base during processing.</td>
<td></td>
</tr>
<tr>
<td>• Immersing in too hot water.</td>
<td></td>
</tr>
<tr>
<td>Lack of or inappropriate relief of areas unlikely to withstand compression/displacement, e.g. tori, sharp ridges, knuckles of bone on the buccal/lateral aspects of ridges, exfoliating bone spicule, retained root, ridges with atrophic mucosa which are unable to tolerate much loading or superficial mental nerve. This may be subsequent to pre-prosthetic surgery or overzealous carving of post dam on master cast. Also lack of relief for frenae or muscle attachments or of muscle, e.g. mandibular denture over-extended buccally and masseter muscle constrained. May also arise as a result of insufficient relief, e.g. root of zygoma or, less commonly, anterior nasal spine.</td>
<td>Examine denture-bearing area closely and assess displacability of mucosa over ridges, buccal shelves, palate, etc. Palpate the ridges with a finger and record any blanching seen or discomfort experienced by patient during this exercise (93). Compare the contours of the denture to the contours within the mouth.</td>
</tr>
</tbody>
</table>

90  Testing for acrylic spicules.

91  Identification of a region of over-extension.
### Overcoming

Use disclosing material on localised area of denture and ease denture in region of 'wipe-off' (91).

Alternatively, place disclosing material over ulcerated or erythematous area and 'pick-up' material on offending area of denture which may then be relieved (92).

As above to adjust denture. Care should be taken to evaluate displaceability of the tissues at maximum contour of the ridge/tuberosity as an excessive amount of denture base may be removed with subsequent reduction in retention.

Use disclosing material to locate pressure area and relieve denture.
   If severe, remake.

Use disclosing material to locate and then relieve denture for most of the accompanying list except for:

- Retained roots – consider extracting.
- Tori—take a wash impression inside denture and reline (see Chapter 7). See right.

Beware prescribing a resilient lining for patients with superficial mental nerves—unless appropriate relief is prescribed, a plug of liner may aggravate the problem.

### Avoiding

Good prosthodontic practice includes a thorough examination of denture prior to insertion.

Good dentist/laboratory rapport.

As above. Survey master casts and instruct technician to block out unwanted undercuts or, alternatively, utilise appropriately selected undercuts where displaceable tissue is present (see page 49).

Thorough examination of denture supporting area and use of appropriate impression technique (see Chapter 5).

Clear and accurate instructions to laboratory regarding placement and thickness of relief. Optimum processing technique.

Clear instructions to patient regarding denture care (see Chapter 8).

This problem could be anticipated and treated by:

- Careful examination, including the use of appropriate radiographs where indicated.
- Use of appropriate impression technique (see Chapter 5).
- Clear instructions to technician concerning site, extent and thickness of relief.

---

92 Using a 'pick-up' technique to localise a pressure point.

93 Palpation of the residual ridge.
<table>
<thead>
<tr>
<th>Cause</th>
<th>Recognising</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Related to impression surface continued</strong></td>
<td><strong>Denture lifts when tongue is protruded, ulcers on mucosa overlying mylohyoid ridge or pain during swallowing.</strong></td>
</tr>
<tr>
<td>Over-extension of lingual flange—impinges on to mylohyoid ridge.</td>
<td><strong>Generalised pain attributable to insufficient utilisation of denture-supporting area (DSA) or as a result of over-adjustment to the periphery or impression surface of the denture.</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Relate size of denture base to DSA; scrutinise extension of flanges. Lack of extension may be on buccal/lingual aspects of the denture but also examine distally, as dentures are commonly not extended adequately on to the retromolar pads.</strong></td>
</tr>
<tr>
<td>Over-extension of periphery because of:</td>
<td><strong>Examine denture in mouth and note relationship of denture base to adjacent tissues, both at rest, during simulated functional movements and during articulation. Look for excessive extension or thickness of dentures.</strong></td>
</tr>
<tr>
<td>● Lack of relief for frena or muscle attachments.</td>
<td></td>
</tr>
<tr>
<td>● Pinching of soft tissues between denture base and retromolar pad and/or tuberosity.</td>
<td></td>
</tr>
<tr>
<td>Post dam too deep—patient complains of sore throat/difficulty in swallowing.</td>
<td><strong>Examine tissues in area of prescribed post dam — may be reddened or ulcerated (especially at pterygomandibular notch), rarely may be blood-filled bullae. In unusual cases, extra-oral bruising may be observed (94, 95).</strong></td>
</tr>
</tbody>
</table>

If occlusion is found to be acceptable and denture bases are well adapted and free from blemish, then problems are probably related to support, e.g. atrophic mucosa/spiky ridge with resultant excess forces on mucosa (96).

If pain is experienced in the absence of obvious pathology, palpate ridge—if pain experienced then problems associated with denture-supporting tissues exist.

94 Trauma associated with post dam area.

95 Extra-oral manifestation of the effects of trauma shown in 94.
<table>
<thead>
<tr>
<th>Overcoming</th>
<th>Avoiding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use disclosing material to identify the position and extent of over-contour and relieve appropriately. Ensure that any trimmed acrylic is thoroughly polished prior to re-insertion.</td>
<td>Thorough examination to identify extent of posterior lingual sulci and use of appropriate impression technique (see Chapter 5). Clear instructions to technician regarding maintenance of prescribed denture form.</td>
</tr>
<tr>
<td>Extend denture to cover optimum DSA. This may be done diagnostically, via tracing compound, or transitionally with butylmethacrylate resin. If available DSA is small, reduce load applied to tissues by decreasing size (width and length) of occlusal table.</td>
<td>Careful evaluation of available denture-supporting tissues and sound impression technique. In addition, ensure laboratory is instructed to preserve the extent of the proposed denture periphery. Consider reduced occlusal table.</td>
</tr>
<tr>
<td>Use disclosing material to identify the position and extent of over-contour and relieve appropriately. Ensure trimmed acrylic is repolished.</td>
<td>Sound impression technique and clear instruction to laboratory. Ensure bases have suitable extension at registration and trial insertion stages. This will eliminate potential problems.</td>
</tr>
<tr>
<td>Relieve appropriately. May require removal of present post dam and addition of a replacement in greenstick. Return denture to laboratory for permanent addition of new post dam.</td>
<td>Careful assessment of anatomical form and physical consistency at junction of hard and soft palate. Proficient impression technique plus appropriate carving of groove for post dam on master cast. In cases of doubt, a double post dam may be incorporated to ensure retention is not compromised if posterior dam is relieved or removed.</td>
</tr>
<tr>
<td>Relieve denture base after identifying pressure areas with disclosing material. In some cases, e.g. displaceable ridges, ‘special’ impression techniques may be required (see Chapter 5). Reduce load applied to tissues by decreasing size of occlusal table. A resilient liner may be considered but such linings are not an alternative for appropriate impression techniques and may facilitate candidal infections in, for example, patients with xerostomia.</td>
<td>Appropriate clinical examination and impression techniques. Appropriate instructions to technician regarding placement of relief and extension of denture base. Patient education concerning denture and oral hygiene (see Chapter 8).</td>
</tr>
</tbody>
</table>

**96 Reflection of the mucoperiosteum to disclose a knife-edge residual ridge.**
<table>
<thead>
<tr>
<th><strong>Cause</strong></th>
<th><strong>Recognising</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Related to polished surfaces</strong></td>
<td>From symptoms reported, namely pain on opening or on yawning, also characteristic rub-off if disclosing material used (97).</td>
</tr>
<tr>
<td>Pain felt at posterior aspect of upper denture, usually associated with opening movements. Cause: flange too thick and constraining coronoid process.</td>
<td></td>
</tr>
<tr>
<td><strong>Related to occlusal surfaces</strong></td>
<td>Check support is acceptable then closely examine occlusion for occlusal balance in RCP. Position index fingers on buccal flanges of lower denture, with thumbs under chin (as per registration technique) and ask patient to close slowly into RCP. Watch for sliding into ICP. Thereafter check for balanced articulation in protrusion, also right and left lateral excursions – should have balancing contacts (see Chapter 6).</td>
</tr>
<tr>
<td>Pain on eating in the presence of occlusal imbalance. This may include:</td>
<td></td>
</tr>
<tr>
<td>● Anterior prematurity.</td>
<td></td>
</tr>
<tr>
<td>● Posterior prematurity.</td>
<td></td>
</tr>
<tr>
<td>● Incisal locking.</td>
<td></td>
</tr>
<tr>
<td>● Lack of balanced articulation.</td>
<td></td>
</tr>
<tr>
<td>Pain/ulceration lingual to lower anterior ridge. If no over-extension of denture base or unrelieved bony exostosis, look for protrusive slide from RCP to ICP.</td>
<td>Stabilise lower denture with forefingers and ask patient to close together gently. When patient is viewed in profile, a forward slide into ICP may be seen (see Chapter 6).</td>
</tr>
<tr>
<td>Pain and/or ulceration on labial aspect of lower ridge that is not attributable to undercut flange or acrylic pearls: cause is insufficient incisal overjet giving incisal locking and tripping between dentures. Sometimes this may be associated with pain around the incisive papilla as upper denture rocks.</td>
<td>Examine relationship of upper and lower incisors as patient slides from RCP into protrusive; if incisal guidance angle is too steep, then the lower incisors will trip on the uppers, causing rocking or dislodgement of lower and/or upper denture.</td>
</tr>
<tr>
<td>Excessive vertical dimension – pain usually reported to be at periphery of dentures, in depth of sulci. May be discomfort or pain in affected muscles of mastication, e.g. masseter and posterior fibres of temporalis. Pain tends to intensify as day progresses (&quot;by evening I have to take them out&quot;)! May be attributable to burning mouth syndrome.</td>
<td>Symptoms generally pathognomonic. Often history of 'tramlines' or ulcers on buccal shelves with repeated adjustments. A vicious circle of complaints and adjustments occurs.</td>
</tr>
</tbody>
</table>

97 The coronoid process may impinge on a thick buccal flange.
<table>
<thead>
<tr>
<th><strong>Overcoming</strong></th>
<th><strong>Avoiding</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Treated by disclosing offending area on denture periphery, relieving as required and repolishing.</td>
<td>Determine functional width of sulcus and relative position of coronoid process prior to definitive impression. Place finger on buccal aspect of posterior maxilla and ask patient to open mouth—assess space available for flange (98).</td>
</tr>
</tbody>
</table>
| Adjust occlusion by selective grinding (using acrylic burs or carborundum paste) at chairside, or in laboratory after re-registration. If severe error, reset, using facebow and new interocclusal records (see Chapter 6). | Sound registration techniques and careful re-appraisal at trial insertion stage.  
Good technical support.  
Split cast techniques to re-mound after deflasking enables grinding-in to eliminate processing errors. To be performed prior to delivery.  
Balanced articulation is a desirable feature of all complete dentures, especially Class 2 Division I patients.  
In cases where patient has never worn a lower denture satisfactorily or is unable to provide a reproducible occlusion, consider occlusal pivots (see Chapter 6). |
| Mark deflecting inlines of posterior teeth with articulating paper; these will be the mesial-facing slopes of the upper buccal cusps and distal-facing slopes of the lower buccal cusps. If slide is greater than half a cusp width, re-register and re-try. | Take care at registration phase. As an option to conventional techniques, arrowhead tracing methods tend to give more consistent results.  
Check at trial insertion stage and re-register where appropriate using facebow transfer plus RCP and protrusive records. |
| Reduce vertical overlap by removing excess from labio-incisal aspect of lower incisors or from palato-incisal aspect of upper incisors. If appearance is compromised, reset of the incisors may be required (see Chapter 6). | Careful determination of upper lip support and functional determination of incisal positions for upper and lower teeth at both registration and trial insertion stages. |
| If excess is less than 1.5 mm, grind to provide freeway space.  
If greater than 1.5 mm, re-register and reset at new vertical dimension of occlusion (see Chapter 6).  
Remake may be more sensible solution when upper and lower incisal levels require alteration. | Use functional tests, e.g. speech, at registration and try-in appointments.  
Provide freeway space commensurate with age and functional capability of patient. |

98 Determining the space available for the denture flange.
<table>
<thead>
<tr>
<th>Cause</th>
<th>Recognising</th>
</tr>
</thead>
</table>
| **Related to occlusal surfaces continued**                           | Scrutinise buccal/incisal overjet when dentures are in occlusion in RCP. 
Relate findings to corresponding overbite and to lips, cheeks and dentures in function. |
| Cheek/lip biting because of insufficient overjet (99).             |                                                                                                                                               |
| **Tongue biting – teeth generally placed lingual to lower ridge.**  | Place wax knife on impression surface of denture in imprint of ridge. Central fossae of lower posteriors should lie over the blade of the knife (100). 
Alternatively, remove denture and look at ridge of the patient; insert and remove denture several times to establish position of central fossae relative to ridge. 
Note if teeth lingually placed (see also 64, 65). |  |
| **Related to miscellaneous causes**                                 | Examine occlusion then watch denture as patient speaks or 'mimics' chewing. 
For other aids to recognition, see section on looseness, pages 50 to 55 and 58 to 63. |
| Occlusion acceptable, and dentures otherwise satisfactory but dentures move in function since do not conform to available denture space and/or neuromuscular control deficient. Such movement gives rise to pain. |  |
| **Burning mouth syndrome.**                                         | Accurate history – diagnosis by exclusion.                                                                                                                                 |
| **Herpetic ulcers (caused by Herpes simplex or H. zoster).**         | From history and distribution of lesions.                                                                                                                                 |
| **Vitamin B₁₂/folate deficiency.**                                  | Beefy red tongue (46). 
May have neurological symptoms including glossodynia. 
Haematological investigation. |  |

99 Lesion produced by cheek biting.
<table>
<thead>
<tr>
<th>Overcoming</th>
<th>Avoiding</th>
</tr>
</thead>
<tbody>
<tr>
<td>For cheek biting, round appropriate buccal cusps or reset to provide suitable buccal overjet. Problem may also occur in patients with flaccid cheeks, e.g. following stroke. For lips, mark ‘trip line’ on lower incisors and grind to give more appropriate incisal guidance angle (see Chapter 6).</td>
<td>Ensure sufficient buccal/incisal overjet present at trial insertion by checking presence of balanced articulation in protrusion plus right and left working excursions. May need to increase cheek support in some patients to ensure tooth placement is harmonious with function of lips and cheeks.</td>
</tr>
<tr>
<td>Remove lower lingual cusps—if severe, reset.</td>
<td>Ensure teeth set appropriately at trial insertion – follow guidelines given in ‘Recognising’. In cases where tongue is large, consider using posterior crossbite in addition to narrow posterior teeth.</td>
</tr>
<tr>
<td>If possible, reshape dentures to aid neuromuscular control and conform to denture space (see pages 50 to 55 and 58 to 63). Resetting of teeth or remaking of dentures may be required.</td>
<td>Design dentures for optimum neuromuscular control and to conform to available denture space (see pages 50 to 55, 58 to 63 and 93). Good rapport with laboratory to ensure that clinical prescription of new dentures is followed.</td>
</tr>
<tr>
<td>May require multivitamin/nutrition advice and treatment and perhaps antidepressant therapy.</td>
<td>Spot early! Careful history and examination essential, plus appropriate treatment planning and execution of treatment.</td>
</tr>
<tr>
<td>Prescription of appropriate medication (e.g. acyclovir); also oral hygiene instruction.</td>
<td>Problematic, but some sufferers should be advised of need to take preventive remedy (e.g. acyclovir) if exposed to high sunlight hours.</td>
</tr>
<tr>
<td>Refer to physician for appropriate therapy.</td>
<td>Not always possible but should be eliminated at time of initial examination.</td>
</tr>
<tr>
<td>Cause</td>
<td>Recognising</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Related to miscellaneous cause continued</td>
<td>Some patients complain of dry mouth, others do not (see page 19). Look in mouth—often see dry mucosa with cobblestone-appearance and ‘bubbles’ of saliva on polished surfaces of denture(s). Patients may be receiving several drugs some/all of which may reduce salivary flow.</td>
</tr>
<tr>
<td>Xerostomia.</td>
<td>Check stability of upper denture and correct peripheral over/under-extensions as per section on looseness. Ensure occlusion is balanced in RCP. Other patients tolerate extensive digital examination of the hard palate and junction of hard and soft palates yet do not tolerate empty impression trays. Check the position of the posterior teeth on the maxillary denture relative to the dorsum of the tongue, plus the thickness of the palatal base and (lower) lingual flanges.</td>
</tr>
<tr>
<td>Nausea.</td>
<td>Palpation, direct or indirect assessment of function.</td>
</tr>
<tr>
<td>Temporomandibular joint(s) and/or associated muscles of mastication (only a brief explanation included here).</td>
<td>Palpation, direct or indirect assessment of function.</td>
</tr>
<tr>
<td>Parafunctional habits, including tongue thrusting.</td>
<td>May be difficult to detect – examine occlusal surfaces for unusual wear patterns/facets and observe patient’s mouth closely as he/she speaks.</td>
</tr>
<tr>
<td>Allergy, inadequately polished acrylic, residual monomer.</td>
<td>Rare. Diagnose with aid of patch testing. Determine residual monomer content of denture.</td>
</tr>
<tr>
<td>Denture stomatitis.</td>
<td>Generally painless and often asymptomatic. Seen at examination and may be accompanied by angular cheilitis. Usually has frictional element (ill-fitting denture) plus opportunistic candidal infection.</td>
</tr>
</tbody>
</table>
## Overcoming

For patients with some flow of saliva, the prescription of sugar-free citrus lozenges is often useful.

For those patients with a paucity of saliva, artificial saliva may be considered. Note some saliva substitutes are of porcine origin and thus are barred in certain religious groups.

In some cases, physicians may alter prescriptions to include drugs with less xerostomic effects.

Ensure denture is adequately extended along periphery and that there is no occlusal factor which could cause instability.

If denture is otherwise satisfactory, check extension of post dam. May need to be moved anteriorly – use greenstick to trace and add light/cold cured acrylic as required.

**Treatment as appropriate.**

May include occlusal adjustments and/or occlusal pivots (*see Chapter 6*).

## Avoiding

Depends on case. For assessment, *see page 19.*

Desensitising techniques, training plates (101).

If gagging induced by presence of empty tray in mouth, a psychological assessment may be appropriate. Consider use of ego-strengthening techniques in some cases, e.g. nausea after impressions have been taken.

**Careful examination and registration techniques.**

Appraisal at trial insertion stage.

Identify potential denture space and use appropriate occlusal scheme or pivots (*see Chapters 5 and 6*).

Make denture in polycarbonate or other non-polymethyl methacrylate resin.

**Tissue conditioner and oral and denture hygiene instruction (OHI/DHI).** Recommend cleansing denture by scrubbing and soaking in hypochlorite solution. Antifungal therapy may be required (*see Mouth preparation, page 37*).

Careful examination and preparation of mouth; thereafter good OHI/DHI and regular follow up as part of denture aftercare.

If angular cheilitis is present, combinations of antifungal agents and antibacterial agents, e.g. miconazole, are usually prescribed.

---

101 A training plate.
Other difficulties

There are a number of other difficulties which are reported from time to time by complete denture patients, and which do not fit readily into Tables 4.1, 4.2, 4.3 and 4.4. They are nevertheless important as they are not infrequently encountered in dental practice. The most common of these are:

- Noise on eating and speaking.
- Speech problems.
- Eating difficulties.
- Where the appearance of the dentures is not acceptable.
- Altered taste sensation.
- Gagging (nausea).

Table 4.5 Other difficulties: their recognition, overcoming and avoidance.

<table>
<thead>
<tr>
<th>Cause</th>
<th>Recognising</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Noise on eating and speaking</strong></td>
<td>Unfamiliarity with new appliance—but check factors below:</td>
</tr>
<tr>
<td>May be apparent on first insertion of dentures, or may appear as alveolar resorption occurs and dentures loosen.</td>
<td>• Excessive occlusal vertical dimension.</td>
</tr>
<tr>
<td></td>
<td>• Occlusal interference, e.g. unbalanced occlusion, too great incisor overlap.</td>
</tr>
<tr>
<td></td>
<td>• Loose dentures.</td>
</tr>
<tr>
<td><strong>Speech problems</strong></td>
<td>Systematic search for cause required as may not be obvious.</td>
</tr>
<tr>
<td>Uncommon, but when present can be of great concern to patient.</td>
<td>If possible, check that no problem with old dentures.</td>
</tr>
<tr>
<td>Unfamiliarity with new dentures.</td>
<td></td>
</tr>
<tr>
<td>Sibilants (e.g. [s]).</td>
<td>Count from 60 through to 70. Upper and lower incisor teeth should just not contact. If contact, check for excessive occlusal vertical dimension/vertical incisor overlap.</td>
</tr>
</tbody>
</table>
### Overcoming

Reassurance. Encourage persistence with new appliance.  
*See* Chapter 6 for excessive occlusal vertical dimension and occlusal interference for loose dentures.  
*See* pages 39 to 63.

---

### Avoiding

Construct appliances to maximise retaining forces and minimise displacing forces (*see* pages 39 to 63).

---

Encourage reading aloud in private.

*See* pages 76 and 77.

---

If satisfactory old denture, consider replication of polished surface contour via template technique (*see* Chapter 7).

---

Removal of acrylic/addition of wax until problem resolved. Wax replaced with acrylic, abraded acrylic repolished.

*See* above.

---

*102* Disclosing paste may be used to detect the cause of speech defects, e.g. air leakage in anterior region during (t) sound.

*103* Leakage corrected by addition of wax prior to replacement with acrylic.
<table>
<thead>
<tr>
<th><strong>Cause</strong></th>
<th><strong>Recognising</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Speech problems continued</strong></td>
<td></td>
</tr>
</tbody>
</table>
| Bilabial (e.g. [p], [b]). | Can lips be easily approximated? Check:  
  - Occlusal vertical dimension.  
  - Incisor position. |
| Labiodental (e.g. [f], [v]) | Can lower lip easily rest against incisal edges of upper teeth? Check:  
  - Occlusal vertical dimension.  
  - Incisor position.  
  - When patient swallows, lower lip can overlap labial surface of upper incisors. |

<table>
<thead>
<tr>
<th><strong>Eating difficulties</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Unstable dentures.</td>
<td>Examine appliances to check that retentive forces maximised, displacing forces minimised, and support utilised to best advantage.</td>
</tr>
</tbody>
</table>
| ‘Blunt teeth.’ | Excessive abrasion of occlusal surfaces—as result of adjusted occlusion or of prolonged wear.  
  - Non-anatomical (flat or inverted cusped) teeth, especially if cusped teeth on previously satisfactory denture.  
  - Broad posterior occlusal surface, especially if narrow teeth on previously satisfactory denture. |
| Insufficient occlusal vertical dimension (mandibular elevator muscles not working efficiently). | Assess occlusal vertical dimension. |

| Excessive occlusal vertical dimension (‘cannot open wide enough to get food in’; ‘no space in mouth for food’). | Assess occlusal vertical dimension.  
  - May have speech difficulties.  
  - May have pain (see page 76). |

<table>
<thead>
<tr>
<th><strong>Appearance</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Is a personal opinion. Patients must be happy with appearance of their appliances or may not wear them/return with vague complaints of looseness or pain which have no obvious cause. Family/relatives may dislike appliance with which patient is satisfied.</td>
<td>Careful discussion with patient as to opinion on appearance. Patient may be more willing to talk to nurse/receptionist in absence of dentist in order to avoid offending latter.</td>
</tr>
</tbody>
</table>
### Overcoming

- **Occlusal vertical dimension (see Chapter 6).**
  - Remove suspect incisors, replace in wax and adjust position at chairside until problem resolved. Replace wax with acrylic resin.

- **See bilabial sounds above.**

---

### Avoiding

- **See above.**

---

**See pages 39 to 69.**

### Reshape occlusal surfaces. If this would cause loss of occlusal vertical dimension, reset teeth or remake denture.

- May be possible to reshape occlusal surfaces. Explain rationale behind use of non-anatomical teeth and encourage persistence. Replace teeth or remake denture.

- Narrow lower posterior teeth.

---

### Construct appliances to maximise retaining forces and minimise displacing forces (see pages 39 to 69).

- If anticipated that excessive occlusal adjustment will result in loss of anatomical form, consider replacing teeth/remaking dentures.

- Educate patient from examination stage onwards as to why change to non-anatomical teeth being made.

- Routine use of narrow posterior teeth is recommended.

---

### Up to 1.5 mm increase in occlusal vertical dimension can be achieved by relining dentures.

- Increases in excess of 1.5 mm require teeth to be reset/dentures remade. (Beware excessive alteration in contours rendering neuromuscular control difficult.)

---

### Accurate assessment of occlusal vertical dimension required and incorporation in new appliances.

- Up to 1.5 mm may be removed from occlusal plane of each denture by careful occlusal adjustment; beware production of flat occlusal surfaces or unaesthetic appliances. Further decreases in occlusal height require teeth to be reset/dentures remade.

---

### Correct cause of patient’s complaint. Give ample time for patient to comment when teeth reset in wax. Opinion of friend/relative invaluable.

- Beware producing, for example, excessive vertical incisor overlap leading to increased displacing forces/ speech difficulties.

---

### Accurate assessment of aesthetic requirements of patient. Meet patient’s needs so far as not to compromise other functions of appliances.

- Ample time for patient to comment at trial insertion stage, see left.
<table>
<thead>
<tr>
<th>Cause</th>
<th>Recognising</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>COMMON CAUSES OF PROBLEMS</strong></td>
<td></td>
</tr>
<tr>
<td>• Shade of teeth – too light/too dark.</td>
<td>Check orientation of occlusal plane/incisal level. Also labiobuccal or labiopalatal position.</td>
</tr>
<tr>
<td>• Mould – too big/too small.</td>
<td></td>
</tr>
<tr>
<td>• Arrangement – no diastemata/too even/too irregular.</td>
<td></td>
</tr>
<tr>
<td>Insufficient or too much visibility of teeth – upper or lower.</td>
<td></td>
</tr>
<tr>
<td>Creases at corners of mouth.</td>
<td>Check labial fullness and anterior tooth position (add wax to labial/buccal surfaces of teeth to visualise effect of moving teeth). Check occlusal vertical dimension.</td>
</tr>
<tr>
<td>Colour of denture base material.</td>
<td>For example, pale acrylic in puffy patient; acrylic resins suitable for white patients unsuitable for black.</td>
</tr>
<tr>
<td>Form of denture base material.</td>
<td>Over- or under-contouring of ‘gingival’ regions.</td>
</tr>
<tr>
<td><strong>Altered taste sensation</strong></td>
<td></td>
</tr>
<tr>
<td>Dentures do not cover many taste buds, thus no physiological basis for this complaint.</td>
<td></td>
</tr>
<tr>
<td>Increased palatal cover relative to old satisfactory appliance.</td>
<td>Compare old and new appliances.</td>
</tr>
<tr>
<td>Decreased taste sensation, recognised only on insertion of new appliance.</td>
<td>Careful history.</td>
</tr>
<tr>
<td>Acrylic base material—thickness, low thermal conductivity.</td>
<td>Satisfactory old denture may have had metal base.</td>
</tr>
<tr>
<td><strong>Gagging (nausea)</strong></td>
<td></td>
</tr>
<tr>
<td>May be volunteered by patient before treatment commences; apparent at commencement of treatment, on first insertion or a short time following insertion.</td>
<td>Check physical factors:</td>
</tr>
<tr>
<td></td>
<td>• Loose dentures.</td>
</tr>
<tr>
<td></td>
<td>• Thick distal termination of upper denture.</td>
</tr>
<tr>
<td></td>
<td>• Lingual placement of upper posterior teeth.</td>
</tr>
<tr>
<td></td>
<td>• Occlusal plane low.</td>
</tr>
<tr>
<td><strong>Overcoming</strong></td>
<td><strong>Avoiding</strong></td>
</tr>
<tr>
<td>-------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Invaluable evidence supplied by previously satisfactory dentures/photographs of patient with natural dentition.</td>
<td>Utilise evidence available, see left.</td>
</tr>
<tr>
<td>Reset teeth/remeke dentures as necessary.</td>
<td>Supply accurate prescription to laboratory via optimally adjusted record rims.</td>
</tr>
<tr>
<td>Move teeth as appropriate.</td>
<td>See above.</td>
</tr>
<tr>
<td><strong>See Chapter 6.</strong></td>
<td></td>
</tr>
<tr>
<td>Remake dentures utilising suitable base material.</td>
<td>Pigmented acrylic resins available. Possible to include ‘melanotic’ areas (see literature).</td>
</tr>
<tr>
<td>Rebase denture or reface gingival region.</td>
<td>Ensure detailed prescription to technician at waxing stage.</td>
</tr>
<tr>
<td><strong>May be possible to decrease palatal cover without compromising retentive forces so long as optimal new post dam incorporated (see page 44).</strong></td>
<td>Where problem anticipated, reproduce palatal cover of old appliance so long as retentive forces deemed adequate.</td>
</tr>
<tr>
<td>Explanation (patient may not be receptive to this, viewing it as an excuse).</td>
<td>Recognition of problem and explanation to patient throughout treatment.</td>
</tr>
<tr>
<td>Remake denture with metal base.</td>
<td>Recognise problem and incorporate metal base in new appliance. Increased thermal conductivity may enhance food appreciation.</td>
</tr>
<tr>
<td>Aim to maximise retaining forces and minimise displacing forces.</td>
<td>Construct appliances to maximise retaining forces and minimise displacing forces. Psychological assessment if indicated. Use ‘conditioning’ appliance, e.g. fully extended base for home use (see also page 81).</td>
</tr>
</tbody>
</table>
5. Managing the Edentulous Space

Introduction

In this chapter, consideration will be given to clinical advice on how to manage the edentulous milieu in the preparation of master casts for definitive prostheses. A knowledge of basic impression techniques is assumed, and here we will discuss these techniques and surgery.

Impressions

This section describes some impression techniques aimed at maximising denture retention and stability in various clinical situations.

Aims

These are to customise the denture bases to the denture-supporting tissues and to develop the functional border of the denture. In consequence, the retention, stability and appearance of the dentures are influenced as is the maintenance of the health of the oral tissues.

Principles

1. The denture base should cover the maximum possible denture-supporting area compatible with effective function.
2. The impression surface should achieve the closest possible contact with the underlying epithelium commensurate with its tolerance.
3. The border form of the prosthesis should establish a peripheral seal and, further, help support lips and cheeks in a functionally and aesthetically acceptable manner.

Impression techniques

In order that the preceding principles are achieved, a two-stage procedure is required.

Primary impressions are made in stock trays and their function is to outline the denture-supporting areas. Impression compound or silicone rubber putty may be commonly used as an impression material for this stage. These materials may be moulded and reshaped until the impression is adequately extended, enabling the operator to demonstrate the presence of a peripheral seal. The impression will generally tend to be over-extended. Alginate may be used to record a primary impression, although the presence of a peripheral seal cannot be assumed as the peripheral form of the resulting impression may be at variance with the functional form of the sulci. An alternative approach is to record an impression in compound, reduce the height and width of the periphery and then take an alginate wash impression.

From these primary impressions, a cast is poured on which customised ('special') trays are made. Customised trays should be made of a rigid material and should be designed to provide uniform spacing from the tissues appropriate for the impression material to be used. In addition to providing an appropriate fit to the denture-supporting tissues, they should also be dimensionally stable and not excessively bulky. Handles, when used, should not be in conflict with labial musculature (79). Instead of handles, it is recommended that finger-rests be placed in the premolar regions. These will assist in obtaining optimal peripheral moulding.

A peripheral seal should be apparent with a customised tray prior to making the definitive impression. Tracing compound, or an alternative material, may be required to develop this seal.

Impressions appropriate to the existing clinical conditions should be used and suggested impression options are listed in Table 5.1.
Table 5.1 Suggested impression techniques.

<table>
<thead>
<tr>
<th>Clinical finding</th>
<th>Primary impressions</th>
<th>Secondary impressions</th>
<th>Technique</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good ridge form</td>
<td>Impression compound</td>
<td>Plaster of Paris, zinc oxide/eugenol, alginate or elastomer</td>
<td>Conventional</td>
</tr>
<tr>
<td>Sound denture-supporting tissues</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No undercuts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>As above but undercuts present</td>
<td>Impression compound</td>
<td>Alginate or elastomer; depends on degree of undercuts</td>
<td>Impression technique conventional but plan path of insertion and removal of tray to match that of the proposed denture</td>
</tr>
<tr>
<td>Good ridge form</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper ridge displaceable</td>
<td>Alginate</td>
<td>Use a two-stage impression technique (see page 90)</td>
<td>Controlled minimally displaceable impression techniques (see page 90)</td>
</tr>
<tr>
<td>Ridge may look satisfactory but consists of fibrous tissue or has non-corticated (e.g. knife-edge) ridge—pain elicited when palpated</td>
<td>Alginate or medium-bodied elastomer</td>
<td>Zinc-oxide/eugenol or light-bodied elastomer</td>
<td>Controlled pressure impression technique (see page 92)</td>
</tr>
<tr>
<td>Very atrophic ridges or where optimum peripheral extension is indeterminate</td>
<td>Impression compound</td>
<td>Functional impression method (see page 93)</td>
<td>Modify denture appropriately and add impression material which is moulded by functional movements (see page 93)</td>
</tr>
</tbody>
</table>

Conventional procedures will not be discussed further, as they are well described in standard textbooks, although the need to abide with the principles of impression-making is stressed. Impressions of clinical conditions, such as a V-shaped or a flat maxillary denture-supporting area, are not considered to require special techniques as a sound conventional method should overcome stability problems.

As Table 5.1 indicates, the following special impressions are considered further:

1. **Controlled minimally displaceable impression techniques**, e.g. for displaceable (flabby) upper ridge.
2. **Controlled-pressure impression techniques**, e.g. where patient complains of pain under lower denture caused by either a mobile fibrous ridge or a non-corticated (knife-edge) ridge.
3. **Functional impressions** where peripheral extensions are indeterminate.

**Controlled minimally displaceable impression technique**

A displaceable upper ridge (104) usually occurs when a patient has worn a complete upper denture opposed by six to eight lower anterior teeth, although it may occur in some patients who have worn upper and lower complete dentures for many years. The maxillary anterior ridge is replaced by fibrous tissue and the patient complains of a loose denture. Such reduction in support anteriorly may lead to reduced levels of patient satisfaction with replacement dentures and it is recommended that impression techniques should avoid undue displacement of the fibrous tissues.

There are two recommended methods of making such impressions and both require that the primary impression be recorded by a minimally displaceable technique. The form of the customised tray for the definitive impression depends on which of two techniques is used.
Method A

1. Make a special tray with a window cut in the region of the displaceable tissue (105).
2. Border mould the periphery with greenstick or other viscous material and record an impression in zinc-oxide/eugenol paste or medium-bodied elastomer (106).
3. Trim the set impression clear of the displaceable tissue, re-insert the tray and brush, run or syringe plaster of Paris or light-bodied elastomer over the tissues in the window of the tray to complete the minimally displaced impression of the tissues (107).

Method B

1. Make a special tray with no window and border mould the tray to provide a peripheral seal (108). This important requirement is often overlooked and its omission reduces prospects of success.
2. An impression is made using a medium-bodied elastomer or zinc oxide/eugenol paste. When set, remove the impression material corresponding to the displaceable tissue and perforate the tray in this cleared region (109).
3. In the cleared area, brush, run or syringe impression material of compatible chemistry to that previously used and re-seat in the mouth.
Controlled-pressure impression techniques

These techniques are used where an alveolar ridge is unable to provide acceptable support against vertical loads or to provide positive stability against lateral forces.

1. Make the primary impressions using a minimally displacive impression method. This may require the use of impression compound or silicone rubber putty, relieved in the ridge crest area, followed by a wash impression using a low-viscosity material (110 and 111).

2. Construct a customised acrylic tray with 2-mm spacing over the denture-supporting area of the cast.

3. Perforate this tray in the region of the ridge crest (112).

4. Use tracing compound or putty elastomer to make an impression of the primary cast. Soak the cast to prevent the impression material adhering.

5. Reduce the impression material in the region of the buccal and lingual sulci to clear the peripheral tissues, then border mould the tray in the mouth with an appropriate material. If discomfort is experienced when the tray is pressed firmly into place the offending area of the tray or impression should be relieved. Re-insertion of the tray should not then result in pain (113).

6. The definitive controlled-pressure impression may then be made using a light-bodied wash material under digital pressure.
**Functional impressions**

When retentive forces are reduced (e.g. atrophic ridges), or displacing forces are high (e.g. dyskinetic movements or uncontrolled muscle activity), then there may be a need to consider functional impressions. In this technique, the peripheral form is moulded by the peri-denture musculature.

Any material used for a functional impression should be sufficiently plastic to permit moulding during mastication. However, the material should not exhibit flow at the time of model casting.

Most functional impression materials are delivered in the form of a powder and liquid preparation of an ester and ethyl alcohol. The alcohol of the mixed impression material gradually leaches out, causing the material to harden. For this reason, it is advocated that the formed impression be removed and a cast poured 3–6 hours after insertion. While the impression is inside the mouth, patients should be encouraged to perform normal oral functions.

One recommended technique for a functional impression is as follows:

1. Examine the impression surface and periphery of the denture. Any undercuts should be removed and the periphery reduced to create a 1.5–2 mm space between the functional form of the sulcus and the acrylic. This space enables moulding of the impression yet retains sufficient bulk of gelled material to resist distortion when the model is cast.

2. The acrylic of the impression and peripheral surfaces is roughened and dried to facilitate adhesion of the impression mixture. The impression material is then added to the prepared surface.

3. The patient is asked to close lightly into RCP.

4. A range of functional movements such as talking, swallowing, smiling, etc. is encouraged to create a functionally generated impression. After 5–6 minutes, the material will have gelled sufficiently to permit the extra-oral removal of excess material with a scalpel. Care is taken not to disturb the developing border form (114).

5. When the patient has returned after 3–6 hours, the impression is inspected and, if satisfactory, cast.

**Denture space determination**

**Aims**

To determine the space within which a denture can be sited without being subjected to excessive displacing forces from the surrounding musculature.

**Indications**

When difficulty is anticipated or has been experienced in providing a stable denture (usually the lower) because of high or abnormal displacing forces from the surrounding musculature, for example:

- Past denture looseness ascribed to powerful lower-lip activity.
- Non-replacement of missing teeth leading to tongue/cheeks/lips partially occupying the usual space for the denture.
- An enlarged tongue, e.g. patients with Down’s syndrome.
- Abnormal anatomy, e.g. surgical removal of a portion of the mandible.
- History of inability to wear a lower denture.

**Outline of technique**

The determination of the lower denture space is most frequently undertaken and therefore the existence of an optimum upper denture is assumed in the following description.

1. An accurate cast of the lower denture-supporting area is obtained and a record rim constructed. The retruded jaw relationship is recorded against the upper denture at 1 mm less than the projected final occlusal vertical dimension. Using this registration, the lower cast is articulated against the upper appliance (or model thereof).

2. An acrylic resin tray is constructed to cover the anticipated supporting area. The spacing from the cast should be appropriate for the chosen impression material. Narrow acrylic or impression compound pillars are added to contact the second pre-molar and the first molar of the upper denture; they should not interfere with any anticipated activity of the cheeks or tongue. Retention for the impression material should also be provided; a length of crimped wire should be attached to the tray over the crest of the residual ridge (115).
3. The borders of the tray are adapted to the anticipated functional depth and width of the sulci as usual. A slow-setting material of medium viscosity is prepared (silicone impression material mixed with less activator than normal, or tissue-conditioning material) and all surfaces of the tray coated. The quantity of material applied should approximate the volume and shape of the final appliance. Following application of the impression material, the tray may be handled using one of the occlusal stops and the adjacent border. The loaded tray is inserted in the mouth and the patient asked to smile, to swallow and to produce vowel sounds e.g. ‘ooh’ and ‘ah’ while the material sets. The impression is then removed and carefully inspected as its appearance may be totally unconventional (116 and 117). Evidence of large areas of air entrapment or insufficient or excess volume will necessitate re-taking the impression. Areas of tray or pillars showing through the material should be reduced and the impression repeated.

4. In the laboratory, a cast is prepared to record the supporting tissues and the depth and width of the sulci. Matrices (of gypsum or laboratory-grade silicone putty) are made to record the labial, buccal and lingual contours of the impression (118, 119 and 120). The cast is articulated against the upper denture or model and the posterior teeth positioned in contact with their opponents and within the space delineated by the matrices; the latter may require the teeth to be narrowed. Softened modelling wax is then placed labially, buccally and lingually and the matrices firmly placed in position to mould the wax to the recorded shape of the denture space. Waxing-up of the trial denture is then completed without altering the basic contours of the appliance (121).

5. The routine assessments are conducted at the trial insertion, with special emphasis on the stability of the appliance.
Precautions

1. The upper denture should be of optimal design to maximise retaining forces, minimise displacing forces, obtain good support, and provide acceptable aesthetics since the contours influence the lower denture space.
2. The impression tray should be stable in the mouth and should not impede muscle activity.
3. The patient must rehearse and master the required moulding routine prior to inserting the loaded tray.
4. An excessive volume of mouldable material should not be used since distortion of the potential denture space will occur.
5. Since the impression may be totally unlike the shape of a ‘normal’ denture, the laboratory staff must appreciate the objective of the technique and take care to reproduce the recorded contours in the trial appliance.

Modifications of basic technique

**Determination of the optimal space for a segment of a denture (e.g. the lower anterior region)**

Remove the teeth and the majority of the base material from the appropriate segment. Rehearse the patient in the moulding routine outlined above. Apply adhesive (if appropriate) to the modified area and load with the selected mouldable material. Place in the mouth, mould while setting, remove and carefully inspect (122). Re-insert in the mouth to check for stability; if still unsatisfactory, insufficient or inappropriate area has been investigated or an incorrect diagnosis of the cause of the instability has been made. When satisfactory, the appliance is conveyed to the laboratory, the appropriate matrices manufactured and the teeth and polished surfaces waxed up to the recorded contours. The trial denture is re-checked for stability prior to permanent attachment of the teeth to the base.

122 Moulding of a segment of a denture by muscle activity.
Determination of the fit of the completed denture to the potential space

This is useful to detect the presence and the site of interference with normal muscle activity by an existing appliance. Coat the borders and the polished surfaces of the denture (not the occlusal surfaces) with a low-viscosity silicone impression material (adhesive is not required). Insert the coated appliance into the mouth and request the patient to perform the moulding routine described above. Chewing on a 30 mm square portion of wet paper towel can also be undertaken. When the material has set, remove the denture from the mouth and inspect it; the material will have been displaced from the surface of the appliance where the latter interferes with normal muscle activity. 123 shows excessive pressure on the buccal flange and teeth in the left pre-molar region of the lower denture. If necessary, the appliance can be modified or remade to avoid such interference.

Aims

Surgical correction of hard- and/or soft-tissue conditions that are prejudicial to denture support, retention or stability. Such surgery should be directed towards the creation of satisfactory dentures.

Indications

Where indicated, surgical correction of the edentulous mouth should be performed prior to the definitive stages of denture construction and should follow planned consultation between prosthodontist and oral surgeon. While detailed descriptions of operations are beyond the scope of this textbook, surgical procedures may be classified as follows:
2. Major intervention to increase the denture-supporting area or to alter intermaxillary relations.
3. Implants.

Outline of techniques

Correction of hard- and soft-tissue irregularities

Residual hyperplastic tissue: any such tissue (124) which fails to respond to conservative treatment (see page 36) should be considered for removal.

Precautions

Such surgery risks loss of sulcus depth, so close cooperation between prosthodontist and oral surgeon is necessary.

On occasion, the cause may be unexpected, such as phenytoin-induced hyperplasia (125 and 126).

Surgery

Introduction

Regular examinations of oral tissues and dentures in edentulous patients are necessary to ensure that tissue distress or pathology is identified and treated. An annual recall for edentulous patients is considered sound practice. Many denture-induced tissue problems are reversible and respond to simple measures, such as tissue conditioning, occlusal adjustment and oral hygiene instruction, while others require surgical intervention to render the denture-supporting areas suitable for denture treatment.
Enlarged fibrous tuberosities

These may not hinder denture insertion or withdrawal, but they may prevent optimal orientation of the upper occlusal plane and/or severely restrict inter-ridge space (127). In these circumstances, surgical reduction may be necessary. 128 and 129 illustrate the pre-operative and post-operative views of a patient with fibrous tuberosities.

Bony undercut tuberosities

These may compromise retention of the maxillary denture if its base cannot enter these undercuts. Surgery may also be indicated where the posterior intermaxillary space is compromised or where there is insufficient clearance between the tuberosity and the coronoid process. Exostoses on both jaws may also require reduction if judicious blocking out of the bony undercuts does not eliminate the problem.
Bony tori

On occasion, mandibular tori may be too large to permit coverage with a denture base and may require excision. Maxillary tori rarely require excision, unless they are very large or their position is near the junction of the hard and soft palates, thereby preventing development of an adequate post dam seal. Other exostoses, if small, may simply require surveying and blocking-out of unwanted undercuts on the master cast, thereby permitting coverage by the denture base.

Mental or genial tubercles

Removal of mental or genial tubercules (130), in our experience, tends to give rise to unsatisfactory aesthetic and functional results.

Frena or muscular attachments that interfere with peripheral seal

An isolated frenum or muscle attachment may frequently be left in place providing a functional seal can be achieved. However, where several attachments are present or where the attachment is close to the ridge crest, then retention and/or stability of the denture may be impaired and consideration should be given to surgical removal or re-positioning. Muscle attachments which are to be re-positioned require the use of acrylic stents, similar to those used for sulcoplasty (131–133).

130 Prominent genioglossus tubercle.

131 A prominent attachment before removal.

132 The prominent attachment shown in 131 after removal.

133 The acrylic stent required to maintain the ridge form created in 132.
Prominent mylohyoid ridges

Some centres claim increased patient satisfaction with complete dentures following the resection of mylohyoid ridges. We consider that the prosthodontist should always attempt to relieve the lower master cast prior to processing the lower denture, and thus avoid this surgical option. If this is not successful, surgery may be considered.

Major procedures to increase the denture-supporting area or to alter intermaxillary relations

Sulcoplasty and augmentation

Sulcoplasty In this technique, the origins of muscles adjacent to the mandible are detached and re-attached at a lower level. The corresponding procedure in the maxilla is termed a submucous vestibuloplasty. Both techniques are designed to increase the depth of sulci to provide for enhanced denture flanges. In the immediate post-operative phase, well-extended acrylic stents or appropriately adapted dentures are used to maintain the tissues at the new sulcular depth. These procedures may involve grafting of, for example, palatal mucosa, skin or porcine tissue (134, 135). 136 illustrates a poor post-sulcoplasty result with a reduced sulcus form and unfavourable prognosis for lower denture stability.

Augmentation A variety of materials has been implanted in an attempt to restore ridge height. Some materials (e.g. bone) tend to resorb like the host tissue before it. Other materials (e.g. silicone rubber) may accelerate bone resorption. Hydroxyapatite, usually in granular form, may be placed in a subperiosteal tunnel to create a new ridge (137).
Precautions

Recent research indicates that problems with mucosal integrity have occurred and care is needed in assessing the potential for mucosal expansion and subsequent ability to withstand loading.

Other forms of major surgery which may be required include osteotomies to improve antero-posterior intermaxillary relations.

Implants

The most promising forms of implants to date achieve their success via osseo-integration. It is a sine qua non that these systems require appropriate bone geometry and should not be inserted where medically contraindicated. Where bony geometry precludes osseo-integrated implants, other systems may be considered (e.g. sub-periosteal implants), although their prognosis for long-term success is less favourable. Whichever implant system is selected, it is imperative that a team approach to treatment is employed, with the prosthodontist instrumental in advising on the placement and angulation of implants to harmonise with prosthesis design and maintenance.
6. Managing the Occlusion

Introduction

This chapter addresses the identification and management of occlusal problems related to complete dentures:

1. Occlusal assessment and adjustment.
2. Face-bows and face-bow transfer.
3. Occlusal schemes for complete dentures.
4. Single complete dentures opposing natural teeth.

Occlusal assessment and adjustment

Aims

During mastication, swallowing and, abnormally, when speaking, the teeth come into contact and displacing forces are generated. These may compromise the stability and retention of one or both dentures.

It is therefore desirable that the teeth on complete dentures should have simultaneous, balanced, contacts in all these potential positions (balanced occlusion). The starting point, and most reproducible position, in the development of such balanced contacts is retruded contact position (RCP).

RCP should also coincide with intercuspal contact positions (ICP), allowing sufficient provision of ‘freedom’ in RCP to permit up to 1.5 mm of anterior movement. This will reduce displacing forces during small protrusive movements.

This area of ‘freedom’ may need to be enlarged in those patients who are incapable of precise control of mandibular movement (e.g. stroke victims, aged patients). In some cases this may necessitate the provision of cuspletless (non-anatomical) teeth.

Stability will be further compromised unless the cusps maintain sliding contacts during protrusion and right and left lateral mandibular movements. Without such balance, the dentures may rock causing pain, break the peripheral seal causing looseness, or fracture. This dynamic cuspal contact is termed balanced articulation.

Indications

All patients require balanced occlusion. Not all patients, however, require balanced articulation, for example those who exhibit only vertical chewing movements or who have adapted to flat occlusal schemes.

Balanced articulation should be provided for those patients:

- Who exhibit ruminatory chewing movements.
- With wear facets on the occlusal surfaces of their existing dentures.
- With reduced potential for retentive forces, e.g. advanced ridge resorption and xerostomia.
- With Class 2 Division I basal bone relationship.

Ideally, completed dentures should be remounted on an adjustable articulator, using a split cast technique, prior to final polishing and delivery to the clinician. Occlusal adjustment is then performed to eliminate the minor occlusal errors incurred in processing. Whether or not this is undertaken, the initial placement of completed dentures must be regarded as a trial insertion. It is the responsibility of the clinician to detect and eliminate any occlusal errors or any other potential source of pain and discomfort before the patient departs with the dentures.

Recognition of occlusal faults

Occlusal errors may be considered in terms of a horizontal or a vertical component.

1. Ensure denture bases are stable. This may be achieved by placing one’s forefingers along the buccal flanges of the lower denture, to better stabilise this denture.

   On occasion, the upper denture may also require stabilisation.

2. Ask the patient to relax and close slowly into RCP until the teeth just touch. The initial contact may be detected visually, by tactile transmission or by the patient reporting which side touches first, although the latter is not always reliable. Prematurities in RCP or sliding into ICP (which may be in the coronal or sagittal planes) may then be detected.
Excessive occlusal vertical dimension may produce difficulties in approximating the lips.

Errors in vertical dimension may be detected by measuring freeway space indirectly (resting vertical dimension minus occlusal vertical dimension), by phonetic tests, such as ability to make bilabial or sibilant sounds, by general appearance (138) or by patient opinion.

Outline of techniques

Occlusal adjustment is carried out as follows:

Errors in RCP

If a prematurity in RCP exists, avoid reducing cusp tips, as upper palatal cusps and the lower buccal cusps are vertical dimension stops. Upper buccal cusps are also required for balanced articulation in working excursions. Thus, deepen fossae and marginal ridges to eliminate the prematurity and obtain balanced, even contact.

The lower denture may slide protrusively from RCP to ICP on cuspal inclines. This can result in discomfort typically lingual to the lower anterior ridge. If the discrepancy is less than one-half cusp width, identify slide zones with articulating paper and reduce the following cuspal inclines:

- Mesial-facing slopes of upper buccal cusps.
- Distal-facing slopes of lower buccal cusps.

Articulating paper may produce false-positive results because of its thickness, movement or folding (139). Occlusal sprays give more consistent results. A face-bow transfer should be used to relate the maxillary plane to the condylar axis of an adjustable articulator and, provided appropriate occlusal records are made, occlusal adjustments may be performed as described above.

Errors in protrusive excursions

These may result in:

- A negative overbite (‘anterior open bite’) indicating that the sagittal guidance angles on the articulator are at variance with those of the patient.
- A premature contact anteriorly, indicative of an inappropriately steep incisal guidance angle or of a compensating curve that is too flat.

If a negative overbite occurs in protrusion, and if (i) the patient does not exhibit a marked Class 2 Division I skeletal pattern, and (ii) the discrepancy is less than 1 mm, identify the premature contacts using articulating paper and reduce the following cuspal inclines:

- Disto-lingual slopes of upper buccal cusps.
- Mesio-buccal slopes of lower buccal cusps.
- Plus any prematurities in marginal or intercuspal ridges.

If an anterior gap of >1 mm exists between the upper and lower incisor teeth in protrusion, resetting the incisor teeth is indicated.

Where there is a premature contact anteriorly, and the patient is unable to achieve an edge-to-edge position because of incisor locking, mark the excessive overlap with a sharp coloured pencil (140). Recheck the relative lengths of upper and lower incisors to see if one or both require altering. If the level of the upper teeth is acceptable, grind the lower incisors to the level of the pencil mark, angling the trimmer so as not to compromise the appearance. If the lower incisal plane level is acceptable and the upper too low, reduce the excess from the upper incisors by removing more from the palatal than the labial surfaces.

If both incisal levels are not satisfactory, re-set all the anterior teeth.
Use of a pencil to mark the anterior over-bite in occlusion.

Precautions

If the incisal negative overbite is a result of an insufficient compensating curve, then balance in protrusion may not be obtained by grinding incisor teeth. A face-bow transfer plus occlusal records in retruded jaw relation, protrusion and right and left lateral excursions are necessary prior to adjusting the teeth on an articulator. In some cases, the teeth may need to be re-set.

Errors in left and right excursions

Premature contacts on the working side prevent balancing-side contact. Grind whichever of the following is producing an interference: palatal-facing slopes of the upper buccal cusps and/or buccal-facing slopes of the lower lingual cusps on the working side. This is termed the BULL rule – Buccal Upper, Lingual Lower. As none of these is supporting cusps, such adjustments will not compromise occlusal balance in RCP.

Premature contacts on the balancing side rarely occur but their presence requires that the offending area of interference on the supporting cusp tips be reduced to permit contact on the working side. It is suggested that two colours of articulating paper be used in this exercise, to permit the different areas associated with vertical dimension stops and interferences to be identified.

Where the registration is grossly incorrect, if the patient is unable to ‘find’ a reproducible RCP, or if the patient exhibits unusual and uneven wear of the posterior teeth, then the use of occlusal pivots should be considered. This form of appliance may be used on the patient’s existing denture or may be prescribed as a short-term therapy on the replacement lower denture (see below).

Vertical errors

Excessive freeway space

If the upper occlusal plane is acceptable, occlusal pivots should be used to establish an appropriate vertical dimension. Occlusal pivots consist of two flat-surfaced pillars of acrylic that are placed on the second pre-molar and first molar regions of the lower denture. The technique for construction of occlusal pivots on the existing dentures is as follows:

1. Cut two strips of 0.5 mm thick tin foil, 10 × 20 mm, and bend into a U-shape (141).
2. Place the foil over the lower second premolars and first molars after adding self-polymerising poly(methylmethacrylate) (PMMA) dough to the teeth under the foil (142).
3. Seat the denture in the mouth and ask the patient to close gently into RCP.
142 Foil in position after addition of acrylic resin to the second pre-molar and first molar area of the lower denture.

143 Acrylic pivot of planned thickness following removal of foil.

144 Closure beyond the estimated vertical dimension produces excessive displacement of the acrylic dough.

**Precautions** The patient must stop closing when bilateral contact is made otherwise the polymer will be displaced (143, 144).

4. Remove the denture and cure the polymer. Then confirm that the occlusal contacts are bilateral and even.

5. Remove foil and polish the occlusal pivots ensuring that the occlusal surfaces are flat (145). Any modifications to the pivots may be carried out at review appointments where vertical dimension may be increased or reduced as indicated.

Pivots may also be used to assess a patient’s tolerance to a proposed increase in the vertical dimension of occlusion in replacement dentures; the existing denture is again used as a diagnostic aid (146).

**Modification** Occlusal pivots may also be prescribed in replacement dentures if the patient has never successfully worn a complete lower prosthesis or is unable to give a reproducible RCP.

In such cases, the denture stages progress conventionally until after the trial stage. The lower posterior teeth are then removed and replaced by wax pivots; these become acrylic pivots following processing (147). At the time of delivery to the patient, care should be taken to ensure that occlusal contact on the flat pivots is bilateral and even. Further, the
transient nature of this occlusal ‘splint’ should be made clear to the patient. Review visits permit occlusal adjustment, in addition to allowing the denture base to be relieved of any pressure areas. When the patient is able to provide a reproducible RCP, an occlusal registration is recorded by placing a suitable material mesial and distal to the pivots to record the intermaxillary relationship. When the dentures have been mounted on a semi-adjustable articulator, the posterior teeth are added.

_Insufficient freeway space_

If insufficient freeway space exists, then treatment options depend on how much reduction in vertical dimension is required. If less than 1.5 mm space is required, this may be achieved by grinding the central fossae and marginal ridges in the manner described for prematurities in RCP.

If more than 1.5 mm space is required and the level of one occlusal plane is acceptable, record a face-bow transfer, remove the opposing teeth by grinding and re-register in RCP prior to re-setting.

When both upper and lower planes are inappropriate, completely re-making the dentures is a sensible alternative.

**Face-bows and face-bow transfer**

**Introduction**

Clinical experience suggests that many patients are wearing complete dentures that do not conform to prosthodontic ideals, especially those relating to the geometry of occlusion. That these patients cope with their dentures owes much to patient adaptability.

A corollary of this finding is that articulators, articulation and clinical aids to the prescription of complete dentures of appropriate occlusal form are often overlooked; one such omission is the use of face-bow transfers. The purpose of this section is to suggest when, in particular, face-bow transfers are indicated.

**Indications**

Whilst the use of face-bows is not essential in all cases of complete denture construction, they are to be recommended particularly where the patient exhibits obvious signs of non-vertical chewing movements, in those cases where a complete upper denture opposes a natural dentition, and where there are evident unusual facial disproportions.
Reference point for positioning of a face-bow. E = external auditory meatus.

Face-bow positioned using the reference points indicated in 149 and 151.

149 Reference point for positioning of a face-bow. N = nasion.

piece to locate nasion (150). The second type locates over two posterior points (or crosses) placed on the skin approximately overlying the condyles and uses an infra-orbital pointer to locate orbitale and the selected plane of reference is the (horizontal) Frankfurt plane (151). 152 illustrates a face-bow in position where the reference points used are outlined in 151.

The former technique is clinically preferable to the latter owing to the improved stability of the assembly by virtue of the location of the ear-pieces.

The clinical stages are:

1. When the upper record rim has been shaped appropriately and the RCP registered, the blocks should not be sealed together.
2. Heat the face-bow fork and insert it into the record block, taking care not to destroy any markings relating to tooth position, smile-lines, etc. (153). The lower record rim may then be inserted to help stabilise the bite-fork assembly.
3. Place the face-bow over the fork and the three reference points and tighten the locking screws in such a way as to relate the occlusal rim to the reference plane unambiguously. Release the posterior locators and remove the assembly, including the upper record block. After appropriate cross-infection control procedures, send the assembly to the laboratory.

This procedure may be carried out at the trial insertion stage, when it is easier to confirm RCP in addition to recording protrusive and lateral (working) relationships. 154 illustrates the differences in angulation of occlusal planes between (i) the non-use of face-bow transfer and (ii) the use of face-bow transfer.
Occlusal schemes for complete dentures

Introduction

Whilst the detailed theories of occlusal geometry are outwith the remit of this textbook, it is germane for our objectives to indicate factors affecting the selection of teeth and occlusal schemes appropriate to the aesthetic and functional requirements of each patient.

Aims

When planning the occlusal scheme for a prosthesis, the first consideration is to determine if it is possible to include all of the posterior teeth. 155 illustrates a clinical situation where the patient has a large tuberosity with a relatively small intermaxillary space. Whilst placement of posterior teeth here may be anatomically possible, freeway space may be compromised, and an undesirable occlusal plane (i.e. depressed posteriorly) would occur with resultant problems of anterior 'open bite' in protrusive movements (156). In this instance, placement of porcelain
molar teeth is contraindicated, owing to the need for mechanical retention of the porcelain to the denture base acrylic. In many cases, it is advisable to reduce the length of the occlusal tables, so that an appropriate plane of occlusion is provided (157 and 158). Other aspects of intermaxillary space to merit consideration concern pre-molar teeth; for reasons of aesthetics, the length of the upper pre-molar teeth should be in harmony with the canine anterior to them.

Similar consideration should be given to mesiodistal dimensions, for example in the mandible where teeth should not be positioned in the denture base over the retro-molar pad; this situation has been shown previously to lead to instability (84). Similar consideration should be given to those cases where the mandibular ridge rises steeply to meet the ramus.

While many patients tolerate complete dentures that have been set up on plane-line articulators and that exhibit no semblance of balanced articulation, it is nevertheless desirable to identify those patients for whom balanced articulation is advisable. 159 illustrates dentures of a patient who exhibits vertical chewing movements and who would probably function satisfactorily if provided with dentures that were not designed for balanced articulation. 160, however, illustrates wear facets on a complete upper denture and this type of wear would suggest that a range of mandibular excursions are practised in function and that balanced articulation is required.

A practical aid is for the prosthodontist to offer the patient a brittle item of food and to observe the patient’s mandibular movements as it is being masticated. Where non-vertical movements predominate, more elaborate occlusal schemes are indicated.
Indications for types of occlusal schemes

In essence, three types of occlusal schemes are prescribed, namely:

1. Anatomically shaped teeth in upper and lower dentures.
2. Non-anatomically shaped teeth in both dentures.
3. A combination of both types, usually anatomically shaped teeth in the upper.

Whilst there are suggested guidelines for the usage of all three of these options, based on biomechanical determinants, it would be accurate to state that no one form is best for all patients. Some suggested guidelines for occlusal schemes are listed in Table 6.1.

Table 6.1 Type of occlusal scheme related to residual ridge form.*

<table>
<thead>
<tr>
<th>Ridge form</th>
<th>Inter-maxillary space</th>
<th>Skeletal base relationship</th>
<th>Occlusal scheme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atwood II, III or IV; firm</td>
<td>Reduced</td>
<td>Class I, II or III</td>
<td>Anatomical but omit 1st/2nd molar</td>
</tr>
<tr>
<td>Atwood II, III or IV; firm</td>
<td>Average</td>
<td>Class I, II or III</td>
<td>Anatomical cross-bite where required</td>
</tr>
<tr>
<td>Atwood V, VI; firm</td>
<td>Increased</td>
<td>Class I, II or III</td>
<td>Non-anatomical or combination</td>
</tr>
<tr>
<td>Atwood V, VI; displaceable</td>
<td>Normal-increased</td>
<td>Class I, II or III</td>
<td>Non-anatomical or combination</td>
</tr>
</tbody>
</table>

*Modified from Payne, 1941.
control is deemed to be poor, it may be perceived to be inappropriate to incorporate cusped teeth. Proponents of the use of non-anatomically shaped (cusplees) teeth advocate their use for patients with flat ridges. Cuspleess teeth are considered to eliminate displacing forces arising from deflectional cuspal contacts when no food is in the mouth. In addition, lateral stresses on underlying tissues are considered to be reduced. Cuspleess teeth may be ground to provide occlusal balance in RCP and, if desired, areas of occlusal ‘freedom’ may be created near RCP by virtue of the cuspleess nature of these teeth (163). It is true that laboratory time and costs should be reduced in such cases, but it is unlikely that a truly balanced occlusion would be obtained, and some patients consider cuspleess teeth to be unaesthetic.

3. Combinations of cuspleess and anatomical teeth have been used for many years. More recently, modifications of cusped teeth to produce ‘lingualised occlusion’ or ‘palatal cuspal contact occlusion’ have been suggested. In essence, the teeth are modified to reduce bucco-lingual cuspal inclines and the palatal (lingual) cusps of the maxillary teeth are placed in the central fossae of mandibular teeth, as per conventional anatomic arrangements. The buccal cusps of the maxillary teeth are ground out of contact, resulting in a mortar and pestle effect and this directs occlusal forces lingual to the ridge without displacing the denture base lingually (164).

161 Cusped teeth should be used where patients have favourable ridge form.

162 Teeth set-up for the patient shown in 161.

163 Cuspleess teeth set-up for a patient having a grossly atrophic lower residual ridge.

164 Diagram to illustrate ‘lingualised’ occlusion.
Choice of tooth material

No scientifically determined guidelines exist regarding the choice of material for posterior teeth, and it is often a matter of clinical preference or experience that determines the selection. In addition, patient perceptions regarding tooth material may influence choice (e.g. some patients complain of noises with porcelain teeth). Table 6.2 indicates relative advantages and disadvantages of porcelain and acrylic teeth. It is possible to combine porcelain and acrylic resin teeth in opposing dentures.

Table 6.2 Porcelain versus acrylic teeth.

<table>
<thead>
<tr>
<th>Porcelain teeth</th>
<th>Acrylic teeth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wear is insignificant</td>
<td>Wear obvious, even in co-polymer teeth</td>
</tr>
<tr>
<td>OVD tends not to be reduced</td>
<td>Wear results in reduced OVD</td>
</tr>
<tr>
<td>Occlusal form remains unchanged, and may be ground and polished</td>
<td>Occlusal form prone to wear and reverse compensating curve may result</td>
</tr>
<tr>
<td>Tooth contouring exacting and may result in tooth fracture</td>
<td>Occlusal adjustments relatively easy</td>
</tr>
<tr>
<td>Grinding may accelerate wear of opposing occlusal surfaces if polishing not performed</td>
<td>Opposing teeth/occlusal surfaces exhibit negligible wear</td>
</tr>
<tr>
<td>Rely on mechanical retention, silane bonding problematic</td>
<td>Chemical bonding</td>
</tr>
<tr>
<td>Problems of positioning and retention if inter-maxillary space small</td>
<td>Easier to grind without losing retention</td>
</tr>
<tr>
<td>Sharp impact sound, brittle, prone to chipping</td>
<td>Low impact sound, less brittle, rarely chip</td>
</tr>
<tr>
<td>Marginal staining possibly owing to capillary leakage</td>
<td>Easily polished, stained as required</td>
</tr>
</tbody>
</table>

The most common combination is porcelain cusped teeth in the upper and acrylic cuspless teeth in the lower. Wear of the lower teeth is inevitable, as is a compensatory protrusive ‘slide’ of the mandible as the OVD is reduced. If the lower anterior teeth are made of acrylic resin, these will also abrade and little extra trauma to the lower ridge will result. The use of porcelain anterior upper and lower incisors and acrylic posteriors is to be deprecated as, with wear of the posterior teeth, anterior locking of the occlusion will result in trauma to the anterior aspects of both upper and lower ridges.

Single complete dentures opposing natural teeth

Introduction

The single complete maxillary denture opposed by most or some of the natural mandibular dentition is not uncommon. A frequent finding in such cases is that unfavourable (displacing) occlusal forces tend to occur and result in pain, discomfort and often in ridge resorption. Whilst appropriate impression techniques are required to maximise retentive forces (see Chapter 5) great care must be exercised to customise occlusal form, and thus reduce displacing forces, if denture stability and, ultimately, a successful outcome is to be achieved.

The occlusal plane of a single complete denture, opposed by a natural dentition, or predominantly natural dentition, often requires more careful planning of both the natural and the denture’s occlusal surfaces if denture stability is to be obtained.

Aims

To prescribe dentures that remain stable in function and which conform to phonetic and aesthetic determinants imposed by the remaining lower teeth.
**Outline of techniques**

1. A prerequisite of all prosthodontic treatment is the making of impressions appropriate to the tissues on and adjacent to the ridges; this is addressed in Chapter 5.

2. Prior to the making of definitive impressions, mount the study casts on a semi-adjustable articulator with a view to assessing the need for desirable modifications to the teeth of the opposing arch. This could involve tooth extraction, crown reduction for overdentures, or the re-definition of occlusal surfaces or occlusal planes via selective grinding, partial onlays (fixed or removable) or crowning (165 and 166).

3. At the registration visit, the proposed maxillary plane is related to the axio-orbital plane. This relationship is transferred to an appropriate semi-adjustable articulator by means of inter-maxillary records. This may take the form of a registration-paste record on the maxillary block or a gothic-arch tracing (167 and 168).

4. At the trial insertion stage, when RCP has been verified and aesthetic and phonetic assessments satisfactorily completed, record the following (where the gothic-arch tracing was performed, confirm the following):

- Protrusive relationship.
- Right and left lateral relationships (169).
These will enable the sagittal condylar guidance and lateral condylar guidance settings to be confirmed following appropriate placement and articulation of the complete denture and the opposing cast on the articulator (170).

In this way, the occlusion may be customised by grinding those cusps or ridges which would result in excessive displacing forces.

5. Care should also be taken to select appropriate occlusal surfaces. This may indicate the use of cuspless (non-anatomical) teeth; as this may affect denture aesthetics, anatomical teeth may require customisation.

Another factor worthy of consideration is wear of the denture teeth (see Table 6.2). Although porcelain teeth have superior wear properties compared to polymeric teeth, customising the occlusion is more difficult and inter-maxillary space may contraindicate their usage. Denture occlusion, however, tends to be better protected against wear by porcelain posterior teeth.

Acrylic occlusal surfaces may be ‘protected’ by placing amalgam in the central stop areas, or by hollowing central fossae of the mandibular posterior teeth and the palatal cusps of the maxillary teeth and generating an occlusal form in wax. The wax pattern so formed may be cast in gold alloy and cemented in place. This would result in occlusal surfaces that, while more expensive, would be more durable than polymeric surfaces.
7. Managing the Existing Denture

Introduction

This chapter discusses how existing dentures, worn apparently successfully by a patient may be improved:

- Linings, both hard and resilient.
- Template dentures.
- Denture repairs.

Hard relining

Aims

To restore close, even contact between the impression surface of a denture and its supporting tissues, thereby improving retentive forces and support.

Indications

When lack of fit to the supporting tissues has been identified as the cause of looseness or pain (see Chapter 4).

While relining may be combined with improving border extension (depth and/or width labially/buccally/lingually, length posteriorly) or provision of a post dam, it cannot correct errors in tooth positioning (vertical and/or horizontal). Nor can it be used where there is:

- No freeway space.
- Lack of balanced occlusion and articulation.
- Non-alignment with optimal denture space.
- Incorrect contour for neuromuscular control.

In such instances, the denture(s) must be re-made. Accurate diagnosis of the cause of the patient’s complaint is therefore of paramount importance.

Precautions

1. During the impression procedure avoid displacing the denture vertically or horizontally relative to its supporting tissues. Such displacement alters the occlusal vertical dimension, occlusal contacts, occlusal plane, incisal level, lip support and position in the denture space thereby increasing displacing forces and changing aesthetics (171). It also increases the thickness of the denture palate, potentially inducing nausea and difficulties with speech.

The maintenance of pre-existing occlusal contacts and jaw relationships during impression taking is the only means of preventing such effects.

A pre-requisite of successful relining is therefore that the occlusion is balanced in the retruded contact position, that intercuspal and retruded contact positions are coincident, and that the occlusal vertical dimension can be increased by up to 1.5 mm.

171 This denture has been displaced downwards and forwards by an inappropriate relining procedure.
Denture prepared for a relining impression.

A film of impression material which includes all denture margins is required.

An inadequately prepared denture with incorrectly applied impression material is a recipe for disaster.

diameter holes to prevent excessive hydrostatic pressure within the film of impression material (172).

- After seating the denture on its supporting tissues and checking for the presence of pre-existing occlusal contacts and jaw relationship, maintain the position of the denture while the impression material sets using only minimal finger pressure.

3. If the old denture base material has deteriorated or there is a history of repeated fracture, request the laboratory to re-base the denture rather than simply reline it (the clinical technique is identical).

Outline of technique

1. Prepare supporting tissues (see precaution 2 above).

Prepare denture:

- Perfect occlusal contacts if not done previously.
- Perfect border extensions if not done previously.
- Make holes in palate.
- Remove undercuts from impression surface.

2. Apply any necessary adhesive to the prepared denture surfaces, followed by the impression material as a thin film, ensuring that the borders are covered (173). Pooling of the material in the ridge area (174) predisposes to an inaccurate impression.
175 Zinc oxide/eugenol is also a satisfactory material for impressions prior to relining.

177 Non-corticated bone does not represent a good base for the placement of resilient linings.

3. Take impression in upper denture applying seating pressure in upwards and backwards direction. Check that pre-existing occlusal contacts and jaw relationship with lower denture are maintained.

4. Take impression of lower denture utilising, mutatis mutandis, the same precautions. (Completed impressions are shown in 175.)

5. When upper cast becomes available, cut the groove for the post dam to the clinically predetermined depth and width that will provide the optimal posterior border seal (see page 13). The groove should extend through the hamular notches into the disto-buccal sulci.

6. When returning the relined dentures to the patient, carefully re-check, and if necessary adjust, the occlusal contacts and jaw relationship provided by the appliances.

Resilient soft linings

Aims
To absorb the impact energy of masticatory forces and distribute it more evenly over the supporting tissues. Acrylic and silicone materials are available, silicone being the softer.

Indications
A resilient lining must not be regarded as a panacea. It is most effective when used over corticated bony elevations (176); it is not particularly useful in reducing discomfort produced by spiky non-corticated hard tissues (177). Some authorities advocate their use for improving denture retention (e.g. engaging undercuts). They are not advised
where the mental neurovascular bundle is superficially placed.

Such linings have considerable disadvantages:

- They may tend to peel off the hard acrylic denture base (acrylic materials adhere better).
- They are difficult to adjust (acrylic materials are more easily altered).
- They are porous, tending to absorb oral fluids (with resultant swelling and odour) and harbour bacteria and fungi (178).
- They rapidly deteriorate and require replacement at approximately 9–18 month intervals (179).
- They must be 3 mm thick for maximum effectiveness (180); this may seriously weaken a lower denture which then requires strengthening (e.g. by a cast metal plate [181]).
- Patients can become habituated to such linings, believing that a hard denture impression surface could never be satisfactory.
- They rub the oral mucosa since they deform under masticatory pressure. This effect is exacerbated if the occlusion is not perfect; indeed, perfecting the occlusion is difficult in the presence of a resilient lining since the denture moves under occlusal load. This rubbing contraindicates their use in patients with severe mucosal atrophy and/or xerostomia.

In view of these problems, it is recommended that the lower denture be initially processed totally in hard acrylic. This permits checking of denture base fit and border extension, and perfection of occlusal contacts (preferably by using a face-bow transfer and adjustment of the appliances following mounting on an articulator). The need for a resilient lining may then disappear. If, after careful assessment, a resilient lining is still required, it can be added in the laboratory following a normal reline impression procedure (vide supra).

Cleaning and adjustment of resilient linings are considered in Chapter 8.
Template dentures

Aims
Transfer of contours from old to new dentures for maintenance of neuromuscular control.

Synonyms
Copy dentures, replica techniques.

Indications
A denture that has been worn satisfactorily for a period of time may become ill-fitting as alveolar resorption proceeds. The patient is able to continue to wear the denture since neuromuscular control is gradually learnt as the fit of the appliance to its supporting tissues slowly deteriorates. Elderly and/or infirm patients may never learn to control a new denture if the contours of the latter, particularly the shape of its polished surfaces, differ greatly from those of the old appliance.

Modifications to the basic shape of the old denture should therefore be only those necessary to correct the cause of the patient's complaint (e.g. loss of fit producing looseness requires an impression of the supporting tissues) and/or those considered essential by the operator (e.g. slight increase in occlusal vertical dimension to reduce over-closure and/or replacement of worn teeth).

This process of modified replication is accomplished by making a mould around the old denture, forming a template in the mould, adjusting the template as required, and conversion of the modified template into the new denture.

This procedure is thus suitable for:
- Replication of dentures for a ‘spare set’.
- Replacement of dentures with provision of new impression surfaces, and/or new occlusal surfaces, and/or slight modification to the occlusal vertical dimension.
- Replacement of dentures whose base material has deteriorated.
- Production of temporary dentures that can be progressively modified if the patient’s capacity to adapt is in doubt (e.g. gradual increase in occlusal vertical dimension) or if the cause of the patient's complaint is in doubt (e.g. ‘denture collectors’, see page 68). Once a satisfactory appliance has been achieved, it can be copied to produce a definitive denture.

The technique is unsuitable for effecting major changes in tooth position that alter denture contours.

Outline of technique
The mould material must be elastic to reproduce the contours of the old denture; alginate or silicone putty is suitable. Alginate must be supported within the most rigid container that is available; a modified denture-processing flask (182) or metal container designed for the purpose is ideal, a similarly modified soap container whose lid and base precisely locate on each other (183) is also suitable if used with care. Silicone putty (a laboratory grade may be used) is more rigid than alginate and disposable stock impression trays are sufficient for support.

An outline of the technique when using alginate investment follows; descriptions of other techniques may be found in the literature.
Clinical visit 1

The history is taken and the patient’s old dentures examined. As an aide-mémoire, the treatment plan should list those features of the old dentures to be copied and those to be modified (see Table 3.2). Any under-extension in depth/width/length of the borders of the old dentures is corrected by addition of tracing compound (184). The occlusal and polished surfaces of the dentures are invested in alginate in the base portion of the container; the set alginate is trimmed in a straight line from the borders of the container to the borders of the denture (185). The exposed impression surface of the denture is carefully covered with freshly mixed alginate to exclude air before the lid of the container, filled with more of this mix of alginate, is seated on the base utilising pressure applied to the corners only (186). When the alginate has set, the container is opened and the denture removed. Any tracing compound is detached and the denture returned to the patient.

Technical stage 1

Sprue holes, approximately the diameter of a pencil, are cut in the alginate from the most distal aspect of the denture to the exterior (187). Modelling wax is melted into the impressions of the teeth until their gingival margins are covered (188). After re-assembly, the box is held together with rubber bands and a mix of self-curing acrylic, the consistency of double cream, is poured down one sprue hole while air escapes from the other; vibration aids this progress. When polymerised, the acrylic baseplate/wax teeth template is removed, trimmed and smoothed for insertion in the mouth (189).
Clinical visit 2

The template borders are adjusted where over-extended and the bases prepared for impression taking as described for the relining of dentures (vide supra). Silicone impression material is recommended since the templates have to be re-inserted in the mouth. When the impressions have been taken, wax is added to, or removed from, the occlusal surfaces of the replica teeth as necessary before the desired jaw relationship is recorded with registration paste. The shade and mould for the teeth are noted.

Technical stage 2

Casts are produced from the impressions and mounted on an adjustable articulator utilising the prescribed jaw relationship. Wax teeth are removed one or two at a time from the templates and replaced with stock teeth (190). The templates are prepared for trial insertion.

Clinical visit 3

The modified templates are tried in the mouth and their fit, border extensions, occlusion, jaw relationship and aesthetics checked. The groove for the post dam is carved in the upper cast to the clinically determined depth, width and length.

Technical stage 3

The templates are flasked and the self-cure baseplates removed before the moulds are packed with normal denture base acrylic. The polymerised dentures are prepared for delivery to the patient.

Clinical visit 4

The dentures are inserted and checked as usual.
4. Since the spatial positioning of the teeth and the contours of the polished surfaces are important for neuromuscular control, the placement of the stock teeth on the templates must be undertaken with great care.

**Modifications of basic technique**

**Addition of labial flange to open-face denture**

Immediate dentures provide a valuable record of the position of natural teeth relative to the muscular environment and residual alveolar ridge; the template technique is therefore ideal for the production of replacement appliances. However, alveolar resorption usually requires the provision of a labial flange on the replacement denture in order to support the lip and increase denture stability (191).

Softened tracing compound should be placed on the gingival margins of the relevant teeth and moulded between the fingers into roughly the size and shape of the flange to be added. Following re-softening of the compound, moulding is completed with the denture in the mouth (192). Any excess compound on the labial surfaces of the teeth is removed before the denture is invested in the alginate or silicone mould material. The compound is removed before returning the denture to the patient. The template is formed in the usual way (193).

The extension of the flange and its effect on lip position and denture stability can be assessed prior to perfecting the fit of the template to the supporting tissues with an impression in the manner previously described. Normal procedures are also used in the production of the trial denture and ultimately, the finished replacement denture.
Denture repairs

Introduction
A factor to consider in the aftercare of denture provision is the need to repair either a tooth of a denture or the denture itself. The clinician should determine the cause of a fracture; failure to correct any underlying cause will result in subsequent fractures.

Materials used
It is possible to repair acrylic resin-based complete dentures using heat-polymerised, autopolymerised or light-polymerised materials. The use of heat-cured resin to repair a denture carries the risk of incurring warpage of the denture base during processing. However, autopolymerised repairs lack the strength of heat-cured repairs and may be prone to porosity and discoloration after some time. A light-cured resin may be used but insufficient long-term data are available to accredit this system.

Where the acrylic of any of the three curing mechanisms is applied to areas exposed to the cast, the cast should be coated with a separating material to prevent adherence of the polymer to the cast.

Techniques

Chipped tooth
- If the tooth is acrylic and in a non-critical position (e.g. the incisal edge of an incisor or a non-cenric stop cusp of a molar tooth), then the tooth could be polished. In some cases, this may impart a natural appearance to the denture (195).
- If the teeth are made of porcelain, or the fracture is so large that polishing is not acceptable (196) remove the tooth or teeth concerned (197), wax the replacement teeth in place, taking care to make a plaster or silicone putty index of the repaired form (198) and replace the wax with acrylic resin (199). To facilitate union, the prepared acrylic surface should be primed with monomer. Care must be taken to ensure that occlusal interferences do not occur.
195 A chipped tooth may be 'repaired' by re-polishing.

196 The fractured tooth (31).

197 Tooth 31 has been removed.

198 An index in silicone rubber has been prepared after waxing tooth 31 into position.

Lost tooth or teeth
Treatment will normally be as in the case of porcelain (above). If, however, the tooth or (especially teeth) are lost and if the denture opposes a natural dentition or a restored arch, then an impression of the opposing arch plus an interocclusal record will be required. The denture being repaired may thus be articulated against a model of the opposing arch, and the teeth set up without the creation of occlusal discrepancies.

Fractured flanges
In essence, this is dealt with in a similar way to the reline of an open-faced denture. The deficient piece of flange (200) is replaced by forming tracing compound on to the lost area of flange in situ (201), pouring a cast and replacing the compound with acrylic resin after appropriate separation of the cast.
Fractured flange plus tooth or teeth

This type of repair may be better combined with a re-base and it is often advantageous to replace the lost area of flange with tracing compound, and to take an impression of the opposing arch plus an inter-occlusal record as in the case above.

Midline fractures

Repair of such fractures (202) is not recommended if the fractured fragments cannot be accurately approximated.

The techniques for maxillary or mandibular prostheses are similar. Here, the use of an autopolymerised resin is described.

Assemble the fractured pieces (203) and hold the fragments together with wooden sticks or metal rods plus sticky wax. If possible, re-insert in the mouth to verify accuracy of re-assembly. Block out any undercuts on the impression surface with moist cotton wool prior to pouring a plaster cast. When the plaster has set, remove the wooden sticks or metal rods and sticky wax before elevating the fractured fragments from the cast. Prepare the fragments by removing 3 mm of acrylic from the fracture line. It is recommended that a long rounded bevel be used to produce a bond of acceptable strength, that the acrylic be removed from the polished surface of the denture and that this be extended on to the labial surface (204). Coat the cast with separating material. When this has dried, place the fragments on to the cast, wet the edges of the bevel with monomer and place the acrylic, incrementally, on to the bevel until all areas of the bevel are covered. After curing under pressure, the repaired areas are polished before the denture is returned to the patient (205).
Complete Prosthodontics: Problems, Diagnosis and Management

204 Preparation of the denture for repair.  205 The completed repair.

206 Occlusal error requiring replacement of the lower posterior teeth.

207 Articulated dentures from which the lower posterior teeth have been removed.

**Replacement of posterior teeth**

This may be necessary because of a need to alter the vertical dimension of occlusion, due to a gross error in occlusion (206), or patient preference.

The technique is as follows:

1. Ensure that both RCP and OVD are confirmed and that the casts are placed on a semi-adjustable articulator following face-bow transfer and appropriate settings of sagittal and lateral condylar inclines.

2. Block out undercuts on the fitting surface, pour a cast on to the impression surface of the denture and articulate the dentures. Remove the appropriate posterior teeth; if acrylic, by grinding and if porcelain by heating the acrylic enveloping the teeth and removing with an appropriate instrument.

3. Remove sufficient denture base to accommodate replacement teeth (207).
Lower teeth waxed in position.

Silicone rubber index prepared.

4. Wax teeth to replacement position (208). Make indices of the buccal and occlusal surfaces of the teeth in their new positions (209).
5. Remove indices plus teeth.
6. Remove wax, roughen surface of prepared denture base, replace indices with attached teeth and add acrylic, incrementally.
7. When curing has been completed, ensure occlusion is unaltered, polish denture and re-confirm the occlusion clinically (210).

Repair completed.
8. Managing the Outcome: Audit

Denture identification

Identification marks on dentures have two purposes: (i) the identification of the patient from the denture (useful for loss of memory or forensic purposes) and (ii) the identification of the dentures for the patient (useful if dentures are removed en masse for cleaning in residential homes or hospitals). In the latter instance, old dentures may be deficient in fit and function but if misplaced, a valuable clinical reference is lost and replacement appliances may be beyond the adaptive potential of elderly patients.

A variety of methods exist for the incorporation of aids to identification within dentures under construction. Most of these ensure permanent legibility of names; some are readable only with the aid of specialist equipment (e.g. an ultraviolet light source) whilst others have to be removed from the dentures before the recorded details can be deciphered. For routine use, any inclusion method that ensures legibility is acceptable, provided the denture is not weakened or aesthetics impaired (incorporation in the posterior aspect of a buccal flange is recommended). Scribing the surface of the master cast so that a raised name or number appears on the impression surface of the denture is deprecated since chronic irritation of the contacted oral mucosa may result.

In the absence of universal inclusion marking of dentures, appliances can have aids to identification applied to the surface of the acrylic. Denture cleansing procedures or function within the oral cavity may, however, render the marks illegible. Covering a mark with sealant increases its longevity.

A method for applying a surface aid to identification with satisfactory longevity is as follows:

1. Seek patient’s permission to apply identification mark.
2. Remove polish and lightly roughen distal aspect of buccal flange with rotary instrument, small square of disposable scouring pad or small piece of sandpaper. Remove debris and dry area by wiping with paper tissue.
3. With fine graphite pencil, write patient’s name and initials and/or other information on abraded acrylic surface. Remove any graphite dust.
4. Cover identifier with two coats of clear sealant applied with a small brush. Allow to dry and harden before returning denture to patient. Marked dentures are shown in 211.

Nail varnish does not bond with the acrylic and offers only limited protection to the identifier. Proprietary sealants are available; an effective substitute may be prepared by dissolving 5 g of clear acrylic polymer in 20 ml of chloroform. The resultant solution may be stored in a bottle with a brush attached to the cap.

If necessary, the identification marks can be replaced at the annual recall visit.
Essential instructions to patients

These should include verbal outlining of the most important principles and a printed sheet of more detailed instructions for the patient to take home and read at leisure. Simple instructions in large print are advised.

The wearing of dentures is an activity that initially requires conscious effort; patients must be warned of this as treatment progresses so that the dentist is not blamed for any early difficulties with mastication (e.g., it will take longer to eat a meal as both dentures and food have to be controlled). Even when the template method for denture production is utilised (see Chapter 7), elderly and/or infirm patients may take longer to develop the necessary adjusted reflexes for habitual appliance control. To encourage rapid development of such reflexes, the dentist must produce stable, comfortable dentures and the patient should be advised to eat small portions of soft food using the posterior teeth. It can take up to three months for new dentures to attain the masticatory efficiency of the previously worn appliances.

If the new dentures make the mouth very sore, they should be removed and the previous appliances temporarily replaced. The patient should seek an early review with the dentist; indeed, it is good practice to book an appointment one week after inserting the dentures. The new dentures should be worn for 24 hours prior to this appointment to aid determination of the cause of the problem. Self-adjustment of dentures is deprecated and patients must be advised accordingly.

Patients should be advised of the ‘relaxing space’ (freeway space, inter-occlusal clearance) between the teeth. ‘Teeth should not be in contact except when eating‘; ignoring this advice will result in considerable discomfort.

Dentures should not be worn at night to permit the tissues:

- To recover from the physical trauma of contact with the appliances.
- To receive some stimulation from the tongue and beneficial contact with saliva.
- To be relieved from contact with plaque and debris on the appliances.

Patients should be advised that plaque grows on dentures and of the most effective method for removing it. Food debris can and should be rinsed off dentures after every meal; plaque adheres well to acrylic resin and requires thorough removal at least once a day, preferably following removal of the dentures prior to sleep.

A suitable cleansing regime comprises:

- The use of a small head toothbrush to clean all surfaces of the dentures thoroughly (212). A denture or nail brush has a large head that restricts filament access (213); the stiff filaments also have poor compliance with the irregular denture surface (214). However, the use of a small brush

212 A brush with a small head is recommended.

213 Filament access is restricted when a brush with a large head is used.
214 Stiff filaments have poor compliance to denture contours.

215 Abrasion resulting from incorrect cleaning regime.

216 Do not hold a lower denture using a squeezing action during cleaning.

217 Recommended method for holding a lower denture during cleaning.

- Does increase the time taken to clean the appliances.
- The use of soap or other non-abrasive agent on the toothbrush. Abrasives readily remove the acrylic resin, resulting in loss of fit, poor aesthetics (215) and a rough surface to which plaque and stain more readily adhere.
- Care in holding the dentures; squeezing in the palm of the hand is liable to result in fracture of the appliance (216). Fingers and thumb should grip the posterior teeth on one side of the denture at a time (217).

- Cleaning of the dentures over a bowl full of water; this usually prevents breaking of the appliances if dropped.
- Soaking of the scrubbed dentures in a suitable solution overnight. Provided the appliance has no metallic components, a dilute solution of hypochlorite is ideal. If, for example, a metal palate is present, a proprietary soaking-type cleanser may be utilised but may not be as effective in removing and/or disinfecting plaque as hypochlorite solution.
The avoidance of hot water (above 70°C) as a solvent for the cleanser. The elevated temperature crazes the surface of the denture resulting in a ‘bleached’ or whitened appearance (218).

Cleansing problems

Where patients’ manual dexterity is impaired, the toothbrush handle may have to be modified as described for cutlery (see page 17). Thorough rinsing followed by prolonged soaking may have to suffice until a carer can undertake mechanical cleansing. Carers frequently require instruction in denture hygiene and oral health maintenance.

Tissue conditioners are readily deformed by vigorous mechanical cleansing and should be gently wiped under running water with cotton wool. They may usually be soaked in hypochlorite solution with no deleterious effects; effervescent cleansers may disrupt the surface of the material and should be avoided.

Resilient linings should be cleansed in the same manner as tissue conditioners. Soaking in dilute hypochlorite solution has the additional function of preventing the growth of candidal colonies within the material (178).

Continuing care

Once post-insertion adjustments have been completed and the patient can wear the dentures with comfort, regular review appointments (e.g. annually) should be arranged in order to:

- Check on patient compliance with cleansing regimes and remove any accumulation of calculus.
- Inspect the mouth and masticatory apparatus to detect disease or dysfunction early.
- Correct the deleterious effects of continuing alveolar resorption. These are:
  - increasing appliance instability producing abrasion of the supporting mucosa, difficulty with mastication and speech, and embarrassment for the patient.
  - gradual over-extension of the flanges which may result in fibrous hyperplasia of the sulcus tissues.
  - derangement of occlusal contacts, further increasing trauma to the supporting tissues, and loss of occlusal vertical dimension which may result in habitual mandibular protrusion
- Loss of fit may be corrected by relining the dentures providing the occlusion is satisfactory (see Chapter 7). If occlusal corrections need to be undertaken, replacement dentures can be constructed using the template technique (see Chapter 7). Forty per cent of dentures need replacement five years after construction.

  The patient should be instructed to return between review appointments if:

- The denture fractures.
- There is any noticeable deterioration in any aspect of the denture or its function, for example distortion of a soft lining, calculus accumulation, and impaired mastication or appearance.
- Tissue trauma or discomfort anywhere in the mouth or jaws continues for a period of more than a week.

Patients should not routinely use denture fixatives; however, occasional use (e.g. for an important social function) is permissible. These agents permit the continued wearing of an inherently unstable denture with consequent perpetuation of tissue trauma. They also hinder denture hygiene and can induce nausea.

The use of home relining agents is also not desirable. They can result in obliteration of freeway space, deterioration of the occlusion and local pressure resorption of the residual alveolar ridges.
Post-insertion adjustments of dentures

At delivery and at any subsequent review appointments, most denture adjustments will involve selective removal of acrylic resin. Adjustment of occlusal contacts is considered in Chapter 6; here the removal of resin from impression or polished surfaces is described. The addition of resin to improve the borders or post-dam seal or restore the occlusal contact of severely abraded teeth is also considered.

Removal of acrylic resin

*Aim*

To perfect the fit of the denture to the supporting or surrounding tissues, thereby eliminating irritating and/or painful stimuli to the mucosa, improving retaining forces and reducing displacing forces.

*Method*

Determine the area of resin that requires adjustment.

1. Examine oral mucosa: visual inspection may reveal signs of tissue irritation varying from mild erythema to ulceration (41). Palpation of the residual ridges may elicit discomfort where mucosa is inflamed or particularly thin over a bony prominence. Manipulation of the patient’s cheeks and lips, or mobilisation of the tongue by the patient, may result in denture displacement indicating non-compliance with potential denture space (e.g. over-extension of the flanges in depth and/or width). Static and dynamic occlusal contacts must always be examined since non-compliance of such contacts with jaw movement patterns is a prime source of tissue irritation. An accurate diagnosis of the cause of the mucosal injury must be made since repeated empirical adjustment of the denture-fitting surface will destroy the fit and therefore increase the trauma to the tissues.

2. Apply pressure-indicating cream to the relevant area of the dried denture surface with a small brush, piece of sponge, or end of a cotton wool roll. The denture is carefully inserted and seated firmly on its supporting tissues. The patient is requested to move the tongue and/or lips and the cheeks are manipulated as appropriate. Following careful removal of the denture, areas of excessive pressure on the tissues are indicated by displacement of the cream to expose the acrylic surface (219). Beware false displacement of the cream by inadvertent contact with the lips, tongue or residual ridge during insertion and/or removal of the appliance; the preliminary examination of the tissues should aid discrimination between areas of true and false cream displacement.

3. The cream can be applied directly to very local areas of dried mucosa and will adhere to a dry denture surface when the latter is correctly seated on the tissues (92).

Following decontamination of the denture, large volumes of acrylic resin can be removed with a trimming bur or coarse grit stone. Beware inadvertent removal of too much resin resulting in a poor fit to the supporting tissues or incorrect polished surface contours. Frequent re-application of the indicating cream and re-insertion in the mouth should be done to assess progress towards optimal appliance form. Total removal of all discomfort may be impossible if the tissues are inflamed; the patient should be requested to wear the denture as little as possible over the next few days to permit healing. An appointment for further review should be made.

The resultant rough acrylic surfaces must be smoothed with a fine grit stone and/or abrasive-impregnated rubber wheel followed by pumice slurry and ultimately polishing compound. Rough appliance surfaces are an additional source of tissue irritation, aid plaque and stain accumulation, and hinder cleaning. The denture must be decontaminated and rinsed under running water before re-insertion in the patient’s mouth.

During trimming, acrylic swarf should be collected by suction (220) to avoid inhalation, workplace contamination and rendering the floor slippery. Protective eye wear and an efficient mask should also be worn.
Silicone-resilient linings are difficult to trim; a coarse stone is most effective (221). Preliminary removal of gross excess with a sharp knife or scissors may be indicated. Acrylic based linings are easier to adjust especially following chilling in cold water.

Addition of acrylic resin

Aims

Resin may be added to dentures in order to:
- Extend the border depth or width to re-establish the seal between the appliance and the cheeks or lips.
- Establish a post-dam seal. Both of these modifications aim to improve retentive forces.
- Restore occlusal contacts and possibly increase the occlusal vertical dimension where abrasion of the posterior teeth has occurred. Mastication, aesthetics and the patient's ability to reseat the dentures on the supporting tissues may thereby be improved. Such 'patch work' additions may enable elderly patients to continue to use their present dentures.

Additions are best performed by placing softened tracing compound on the relevant border area and moulding in the mouth. To improve a post-dam seal, a rope of soft tracing compound no thicker than a matchstick is placed on the impression surface of the upper denture adjacent to the posterior border. The appliance is then firmly seated in the mouth. Occlusal surface additions can be made in softened high-viscosity modelling wax and moulded against the opposing surface at the desired vertical dimension while the dentures are firmly in contact with their supporting tissues. These compound or wax additions can be softened and remoulded or replaced until satisfactory. Following decontamination, the dentures can be conveyed to the laboratory for the temporary additions to be replaced by acrylic resin cured under pressure.

Certain clinical situations require speedy permanent additions (e.g. in the domiciliary situation or if the patient has no spare dentures and is unwilling to leave the appliances even for a short time). An outline of procedures suitable for such circumstances follows. The additions should be regarded as only semi-permanent, since the hardened resin is liable to be porous, weak and have sub-optimal colour stability. It is always wise to precede the resin additions with temporary ones in tracing compound or wax as described above in order to confirm the diagnosis of the cause of the patient's complaint.
Additions to borders

A high viscosity butylmethacrylate resin should be used as it is less irritating to the oral mucosa than the methyl variety. Additions do not bond strongly to the denture and may tend to peel away, providing a focus for debris and plaque retention and direct trauma to the mucosa. To reduce this problem, a butt joint should be prepared on the polished surface of the denture and the border acrylic roughened (222). The butylmethacrylate resin is mixed in accordance with the manufacturer’s instructions and the estimated final volume applied to the denture. Following careful insertion into the mouth, the material is accurately moulded to the optimum depth and width of the sulcus. When sufficient hardening has occurred, the denture is removed from the mouth and suspended in warm water to hasten polymerisation. Any resin excess is trimmed back to the butt joint and the added material and adjacent denture smoothed and polished (223).

Addition of post-dam

If the posterior border of the upper denture does not reach the junction of the hard and soft palates and/or totally enclose the tuberosities and/or enter the hamular notches, it should be extended as described above. Correctly extended borders should have the adjacent impression surface roughened before a rope of correctly mixed butylmethacrylate resin no thicker than a matchstick is applied from the border buccal to one hamular notch to the corresponding position on the other border. The upper denture is then firmly seated in the mouth and the patient requested to occlude the teeth in order to check that the appliance is not being spaced from its supporting tissues by the added material. Resin polymerisation is hastened by immersion in warm water before excess resin is trimmed away and any rough surfaces smoothed. Deficiencies in the seal provided by the new post-dam may be localised by inserting a wet denture; water and bubbles escape...
Abraded posterior teeth prior to the addition of acrylic resin.

Acrylic resin additions to abraded posterior teeth to restore occlusal vertical dimension.

from the posterior border adjacent to the imperfection. The occlusion should be carefully checked again prior to dismissal of the patient.

Modification to occlusal surface
Decide to which posterior occlusal surface the addition is to be made; the lower is usually chosen as it has less impact on aesthetics. The relevant occlusal surface is abraded and butt joints prepared in the buccal and lingual surfaces of the teeth. Bilateral tracing compound stops are formed on the first molar teeth to establish the desired occlusal vertical dimension in the retruded jaw relationship. Petroleum jelly or other separating medium is applied to the opposing occlusal surface. Resin of the appropriate shade is mixed and the estimated final volume applied to the prepared teeth before the denture is carefully inserted into the mouth and the patient is guided into the predetermined jaw relationship. The denture is removed when the added resin is almost hard. Resin polymerisation is speeded with warm water and the added material trimmed. The compound stop is removed and further resin added to complete the occlusal recontouring before final smoothing and polishing (224 and 225). The occlusion must be checked for accuracy before the patient is dismissed.
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