The Pathology and Surgery of the Salivary Glands

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Chapter 9: The surgery of salivary disease

Preoperative Considerations

While all aspects of salivary gland surgery are covered in this chapter, in this section it is necessary to concentrate mainly on the parotid glands both because this is the most common site for tumours and also because it presents the greatest surgical difficulties and the greatest risk of cosmetic damage. Treatment planning for patients with salivary gland tumours is always difficult and, at least initially, arbitrary decisions have to be made for the following reasons.

First, it is impossible to predict behaviour without a conventional biopsy and for that matter, as discussed earlier, the behaviour of some of the rarer tumours is not yet known for certain. However, if it is available, preoperative fine-needle aspiration cytology, followed by frozen-section confirmation during operation, may be valuable in suggesting the need for more radical procedures which may involve sacrifice of the facial nerve and neck dissection. Nevertheless, in many cases, the diagnosis is only made postoperatively.

Second, it may be impossible to make anything more than an arbitrary decision as to the extent of the excision and, if function of the facial nerve is unimpaired, whether or not to sacrifice it. There is also considerable variation in the interpretation of what constitutes a parotidectomy. However, if excision does not appear to have been adequate, the need for reoperation or completion surgery has inevitably to be judged in each individual case from the operative description, the tumour type and its margins, as indicated by the histological findings.

Further, many salivary gland cancers are secondary or tertiary referrals following open biopsy, attempts at enucleation or superficial parotidectomy. In such cases the excision is likely to have to be even more extensive and involve removal of all the area of operation where tumour cells may have had a chance to seed and grow.

Third, there is the perennial problem of prophylactic neck dissection. On the one hand, micrometastases will be present in a significant number of patients, on the other is the inevitable morbidity of neck dissection in the absence of nodal involvement. We have therefore tried to indicate which tumours appear to have particularly low survival rates to allow the surgeon to decide, from experience, whether prophylactic neck dissection is justified.

A fourth consideration affecting management is that of the patient's age. Malignant tumours are significantly more frequent in elderly patients. There is often reluctance to operate on a patient over 80 years. This reluctance may be justified after clinical investigations and fine-needle aspiration biopsy have shown that the tumour is benign or of low-grade malignancy. In some of these cases the tumours appear to be progressing so slowly that the patient's expectation and quality of life may possibly be better if there is no operative

interference. However, this involves taking the risk that the tumour will maintain its behaviour pattern for sufficiently long, but this is always uncertain. By contrast, some patients may feel that to have to live with a tumour is unacceptable and their request for surgery should be respected. If this is agreed and the patient is fit for the operation, surgery should be definitive, not palliative.

Fifth, the role of radiotherapy has to be considered and has been discussed earlier, as best we can, in relation to individual tumour types. However, there is no firm evidence that radiotherapy is satisfactory as the *primary* treatment of any salivary gland tumours apart from lymphomas. Nevertheless, it may sometimes usefully supplement surgery, particularly for other malignant tumours.

High success rates have been claimed for neutron-beam (cyclotron) therapy, but the numbers of salivary gland tumours that have been treated have been so small and the period of follow-up so short, that results are of no statistical significance.

There is also no clear evidence as to the value of chemotherapy except perhaps as a treatment of last resort. More information is available on the effects of chemotherapy on oral cancers where Stell (1990) in a meta-analysis of published reports has shown that the mortality is actually increased by the toxic effects of the drugs. There is little to suggest, as yet, that chemotherapy of salivary gland cancer is likely to be any more useful than for oral cancers. Such evidence as there is, is no more than anecdotal in terms of numbers of patients and duration of follow-up.

In the management of salivary gland cancer therefore, it has to be accepted that no hard and fast guidelines can be drawn. Our aim has been to provide the best information available to us, but inevitably, it is not enough in a field where new types of cancer are being recognized faster than knowledge about their management.

In summary, the patient will fall into one of a number of clinical categories and the approach chosen will have to take into account these possibilities:

➤ New patients (primary referrals):

clinically benign tumours
clinically suspicious tumours (short history or pain);
clinically malignant tumours (facial or other cranial nerve palsy; or ulceration).

➤ Patients sent by other surgeons in the immediate postoperative period:

for further management of previously unsuspected malignancy;
for management of complications (mainly facial palsy);
after incomplete resection.

➤ Patients with recurrent disease.

With these problems in mind, each should be considered for the following treatment options, namely:

➤ Limited or radical resection (for example, superficial, total conservative or radical parotidectomy).

➤ Revision surgery.

➤ Complementary surgery (neck dissection, facial re-animation or exploration and nerve grafting).

➤ Radiotherapy.

➤ Chemotherapy.

Surgery of the Parotid Gland

Resections of the parotid gland are without doubt the most demanding form of salivary gland surgery because of the difficulty of avoiding damage to the facial nerve. As discussed later, the anatomy of the facial nerve within the gland is subject to variation and its identification may be further complicated by distortion of its course by tumours, scarring secondary to past inflammatory disease or surgery, or congenital abnormalities such as haemangioma or cystic hygroma. Inadvertent damage to the facial nerve may produce partial or complete facial palsy, either temporary or permanent. Apart from the obvious and immediate cosmetic disfigurement, eye problems, masticatory difficulties, gustatory sweating and subsequent synkinesis of facial expression, all contribute to the patient's continuing misery. While the risk of facial nerve damage can be minimized by experience and modern techniques, it cannot (and should not) always be avoided.

The literature is complicated by a multitude of terms that have been used to describe the various surgical procedures that have been undertaken on the parotid gland. Most confusion has arisen between the interpretation of the terms 'enucleation', 'limited excision' and 'superficial parotidectomy'. To most surgeons the term 'enucleation' implies the shelling out of a lesion, while to others it means the careful extracapsular dissection or even resection of the tumour together with a small cuff of apparently normal salivary tissue. Some consider an operation which defines the main trunk of the facial nerve before removal of the lesion together with a margin of normal tissue to be a superficial parotidectomy, while others reserve this term for the complete removal of all salivary tissue lateral to the facial nerve and would prefer the term 'limited excision'. It is very important to be clear about this terminology and be precise about the degree of parotid resection that has been undertaken particularly in the operative notes. Undoubtedly the differences that currently exist in the interpretation of the terminology have been responsible for persistent controversy about the best method of treatment for benign salivary tumours and also for reported differences in the recurrence rates following surgery. Besides this, it is essential to know exactly what was done at primary surgery when planning secondary procedures, for example for recurrent disease.

Fundamentally there are five commonly described operations on the parotid gland, which we define as follows:

1. *Enucleation.* Sometimes called an extracapsular dissection, is the removal of a parotid tumour by capsular dissection without reference to the facial nerve. This implies that there is a complete definable capsule, but as discussed in Chapter 6 this is frequently lacking.

2. *Limited excision.* The removal of a parotid tumour together with a wide cuff of normal tissue after finding and dissecting the main trunk and relevant branches of the facial nerve, but leaving some apparently normal parotid tissue lateral to the facial nerve.

3. *Superficial parotidectomy.* The removal of all, or at least most, parotid tissue lateral to the facial nerve.

4. *Total conservative parotidectomy.* The removal of all, or at least most, parotid tissue superficial and deep to the facial nerve with preservation of the nerve.

5. *Radical parotidectomy.* The removal of all parotid tissue together with the facial nerve. In the presence of a highly malignant tumour or evidence of extensive local spread this procedure may be combined with an *en bloc* neck dissection, resection of the mandibular ramus, maxillary tuberosity or petrosectomy.

Synchronous facial re-animation may be indicated in some cases where the facial nerve has been resected at its main trunk or major divisions. In others where resection of the major branches of the nerve has not been necessary, a more expectant approach should be adopted. Several months should pass to allow spontaneous recovery of neural function to be assessed before resorting to reconstructive surgery which might also include the transfer of tissue to fill out an operative defect. During this period it may be necessary to protect the eye with a temporary tarsorrhaphy.

Guidelines

The following guidelines are recommended but it cannot be pretended that there is any definitive protocol for any of the categories suggested earlier.

Indications for enucleation

None. Although a body of opinion suggests that certain lesions of the parotid gland can be treated or investigated in this fashion, for example, lymphoma, it is the authors' opinion that this is bad and unsafe practice and should not be encouraged.

Indications for limited excision

➤ As primary treatment for benign tumours arising in the lower pole of the parotid gland.

➤ In some cases of recurrent disease where there has been adequate primary surgery and the recurrence is distant from the majority of branches of the facial nerve. In these cases aggressive dissection of the nerve is likely to lead to an unacceptable neural deficit.

Indications for superficial parotidectomy

➤ As primary treatment for benign or malignant salivary tumours situated totally lateral to the facial nerve and not involving it.

➤ For secondary referrals following incomplete excision of benign tumours, which may recur, superficial to the facial nerve.

➤ In conjunction with a radical neck dissection for the control of squamous-cell carcinoma arising on, or around, the face in order to remove first echelon nodes.

Indications for total conservative parotidectomy

➤ Resection of benign salivary tumours occupying both deep and superficial lobes of the parotid gland (dumb-bell tumours) and low-grade malignant tumours not involving the facial nerve.

➤ Control of recurrent sialadenitis.

➤ For recurrent benign tumours, but only when the facial nerve is readily identifiable.

➤ To remove parapharyngeal tumours.

Indications for radical parotidectomy

Resection of malignant salivary or adnexal tumours involving, or in such close proximity to the facial nerve that it cannot be dissected clear of the tumour without jeopardizing the surgical margins.

Contraindications to parotid gland surgery

Poor general health is the only valid contraindication to surgery on this gland. In general, it is tolerated well by the patient, the only proviso being their fitness for general anaesthesia.

Preoperative Investigations

Imaging

Computerized tomography and MRI do not contribute surgically significant information about the majority of suspected parotid neoplasms, but specific indications have been discussed in Chapter 2. Most may be resected quite safely after careful local and general clinical examination. Parotid masses which require detailed computerized tomography or MR imaging can be recognized on strictly clinical grounds, namely:

➤ All masses with suspected deep-lobe involvement or that are displacing the soft palate and superior pole of the tonsil medially.

➤ All tumours causing any degree of facial weakness or known to be malignant.

➤ Extensive lesions or those with suspected local or regional spread.

➤ All recurrent tumours.

It is a *sine qua non* that all patients with suspected neoplastic disease should also have a chest radiograph. Although uncommon, the presence of unsuspected pulmonary metastases greatly influences patient management.

Biopsy

Open biopsy is absolutely contraindicated and the role of fine-needle aspiration cytology is considered by some clinicians to be controversial as discussed earlier. However, there is no doubt that in expert hands FNAC can sometimes convey to both the surgeon and patient several advantages. First, it is capable of warning the surgeon of malignant disease which may not have been suspected and which might necessitate facial-nerve resection. Second, lymphoma, infections and cysts should be readily recognized, thereby indicating further investigation before deciding on the role and extent of surgical intervention. Third, it is quick and simple to perform in the clinic and acceptable to the patient. Expertise in interpretation of fine-needle aspirates cannot develop without frequent practice and therefore it is the authors' opinion that it should be considered in every case. The risk of seeding in the needle track is very small indeed and has been discussed in Chapter 2.

Informed Consent

The patient should be gently but fully forewarned of the following possible complications.

Facial weakness

The risk of temporary or permanent facial weakness must be carefully explained. Facial nerve neuropraxia usually recovers within 4-6 weeks, but in severe cases is almost always associated with some degree of neural degeneration. Complete recovery of facial

symmetry may therefore take 6-12 months and in a few is never achieved. It is worth explaining to the patient that the risk of facial weakness applies equally to benign as malignant tumours because of the variable anatomy of the facial nerve and position of tumour relative to it.

Facial anaesthesia

Anaesthesia in the distribution of the greater auricular nerve (over the angle of the mandible and inferior two-thirds of the pinna) is unavoidable. It can be most irritating for the patient especially if not forewarned. No recovery should be expected as the greater auricular nerve is deliberately sacrificed during the resection. Most patients learn to accept this deficit with time.

Cosmetic defects

The patient may be reassured that the cosmetic appearance of the incision rarely causes concern. However, the loss of bulk behind the ramus of the mandible may result in a mildly unsightly dent in the normal outline of the jaw and make cleaning difficult. Bulk defects can be minimized by soft-tissue rotation flaps derived from the sternomastoid muscle.

Frey's syndrome

Gustatory sweating (Frey's syndrome) is a socially embarrassing complication of parotidectomy and develops in nearly all patients to some degree. Its frequency is sufficient to warrant preoperative explanation together with the reassurance that it is rarely significantly disconcerting and usually amenable to simple preventive measures, for example, the application of an antiperspirant (Chapter 5).

Surgical Anatomy of the Parotid Gland and Facial Nerve

The gross relationships of the gland have already been described in Chapter 1. From the surgical standpoint the most important and difficult aspect of parotid surgery has always been the management and location of the facial nerve. Surgeons undertaking parotidectomy during the first half of this century were severely hampered by what would nowadays be considered primitive anaesthetic techniques. Blood pressure was poorly controlled and diathermy dangerous in the presence of explosive anaesthetic agents. These two factors made haemostasis almost impossible and as a result, visibility of fine structures was very poor. Also, at that time, few were technically able to locate the main trunk of the facial nerve at the base of the skull. For the majority, therefore, reliable isolation of its divisions and branches was an impossible task. Indeed, they were not helped by the classical anatomical descriptions of the major salivary glands. These descriptions had been based on cadaver dissections and were in many respects inaccurate. While useful for surface markings and gross relationships, these descriptions failed to take into account the normal variations or describe detail relevant to the surgeon and essential for removal of diseased glands with minimal morbidity. As a result, potentially curable tumours were inadequately resected merely to minimize facial-nerve damage. Local excision, intracapsular removal, enucleation, with or without subsequent radiation, were widely practised and, sadly, are still practised and even advocated by some today. Consequently, various surgeons from all over the world have

reported recurrence rates of 10-50% with these techniques.

Familiarity with the form, location and peripheral distribution of the facial nerve is of paramount importance in salivary gland surgery. Studies over the past 30 years have helped to elucidate its detail and develop methods for finding it at a variety of peripheral sites. The following section is a synopsis of our current understanding of the extratemporal facial nerve as it applies to the parotid and submandibular salivary glands.

Branching patterns of the extratemporal facial nerve

In the vast majority of cases, the facial nerve leaves the skull as a single trunk through the stylomastoid foramen then splits within the substance of the parotid gland into zygomaticotemporal and cervico-mandibular divisions. The terms 'zygomaticofacial' and 'cervicofacial' respectively, are sometimes used for these divisions. Each division further subdivides to produce five major branches: temporal, zygomatic, buccal, mandibular and cervical. Katz and Catalano (1987) in a study of the facial nerve's anatomy in 100 patients undergoing parotidectomy, observed double trunked nerves in three individuals and cautioned surgeons that unless they were aware of this anomaly, unnecessary damage to the facial nerve could result. Others, in equally large or larger series, have failed to encounter this variant. However, detailed studies of the intratemporal course of the facial nerve have demonstrated both bifurcation and trifurcation of the main trunk within its mastoid segment and therefore the double-trunked, extratemporal, facial nerve must exist, though perhaps less frequently than Katz and Catalano suggested. Division of the facial nerve within the temporal bone is frequently associated with congenital abnormalities of the pinna or inner ear. An abnormally formed ear or congenital hearing loss should therefore alert the surgeon to this possibility. When present, the minor trunk of the facial nerve is said to enter the zygomaticotemporal division of the main trunk.

The pattern of branching of the facial nerve within the parotid gland is also variable. Although not the first to study the detailed ramifications of the nerve in cadavers, Davis *et al* (1977) were probably the most thorough. They performed dissections on 350 cervicofacial halves and classified the branching patterns of the facial nerve into six types. Miehlke *et al* (1979) studied the operation records of 100 patients at their institute and grouped the branching patterns into eight types. The more recent study of Katz and Catalano (1987) reclassified these patterns into only five types. This study has the advantage that it was derived from contemporary operative findings rather than cadaver dissections and, as a result, incorporated functional information and the postoperative significance of damage to some of the fine branches. This classification has therefore been adopted here as being the simplest and most practical.

The five types of branching patterns of the facial nerve are illustrated in Fig. 9.1 to 9.9 and are as follows:

Type 1: This pattern lacks anastomotic links between the main branches of each division. However, in one subtype, there is splitting and subsequent reunion of the zygomatic branch while in the other, the mandibular branch splits and reunites (Figs 9.1-9.2). Comprises 25%.

Type 2: In this type, subdivisions of the buccal branch fuse peripherally with the zygomatic branch (Fig. 9.3). Comprises 14%.

Type 3: There are major communications between the buccal branch and others (Figs 9.4-9.6). Comprises 44%.

Type 4: In this type there is a complex branching and anastomotic pattern between the major divisions (Figs 9.7-9.8). Comprises 14%.

Type 5: The facial nerve leaves the skull as more than one trunk (Fig. 9.9). Comprises 3%.

Unfortunately, it is impossible to incorporate the findings of other series into this classification, or indeed into any other, however detailed, that can be devised. This is not because of any doubt about the validity of the findings of the different workers in this field; the problems of producing a coherent picture of these anatomical details stem from the following:

➤ Some studies have been on cadavers and this has made it possible to extend dissections further than at operation. Some of these studies also have the advantage of having been made on very many specimens.

➤ Other studies have been peroperative, and though on smaller numbers of patients are of greater surgical significance in that it was possible to validate the findings by nerve stimulation.

➤ As mentioned earlier, the terminology of different authors varies.

An almost bewildering of patterns of branching of the facial nerve have thus been described and also, apparently, substantial differences in the frequency of the types of pattern have been found by different investigators. For example, Katz and Catalano (1987) found the Type 1 arrangement in 24% of their parotidectomies while Davis *et al* (1956) documented this straight branching pattern in 13% of their dissections. This difference may have been offset by another 20% of the series of Davis *et al* which were found to have complex zygomatic branches and might therefore have been considered to be Type 1 by Katz and Catalano (1987). In sharp contrast, Miehlke (1979) reported these patterns in 75% of his series.

Differences are even more apparent when considering the frequency of distribution of the other types. Katz and Catalano (1987) found the relatively simple anastomotic patterns, Types 2 and 3, in over 50% of their series and the more complex branching arrangement in only 10%. Similarly Miehlke, whose data were also based on operative records, found complex branching patterns in relatively few patients (5%). By contrast, Davis *et al* (1956) reported a much higher incidence of complex branching patterns (39%). It would seem that these apparent discrepancies between the relative frequencies of the types most probably reflects the ability of Davis *et al* (1956) to dissect further distally in the cadaver than either Katz or Miehlke needed to at operation.

Example may also be given of the confusion that is caused by the terminology different authors have used. A nerve that one author might describe as a 'division of the mandibular branch' is termed the 'cervical branch' by another. Nowhere is this more evident than in the distinctions between the zygomatic and buccal branches. Davis *et al* (1956) accurately noted that the zygomatic branch followed the parotid duct throughout the substance of the gland and was usually superior to it. Yet others, including the classical anatomical texts and dissections, state that the parotid duct is intimately related to the buccal branch. Some have gone so far as to recommend location of the buccal branch by exploring the course of the duct, which runs along a line drawn from the ear lobe to the vermilion border of the upper lip.

It is not surprising therefore, that a variety of terms for some of these branches has come into use in surgical parlance. For example, the complex branched patterns, just described, near the periphery of the facial nerve, and present in many patients, are referred to by most surgeons as 'vertical anastomoses'. The latter are important because there are two clinical circumstances in which their presence is of surgical significance. First, these anastomoses explain the unexpected absence of facial weakness when relatively major branches have been sacrificed or inadvertently damaged. Second, when undertaking selective denervation procedures such as for the treatment of blepharospasm, it is important to establish peroperatively that avulsion of the nerve branch has been achieved at an adequately peripheral site.

In summary therefore, there seems to be no doubt that many variations in the branching patterns of the facial nerve exist and the positions of these branches vary. However, the nature of any given pattern in a particular patient is quite unpredictable preoperatively and it is clearly impossible to take account of all possible patterns during parotid surgery. The most important consideration, therefore, is to be aware that many possible variations exist and to define the facial nerve and its branches as precisely as possible to taking into account its most frequently found patterns. The other consideration is that however much care is taken in seeking out the branches of the facial nerve, *some* damage to one or more of these branches may be unavoidable but is not necessarily catastrophic. Nevertheless, the existence of this multiplicity of variations makes it imperative to warn the patient of the possibility of some degree of functional deficit.

Location of the facial nerve trunk and its branches

In practice, there are three major difficulties in the management of the facial nerve in parotid gland tumours. The first, as discussed below, is the difficulty of preserving the major trunk and as many minor divisions as possible when dealing with a benign tumour. The second is to decide when to sacrifice the facial nerve when removing a malignant tumour. The third is to advise the patient of the possibility of either unavoidable damage if the anatomy proves to be abnormal or else of the need to sacrifice the nerve to allow complete removal of the tumour. These last two aspects are considered in relation to the section on total parotidectomy.

The methods of locating the facial nerve and its branches at operation are discussed later in this chapter. However, it may be useful to summarize the main points here, if only to emphasize the difficulties of defining reliable anatomical landmarks.

Identification of the facial nerve trunk is best achieved by reference to its immediate anatomical relations. A facial nerve monitor is particularly useful at this point in the operation, provided that the patient has not been paralysed by a muscle relaxant. The landmarks most commonly used are:

➤ The inferior portion of the cartilaginous canal. This is termed the 'pointer' and the facial nerve lies 1 cm deep and inferior to its tip.

➤ The groove between the cartilaginous and bony external auditory meatus. The sharp lateral edge of the tympanic ring at the antero-inferior border of the external auditory canal (the vaginal process) lies immediately superficial and superior to the nerve at its point of exit from the skull. This edge is easy to feel.

➤ The anterior border of the posterior belly of the digastric muscle. The facial nerve leaves the skull immediately anterior to the attachment of this muscle. Definition of the digastric muscle therefore outlines an area immediately anterior to it in which the facial nerve will be found.

Despite the use of these landmarks, repeated electrical stimulation is sometimes necessary to help to discriminate between stretched fibrous tissue and nerve. With continuous intraoperative monitoring, surgically evoked myogenic activity can be heard and acts as a warning that the nerve is being irritated by surgical manipulation or distortion.

Dissection of the facial nerve along a peripheral branch both centrally and distally was one of the first techniques to be developed and has proved to be one of the most useful. Recognition of the mandibular branch at the angle of the mandible, as it lies superficial to the facial vessels, is a pivotal surgical landmark today. Retrograde dissection of this branch to the main trunk is an important first step. A similar technique can be used to identify the cervical branch of the nerve at the point at which it pierces the deep fascia, below the body of the mandible.

Current surgical teaching to avoid accidental section of the mandibular branch, is to place the incision in a skin crease at least two finger breadths beneath the lower border of the mandible. However, the facial artery is a valuable palpable marker and the mandibular branch lies above the lower border of the mandible, posterior to the artery, in 81% of cases. Anterior to the artery, all mandibular branches are above the mandible (Fig. 9.10).

Nelson and Gingrass (1979) have questioned the reliability of the relationship of the mandibular branch to the lower border of the jaw. They isolated the rami supplying the labial depressors and found at least three branches in every case. The most inferior supplied the mentalis muscle and invariably ran entirely below the mandible. The branch to the depressor labii inferioris lay just above it and below the branch to the depressor anguli oris. This was the only branch found to run reliably at, or above, the inferior border of the mandible anterior to the facial artery. These nerves all ran deep to the platysma in the thin fascial layer overlying the submandibular gland. The surgical significance of these studies is that identification and preservation of one branch may not guarantee against subsequent weakness of the lower lip.

Bernstein and Nelson (1984) when examining the zygomaticotemporal division, found that four rami of the temporal branch crossed the zygomatic arch. All were anterior to the superficial temporal artery and evenly distributed over the articular eminence of the zygomatic process or middle third of the zygomatic arch. The frontal and orbital rami of the temporal branch ran consistently to the lateral edge of the eyebrow at the frontozygomatic suture within a strictly defined area (Fig. 9.10). This area was bounded by a line from the ear lobe to the lateral edge of the eyebrow inferiorly and superiorly by a second line from the tragus to the lateral coronal suture just above and behind the highest forehead crease. This suggests that incisions in this part of the face should be made superior and posterior to the temporal vessels and that identification of the superficial temporal artery at the upper pole of the parotid followed by soft-tissue dissection towards the lateral edge of the eyebrow should expose the temporal branch and its rami.

Bernstein and Nelson (1984) also described tethering of the temporal and zygomatic branches by anastomotic rami from the auriculotemporal nerve and the relationship of these rami to the superficial temporal and transverse facial arteries and veins. The facial nerve branches may embrace the transverse facial vessels and should therefore be approached with extra care at this point (Fig. 9.11).

The intimate relationship of the parotid duct and zygomatic branch of the facial nerve has been noted by many. The duct runs along a line drawn from the tragus to the vermilion border near the angle of the mouth and enters the mouth opposite the upper first molar tooth, 0.5-1.0 cm anterior to the masseter muscle. It lies inferior to the zygomatic branch, though is frequently overlain by numerous zygomatic rami.

The anatomical relations of the main trunk of the facial nerve at the stylomastoid foramen are described in the section on superficial parotidectomy (p. 203). In summary, a variety of landmarks for identification of the facial nerve and its branches have been described and it is important to emphasize that a combination of these landmarks usually needs to be used.

The deep and superficial lobes

The controversy surrounding the existence of an isthmus has been discussed in Chapter 1. The reason is that there has been a desire to establish why development of a surgical plane round the facial nerve within the parotid gland is relatively simple. It is now established that the facial nerve becomes engulfed by embryonic glandular parenchyma between the 16th and 21st week of fetal life. As the gland wraps itself around the nerve, a layer of loose connective tissue remains around it. This tissue forms the plane of dissection around the nerve and can be opened with ease during parotidectomy unless it has been destroyed by either recurrent infection or tumour infiltration.

It also seems likely that the presence and site of an isthmus might determine the origin and management of deep-lobe tumours. The presence of an isthmus between the major divisions of the facial nerve would also provide a route by which a tumour arising in the deep lobe can extend into the superficial lobe to form a dumb-bell shape. However, some large tumours arising from the deep lobe remain totally confined to the parapharyngeal space. It is possible that some of these may have developed from minor salivary gland tissue but if this

were the case they would be attached to the pharyngeal mucosa. However, this is rarely the case.

Some surgeons who believe that deep-lobe tumours arise from minor pharyngeal salivary glands manage them by either the transmandibular or transcervical approach. In effect, they are performing an enucleation and do not remove the whole parotid gland. This approach has disadvantages which are discussed later not the least of which is the very significant risk to the facial nerve.

It is also known that the deep lobe drains by a separate system which joins the main excretory duct. However, the precise position of the isthmus is probably variable.

Surgical anatomy of the autonomic nerve supply

The secretomotor fibres to the parotid gland emerge from the otic ganglion which is closely related to the auriculotemporal nerve. Preganglionic fibres reach the ganglion from the inferior salivary nucleus via the glossopharyngeal nerve, tympanic plexus and lesser superficial petrosal nerve.

Surgeons have attempted to interrupt this pathway in an attempt to alleviate severe Frey's syndrome. The most accessible approach to the parasympathetic pathway is in the middle ear, where the tympanic plexus can be destroyed on the promontory. Others have attempted to avoid this complication by avulsing the auriculotemporal nerve during parotidectomy or even by interposing a fascial graft, or muscle flap, between the cut surface of the gland and the skin flap to prevent subsequent regrowth of postganglionic secretomotor fibres into the sweat glands of the skin. As discussed earlier, neither of these measures gives predictable results nor long-standing relief.

The sympathetic supply reaches the gland from the superior cervical ganglion via the neural plexus surrounding the major blood vessels. The effects of drugs acting on these autonomic pathways has been discussed in more detail in Chapter 5.

Superficial Parotidectomy. Operative Procedure.

Preparation

After skin preparation and towelling, it is helpful to infiltrate the superficial tissues with 1:200.000 adrenaline solution. This aids the development of the skin flaps and improves visibility around the facial nerve at the most critical stage of the operation.

Incision

Most surgeons use the 'lazy S' incision with appropriate extension into the hairline or neck for larger tumours (Figs 9.12 and 9.13). In the past, a variety of incisions has been described, all of these aimed to gain maximal access to the retromandibular fossa and parotid gland, while at the same time being cosmetically acceptable (Fig. 9.14). Occasionally, these are still useful but each has disadvantages of which the surgeon should be aware. A purely retroauricular incision, although cosmetically attractive, fails to give adequate space and

visibility anteriorly and superiorly. The rhytidectomy incision favoured by some plastic surgeons has the same limitations. Superior displacement of the pinna with a 'Y' incision provides maximal exposure of the main trunk of the facial nerve which can be access in the temporal bone, but for total conservative parotidectomy, the extra access afforded over the 'lazy S' incision is seldom required. In addition, the resultant three-point junction with its attendant problems of diminished tissue viability is a distinct disadvantage. The preauricular incision as described by Blair (1941), with extension onto the zygoma, affords good access but is cosmetically unsatisfactory. The 'lazy S' incision was developed from the incision first described by Bailey (1941). He advocated the preauricular component linked to a skin-crease incision in the neck by a pronounced retroauricular extension. The extension behind the ear had a most precarious blood supply, did not improve cosmesis and was found to be unnecessary.

Skin flaps should be raised with considerable care as cutting too thin can easily result in button-holing, but if too thick, endangers the facial nerve anteriorly. The correct level is just above the parotid fascia, well below that of the hair follicles, which if seen, indicate that the flap is too thin. The skin flap should be raised as far anteriorly as the posterior border of the masseter muscle and posteriorly sufficiently far to allow complete access to the parotid gland. The raised flaps are sutured to the towels and covered with saline-moistened swabs (Figs 9.15 and 9.16).

Mobilization of the gland

The second part of the dissection aims to free the posterior margins of the gland to allow the facial nerve to be safely identified at a point just distal to its exit from the stylomastoid foramen. Dissection should start at the anterior border of the sternomastoid muscle and necessitates transection of the greater auricular nerve and sometimes, ligation of tributaries of the external jugular vein. The gland is gradually mobilized by both blunt and sharp dissection towards the mastoid process and around the cartilaginous external auditory canal to a point superior to the tragus. The tissue plane between the parotid gland and these structures is relatively easy to define. The subsequent dissection is considerably simplified if the operator stays strictly within this layer.

Location of the facial nerve

Identification of the facial nerve can be very difficult, especially if the gland is not or cannot be well mobilized, and requires both experience and patience. It is best achieved by reference to several structures which are its immediate anatomical relations. A facial nerve monitor is particularly useful at this point in the operation, but if this is not available, the surgeon should have a variable output nerve stimulator. Neither can work if the patient is paralysed and therefore the anaesthetist should check that the action of any short-term muscle relaxant has been totally reversed. The landmarks most commonly used are (Figs 9.17 and 9.18):

➤ The inferior portions of the cartilaginous canal. This is termed the 'pointer' as it indicates the position of the facial nerve which lies 1 cm deep and inferior to its tip.

➤ The groove between the cartilaginous and bony external auditory meatus. The sharp lateral edge of the tympanic ring at the anterior-inferior border of the external auditory canal (the vaginal process) is easy to feel. It lies immediately superficial and superior to the nerve at its point of exit from the skull.

➤ The anterior border of the posterior belly of the digastric muscle. The facial nerve leaves the skull immediately anterior to the attachment of this muscle. Definition of the digastric muscle therefore serves two purposes. First, it mobilizes the parotid gland and second, it outlines an area immediately anterior to it, in which the facial nerve will be found.

Location of the facial nerve by this method may be hindered by the tumour itself which can lie over the nerve or behind it, thereby displacing it laterally into an unexpected position. During this phase of the operation, the assistant plays an equally important role in providing adequate retraction for maximal vision, without either rupturing the tumour mass or inadvertently damaging the nerve by pressure. In a high proportion of cases, and with experience, the nerve is found easily but in some cases the surgeon must gently separate each strand of tissue in the zone until the nerve is reached. This is most easily undertaken with a peanut swab and small, blunt, dissecting scissors. Repeated electrical stimulation will help to discriminate between stretched fibrous tissue and nerve, though this should never be accepted as definitive proof if the surgeon is in doubt. If doubt remains the surgeon should work from a different angle in order to define the structure more clearly. Control of haemorrhage is vital as bleeding, no matter how minor, considerably handicaps the visibility of the surgeon. Forceps, clips and bipolar diathermy must be used with extreme caution as the nerve is approached. The stylomastoid artery which lies immediately lateral to the nerve at the skull base is particularly troublesome in this respect. If torn, it bleeds briskly and this should be an additional warning of the proximity of the nerve. Even bipolar diathermy is dangerous at this juncture and should bleeding be a problem, swabs soaked in adrenaline 1:200.000, can be usefully applied to staunch the ooze.

Dissection of the facial nerve

Once found, the trunk of the nerve is exposed further by firmly inserting a pair of fine artery clips or scissors into the perineural plane, spreading them to create a tunnel and then incising the overlying parotid tissue with a No. 12 blade (Figs 9.19 and 9.20). The major divisions and branches of the facial nerve are then followed to the periphery in this manner, beginning with the upper division and progressing inferiorly. In this way, the superficial lobe and tumour are peeled off the facial nerve. The upper division of the nerve, unlike the inferior, tends to be slightly tortuous and can be inadvertently damaged unless great case is taken when opening the tunnels created by perineural dissection. The parotid duct is sometimes encountered running parallel and inferior to the zygomatic branch of the facial nerve and may restrict mobilization at the anterior part of the dissection unless transected and ligated.

It may not be necessary to dissect the nerve completely as a perfectly adequate tumour clearance may be achieved with a more conservative or near total resection of the superficial lobe. The precise amount of parotid tissue that should be removed depends entirely on the size of the tumour and its location. Occasionally, it is also necessary to remove part of the

deep lobe to obtain a satisfactory margin.

Branches of the facial nerve *inseparably adherent* to tumour, or running through it, must be resected. If the resected segment is either the upper or lower division it should be repaired immediately with a cable graft. Donor segments can be harvested from the greater auricular nerve, if this is not involved by tumour or the sural nerve. The result of damage immediately peripheral to the major divisions is sometimes considerably less than would be expected. Compensatory innervation from adjacent branches, through the vertical system of anastomoses, would seem to account for this fortunate phenomenon.

Closure

Vacuum drainage should be inserted and the wound closed in two layers with Vicryl or chromic catgut subcutaneously and monofilament nylon for the skin. Drainage is maintained until < 25 mL has escaped during a 24-hour period and the sutures are removed after 7 days.

Total Conservative Parotidectomy Operative Procedure

Incision

Extension of a 'lazy S' incision into both the hair-line and neck is a prerequisite for this procedure if undertaken for the removal of a tumour. However, many cases of chronic sialadenitis can be managed quite satisfactorily without this additional access. The only other distinction in technique is that removal of the deep lobe should be in continuity with the superficial lobe in tumour surgery. A more piecemeal approach to the deep lobe can be taken in patients with intractable sialadenitis. The first part of the operation is identical to that of superficial parotidectomy.

Exposure of the facial nerve

The facial nerve is identified and the superficial lobe of the gland reflected inferiorly so that the deep lobe remains connected to it only by glandular tissue inferior to the mandibular branch. The main trunk of the nerve and its divisions are then gently freed from the lateral aspect of the deep lobe (Figs 9.21 and 9.22). This is a very delicate procedure which requires great care on the part of the surgeon and assistant. At this stage, the minimum of tension and traction should be applied to the nerve. It is best elevated by steadying the adjacent salivary tissue with a small swab and carefully dissecting beneath a segment of the nerve with curved Kilner scissors. Once this has been separated, a nerve hook, plastic sling or the gentle curve of a fine artery clip provides safe elevation and gentle traction. From this vantage point, dissection can proceed both peripherally to the posterior margin of the masseter and centrally to the stylomastoid foramen. Continuous attention must be paid to the position and tension applied to the nerve when free from the deep lobe, as it can be easily overlooked while manoeuvreing a deep lobe tumour and unnecessarily damaged.

Before removing a tumour, the external carotid artery, at the inferior pole of the gland, together with its terminal branches - the maxillary, superficial temporal and transverse facial arteries - at the superior and anterior margins, should be ligated (Figs 9.23 and 9.24). The

veins related to the latter arteries must also be tied. This is not necessary in cases of chronic inflammatory disease for which piecemeal clearance of the residual gland, between the branches of the facial nerve, is perfectly acceptable.

Dissection of the deep lobe

Once free from the nerve, the deep lobe and tumour, if large, are gradually mobilized by finger dissection (Figs 9.25 and 9.26). However, if the deep extension is small, dissection with forceps and scissors is more appropriate and certainly less traumatic to the nerve. With care, the tumour can be released from its attachments to the lateral pharyngeal wall and cranial base. Small and soft tumours of the deep lobe may be manipulated beneath the mandibular branch of the facial nerve and removed in continuity with the superficial lobe. This process is facilitated by the assistant's finger, placed in the patient's mouth, exerting gentle lateral pressure on the tumour.

Unfortunately, many tumours in this site are large and become trapped between the styloid process, ramus of the mandible, stylomandibular ligament and base of the skull. Additional space is required to manipulate them free without damaging the facial nerve. For most, division of the digastric muscle and stylomandibular ligament is sufficient, but a few may need temporary, anterior dislocation of the mandible, osteotomy or even partial resection of the ramus.

Several different access osteotomies of the mandibular ramus have been described (Fig. 9.27). Some are technically easy while others are more demanding. From the patient's standpoint, time and care spent performing the more complicated procedures is rewarded by minimal morbidity in terms of mandibular nerve deficits and subsequent bony union. For these reasons, an angle osteotomy is no longer acceptable and the L-shaped osteotomy of the ascending ramus described by Trauner and Obwegeser (1957) is most appropriate. There are two critical measurements in this technique which relate to the position of the lingula on the medial aspect of the ramus and therefore help the surgeon avoid inadvertent damage to the mandibular nerve. It lies 15 mm anterior to the posterior margin of the ramus and 45 mm above the lower border of the mandible. The outline of the vertical osteotomy should be marked on the surface of the mandible which has been appropriately stripped of the attached masseter muscle fibres. Mini-plates are prepared and fitted so that the bone can be reconstructed precisely after resection of the tumour as described later (p. 209-10). By dissecting between the masseter and the ramus, and retracting the masseter laterally, the anterior border of the mandible is identified and the position for the horizontal limb of the osteotomy can be defined. Section of the bone can be most accurately undertaken with a small oscillating saw. If such a saw is not available, the surgeon can make a series of pilot holes with a rose-head bur and subsequently connect them with a fissure bur, thereby completing the osteotomy. Some mobilization or relieving incision in the medial pterygoid muscle will be necessary to allow the mandibular segment to swing laterally. Such incisions should be kept to a minimum otherwise avascular necrosis of the mobilized segment may ensue.

Closure

Either vacuum, corrugated or tube drains should be inserted and the wound closed in two layers. The surgeon must be careful with vacuum drains that segments of the unsupported

nerve are not entrapped in the suction holes (Figs 9.28 and 9.29). It is for this reason that the author prefers corrugated drains in combination with a light pressure dressing to the side of the neck. Drains should be removed when the surrounding dressings remain dry, usually within the first 24-48 hours and the sutures after seven days.

Other Approaches to Deep-Lobe Tumours

Cervical and transoral approaches to the parapharyngeal space have been described. However, they are totally unsuitable for the management of deep-lobe parotid tumours because of the limited access that they provide. The only alternative to the transparotid technique is the transpharyngeal (jaw splitting or mandibular swing) approach.

Transpharyngeal Approach

Preparation

This approach is most appropriately used for large *extraparotid* parapharyngeal masses, namely those arising from minor oropharyngeal glands. It is particularly useful for vascular tumours such as extensive paragangliomas of the carotid body that encroach on the skull base, as it gives exceptionally good exposure. The cooperation of an oral surgeon is essential if the operator is inexperienced in mandibular fixation. Oral surgeons usually appreciate a few days' warning before surgery so that the dentition can be prepared, if necessary, for intermaxillary fixation by interdental wiring or cap splints. If the patient is edentulous Gunning-type splints might be required. However, the majority of cases are suitable for compression-plate fixation of the mandible for which little preparation is necessary and subsequent intermaxillary fixation is unnecessary.

After induction of anaesthesia a preliminary tracheostomy is performed to protect the airway, as this approach includes a mandibulotomy and, sometimes, subsequent intermaxillary fixation. The tracheostomy has the additional advantage of removing the endotracheal tube from the operative field and therefore increases the available exposure.

Incision and exposure

A skin-crease incision is made at the level of the hyoid bone and extended forwards around the chin to split the centre of the lower lip (Fig. 9.30). The contents of the carotid sheath are identified and traced to the base of the skull. The common and internal carotid arteries are secured with slings to enable rapid control of these vessels in the event of inadvertent rupture later on in the procedure. Often it is advisable to ligate the external carotid artery at this stage. The dissection is then continued deep to the submandibular gland until it is free from the surface of the hyoglossus muscle. Attention is then focused on the buccal gingivae which are very carefully elevated from the underlying bone over the chin. Holes are prepared on either side of the proposed, stepped, osteotomy and compression plates fitted. It is essential that the placement of the compression screws avoids the roots of the underlying incisor and canine teeth and that the plates are accurately bent to the outline of the mandible. Once fitted, the plates and their screws are removed and placed to one side until the end of the operation. A midline mandibulotomy is then made with a fine oscillating saw. If the lower incisors are overlapping or imbricated, it may be necessary to extract one of them to make

space for the bone cut. The mandible is then retracted laterally so that the incision can be extended between the papillae of the submandibular ducts, along the floor of the mouth and up the anterior faucial pillar to the superior pole of the tonsil (Fig. 9.31). During this part of the exposure, the lingual and hypoglossal nerves should be identified and displaced medially, but not overstretched or cut if possible. While it is relatively simple to preserve the hypoglossal nerve, this is not the case with the lingual nerve, which is frequently damaged unless it is released posteriorly at its origin from the mandibular nerve. Because of this, the patient must be forewarned of the probability of hemilingual anaesthesia following surgery.

At this stage, the exposure is complete and the tumour may be mobilized and removed by blunt dissection. This technique provides excellent exposure of the medial and superior aspects of the tumour which by any other method have to be approached blindly. The facial nerve is not necessarily identified but, if seen, should be carefully retracted laterally.

Closure

After removal of the tumour, it is prudent to cover the carotid arteries with an interposition flap fashioned from prevertebral fascia. This reduces the risk of a carotid blow-out if the wound dehisces and becomes infected. The mucosa is closed with a single layer of interrupted 3-0 Vicryl sutures and the mandible secured with the compression plates (Figs 9.32 and 9.33). The external wound is sutured in two layers with chromic catgut for the platysma and subcutaneous tissues and 4-0 nylon for the skin. A corrugated drain should be brought out through the inferior limit of the wound. Although some surgeons dispute the need for compression plates and rely on direct wires this is bad practice, unreliable and invites non-union. Indeed, in some cases, admittedly rare, it may be necessary to employ additional mandibular fixation, for example interdental wires or cap splints, to minimize the risk of non-union.

Though it may seem a minor consideration, it is easy to damage the teeth when carrying out a mandibulotomy and this can cause considerable dental disability for the patient and even give rise to medicolegal problems later. If this seems to be an overstatement, it is perhaps worth pointing out that damage to the teeth is the largest single cause of litigation against anaesthetists in the USA.

The drain should be removed after 48 hours and the sutures on the 7th postoperative day. If used, intermaxillary fixation or cap splints are usually kept in place for 4-6 weeks and are not removed until adequate bony union has been achieved.

Advantages and disadvantages

The major advantage of this technique is the exposure that it provides. Unlike other approaches, the medial, posterior and superior aspects of large tumours can be inspected directly. There is good control of the major blood vessels and removal of the tumour is not restricted by the styloid process, stylomandibular ligament or ramus of the mandible. These are considerable advantages but have to be weighed carefully against the disadvantages.

It is exceptionally difficult to determine from preoperative computerized tomography scans the precise nature of parapharyngeal masses. While magnetic resonance imaging has

helped distinguish neurofibromas from salivary neoplasms, the appearances of deep-lobe parotid tumours are not unlike those of meningiomas or metastatic nodes. From an oncological standpoint, the surgeon is performing little more than an enucleation with this technique which would be considered very unwise if the mass were situated in the superficial lobe of the parotid gland. There is rarely positive identification of the facial nerve which might therefore be inadvertently damaged, though admittedly this rarely happens. Traction on the lingual nerve often produces a temporary and sometimes permanent hemianaesthesia of the tongue, and as stated earlier, it is often impossible to preserve it. The time saved in removal of the tumour, which is initially so attractive with this technique, is lost later in the operation with closure. Finally, and perhaps most important, the morbidity for the patient in terms of a permanent lip-splitting scar together with potential dental injury, intermaxillary fixation and dietary restriction are considerable. While a patient should have completely recovered within two weeks after an uncomplicated lateral approach, the recovery period for a similar patient following a transmandibular approach might be anything up to three times longer.

Furthermore, if a deep-lobe tumour is so large that it proves impossible to deliver between the ramus of the mandible and the styloid process with a lateral approach, additional access can be made by one of two techniques. The mandible can be dislocated forwards, the styloid process fractured and the stylomandibular ligament transected, or alternatively, an osteotomy can be made in the ramus of the mandible as described previously, which is subsequently fixed by compression plates. There can be little doubt that either of these is aesthetically better than the midline mandibulotomy. Exponents of lateral osteotomies state that the inferior dental nerve deficits are uncommon and resolve in almost every case. It is for these reasons that the mandibular swing technique should be avoided, if possible. In the author's experience this approach has only been required on two occasions for the management of salivary gland tumours. The first was necessary when confronted with a massive palatal pleomorphic adenoma which was causing airway obstruction and extended from the base of the skull to the laryngeal inlet. The second was for the removal of multiple recurrences of a deep-lobe epimyoepithelial carcinoma which had developed in the medial pterygoid muscle some eight years after a primary total conservative parotidectomy and postoperative radiotherapy.

Radical Parotidectomy

Patient communication and consent

There are two essentials, first to warn the patient thoroughly about damage to their facial nerve and its consequences, and second, to warn of the risk of recurrence of the tumour. In the clinical situation where a radical parotidectomy has become necessary, it is important to emphasize to the patient that the results of their surgery may well be disfiguring but that this is the price that has to be paid for what may be a life-saving measure. This is not a step to be taken lightly and the decision to sacrifice the nerve should only be taken when there is clear histological evidence of the aggressiveness of the tumour and signs of involvement of the facial nerve at or before operation. Sacrificing the nerve when there is no evidence of its involvement at operation does little to improve prognosis and merely makes the patient's remaining life miserable. The histological nature of the tumour may be evident from intraoperative frozen sections, reliable fine-needle aspiration biopsy (where available) or even

as a result of a previous operation when for example, a misguided attempt has been made to remove what appears to be a sebaceous cyst behind the angle of the jaw, but a malignant tumour has been found.

In the unlikely event that the fully informed patient finds the possibility of facial palsy totally unacceptable then preservation of the facial nerve must be attempted. Even so it must be explained to the patient that, even with the best will in the world, some motor deficit may be unavoidable. In addition, it needs to be pointed out that (even though facial nerve function may be unimpaired at the time of consultation), facial palsy can result later from involvement of the nerve by tumour if an attempt is made to preserve it.

In this very difficult area it is essential to have written evidence of fully informed consent to avoid claims and medicolegal complications.

It is hard enough for surgeons to have to see, again and again, patients whom they have disfigured by facial palsy. However, it is difficult for the surgeon fully to appreciate how disabling and embarrassing this disability is for the patient who has to bear it through every day of life. In addition to the distortion and inappropriate movements of the face, there can be conjunctivitis from deficient lid movement and exposure keratitis from inadequate lubrication. Alternatively or in addition, in those patients whose facial nerves have been repaired by grafts, lacrimation may accompany eating or be unpredictable and uncontrollable. Sudden weeping of one eye can for example, make driving difficult or dangerous. In the worst cases, the embarrassment caused by drooling of saliva may be sufficient to deter the patient from eating in public.

It may, incidentally, be suggested that sacrifice of a facial nerve involved in a malignant tumour has not been shown to improve the prognosis. Evidence for this proposition has come from study of the management of adenoid cystic carcinomas. Such tumours may infiltrate the facial nerve so far back that total excision is impractical. However, even if it is accepted that preservation of the facial nerve does not worsen the prognosis of adenoid cystic carcinomas, this decision cannot be applied blanket-fashion to other, more rapidly growing tumours with equal expectation of a satisfactory outcome.

In yet other cases, the expectation of life may be so short that preservation of an infiltrated nerve may make little difference. It may then be felt to be unacceptable to increase the misery of the patient's remaining days with a facial palsy.

There can therefore be no completely hard and fast rules about sacrificing the facial nerve. All that can be said is that, unless there are overwhelmingly strong reasons against so doing, it should be sacrificed as part of a total parotidectomy for a malignant tumour in a patient who otherwise has a reasonable expectation of life. In reality, there are few occasions when this dilemma of having to sacrifice a functional facial nerve has to be faced.

Operative procedure

The extent of the resection in a radical parotidectomy is variable, and the dividing line between what is termed 'radical' by some and 'supraradical' by others is ill-defined. The resection nearly always includes either a suprahyoid or radical neck dissection. If the

overlying skin is infiltrated or has been previously breached by biopsy, it too must be included. Removal of the maxillary tuberosity, ramus of the mandible and mastoid process or petrous bone are supraradical procedures frequently justified by the extent or aggressive nature of the salivary malignancy. As each resection is tailored to an individual patient only those general points that need to be considered will be discussed further.

Incision

An extended 'lazy S' incision or 'Y' from which an inferior limb is dropped to the junction of the outer one-third and medial two-thirds of the clavicle is usually adequate. However, each case must be assessed on its own merits and modifications made to the incision in order to fulfil individual requirements. For example, skin removal or skin preservation in a previously healthy irradiated neck, a McFee neck incision might seem more appropriate (Fig. 9.34).

Re-animation

It is sometimes possible to preserve peripheral branches of the facial nerve to the mouth and eye but attempts to do this must not compromise the adequacy of the resection. More and more often, surgeons are employing immediate nerve-grafting techniques to re-animate the face. The sural nerve, located immediately behind the lateral malleolus, is easy to harvest and very suitable as a graft for the facial nerve. Up to 20 cm of sural nerve can be obtained from the lower leg either through a curvilinear or multiple horizontal stab incision. It can be divided into its constituent fascicles for peripheral anastomosis while leaving the main trunk to be sutured or approximated to the proximal stump of the facial nerve (Figs 9.35 and 9.36). While waiting for the graft to take and facial function to be restored, the eye must be protected. A lateral tarsorrhaphy or the insertion of a gold weight into the upper eyelid are simple and very effective methods.

Some surgeons still use a temporalis muscle transfer for facial re-animation. In this procedure, a long strip of temporalis muscle is mobilized, split and tunnelled through the eyelids to be attached firmly to the medial canthal ligament. If necessary, additional length can be obtained by suturing fascial slips to the muscle strips. This avoids mobilization of the muscle below the zygomatic arch and jeopardizing its blood supply. Other strips of the temporalis muscle can be firmly attached to the fascia beneath the vermilion border of the lip to prevent drooping of the oral commissure. At the time of surgery, both the eyelids and mouth must be overcorrected to a considerable degree. If this is not done, drooping of the mouth and eyelids will persist and no active movement can be produced by muscle retraining.

Surgery for Recurrent Benign Disease

There are no hard and fast rules concerning the management of recurrent benign disease, which in the vast majority of cases is pleomorphic adenomas. Every patient presents a slightly different problem according to the pattern of their recurrence and past surgical history. It is as well to be realistic with regard to the patient's ultimate prognosis. The surgeon should be continually aware that no matter what is done, approximately 30% of these patients will develop a further recurrence or recurrences, and that with every surgical intervention the risk of permanent damage to the facial nerve increases.

It is possible to suggest broad guidelines for the surgeon in this difficult aspect of salivary surgery, according to adequacy, or otherwise, of treatment.

Inadequate treatment of primary lesions

Patients who have previously had inadequate treatment (for example, enucleation, minimal limited excision, incomplete excision or open biopsy) should have at least a superficial parotidectomy or, if necessary, a total conservative parotidectomy, together with excision of the previous incision. Recurrences found in close proximity to branches of the facial nerve should be dealt with on their own merits, preserving the nerve if at all possible.

Adequate treatment of primary lesion

In patients who could be considered to have had adequate treatment for their primary lesion (for example, superficial, total conservative or radical parotidectomy) recurrences are probably best dealt with as isolated lesions. For instance, nodules within the scar can be managed by excision of the scar only with no attention being necessary to the parotid bed. An isolated recurrence elsewhere in the field is probably better dealt with by a limited resection. If a branch of the facial nerve is easily recognized then it is reasonable to attempt to dissect it clear of the recurrence, if that is feasible. However, all too often the operative field consists of dense scar tissue in which little more than the recurrence can be identified. In these circumstances, it is better to let the nerve take its chance and to warn the patient that this is preferable to the probability of further recurrence from inadequate removal, and also of unnecessary damage to more proximal branches of the facial nerve.

Sadly, there are still patients who present with confluent recurrences which at surgery are found to encase the facial nerve trunk and its main branches. For these, radical parotidectomy will probably be unavoidable though the author has salvaged some, quite spectacularly and unexpectedly, by using nerve monitoring. Particular attention should be directed to the deep surface of the zygomatic arch and mandible, as in these areas occult extensions of disease can be overlooked. If the main trunk of the facial nerve is sacrificed, it is best to perform an immediate nerve graft or re-animation procedure.

Pediatric Parotidectomy

Resection of the parotid gland in children is rarely necessary, but is most often indicated for developmental disorders, for example first branchial arch anomalies, cystic hygroma and vascular abnormalities. However, both benign and malignant salivary gland tumours are found in children and > 60% of these arise within the parotid gland. The surgery of both types of disease is slightly more difficult in children than in adults for the following reasons:

➤ The facial nerve is smaller and courses more superficially within the parotid in children than in adults. This is partly due to incomplete development of the mastoid process which leaves the stylomastoid foramen and its contents, the facial nerve, relatively unprotected at the base of the skull. As a result, the nerve may be encountered at a very early stage in the surgical procedure and can be inadvertently damaged.

➤ First branchial arch anomalies of the collaural type run lateral, deep to or between the branches of the facial nerve in their passage from the external auditory meatus to the angle of the jaw. Usually the child or young adult will have experienced numerous infective episodes within the fistulous tract before they present to the surgeon. The parotid gland adjacent to the fistula is densely scarred and the plane of dissection around the facial nerve may have been destroyed. Iatrogenic facial weakness or paralysis is a very significant risk in these patients, and is a complication about which their parents should be very clearly forewarned.

➤ Other developmental disorders are notoriously difficult to dissect, for example cystic hygromas and vascular anomalies. These lesions are either so diffuse or bleed so easily that surgical landmarks can be lost and as a consequence accidental damage to the facial nerve be incurred.

The use of a facial nerve monitor for this type of surgery cannot be recommended too strongly. Not only does it predict the impending proximity of the facial nerve trunk, but it also helps minimize trauma to its finer branches which can be irrevocably damaged all too easily. It hardly needs repeating that facial palsy is a devastating handicap to carry through life, both for the child, its parents and the surgeon who inflicts it.

Injuries to the Parotid Duct

Salivary fistulae are caused by facial lacerations or parotid surgery. The majority are transient in nature and close spontaneously. Most surgeons' experience of this complication is limited and therefore the advice proffered in many reports is almost anecdotal. However, few substantial series have been reported. In these it is apparent that the site of injury is important in determining the most appropriate management for the patient and their likely prognosis. Glandular fistulae are more likely to seal spontaneously than fistulae from the parotid duct. Various treatments have been proposed for those that do not close within a few weeks. Tympanic neurectomy, auriculotemporal neurectomy, cautery, irradiation and intravenous nutrition have all been advocated and found to be equally successful. Fluid restriction together with a period of intravenous nutrition, is the least meddlesome option and should be tried before resorting to others.

If the main duct is transected in a facial wound it is advisable to undertake primary repair. The severed duct should be sutured with 8-0 Vicryl and splinted with a silicone tube which can be inserted through the mouth and secured to the buccal mucosa. This is not a simple procedure and is best performed with a microscope. In late cases with well-established fistulae, it may be simpler to re-implant the duct directly into the mouth. Fistulae which are resistant to all methods of treatment should be considered for total conservative parotidectomy.

Surgery of the Submandibular Gland

Indications

Resection of the submandibular gland is indicated for neoplasms or intractable infection. The gland should also be removed as part of a radical or suprahyoid neck dissection for the control of locally invasive or metastatic squamous-cell carcinoma arising within the oral cavity, pharynx or larynx.

Preoperative investigations

In the case of calculi, plain lower occlusal and lateral jaw radiographs are useful to determine their position and number (Figs 9.37-9.39). These may be combined with sialography to determine the state of the ductal system in patients with recurrent inflammatory disease. Computerized tomography imaging is indicated for patients with submandibular neoplasms in which fixation or infiltration of the mandible and tongue musculature is clinically suspected. Radiographic evidence of localized infiltration or erosion is an indication for a wider excision to include a partial glossectomy or rim resection of the mandible. A chest radiograph is mandatory for all cases of known or suspected malignant disease but, with certain tumour types, may not contraindicate local surgery even if metastatic spread is present.

The role of fine-needle aspiration biopsy has been discussed previously.

Informed consent

The patient should be reassured that a properly placed skin incision is unlikely to leave a cosmetically unsightly scar. Damage to the marginal branch of the facial nerve may result in either a temporary or permanent weakness of the angle of the mouth which will be most noticeable on smiling and puckering the lips. In cases of malignant disease involving or abutting this nerve, it may be necessary to resect it, together with the gland, and thereby inflict a permanent deficit (Fig. 9.40).

Neuropraxia of the lingual and hypoglossal nerves is unusual but possible, especially in those patients who have sustained numerous infective episodes. In these cases the gland is likely to be densely tethered to adjacent structures which become more difficult to identify and preserve. Planned resection of these nerves is necessary in locally advanced malignant disease and will result in hemianaesthesia of the anterior two-thirds of the tongue and limitation of tongue movements. Sensory deficit in the presence of malignant disease is usually tolerated well by the patient, but is a common source of litigation in those with benign or inflammatory pathology. Motor dysfunction of the tongue initially impairs articulation and mastication but the patient rapidly compensates. Ultimately the tongue muscles waste on that side but without further symptomatic deterioration.

Surgical Anatomy of the Submandibular Gland

The submandibular salivary glands consist of a large superficial lobe and a smaller deep lobe. These are continuous around the posterior border of the mylohyoid muscle. The medial aspect of the superficial part lies on the inferior surface of the mylohyoid muscle and

is covered there only by the oral mucosa. The lateral surface is covered by the body of the mandible, while its inferior surface rests on both bellies of the digastric muscle. Its inferior surface is covered by the platysma muscle, deep fascia and skin. The anterior facial vein runs over the surface of the gland within this fascia, but the facial artery, for most of its early course, is related to the deep surface of the gland until it ultimately runs adjacent to the anterior facial vein superficially. Posteriorly, it is separated from the parotid by a condensation of deep cervical fascia - the stylohyoid ligament. The deep part of the gland lies on the hyoglossus muscle where it is related superiorly to the lingual nerve and inferiorly to the hypoglossal nerve and deep lingual vein. The capsule of the gland is well defined and is derived from the deep cervical fascia which splits from the greater cornu of the hyoid bone to enclose it. For the surgeon this is an easy plane to find and dissect.

The duct of the gland is formed by the union of several tributaries and is about 5 cm in length. It emerges from the middle of its deep surface and runs in the space between the hyoglossus and mylohyoid muscles to the anterior part of the floor of the mouth, where it opens onto a papilla to the side of the lingual frenulum. In its anterior part it is related laterally to the sublingual glands and may receive many of their ducts. During its course on the hyoglossus muscle it is crossed from its lateral side by the lingual nerve. This is a most important surgical point in duct relocation procedures. The lingual nerve must be disentangled from the duct at its crossing point otherwise inadvertent damage may result.

The submandibular gland receives its blood supply from branches of the facial and lingual arteries. Venous drainage accompanies these vessels. There are several lymph nodes immediately adjacent to the superficial part which drain the gland and adjacent structures. Multiple parasympathetic secretomotor fibres are distributed from the submandibular ganglion which hangs from the lingual nerve and may occasionally be easily observed at surgery. Preganglionic fibres join the lingual nerve from the chorda tympani.

Operative procedure

General anaesthesia with either an oral endotracheal tube, secured to the contralateral side of the mouth, or nasal tube, is used. In previously infected cases a prophylactic broad-spectrum antibiotic is given intravenously at the start of the operation. Patients should be placed on the operating table in the supine, reverse Trendelenburg position with the neck extended by means of a sandbag placed beneath the shoulders, and their face turned away from the operator and the side of the lesion. The skin should be carefully cleansed with a disinfectant soap solution and the area draped with head, side and body towels. Dissection is considerably facilitated by preliminary infiltration of the skin and subcutaneous tissues with 40-50 mL of a 1:200.000 solution of adrenaline, but this is not an essential prerequisite if there is a cardiovascular contraindication to its use.

The incision is outlined with a skin marking pen (Fig. 9.41). It should be made to lie in a natural skin crease approximately 2.5 cm below the lower border of the mandible and extending for approximately 10 cm anterior to the sternomastoid muscle. The incision is deepened through the platysma muscle and flaps developed in the fascial plane immediately beneath it. The superior flap is extended to the body of the mandible, taking care not to damage the marginal mandibular branch of the facial nerve which runs in the same tissue plane (Figs 9.42 and 9.43). The nerve enters the neck 1 cm in front of the angle of the

mandible, loops over the facial artery and vein up to 2 cm below the lower border of the body of the mandible before sweeping superiorly to the angle of the mouth. The inferior flap is developed to the level of the body of the hyoid bone.

If there is no concern about invasion of the mandibular branch of the facial nerve, it can be protected from inadvertent damage by one of two manoeuvres. The facial vessels can be transected at a low level on the surface of the submandibular gland and reflected superiorly (Figs 9.44 and 9.45). The nerve, which lies lateral to the facial vessels, can thereby be lifted out of the operative field. Alternatively, the capsule of the gland can be opened at the level of the hyoid bone and dissection continued beneath it. The elevated capsule protects the nerve in a similar fashion to the first technique. Occasionally, it is very difficult to identify the mandibular branch, and in these cases a nerve stimulator or monitor with sensing electrodes inserted into the orbicularis oris is helpful.

The superficial part of the gland is then mobilized by either blunt or sharp dissection and retracted posteriorly in order to expose the deep portion which lies on the hyoglossus muscle and is partly covered by the mylohyoid muscle (Figs 9.46 and 9.47). The facial vessels are ligated as necessary if this has not already been accomplished or there are significant branches to the gland itself. Retraction of the mylohyoid anteriorly, together with posterolateral traction on the gland, brings the lingual nerve, duct and more proximal part of the facial artery into the operative field (Figs 9.48 and 9.49). The lingual nerve appears as a ribbon-like band loosely attached to the body of the gland by a few fibres - the parasympathetic secretomotor supply. Section of these fibres releases the nerve from the gland and permits it to assume a more superior relation. At this stage, the hypoglossal nerve may be seen inferior and parallel to the lingual nerve but is sometimes partially covered by the posterior belly of the digastric muscle. The proximal part of the facial artery is usually ligated at this point.

The gland is then further mobilized from the hyoglossus muscle and about its duct so that this may be ligated and transected as far anterior as possible (Figs. 9.50 and 9.51). Failure to attend to this detail may leave behind troublesome paraductal salivary tissue which is exceptionally difficult to eradicate by subsequent surgery. It is thought that the mucoid secretions of these paraductal glands are very viscous and that they stagnate and eventually calcify in the remnant of Wharton's duct. Recurrent and symptomatic calculi have been reported in the residual duct many years after primary surgery. An alternative explanation is that these calculi were overlooked at the time of initial surgery and present again when sufficiently large enough to obstruct the sublingual glands. In the light of these reports, it would seem prudent to carefully palpate the duct for the presence of calculi and ensure that any found are removed with the gland or delivered into the mouth.

The operative field should be irrigated with normal saline and perfect haemostasis achieved. A small vacuum drain is inserted and brought out through the skin posteriorly. The wound is closed in two layers with 3-0 chromic cat gut or Vicryl subcutaneously and 4-0 monofilament nylon for the skin. The drain is removed on the first postoperative day and the skin sutures after one week.

Surgery of the Submandibular Duct

Indications

The main indication for surgery to the submandibular duct is the removal of distally situated, but otherwise easily accessible, calculi. Patients with multiple strictures of the ductal system, recurrent or multiple stones, are better treated by total resection of the gland.

Preoperative Investigations

Plain radiographs of the floor of the mouth and lateral neck are essential. Patients who have had previous multiple infective episodes should have sialographic evaluation of the duct system.

Informed consent

The patient should be warned of the possibility that infection may recur or that at operation the stone may fall back into the body of the gland and become inaccessible. Exploration of the posterior portion of the duct by a transoral approach may damage the lingual nerve and cause a temporary or permanent sensory deficit of the anterior two-thirds of the tongue on that side.

Operative procedure

Calculi at the orifice of the duct may be removed under local anaesthesia provided by a lingual nerve block or local infiltration of 2% lignocaine with 1:80.000 adrenaline. Ducts containing multiple calculi or with stones relatively far back in the mouth are better explored under general anaesthesia delivered through a nasal endotracheal tube.

The mouth and face are cleansed with a disinfectant soap solution and the head and neck draped. Gags or interdental props are inserted to maintain the mouth open. A sling suture is inserted around the duct proximal to the calculus and tensioned sufficiently to prevent the calculus slipping back into the gland. The area of the distal duct is then infiltrated with a 1:200.000 solution of adrenaline. The duct is then either cannulated with a fine probe and opened along it so that the calculus can be removed (Figs 9.52 and 9.53), or an incision is made directly over the calculus. 4-0 resorbable sutures are placed so that the duct orifice is marsupialized to the floor of the mouth (Figs 9.54-9.57).

The patient is instructed to rinse their mouth with hot isotonic saline solution three times each day for the first postoperative weeks (Figs 9.58 and 9.59).

Surgery for Sialorrhoea

Sialorrohoea (drooling) is a distressing complaint most often seen in children with cerebral palsy or adults with acquired bulbar palsies, strokes or Parkinson's disease. Many of the children with cerebral palsy are also severely epileptic and this adds to the management difficulties as discussed later. The fundamental disorder is that of neuromuscular incoordination, patients being unable to swallow or control their saliva rather than having an

excess. It is easy to underestimate the social impact of this condition on even mildly affected patients. These individuals frequently perceive their drooling as the main cause of social isolation whether or not this is the case. Parents of severely affected children may need to change their child's clothing many times every day or submit their child to long-term hospitalization.

Preoperative assessment and conservative therapy

A multidisciplinary approach to assessment and management is essential. Speech therapists, physiotherapists, dental surgeons and otolaryngologists can all make valuable contributions. Surgery should only be contemplated after a period of intense conservative therapy and prolonged observation. It is also inadvisable to operate on children under the age of six years, as drooling may improve spontaneously with further development. Close attention should be paid to the correction of abnormal body posture, dental malocclusion and nasal obstruction. All of these worsen drooling but are easily correctable. Such capacity as there is to initiate and complete swallowing should be maximized by appropriate sensory training.

In some patients, behavioural modification by auditory evoked conditioned reflexes has been found to be helpful. Commercially available devices (dribbling boxes) consist of a collecting box containing a sensor. The box is placed beneath the child's chin and bleeps each time saliva drips into it. The success of all conditioning and postural therapy has been found to be largely dependent on the intellectual capacity of the patient, the age at which therapy is started as well as on other disorders or disabilities that may be associated.

Pharmacotherapy with anticholinergic drugs may be helpful in a few, but in general, the side-effects of these drugs (constipation, urinary retention, impaired visual accommodation and often, agitation) only compound the patient's troubles.

Surgical treatment

Surgical approaches to the control of drooling that have been proposed range from excision of the major glands and denervation procedures, to relocation or ligation of the salivary ducts. The submandibular salivary glands, as the major contributors to resting salivary flow, have received most attention in this respect. Naturally, all operations have to be undertaken bilaterally. This is therefore a serious consideration in treatment planning as these procedures are major undertakings even in normal patients, let alone those with neurological disabilities.

The results of denervation by section of the chorda tympani nerve, through a tympanotomy approach, are disappointing. Only 50-80% of patients are reported to achieve a satisfactory outcome and even some of these regress with time because of neural regrowth. Bilateral tympanotomy is inevitably attended by a period of hearing loss until middle ear exudates have dissipated. Nerve sections therefore have to be undertaken as staged procedures in order to avoid this period of temporary deafness. Furthermore, section of the chorda tympani automatically leaves a deficit of taste to the anterior two-thirds of the tongue and therefore the operation has largely become obsolete.

Although some still advocate bilateral resection of the glands, the majority now agree that equally good results can be obtained by relocation of their ducts. There are significant advantages to both the patient and surgeon from duct relocation of which the most obvious is the avoidance of the potentially distressing effect of inadvertent marginal nerve damage on the oral competence of a cerebral palsied child.

Submandibular Duct Relocation. Operative Procedure.

Preparation

The operation of submandibular duct relocation is performed under general anaesthesia with a nasal, endotracheal tube and small pharyngeal pack. A pack that is too large and bulky makes the procedure very difficult indeed. A broad-spectrum antibiotic given with the premedication is a sensible precaution and should be continued for at least one week.

Operative technique

The surgeon is seated at the head of the table with an assistant at his side to retract the tongue as required. The floor of the mouth is infiltrated with 1:200.000 adrenaline. An elliptical island of mucosa is incised around the submandibular papillae and by blunt dissection, the individual ducts and lingual nerves are identified (Figs 9.60 and 9.61). The island is then divided (Figs 9.62 and 9.63) and a submucosal tunnel created on each side of the floor of the mouth to open at the base of each tonsillar fossa approximately 1 cm behind the anterior pillar of fauces (Figs 9.64 and 9.65). A fine rubber sling or silk suture is pulled back through the submucosal tunnel to exit at the initial incision (Figs 9.66 and 9.67). The mucosal cuff surrounding each duct orifice is sutured to the sling, which is then used to pull the duct to its final position in the tonsillar fossa where it is secured with a resorbable suture (Figs 9.68 and 9.69). The anterior incision is also closed with resorbable, interrupted sutures.

Postoperative care and complications

Most patients develop swelling of the floor of the mouth which normally subsides within 2-3 days, but has on rare occasions compromised the airway and necessitated intubation. Intravenous access for fluid replacement and drug administration is frequently necessary postoperatively until a normal diet is established and patients can take drugs by mouth. This is rarely necessary for more than 24-48 hours as the majority of patients are fit for discharge home by the third postoperative day. However, it has to be emphasized that there must be no doubt that epileptics are fully stabilized before discharge.

Two complications are regularly encountered: ranula formation and submandibular duct obstruction. Crysdale and White (1989) reported an 8% incidence of postoperative ranula formation in their series of 194 patients. The frequency of this complication prompted them to modify their technique and resect all sublingual tissue at the time of relocation.

Late obstruction of relocated submandibular ducts has been attributed to excessive tonsil size and recurrent tonsillitis. Surgical removal of these obstructed and rerouted glands has been found to be difficult because of adhesions. Bailey and Wadsworth (1985) claim to have circumvented this complication by resiting the duct at the base of the anterior pillar

rather than within the tonsillar fossa. Obviously enough, patients with a long-standing history of tonsillar infection should have a tonsillectomy some weeks before relocation.

Prognosis

The results of treatment by submandibular duct relocation are difficult to interpret. Reduction in the severity of drooling should be achieved in at least 80% of patients, but that is not synonymous with the cessation of sialorrhoea. Saliva is still present on the chins of ≤ 70% of those cases deemed by the surgeon to be successful. Success is therefore very difficult to assess and greatly depends on the expectations of the patient or parents. At one extreme, a patient may be happy with a minor improvement in drooling despite persistence of saliva on the chin; at the other, the patient may cease drooling as a result of removal of the major glands but be made unhappy by the discomfort of a dry mouth.

Bilateral submandibular gland excision and parotid duct ligation is claimed to be more effective than submandibular duct relocation alone. Certainly salivary flow is substantially reduced by this technique, but at the cost of external scarring and sometimes a distressingly dry mouth with its attendant risk of orodental infection. Surprisingly, postoperative parotid swelling has been neither invariable nor troublesome. Brody (1989) has cautioned against this procedure in patients with severe athetosis. In his experience, their tongue movements whipped the thickened residual saliva into an intensely adherent and fetid gum which became plastered to the lips and teeth. Brody felt that this complication was worse for patients and their families than the original sialorrhoea and caused him to abandon ablative surgery for drooling in athetoid patients.

In summary, surgical treatment should be tailored for each particular patient and not undertaken until all other potential influences have been properly addressed. There is always much to commend a single surgical intervention for any individual. Patients with incessant, drenching sialorrhoea should therefore be considered for more radical therapy than those less severely affected. Nevertheless, whatever the procedure adopted, it is important first to warn patients or parents that it may be a major undertaking and, second, to caution them against any excessive hopes of total cure.

Surgery of the Sublingual Glands

Indications

There are two conditions affecting the sublingual glands that necessitate surgical attention: tumours and ranulae. The detailed technique of sublingual tumours is identical to those of the submandibular gland and therefore will not be repeated later in this section.

Preoperative investigations

Well-circumscribed or relatively small lesions do not require diagnostic imaging, but in view of the propensity of tumours to be malignant at this site, fine-needle aspiration cytology is advisable. Extensive cysts, which on clinical grounds are suspected to be plunging ranulae, or tumours with any degree of fixation, are better evaluated by MRI. An external approach is indicated for any ranula which has a significant component within the submental

and submandibular triangles of the neck.

Informed consent

The patient should be warned about possible anaesthesia of the anterior two-thirds of the tongue which can be caused by damage to the lingual nerve where it is intimately related to the submandibular duct.

Surgical Anatomy of the Sublingual Salivary Glands

The sublingual salivary glands lie in the anterior part of the floor of the mouth, between the mucous membrane, the mylohyoid muscle and the body of the mandible close to the symphysis, where it may produce a small depression - the sublingual fossa. It has numerous excretory ducts which either open directly onto the mucous membrane or into the terminal part of the submandibular duct.

Ranulae

Preparation

The operation is performed under general anaesthesia with a nasal endotracheal tube and small pharyngeal pack. Systemic, broad-spectrum antibiotics are given with the premedication if there has been a history of repeated infection and should be continued for at least one week.

Operative technique

The surgeon is seated at the head of the table with an assistant at the side to retract the tongue. It should be the intention of the surgeon to completely excise the ranula rather than marsupialize it, as this reduces the chance of further problems. The floor of the mouth is infiltrated with 1:200.000 adrenaline to provide a blood-free field and to facilitate dissection. Cannulation of the submandibular duct at this stage is a wise precaution as it serves to indicate the course of the duct and the likely position of the lingual nerve, which passes deep to the duct. The ranula is then separated from the floor of the mouth by blunt dissection.

Occasionally the ranula will be found to extend further along the lateral border of the mylohyoid muscle than was anticipated. Complete resection of this type of cyst is not possible by an intraoral approach alone. It is then necessary to open the submandibular triangle as described for resection of the submandibular gland. At least the cervical component of plunging ranulas are mucous extravasation cysts and need to be handled with extreme care. It is all too easy to rupture them at a premature point in the operation. Collapse of the cyst makes subsequent dissection extremely difficult and remnants are then often left behind which give rise to recurrences.

Surgery of Palatal Tumours

The three factors that determine the surgical management of palatal tumours are:

➤ The histological nature of the tumour.

➤ The size and extent of the tumour.

➤ The age and general health of the patient.

Precise knowledge of the histological nature and malignant potential can be obtained by incisional biopsy and the extent of the tumour by clinical examination and computerized tomography scans. The amount of tissue that need be removed with the tumour is variable. For example, a small adenoid cystic carcinoma of the palate in a relatively young patient would indicate an extensive resection because of the extensive malignant potential of the tumour. This resection might include the alveolar ridge, nasal septum, posterior aspect of the maxilla, together with a clearance of the pterygopalatine and infratemporal fossae. In general the surgeon should aim to obtain a tumour-free margin of about 2 cm for all malignant tumours. On the other hand, a palatal pleomorphic adenoma in an elderly patient could be adequately treated by a more localized excision leaving the palatal bone intact. In patients with a longer life expectancy, this conservative approach for certain benign tumours would be inappropriate and a limited removal of underlying bone (palatal fenestration) should be undertaken.

It is fortunate that the palate is almost the only site where preoperative incisional biopsy is not contraindicated. Surgical excision of palatal tumours always includes the overlying mucosa and therefore, in contrast to the major glands, preliminary biopsy does not predispose to recurrence or influence long-term results.

Operative Technique. Local Excision of Benign Tumours.

It must be emphasized that this approach to the management of palatal tumours should be reserved for those tumours with little potential to recur, for example, neurofibromas and haemangiomas. A special case can occasionally be made to treat some adenomas in elderly patients by this technique. The resection is performed under general anaesthesia with either an oral or nasal endotracheal tube. Patients should be positioned on the operating table in the supine position with a sandbag placed beneath their shoulders to extend their head and neck. This allows the surgeon to sit at the patient's head, which is immobilized and suspended in extension by a mouth gag and Draffin rods. The table may need to be tilted slightly head down to obtain a perfect view of the tumour and surrounding tissue. Preliminary infiltration of the area with 2% lignocaine with 1:80.000 adrenaline solution provides an almost bloodless field.

An incision is made around the tumour down to the periosteum, with an adequate margin of normal palatal tissue to ensure a complete lateral excision (Fig. 9.70). The tumour is then removed by developing a plane between the periosteum and the palate with an elevator. The defect can be left open to heal by secondary intention, a process that may take

several weeks or even months. Alternatively, it can be protected by an acrylic dental appliance adequately relieved in the area of the resection to retain a Coe-pak dressing. Some surgeons favour closure by rotation flaps based on either the greater palatine artery, or from the buccal mucosa where the blood supply is derived from the submucous plexus and underlying facial muscles. The palatal flap should be raised parallel to the dental arch and extended posteriorly to a point 1 cm anterior to the greater palatine foramen (Fig. 9.71). The periosteum beneath the flap is not raised. The flap is rotated and sutured into position with 3-0 Vicryl sutures on a round bodied needle. The residual defect at the donor site may be closed by advancement of a buccal flap, covered by a free graft, held in position by a bolster or acrylic dental appliance, or left to granulate (Fig. 9.72).

Small, benign tumours confined to the soft palate are excised using an elliptical incision made in the long axis of the palate (Fig. 9.73). An adequate cuff of underlying muscle must be included. Parallel, mucosal relieving incisions facilitate primary closure of the defect with 3-0 Vicryl mattress sutures and prevent excessive shortening of the palate (Fig. 9.74).

Operative Technique. Palatal Fenestration.

Removal of palatal bone is mandatory for all malignant tumours and should be seriously considered for those benign tumours which have a tendency to recur or have already recurred after a local excision. Small or localized growths are easily managed by fenestration, while extensive tumours or those with a reputation for advanced early spread, for example adenoid cystic carcinoma, necessitate a more extensive resection or maxillectomy.

Before surgery the patient should be assessed by a dental surgeon. An appliance (obturator) must be made to cover the operative defect, allow the patient to eat normally and prevent nasal regurgitation during the immediate postoperative period. For partially or completely edentulous patients, minor adjustments can be made to their existing denture to enable an obturator to be attached. Prosthetists require some time to construct these appliances and therefore allowance should be made for this when planning surgery.

Preparation of the patient for fenestration is identical to that described for local excision. Some surgeons, however, prefer to work from the front of the patient and use dental props and cheek retractors to keep the patient's mouth open. An incision is made around the tumour and incorporates a margin of healthy tissue. The adjacent mucoperiosteum of the healthy palate is elevated and retracted. Cuts are made in the palatal bone beneath this retracted periosteum with either an osteotome or fine oscillating saw. The tumour, in continuity with the palate, floor of the nose or maxillary antrum are then gently eased out of the mouth by cutting any deep attachments. The periosteum is then allowed to fall back into the operative defect and any bone edges that it fails to cover are cut back further (Fig. 9.75).

Small defects in the palate may sometimes be closed with local flaps, as described in the previous section. The majority of defects, particularly those which include the entire length of the soft palate, are not closed and at this point the prosthetist should fit the obturator and make sure that it is well retained. It is very important that it does not fall out or become displaced easily. If this should happen immediately after surgery it could obstruct the airway or at a later stage be a constant source of discomfort to the patient. In some, adequate

adhesion of the obturator to the palate is achieved, but in others either clasps to remaining teeth are necessary to provide sufficient retention or a two-part, interlocking device can be made which uses the cavity to its fill retentive capability. In a few patients, additional temporary anchorage is necessary and can be easily provided by circumzygomatic wires fixed to cleats on the buccal side of the denture.

Postoperative care

The prosthesis is usually left in place for 7-10 days and then removed, cleaned and adjusted under mild sedation. Further modifications and adjustments are made at weekly intervals until the area has healed completely and the palatal contour stabilized. At that time, a definitive appliance is made and fitted. A speech therapist should be encouraged to contribute to the postoperative management of the patient. Their skill in the rehabilitation of speech and swallowing is often greatly appreciated.

Note

1. Friedrich Trendelenburg (1844-1924), Leipzig surgeon. Thought to be the first surgeon to carry out a pulmonary embolectomy.