Chapter 19: Benign salivary tumours

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Historical perspective

Salivary gland surgery in the years leading up to the Second World War was, by contrast with the present day approach, a timid and halting affair for reasons which are now all too clear.

A poor understanding of the natural history of salivary diseases in general, and tumour pathology in particular, together with a fear of damaging the facial nerve stand out in retrospect as the main obstacles to progress. Despite being well versed in the anatomy of the facial nerve, there was little enthusiasm on the part of surgeons for confronting the nerve in vivo, a diffidence born in part from the difficult operating conditions of the time, but also from the fear of dissecting around the nerve. Safeguarding the physiological integrity of nerves by delicate handling was a relatively recent concept, and seemingly the hallmark of neurosurgeons, whereas the saying that 'a nerve exposed is a nerve damaged' very much dominated the thinking of the general surgical circles.

Operations on the submandibular gland would have been viewed with much less reluctance, and fears there would have focused more on the danger of spread of infections in fascial planes, rather than on the bogey of damaging nerves such as the mandibular branch of the facial nerve.

The lack of a proper classification of salivary tumours and general ignorance of their natural history probably constituted greater impediments to progress. For many years, the belief existed that mixed tumours were a low-grade form of malignancy largely because of their propensity to recur after local enucleation. It was not appreciated that the degree of encapsulation of pleomorphic adenomata was variable and often incomplete, or that their surface was frequently bosselated, features which favoured recurrence if simple enucleation were practised.

Others ascribed the high recurrence rate of pleomorphic adenomata to a multifocal origin, not realizing that the appearance of separate outlying foci was an artefact created by the plane of section passing, not only through the main bulk of tumour, but also through a number of surface excrescences. Serial sections ultimately established the continuity of the small extensions to the parent tumour and redirected attention to the real cause of recurrence, namely inadequate surgical margins and spillage of tumour.

During the war years, the foundations of our present knowledge and expertise were laid down through the efforts of a number of individuals working mainly in North America, France, and the UK. Later contributions emanated from these countries and from Scandinavia.

McFarland (1942) attempted to correlate the histology of mixed tumours to their prognosis after surgery, while Foote and Frazell (1953) were largely responsible for placing the classification of salivary tumours on a sound basis and for providing a comprehensive account of their natural history.
The implantation of mixed tumours during the operation of enucleation, long suspected as a cause of recurrence, was eventually demonstrated in a most convincing manner by Patey and Thackray (1957-1958) and the belief that they were multifocal in origin finally put to rest.

Bailey (1941) was the first in the UK to practise formal dissection of the facial nerve in operations for benign parotid tumours, while Redon (1945) in France was advocating total parotidectomy with conservation of the facial nerve at much the same time. The former considered the parotid to be essentially a bilobed structure separated by an anatomical plane containing the facial nerve, a concept which is now known to be fallacious, but which in no way detracts from Bailey's valuable contribution to parotid surgery. Redon, on the other hand, believed that all mixed tumours were multifocal in origin and consequently advocated removal of both superficial and deep parts of the parotid after freeing the facial nerve of its attachments.

Although this belief was finally and irrevocably refuted, Redon's contribution should not be minimized since it broadened the technical repertoire of parotid surgeons and provided insight into the functional capabilities of the facial nerve in the face of operative trauma.

**Surgical anatomy**

**The parotid gland**

A horizontal section of the parotid gland is much more informative about the normal disposition of salivary gland tissue than might be presumed from lateral inspection. Such a section would clearly demonstrate that most of the gland actually lies in the retromandibular sulcus, rather than on the external of the masseter muscle and would thus explain why the majority of tumours are to be found in that segment. Since the facial nerve splits this area unequally into a major portion lateral to the facial nerve and a much smaller part medial to it, it is not surprising that most tumours are to be found superficial to the nerve.

The gland is incompletely invested by a continuation of the deep cervical fascia, which surrounds the sternomastoid posteriorly and overlies the masseter muscle anteriorly. The surface component of the parotid fascia is exceedingly tough, but as it branches medially over the anteromedial and posteromedial aspects of the gland it thins out progressively. Where the gland lies close to the styloid process, the fascia blends with a tough band of fibrous tissue which joins the styloid to the posterior aspect of the angle of the mandible, thus forming the stylomandibular ligament.

The toughness of the parotid fascia on the external surface of the gland inevitably means that benign tumours are slow to project outwards to any great extent, and hence it takes years for them to present as large unsightly bulges. The facial nerve is often displaced by the tumour, either inwards, where there is little resistance from the deep component of the parotid fascia, or upwards or downwards, depending on the relationship of the nerve to the tumour.

The facial nerve emerges from the fallopian canal and runs anteriorly, inferiorly and laterally to enter the posteromedial surface of the gland. The segment of the nerve which lies in the interval between the stylomastoid foramen and the parotid is extremely short, but is the
ideal location for finding the facial nerve before the parotidectomy proper gets under way. It is best found by searching in the tympanomastoid sulcus which is formed by the edge of the bony external meatus on the one hand and the anterior face of the mastoid process on the other. The nerve emerges from the stylomastoid foramen some 3-4 mm deep to the outer edge of the bony external canal (Conley, 1978).

The second most reliable landmark for finding the nerve is the posterior belly of the digastric muscle which lies just inferior to it and allows a similar trajectory. The styloid process is a useful landmark, but to depend on it for finding the nerve is to court trouble since it lies medial and anterior to the nerve's point of emergence from the mastoid. The posterior auricular artery frequently bleeds during the process of looking for the nerve, since it lies below and just lateral to the facial nerve.

The cartilaginous pointer described by Conley (1978) is an artificially created landmark formed by posterior traction of the external auditory canal. The backward pull on the cartilage causes the meatus to assume the shape of a cornucopia, the curved extremity of which allegedly points to the position of the facial nerve. Of all the landmarks mentioned, this is probably the least reliable since it very much depends on the configuration of the cartilaginous meatus.

The facial nerve divides into upper and lower divisions about 1 cm beyond this point of entry into the parotid, and each then diverges sharply from the other.

The upper division proceeds upwards forwards and very much outwards towards the zygomatic arch and gives off temporal, upper zygomatic, lower zygomatic and buccal branches. This division is almost invariably stouter than the lower division and can therefore withstand more handling. But in elderly or obese individuals, its branches are often tortuous, a feature which makes them liable to be damaged if efforts are neglected to keep the tissues constantly on the stretch while the nerve is being dissected. The pattern of branching in both upper and lower divisions is variable, both in terms of the number of branches and their point of origin. The lower zygomatic branch is, however, constant in one respect, in that it almost invariably lies just above the parotid duct, a point to be remembered when attempting to deal with duct stenoses or stones.

The lower division passes downwards and forwards but lacks the outward inclination of the upper division and, by comparison, therefore lies deeper. It gives off buccal branches, a mandibular and cervical branch and it thins progressively as it becomes more peripheral. Occasionally, a buccal branch may arise from the bifurcation itself.

The thinness of the branches of the lower division, and the mandibular branch in particular, makes paralysis of the depressor anguli oris a common complication of parotidectomy. The very fine interlacing nerve fibres between one branch and another could well explain why the facial nerve will withstand more than a modest degree of handling at operation and yet still recover. These communicating fibres are often absent between the lowest buccal and mandibular branches, hence the propensity to paralysis of the muscle supplied by the latter.
The mandibular branch invariably emerges from the tail of the parotid gland immediately anterior to the retromandibular vein and then passes downwards and forwards on the outer aspect of the deep cervical fascia to enter the submandibular triangle. The proximity of the mandibular branch of the facial nerve to the retromandibular vein at their point of emergence from the tail of the parotid, provides an alternative method for locating the nerve if the usual method is for any reason not possible. By working backwards along the nerve, the two divisions, the other branches, and the main trunk can be found in turn.

The retromandibular vein lies in the deep lobe of the gland immediately medial to the facial nerve and its branches, although very occasionally it may be superficial to it. It gives off small tributaries which pass outwards between the nerve branches and which may be a source of troublesome bleeding when dissecting out the nerve. Deep to it lies the continuation of the external carotid artery which gives off, in turn, transverse facial, internal maxillary and superficial temporal branches as it proceeds superiorly within the deep lobe of the gland. These branches with their venous counterparts must be ligated when the deep of the gland is removed.

The submandibular gland

The gland lies in the triangle of that name, covering the mylohyoid and hyoglossus muscles, and overlapping the inferior margins of the triangle, namely the anterior and posterior bellies of the digastric and their common tendon. It is itself overlapped by the horizontal ramus of the mandible which forms the upper margin of the triangle. Inferiorly, the gland approaches the greater horn of the hyoid which serves as a useful landmark when siting the incision for the operation to remove the gland.

Although ovoid in appearance when viewed from a lateral standpoint, the gland is in fact U-shaped in sagittal section, possessing a large outer component which lies outside the mylohyoid muscle, and a smaller inner component giving origin to the duct on the inner aspect of this muscle. The common stalk joining these two parts curves round the posterior free edge of the mylohyoid. In operations to remove the gland, retraction of the mylohyoid forwards will facilitate exposure of the deep part of the gland and the duct.

The gland is invested in a loose fine capsule which is derived from the overlying deep cervical fascia. If surgical dissection of the gland is limited to a plane within this capsule, any important structure lying outside it will not come to any harm. The deep cervical fascia provides a further external protection since the mandibular branch of the facial nerve and its subsidiary branches lie plastered to its outer aspect and never make contact with the gland or its capsule.

However, it must be appreciated that the most inferior of the branches of the mandibular nerve lies close to the lower border of the submandibular gland and could be damaged when gaining entry to the plane of surgical dissection at the beginning of the operation.

The hypoglossal nerve with its venae committantes lies on the hyoglossus, but is separated from the deep aspect of the gland by a potential space. Escape of disease from the
deep aspect of the gland would be the only likely circumstance to put the nerve at risk when removing benign tumours.

The lingual nerve arches gently downwards just above the deep part of the submandibular gland to which it is attached by a ganglionic connection, alongside which is a small blood vessel. It subsequently passes below the duct then round its outer aspect in the form of a broad loop before heading for the mucosa of the tongue. It is at risk when the deep part of the gland is being mobilized.

**The sublingual gland**

Also ovoid in shape and about 2 cm in size it lies below the submandibular duct between the genioglossus on the one hand, and the mandible and mylohyoid on the other. About half its ducts drain into Wharton's duct and the remainder directly onto the sublingual papilla.

**Incidence of salivary tumours**

Although the geographical incidence varies somewhat from one location to the next, salivary tumours are in general uncommon. In a population of 2.8 million living in an area comprising Liverpool, Merseyside, North Wales and the Isle of Man, the incidence of neoplasms of all complexions was of the order of 1.1 per 100,000 persons. This can be compared with a slightly higher incidence of 1.5 per 100,000 Caucasians in the USA, rising to 1.6 for non-white males and 2.5 non-white North American females. The highest incidence would appear to be among the Eskimos in whom the majority of tumours are of the malignant kind (Evans and Cruickshank, 1970).

Salivary tumours represent about 3% of all neoplasms. Approximately 80% are located in the parotid, 10% in the submandibular gland, the remainder being distributed between the sublingual gland and the countless minor salivary glands (Snow, 1979). This last group comprises the innumerable tiny submucosal serous and mucinous glands to be found in the oral cavity, nose, sinuses, postnasal space, oropharynx, larynx and trachea.

Benign tumours are more common than malignant, although the ratio will vary from one anatomical site to the next. In the parotid, for instance, 80% of tumours are benign whereas in the submandibular gland this drops to 60% and in the oral cavity malignant tumours may well outnumber the benign.

Among the white population of Europe and the USA the sex distribution is about equal, but among non-whites in North America and Africa, women outnumber men and if the parotid is considered in isolation, there is a preponderance of tumours in women (Evans and Cruickshank, 1970).

Benign tumours of the major salivary glands may occur in children but are exceedingly rare. Although fractionally more common in adolescence, they are nevertheless still infrequent by comparison with the vast majority of patients who present in the age range 30-70 years, the average being about 45.
Aetiology

Little is known about the aetiology of salivary tumours and much of what has been written is speculative.

The inoculation of newborn mice with polyoma virus is reported to provoke the formation of salivary neoplasms, although there is nothing to suggest that this is the mechanism in man. Hydrocarbons implanted experimentally into the salivary glands of rats and guinea-pigs are also known to result in tumour formation.

The evidence that low dose radiation may induce tumours in man is much more convincing and is derived from studies of people exposed to the effects of the atomic bomb at Hiroshima. In this group of individuals, the incidence of tumours at all sites is significantly greater than that expected in persons who have never been previously exposed to radiation (Ju, 1968; Takeichi, Hirose and Yamamoto, 1976).

Surgical pathology

Approximately 80% of all salivary tumours arise in the parotid gland, the remainder being distributed between the submandibular, sublingual and minor salivary glands. Eighty per cent of tumours in the parotid gland are benign, whereas in the submandibular the figure drops to 60% and at other sites to something just under 50%.

Of the benign tumours which reside in the parotid, about 80% are pleomorphic adenomata and the remainder a conglomeration of monomorphic adenomata, Warthin's tumours otherwise known as cystadenomata or papillary cystadenomata lymphomatosum, oxyphil adenomata or oncocytomata, and vascular and lymphatic swellings.

In the submandibular gland and at other sites, the only benign tumour to occur with any degree of frequency is the pleomorphic adenoma or mixed tumour.

Benign tumours in the parotid seem to occur most commonly in the lower posterior part of the gland, namely in that portion which fills the retromandibular sulcus. They may present less commonly in the preauricular region or even further forwards over the masseter, or alternatively in the deep lobe. Tumours at these sites seem to have a slightly greater tendency to become malignant and should therefore always be viewed with a modicum of suspicion.

There is no obvious site of election in the submandibular gland for mixed tumour, and more often than not the tumour is found at operation to be larger than previously suspected, virtually replacing the entire gland. Benign tumours are rare in the sublingual gland, but not at all that uncommon in the hard and soft palates where they are nearly always pleomorphic adenomata. At sites other than the parotid, the distinction between benign and malignant is not always easy to make on clinical grounds, and a relatively common alternative which may be confused with mixed tumour is adenoid cystic carcinoma.

There is a group of tumours in which both clinical and histological characteristics are difficult to reconcile with the picture of malignancy and yet their progression ultimately
proves to be overtly nefarious. Included in this group are the acinic cell tumours and some mucoepidermoid tumours.

**Vascular and lymphatic malformations**

Although not tumours in the accepted sense of the word, vascular and lymphatic malformations are very much benign surgical swellings and merit inclusion in this section.

The vascular type differs from the lymphatic in certain specific respects. Such tumours tend to be more obviously confined to an anatomical compartment by comparison with lymphangiomata and, although lacking a proper capsule, their limits are relatively easy to define. The larger the vascular spaces within the swelling, the greater the tendency for there to be significant feeding vessels originating from recognizable local arteries.

Haemangiomata are to be found in the parotid, and may make their appearance in that gland at birth. The congenital variety presents as large bilateral bluish spongy swellings which tend to swell when the infant cries, coughs, or is placed horizontally. They are often associated with haemangiomata elsewhere, notably on the lips and in the subglottic compartment of the larynx. There is some evidence that this type of haemangioma will atrophy as the infant grows, the age of two usually being considered as the turning point (Williams, 1975). Other parotid haemangiomata may appear later, in which case atrophy cannot be expected and surgery is required.

Vascular malformations are also seen in the submandibular and sublingual glands and may then present beneath the oral mucosa.

Lymphatic malformations are by contrast no respecters of anatomical compartments. They are diffuse, occupy large tracts of tissue and cross from one plane to another. They lack a precise boundary, infiltrate muscles, glands, and completely engulf nerves and vessels.

Lymphangiomata of the parotid, for example, surround the facial nerve, infiltrate the temporalis muscle and fascia, spread downwards into the sternomastoid, and forwards and downwards into the submandibular gland.

Those which are primarily related to the submandibular gland invade the mylohyoid, the muscles of the tongue, and even the intraoral mucous membrane.

They are difficult to remove because of their indeterminate boundaries, their far-flung and deep-seated extensions, and their tendency to engulf vital structures. It is always advisable to dissect out important nerves beyond the periphery of the malformation and then to follow them into the swelling itself.

Sometimes these malformations appear to be an admixture of vascular and lymphatic tissue which bleeds excessively during their removal.
Pleomorphic adenoma

This is the commonest of all benign tumours and is characterized by slow growth and a clinically benign course. It is essentially an epithelial tumour of complex morphology, possessing epithelial and myoepithelial elements arranged in a variety of patterns and embedded in a mucopolysaccharide stroma. Its capsule is the result of fibrosis of the surrounding salivary parenchyma which is compressed by the tumour, and is referred to as a false capsule. Since the capsule is formed in response to expansion by the neoplasm, it is frequently incomplete, and tumour may be seen projecting through the dehiscences as small bosselations which contact the surrounding gland (Eneroth, 1964).

These projections are sometimes seen in histological sections as small outlying foci of tumour, seemingly separated from the parent tumour by normal glandular tissue, and it is this appearance which prompted the belief at one time that mixed tumours were multifocal in origin. This view was eventually rejected when serial sections demonstrated continuity of the excrescences with the main body of the tumour.

Mixed tumours are often soft in consistency, almost with a myxomatous appearance, and may be the seat of cystic or haemorrhagic degeneration, features which make them susceptible to rupture when handled too enthusiastically.

Their lack of a complete capsule and their softness are compelling reasons for removing them with as wide a margin as possible, and this is generally possible at all the sites from which these tumours arise. The operation of enucleation, which has not been largely abandoned in favour of parotidectomy, resulted in an unacceptably high rate of recurrence, often as high as 40% over a 25- or 30-year period. But, some mixed tumours of the parotid cannot be removed adequately with a satisfactory surrounding margin. Very large tumours replacing the parotid parenchyma, or those sitting on the facial nerve or external auditory canal, are just such instances and the operation to remove them can only be described as a compromise between a parotidectomy and enucleation.

Interestingly, those pleomorphic adenomata which originate from the deep lobe of the parotid and occupy the parapharyngeal space do not commonly recur after surgery in spite of the fact that the operation to remove them is little better than a grand enucleation. The reason for this could well be their tendency to acquire a thicker and more complete capsule than is usually the case at other sites.

The concept of removal with a margin is eminently practicable when mixed tumours arise in the submandibular gland, since it takes many years for the neoplasm to break through the capsule of the gland. It is also feasible when the site of origin is the hard or soft palate, although a surgically created fistula may be necessary to ensure adequate removal.

A recurrent mixed tumour is to be feared, since it presence not a discrete mass but a multiplicity of nodules. In the case of the parotid, it is common to find nodules in the previous scar, subcutaneous tissue, both superficial and deep parotid parenchyma, the sheath of the facial nerve and the perichondrium of the external meatus. Further surgical attempts are often fruitless given the widespread nature of the condition, and may well cause damage to the facial nerve.
Pleomorphic adenomata may, after several years’ growth, become overtly malignant. It is estimated that the incidence of malignancy is approximately 6%, although the factor which more directly determines this likelihood is the age of the tumour.

**Warthin’s tumour**

This is a tumour primarily, although not exclusively, of men, seen generally in middle and old age. Curiously, it is nearly always found in heavily built or obese individuals with short fat necks and prominent jowls. It is occasionally bilateral and often more than one tumour is found in any given gland.

Ovoid in shape, it is rather like a lymph node and is characteristically situated in the tail of the parotid gland.

Histologically, it is made up of areas of lymphoid tissue intermingling with cystic spaces lined by a tall tubular or papillary epithelium. The presence of lymphoid tissue within the tumour makes it susceptible to inflammation, often secondary to upper respiratory tract infections, with enlargement of the tumour, pain and tenderness. The clinical features therefore include fluctuation in size and intermittent pain. Rarely, the inflammatory reaction is so severe as to cause the swelling to enlarge massively and to ulcerate, even to the extent that a malignancy may be suspected.

Removal with a margin such as one would practise for a mixed tumour will generally suffice. When cut across and viewed by the naked eye, the fresh specimen is often found to contain a viscous chocolate-like fluid. Recurrence after surgery is very rare.

**Oxyphil adenoma (oncocytoma)**

This is a rare benign tumour composed of large pleomorphic eosinophilic cells replete with mitochondria not unlike the oncocytes seen in ageing normal salivary glands. It nearly always arises from the outer part of the parotid gland, but there are reports of it developing in the submandibular gland and oral cavity. It may exceptionally become malignant.

**Benign lymphoepithelial lesion**

This is considered by some to be a solid variant of Warthin’s tumour, and by others not to be a tumour at all. As its name implies, it is composed of lymphoid and epithelial components which form a well-defined tumour-like mass indistinguishable from any other benign tumour. It may surround nerve fibres and thus appear malignant, but a frozen section usually settles the issue.

It too has a malignant counterpart which is rare.

**Symptoms**

Patients with benign salivary tumours generally complain of little more than the presence of a swelling, whose growth is so slow as to be barely perceptible from one year to the next. A sudden increase in size strongly suggests malignant transformation, although
infection of a Warthin's tumour may be one explanation. Similarly, pain must be regarded as unusual in benign tumours unless infection or haemorrhage have occurred in a cyst.

Pressure from a benign tumour never causes facial paralysis, even when the nerve is engulfed by the growth as in benign lymphoepithelial hyperplasia. Its presence signifies either malignancy, tuberculosis, or sarcoidosis. Enlargement of the subparotid nodes is a frequent accidental finding during operations for the removal of benign tumours and is invariably due to non-specific reactive hyperplasia.

**Examination**

The precise anatomical site of the lesion must be defined during the clinical examination to establish whether a swelling is likely to have arisen from a salivary gland or not. Swellings in the retromandibular sulcus, the immediate preauricular region, and over the masseter are, in most cases, of parotid origin. Lumps in the submandibular triangle either arise in the salivary gland or turn out to be enlarged lymph nodes. Non-ulcerative swellings of the oral cavity, especially on the hard and soft palates, but also in the floor of the mouth or palatofacial region, are likely to be benign salivary tumours. In the last case, the tumour is likely to have arisen from the deep lobe of the parotid or close to that structure and to have occupied the parapharyngeal space. Exceptionally, the tumour arises from the fauces and grows backwards and laterally into the parapharyngeal space.

Vascular or lymphatic swellings are softer and spongier than most benign tumours and may present with a blue or purplish tinge, while exceptionally the larger variety may produce a vascular hum audible by auscultation.

In the parotid gland pleomorphic adenomata present as round, firm, reasonably well demarcated tumours, with a tendency to nodularity as they grow. Their site of election is between the ascending ramus of the mandible anteriorly, and the mastoid process and sternomastoid posteriorly, towards the tail of the gland.

Occasionally they arise in the immediate preauricular region, where they tend to be small and, less commonly, still further forward.

Recurrent mixed tumours present as multiple nodules, or as a nodular thickening, although what is generally palpable represents a fraction of the full extent of the disease, much of which is at the microscopical level.

Warthin's tumours, by contrast, lie almost invariably in the lower pole of the gland, are ovoid in shape, and vary in consistency between soft and firm, depending on whether they have been exposed to previous inflammation or not. They may well be bilateral.

It is often difficult to distinguish between a tumour arising within the submandibular gland or an enlarged node close to the gland or on its outer surface. Bimanual palpation is essential to differentiate the two, since a node lying on the outer surface of the salivary gland is unlikely to be adequately palpated by a finger in the mouth, whereas a tumour of the gland itself is more readily compressible bimanually. Pleomorphic adenomata of the submandibular
gland are usually large, quite hard and nodular, but may be confused with a slowly growing malignancy such as an adenoid cystic carcinoma.

Tumours of the palate are often fusiform, firm to hard and nodular. Again the distinction between mixed tumour and adenoid cystic carcinoma may be difficult to make. Apart from the obvious difference in the growth rate, the latter tumour is often discoloured by telangiectases or bleeding into the tumour.

For parapharyngeal masses presenting in the faucial region, bimanual palpation is required to elicit the classical signs of ballottement between a finger in the mouth and a hand on the neck. If the tumour only occupies a small segment of the deep lobe of the parotid, there will be little external fullness of this gland, but if it is large and part of the deep lobe, the parotid is visibly and palpably displaced outwards.

**Investigations**

There are only three useful investigations in benign salivary tumours: sialography, computerized or magnetic scanning, and fine needle aspiration.

Sialography is of limited value. Benign tumours of some size appear as punched out areas against a background of contrast-filled ducts and acini. Definition of the precise anatomical site is often difficult, but the distinction between inflammatory disease and neoplasm is easier to make.

If the outline of the area which fails to fill with dye is ragged, rather than clean-cut, the possibility that the swelling may be malignant must be considered. Disadvantages of sialography are the difficulty of duct cannulation in many patients, and inadequate or excessive filling leading to acinar rupture, both of which may well confuse the picture.

Before the introduction of computerized scanning, isotope imaging with technetium was practised for a time, but the information gained was so imprecise as to be valueless. It was soon superseded by CT scanning which indicates the site and size of the lesion and, by contrast with sialography, is easy and painless to perform. In conjunction with sialography, it optimizes definition and is especially helpful in establishing the configuration and outline of parapharyngeal space tumours.

Magnetic resonance imaging may well help in the investigation of salivary tumours since it is above all others the ideal investigation for assessing soft tissue neoplasms.

Fine needle aspiration has now finally come to stay. There is little doubt it has a great deal to offer in the hands of a person practised in the interpretation of small samples of tissue. However, evaluation of the findings may be difficult if the aspirate has been contaminated with blood, or even misleading if sampling of the swelling has been haphazard. Under these circumstances, a negative diagnosis for malignancy should never be considered as final.

Whereas open biopsy or large needle biopsy carries the danger of implanting seedlings into the biopsy track, fine needle aspiration appears not to have this disadvantage.
Surgical treatment

Partial parotidectomy

This is the operation most often performed for benign tumours, since most tumours of the parotid gland lie superficial to the facial nerve.

The patient is placed in the supine position with the neck extended and the head turned away from the surgeon. Tilting the table in a head-up position facilitates the surgery by reducing the venous pressure. The towels should be so arranged that the corner of the eye and mouth are accessible for inspection.

The incision begins in the preauricular crease and descends to the point where the lobule joins the skin of the face, at which point it inclines backwards at first, then downwards and forwards into a cervical skin crease well below the mandible. A skin flap is elevated to uncover the area which the parotid occupies. The posterior extremity of the gland is separated from the external auditory canal, the mastoid process and sternomastoid muscle so that sufficient room is created to find the surgical landmarks for the facial nerve. Using the tympanomastoid sulcus as the starting point, the nerve is found and followed into the parotid gland.

That part of the parotid gland which lies superficial to the facial nerve is then peeled off the nerve together with the enclosed tumour. The wound is then drained and the incision closed in layers. Tumours of the deep lobe of the parotid and parapharyngeal space are generally removed, either by total conservative parotidectomy, a submandibular approach or a transmandibular technique (Shaheen, 1986).

Removal of the submandibular gland

The position of the patient is the same as for parotidectomy. A horizontal skin incision is made just above the hyoid bone preferably in a skin crease. The incision is deepened through subcutaneous fat, platysma, and deep cervical fascia until the surgical capsule at the lower limit of the gland is reached. This is then opened along the lower border of the gland and a large superior flap elevated in the plane between the surgical capsule and the gland. The facial vessels are ligated both at the inferolateral corner of the gland and at its upper border.

The gland is mobilized until it is pedicled on its deep part, whereupon the mylohyoid muscle is retracted forwards to permit separation of the gland from the lingual nerve. Finally, the duct is severed and the wound closed in layers with drainage (Shaheen, 1986).

Removal of the sublingual gland

This may be performed intraorally after injecting an adequate volume of a vasoconstrictor solution immediately beneath the mucous membrane to lessen bleeding.

An incision medial to the line of Wharton's duct provides access to the gland, but care has to be taken to avoid injuring the lingual nerve which winds round the duct. With the...
submandibular duct and nerve retracted medially out of the way, the gland and tumour may be removed.

**Removal of a pleomorphic adenoma from the hard palate**

The patient should be placed in the supine position with a sandbag placed beneath the shoulders and the head fully extended. The table should be in the Trendelenburg position so that, with a Boyle-Davis gag separating the jaws, a clear view of the operation site can be obtained. Illumination with a headlight and adequate suction are imperative.

The incision through the mucous membrane down to the bone of the hard palate is best made with the cutting diathermy to lessen the bleeding, and should be sited a short distance away from the tumour to ensure an adequate surrounding margin of normal tissue.

Enucleation of the tumour by dissection from the underlying bone is not safe unless the bone is drilled away virtually through its whole thickness. The safest approach is to fenestrate the palate so that the tumour is cut out *en bloc*. In either case, provision should be made for the wearing of a protective denture, with or without an obturator, depending on the exigencies of the case.

**Recurrent pleomorphic adenoma**

Recurrence of this tumour occurs when it is enucleated without a margin of healthy tissue or when it is breached accidentally during the course of an operation to remove it, or deliberately as with a biopsy. Spillage of tumour is apt to occur when the tumour is particularly large and tense, or when it is awkwardly situated. Examples of the latter are large tumours impacted between the parotid and the mastoid, deep-seated growths, or tumours sitting intimately on the facial nerve.

As previously mentioned, recurrence presents as a multiplicity of nodules scattered, not only within the parotid parenchyma, but also in the overlying tissues.

If the initial operation which led to the recurrence was simply an enucleation, salvage surgery in the form of a superficial or even total conservative parotidectomy is generally feasible. If, however, the first operation was a parotidectomy with exposure of the nerve, any subsequent attempt to excise residual disease without compromising the facial nerve is difficult to say the least. Under such circumstances, it may be possible to find the nerve in the mastoid, but even then the process of following it through the sea of collagen and neoplastic nodules which is so typical of recurrent mixed tumour is complicated and hazardous. More often than not, the nerve and its branches disappear from view into the surrounding fibrous tissue so that further dissection is technically impossible without damaging the nerve. Given this sort of scenario and the fact that neoplastic nodules are commonly embedded within the sheath of the facial nerve, the surgeon might be forgiven for opting for a radical parotidectomy.

There is, however, an alternative strategy which offers the possibility of preventing recurrence in high risk cases and of dealing with it once it has become established.
It has been common knowledge for many years that postoperative radiotherapy following a limited operation such as enucleation will reduce the recurrence rate of mixed tumours to that expected after parotidectomy, namely about 3-4% (Rafila, 1970).

The rationale for this is that the operation serves to remove the bulk of the disease, leaving scattered microscopical residues which are more readily amenable to sterilization, notwithstanding the known relative radioresistance of mixed tumours.

The application of this philosophy to the management of those patients undergoing adequate surgery by present-day standards, but who are deemed to be at risk, should minimize the risk of recurrence still further. Such cases would include patients with tumours sitting on the facial nerve, those stuck to the meatus, or those which have ruptured during removal.

In practice, the irradiation of such patients has proved to be satisfactory and has eliminated recurrences altogether.

The same approach can be adopted for patients who have an established recurrence. Here the approach is to remove all macroscopical disease by total conservative parotidectomy if this procedure is feasible and to follow on with radiotherapy (Shaheen, 1976).

In those patients in whom the integrity of every branch of the facial nerve is impossible to safeguard, the surgeon cuts his losses by resorting to a total parotidectomy, with every attempt being made to preserve as much of the nerve as possible. Deficits are restored by immediate nerve grafting, and surgery is followed some weeks later by radiotherapy.

Generally, between 4000 and 5000 cGy are given by lateral field and preferably by linear accelerator. The results of treating established recurrences by this method have been equally rewarding, recurrence having been abolished.

This naturally raises the ethical question of whether it is proper to irradiate patients with benign disease. There are indeed isolated reports of patients developing cancers of the parotid gland after radiotherapy, but many of these date back to the era when low dosage therapy was used in the management of lymphoid tissue hypertrophy in childhood. Most radiotherapists with whom the matter can be discussed are sceptical about the likelihood or a properly administered course of irradiation eventually causing cancer of the parotid, although it is conceivable that adjacent areas such as the postnasal space might be at risk.

The pros and cons of the issue will doubtless continue to be debated, but in the final analysis the decision whether to use radiotherapy or not has to be a personal one.
Complications of surgery

Parotidectomy

Haematoma

This is fairly common in view of the dead space resulting from the removal of a substantial segment of glandular tissue. A large suction drain sited away from the facial nerve together with adequate pressure from a suitable dressing will minimize this complication.

Facial weakness

This is generally temporary if it occurs after an uneventful operation. It usually affects the mandibular and frontal branches of the facial nerve and is more prone to occur in the elderly, in those with slender as opposed to stout facial nerves, and when there has been an unusual degree of trauma in the vicinity of the nerve. Pressure or traction on the nerve, constant suction on its surface, excessive dryness of its sheath, and heat from the coagulating diathermy are all factors contributing to facial weakness.

Anaesthesia

Anaesthesia of the lower half of the pinna and preauricular skin results from division of the great auricular nerve and is therefore an inevitable sequel of parotidectomy. The area of numbness gradually diminishes in size and ultimately becomes confined to the lobule of the pinna. Sensation in the surrounding skin rarely returns to complete normality and some degree of hyperaesthesia is usual. In a few patients, the degree of increased sensitivity assumes distressing proportions and is attributable to the presence of an amputation neuroma of the great auricular nerve. Excision of the neuroma and alcohol injection into the cut end of the nerve will resolve the problem by substituting complete anaesthesia for hyperaesthesia.

Fistula formation

This is very uncommon and probably results from an overproduction of saliva in the remaining glandular tissue. A pressure bandage and continuous suction suffice to dry up the wound and permit normal hearing.

Gustatory sweating (Frey's syndrome)

This condition is though to be due to misrouting of parasympathetic secretomotor fibres into cutaneous nerves during the healing phase following parotidectomy. The precise origin of these fibres is uncertain, having been thought to have come by way of the otic ganglion and to have accompanied the auriculotemporal nerve to its final destination int he parotid. There is some reason to suppose that this is not the only source of secretomotor fibres and that some may come by way of the facial nerve itself.

Most patients develop some degree of Frey's syndrome, but in many the condition is so mild as to be barely noticeable. The complaint is of sweating in the preauricular and subparotid regions at meal times, although many patients imagine at first that it is an escape
of liquid through a small opening in the surgical scar. It may on occasion be so bad as to be a severe social embarrassment.

Contrary to reports in the literature, tympanic neurectomy has not been successful in controlling the condition and the effectiveness of other techniques, such as the interposition of fascial grafts between skin and the underlying parotid bed, is also doubtful.

More recently, pilocarpine cream 1% and aluminium hydrochloride solution have been applied with some success (Shaheen, 1984).

**Submandibular gland excision**

**Paralysis of the depressor anguli oris**

This is due to damage to the marginal mandibular branch of the facial nerve and is best avoided by gaining access to the right plane of dissection, well away from the nerve, from the very outset.

Attempts to dissect out the mandibular branch are likely to do more harm than good, and if the nerve is badly traumatized, the likelihood of recovery is remote.

**Damage to the hypoglossal and lingual nerves**

Both these complications are uncommon and generally speaking cannot be rectified (Shaheen, 1984).