Chapter 31

The Salivary Glands

Surgical Anatomy of the Parotid Salivary Gland

Facial Nerve.- The trunk of the facial nerve emerges from the stylomastoid foramen and lies deeply beneath the surface in the angle between the bony external auditory meatus and the mastoid process. It passes forwards around the neck of the condyle of the mandible and rapidly becomes superficial. As it does so, it divides; first into an upper *temporofacial division* and a lower *cervicofacial division* and then subsequently into a varying number of branches, some of which may be interconnected (Pes Anserinus = Like the foot of a goose.).

The Parts of the Gland.- Because the branches of the facial nerve lie, broadly speaking, in the same plane, the gland is described as being composed of a *superficial part* or lobe and a *deep part* or lobe. The superficial part overlies the posterior border of the ramus of the mandible and the masseter muscle. A prolongation immediately above the parotid duct is called the *accessory parotid* (or socia parotidis), but only rarely is the latter separated from the rest of the gland. The size of the deep part is less obvious as it is tightly wedged into the space behind the mandible and medial pterygoid muscle. It embraces the lateral surface of the styloid process and the muscles attached thereto and insinuates itself into every adjacent crevice.

The Duct.- The parotid (Stensen's) (Niels Stensen, 1638-1686. Professor of Anatomy, Copenhagen. He abandoned medicine for the church on being appointed Bishop of Titiopolis. He is also regarded as 'The Father of Geology'.) duct is 2-3 mm in diameter. Beginning deep to and behind the angle of the mandible it curves upwards and forwards through the gland receiving interlobular ducts as it goes. The last three interlobular ducts join it from above, the final lobe being that from the accessory parotid. At its termination it turns inwards between the fibres of the buccinator muscle and then forwards submucosally to open into the mouth via a small papilla on the inside of the cheek, opposite the second upper molar tooth.

Surgical Anatomy of the Submandibular Gland

The gland is composed of a superficial part and a deep part.

The superficial part lies in the submandibular triangle, above and between the two bellies of the digastric muscle. It is superficial to the sloping undersurface of the mylohyoid muscle and superficial to the hyoglossus. One-third to half its bulk lies below the lower border of the mandible and one half to two-thirds above. The upper part lies in the concavity of the submandibular fossa on the medial aspect of the mandible.

The deep part varies in volume with the size of the posterior sublingual glands and lies below and lateral to the line of the submandibular duct, in the floor of the mouth, and above and deep to the mylohyoid.

Figure.- Diagram of the relations of the submandibular gland and lingual nerve from above (ie, through the floor of the mouth, between the tongue and the mandible).

1. The path of the facial artery as it passes upwards in a deep groove in the gland, or through the gland, to reach its lateral surface.

2. The lingual nerve is enclosed in the fascial sheath of the gland at its upper pole. The submandibular ganglion is attached to the nerve at this point and is also within the sheath of the gland.

3. The submandibular duct lies beneath the lingual nerve as it emerges from the upper pole of the gland.

4. The lingual nerve lies first between the duct and the deep part of the gland, then crosses medially beneath the duct to ascend on the hyoglossus to supply the tongue.

5. The lingual nerve gives off a sublingual branch which lies deep in the interval between the sublingual glands and the mandible. It supplies the lingual alveolar mucosa and lateral part of the floor of the mouth.

6. In some subjects a posterior sublingual gland drains into the submandibular duct.

7. Minor sublingual glands drain individually into the plica sublingualis.

8. Bartholin's major sublingual gland may drain via a single duct into the submandibular duct or by a separate opening close to the submandibular papilla.

9. The sublingual artery emerges from deep to the anterior border of the hyoglossus and enters with its fellow of the other side into a small foramen in the mandible, in the midline above the genial tubercles. The artery and sublingual veins lie medial to the submandibular duct.

The duct (Wharton's duct) (Thomas Wharton, 1616-1675, Physician, St Thomas's Hospital, London. Said to have remained on duty during the Great Plague.), about 5 cm long, runs forward from the deep part of the gland to enter the floor of the mouth on a papilla beside the frenum of the tongue. The sublingual veins lie lateral and the sublingual artery medial to the duct, more anteriorly.

The lingual nerve is attached to the upper pole of the gland (superficial part) by the fascial sheath of the gland. The sublingual (submandibular) ganglion may be seen attached by two roots to the lower side of the nerve at this point. The nerve passes forwards and downwards between the duct and the deep part of the gland before passing medially under the duct opposite the first lower molar. While still lateral to the duct it gives off its sublingual branch, which runs close to the mandible, lateral to the sublingual glands.

The facial artery emerges from under the stylohyoid muscle and either enters the gland substance towards the posterior aspect of its deep surface or deeply grooves the gland. It passes upwards to gain the lateral surface of the gland deep in the lower border of the

mandible, around which it curls to enter the face. It lies behind the duct and is at risk from incisions into the upper pole of the gland. Small vessels also enter the gland from the posterior border of the mylohyoid muscle which is firmly attached to the corresponding groove in the gland between the superficial and deep parts.

The venous drainage is into both the anterior facial vein and into the venae comitantes of the lingual artery.

Sialography

A suitable radio-opaque liquid such as Hypaque (sodim diatrizoate) or Lipiodol is introduced into the duct system of the parotid or submandibular gland as appropriate and a radiograph taken. One-half to two mL of solution, depending on the gland, is introduced either through a fine polythene catheter, or a blunt metal cannula which is inserted into the orifice of the duct. The radiograph records the outline of the lumen of the duct system. By this means radiolucent obstructions, and dilation and narrowing of the duct may be shown. The position and size of a salivary neoplasm, or even an extraglandular mass may be determined because the related ducts will be displaced by the expanding lesion. Fistulae and abscess cavities can be displayed.

Inflammations

Acute Parotitis

May be due to a virus, a non-specific bacterial infection or more rarely actinomycosis or tuberculosis. Mumps is the usual virus infection but other viruses such as the Coxsackie A virus may produce a similar illness. A tuberculous infection of a salivary gland is usually as a result of spread from a tuberculous lymph node.

Bacterial infections mostly reach the gland by ascending the duct from the oral cavity. There are two possible predisposing factors - either a reduction in salivary flow or partial obstruction to the duct with retention of secretions. Salivary flow may be reduced:

Following Major Surgical Operations.- Acute parotitis as a complication of major surgery is less common now that the fluid and electrolyte balance is better controlled. Care should be taken to maintain a high standard of oral hygiene during the postoperative period, and patients with neglected mouths should have dental treatment pre-operatively. Serious acute infections in the dehydrated patient are usually due to *Staphylococcus aureus,* as are the rare metastatic abscesses of the parotid gland. Some infections secondary to obstruction of the duct also may be due to staphylococci but more often are due to *Streptococcus viridans* or pneumococci.

During debilitating illness, especially those like typhoid fever and cholera, where the patient may become dehydrated, even while under medical care.

Following radiotherapy where one or more of the major salivary glands are within the field of irradiation. Usually the suppression of salivation following radiotherapy is temporary, but may be permanent.

In Sjögren's Syndrome (Henrik Samuel Conrad Sjögren, Contemporary. Professor of Ophthalmology, Jönköping, Sweden, described this syndrome in 1933.) where the gland substance is destroyed by auto-antibodies.

Clinical Features.- There is a brawny swelling of the side of the face. In the case of a virus parotitis or early suppurative parotitis the swelling corresponds to the shape of the gland and raises the lobe of the ear. As suppurative parotitis progresses, widespread cellulitis is seen and the overlying skin becomes dusky red. Pus can be expressed from the parotid duct, and a swab should be taken for culture, identification of the organism, and antibiotic sensitivity tests. The temperature is usually well over 37.8%. Fluctuation will be elicited only after pus has penetrated the dense fascia of the parotid sheath.

Treatment.- Everything should be done to improve the general state of the patient, and antibiotics are administered. Meticulous oral hygiene should be practised with toothbrush and paste where teeth are present and with sodium bicarbonate mouthwashes for the edentulous patient. Dentures should be left out except at meal times. A soft diet is prescribed as chewing is difficult. The gland can be massaged gently at regular intervals to express pus. If pus ceases to drain through the duct, and improvement in the general and local condition is not seen within 48 hours of the start of treatment, drainage of the gland should be considered. Drainage is essential if the dusky redness becomes localised to the lower pole because an abscess here might drain spontaneously into the external auditory meatus.

Drainage of Suppurating Parotitis.- The line of incision runs vertically in the crease in front of the tragus, curves under the lobe of the ear and curves forward again over the mastoid process and around the posterior aspect of the lower pole of the gland. The transverse incisions in the capsule traditionally used to decompress the gland are rarely necessary. Mosquito artery forceps can be thrust through the fascia and opened within the gland at several levels to effect drainage. Both the extent of the incision and drainage depend on the severity of the case. A corrugated drain is inserted. When the swelling reduces and drainage ceases the wound in front of the ear may be sutured under local anaesthesia.

Acute Suppurative Sialoadenitis of the Submandibular Gland

Is usually secondary to an obstruction to Wharton's duct. The organism is frequently sensitive to penicillin and incision and drainage rarely required, unless suppuration of the adjacent lymph nodes supervenes.

Recurrent Subacute and Chronic Sialoadenitis

These inflammations are always secondary to a pre-existing condition such as an obstruction of the duct or autoimmune disease. The recurrent attacks of pain and swelling are accompanied by the discharge of flecks of pus in the saliva. The infection should be controlled by antibiotics and then a sialogram performed. If the sialographic changes are confined to the side affected by infection then an obstructive cause is most likely. Where changes are present on both sides Sjögren's syndrome is the more likely predisposing cause even if the attacks of pain and swelling are only unilateral. However, calculi can be a complication of the reduced salivary flow of Sjögren's syndrome and this possibility should be borne in mind.

Recurrent Subacute Parotitis of Childhood

The patient may present at any age between 3 months and 10 years with swelling of one of the parotid glands. Both pain and constitutional symptoms are mild. There may have been one or more previous episodes each lasting 10-14 days and affecting either gland. The first attack may have been mistaken for mumps. A sialogram reveals an appearance of multiple, small, proximal dilatations - like a snowstorm. The appearance is called punctate sialectasis. While characteristic of this particular condition, punctate sialectasis may also be seen in Sjögren's syndrome, or after irradiation of the gland.

Katzen (Michael Katzen, Contemporary. Surgeon, Transvaal Memorial Hospital for Children and Department of Pediatric Surgery, University of Witwatersrand, South Africa.) has found that the condition remits spontaneously by age 15. His biopsy material shows an appearance suggestive of an autoimmune cause and similar to that seen in Sjögren's, but there is no evidence that the childhood condition precedes, or progresses to, adult Sjögren's. More than one child in the family and the children of more than one generation may be affected, suggesting a congenital predisposition to the condition. Antibiotics will control the acute episodes, but a sialogram will often cut short the attacks.

Children who combined recurrent parotid swelling with the upper respiratory allergic condition may benefit from regular doses of an anti-histamine mixture.

Obstruction to the Duct of a Major Salivary Gland

The characteristic symptom is recurrent painful swelling of the affected gland at meal times, but the first indication may be an acute or subacute infection as described above.

Proximal to a site of chronic obstruction the duct will be dilated with retention of secretions and chronic infection. Causes of obstruction include salivary calculi, strictures of the duct wall, oedema or fibrosis of the papilla, pressure on the duct due to an adjacent mass, or invasion of the duct by a malignant neoplasm.

Papillary Stenosis.- Ulceration of the papilla of either the submandibular or parotid duct may follow trauma from a denture. Ulceration of the parotid papilla may also follow irritation from a sharp tooth, or a bite of the cheek. The obstruction and recurrent swelling will subside as the ulcer heals. Repeated trauma results in fibrosis which is only relieved by papillotomy with suture of the duct lining to the oral mucosa.

Salivary Calculi.- *Submandibular calculi* are by far the most common and are relatively easy to demonstrate by plain radiography. *Calculi within the duct* may be removed via the floor of the mouth, although those near to the gland require special experience. For calculi anteriorly in the floor of the mouth a stitch is passed under the duct proximal to the stone to stop the stone slipping backwards. An incision is made in the mucosa over the duct and the latter mobilised. A stay suture is passed under the duct to bring it up into the top of the wound and to control it while the wall is incised to release the stone. *Where the calculus is within the intraglandular* part of the duct, or the gland severely damaged by chronic infection, then excision of the gland is indicated.

Excision of the submandibular gland proceeds as follows.- The gland is removed through an incision in a skin crease over the lower third of the gland and about 5 cm long. The tissues are divided down to the platysma muscle and the subcutaneous tissues separated from the surface of the muscle by pressure with a swab (gauze sponge) to facilitate closure of the wound in layers. The muscle is divided to expose the deep fascia which is opened with care to avoid damage to the facial nerve. The marginal mandibular branch of the facial nerve is sought beneath the deep fascia and retracted upwards. The anterior facial vein is found within the fat superficial to the gland. If the anterior facial vein is divided over the gland and below the marginal mandibular branch it may be retracted upwards, drawing the nerve upwards and out of the operative field, because the nerve passes superficial to the vein. The lower pole of the gland is freed keeping close to the surface of the gland, grasped with Allis' tissue forceps (Oscar Huntingdon Allis, 1836-1921. American Surgeon.) and turned upwards and forwards. The posterior belly of the digastric and the stylohyoid muscles are identified and retracted backwards with a Langenbeck's retractor (Bernard Rudolph Konrad von Langenbeck, 1810-1887. German Surgeon.). The facial artery with its veni comitantes will be seen emerging from deep to the muscles and entering the deep surface of the gland. It is ligated three times using an aneurysm needle and divided between the distal two ligatures. Double ligation of the proximal end is advisable as the artery retracts beneath the muscles once it is cut and a slipped ligature results in troublesome haemorrhage. The facial artery is divided again at the lower border of the mandible and the gland drawn down and separated from the lower border of the jaw dissecting close to the gland substance. The submandibular branch of the facial artery will be divided as this is done. If the lower pole is now retracted backwards the posterior border of the mylohyoid muscle may be separated with scissors from the groove between the superficial and deeps parts of the gland. Small arteries entering the gland from the muscle should be sealed with diathermy. A finger is passed around the gland separating loose connective tissue around the capsule and the gland drawn down to bring the lingual nerve into view. The nerve is within the fascial sheath of the gland at the upper pole and will be drawn into a V shape by traction on the gland. The nerve is separated under direct vision after which the duct may be drawn down through the loop of the nerve. The duct should be clamped, divided and ligated well forward to leave only a short stump. If the dissection keeps close to the under surface of the gland the hypoglossal nerve should remain covered with loose connective tissue and should not be at risk. Sometimes veins from the gland drain into the veni comitantes of the hypoglossal nerve or lingual artery and will be divided as the gland is separated. They must be clamped and ligated with care or the nerve will be damaged. The wound is closed in layers with vacuum drainage.

Parotid calculi are not infrequent, but only the larger ones can be seen against the soft tissue image of the cheek in plain radiographs. Sialograms are necessary to identify and locate them but even these are not always easy to interpret.

Parotid calculi anterior to the accessory parotid can be reached via the oral cavity. A Y shaped incision is made around the parotid papilla and a flap raised which includes the submucosal part of the duct. The duct is mobilised for a distance out into the cheek and drawn as a loop into the mouth so that the calculus can be reached. Calculi in the intraglandular part of the duct are approached through a pre-auricular incision as for parotidectomy. The duct is identified at the anterior border of the gland and traced backwards until the calculus is uncovered. Care is taken to identify and conserve related branches of the facial nerve.

Strictures and Fistulas

If a duct ulcerates around a calculus a characteristic short stricture will form after the calculus has been removed. There will then be a recurrence of mealtime swelling. Removal of the stricture or excision of the gland will be required. Fortunately the submandibular duct is the one most often affect. A stricture anterior to the second molar region may be circumvented by transecting the duct behind the obstruction, slitting the end to increase the size of the opening and implanting it in the floor of the mouth.

Some submandibular calculi ulcerate directly into the mouth and an internal fistula is formed. Unless there is also a stricture present this is of no consequence.

Bilateral strictures affecting sizeable lengths of the parotid ducts are seen. The ducts proximal to the stricture dilate and both recurrent obstructive swellings and recurrent infective swellings are experienced by the patient. Mostly these patients do not have positive tests for autoimmune antibodies, nor do they suffer from rheumatoid arthritis, and they lack the characteristic histological changes as seen in labial salivary gland biopsies in Sjögren's syndrome. Dilatation of the stricture with Neoplex filiform bougies lubricated with lignocaine gel will often relieve symptoms temporarily.

Partial excisions or a laceration of the parotid gland may be followed by an accumulation of saliva in the tissues. Aspiration of the pool of saliva through an oblique needle track, followed by the application of a firm pressure dressing, and repeated as necessary will cure this, but may take some weeks or months. Incisional drainage of such a collection of saliva, or of pus in a parotid abscess can result in an external parotid fistula as can a laceration involving Wharton's duct.

Management of Fistulas.- Fistulas from divided gland substance usually granulate and heal. Duct fistulas need to be explored because quantities of saliva pour out on to the face each meal time, and even the amount which leaks out between meals is sufficient to keep the skin and a dressing moist. Following a pre-operative sialogram a flexible bougie is passed into the duct from the mouth, to mark the distal segment. A pre-auricular flap is raised and the proximal end is sought. If repair without tension is possible the ends of the divided duct are slit longitudinally so that they may be joined by an oblique suture line which will not contract to a stricture.

If the distal part has been destroyed, or if a stricture obliterates part of the distal 2 cm of duct, continuity can be restored using a rectangular pedicle flap of mucosa from the inner aspect of the cheek which is rolled into a tube and anastomosed to the duct end. If no reconstructive procedure is possible the gland is excised.

Cysts

As a rare entity a cyst lined with epithelium may be found in the parotid gland and behind the angle of the mandible. The origin of such cysts is uncertain, they may be related to the developmental preauricular sinuses occasionally seen in front of the ear, or they may be related to the branchial cleft cysts which more typically are found beneath the upper third of the sternomastoid muscle. A lateral dermoid cyst of the floor of the mouth which develops

from the first branchial cleft can enlarge backwards until the submandibular salivary gland is spread out over its surface. It will then present as a fluctuant swelling both in the floor of the mouth and in the submandibular triangle. The treatment of these cysts is enucleation.

Neoplasms

The International Classification of Salivary Gland Tumours is recommended and reproduced below.

I. Epithelial Tumours

A. Adenomas
- 1. Pleomorphic adenoma (mixed tumour)
- Monomorphic adenomas
- (a) Adenolymphoma
- (b) Oxyphylic adenoma
- (c) Other types

B. Mucoepidermoid tumours

C. Acinic cell tumour

D. Carcinoma
- 1. Adenoid cystic carcinoma
- 2. Adenocarcinoma
- 3. Epidermoid carcinoma
- 4. Undifferentiated carcinoma
- 5. Carcinoma in pleomorphic adenoma

II. Non-Epithelial Tumours

Many salivary neoplasms are distinctly rare and of interest only to the specialist surgeon and pathologist. Only those which are common enough to be of general interest will be described.

Incidence.- Approximately 75% of all salivary neoplasms arise in the parotid gland. Of these some 80% are benign and 80% of the benign tumours are pleomorphic adenomas.

Approximately 15% of salivary neoplasms arise in the submandibular salivary gland. Of these 60% are benign and 95% of the benign tumors are pleomorphic adenomas.

Approximately 10% of salivary neoplasms arise in the minor salivary glands of palate, lip and cheek and in the sublingual glands; with the site incidence decreasing in that order. Only 40% of these are benign but virtually all the benign tumours are pleomorphic adenomas.

Pleomorphic Adenomas.- Epithelial cells proliferate in strands and some take on a duct like arrangement. Other cells, probably of myoepithelial origin, proliferate in sheets. In parts of the tumour a mucoid material is produced which separates the cells producing a myxomatous appearance and then an appearance resembling cartilage in histological sections. On occasions sufficient mucoid material may accumulate to produce a cystic part to the swelling. In general the tumour is slow growing and forms a firm or elastic, lobulated mass. The pleomorphic adenoma (Pleomorphic = many forms.) is classed as benign, but strands of tumour cells tend to penetrate the thin capsule of compressed gland substance and connective tissue which surrounds it. Further, lobules of tumour attached only by a narrow neck of tissue may extend beyond the main limits of the mass. For these reasons, simple enucleation will leave residual neoplasm behind and result in multicentric recurrence. After perhaps 10, 20 or

30 years a few pleomorphic adenomas will exhibit rapid growth and a clinical signs of malignancy. This is described as a carcinoma arising in pleomorphic adenoma.

Adenolymphoma or Warthin's Tumour.- A benign neoplasm composed of a double-layered epithelium which lines spaces which are frequently cystic. The epithelium is markedly eosinophilic and the inner cells are columnar. It tends to be folded inwards into the cavities to produce a papillary appearance in section. Characteristically the stoma contains lymphoid tissue, including lymph follicles.

Clinically it presents as a slowly enlarging soft, sometimes fluctuant swelling, usually towards the lower pole of the parotid gland in the middle aged or elderly male. More than one tumour may be found at times, either on one side, or bilaterally. Adenolymphomas form 10% of parotid tumours, are rare in the submandibular gland, and found only exceptionally in the minor glands. Unlike all other neoplasms which form a 'cold' spot, the adenolymphoma produces a 'hot' spon in a $^{99}Tc^{m}$ Pertechnetate 'scan' so that a firm pre-operative diagnosis is possible without biopsy. Other types of monomorphic adenoma are rare. Again, they are found in older people and may be bilateral.

Muco-epidermoid Tumour.- Is composed of sheets and masses of epidermoid cells and clefts and cystic spaces lined by mucous secreting cells. The cartilage-like appearance and myxoid appearance characteristic of the pleomorphic adenoma is not seen.

These tumours are of varying degrees of differentiation and speed of growth. Mostly they are slow growing and invade local tissues to a limited degree and only occasionally metastasise to lymph nodes, lungs or skin. Some grow rapidly and are aggressive. Clinically they are usually hard; noticeably harder than a typical pleomorphic adenoma, yet become fixed only when large. Mostly they do not cause facial paralysis when they occur in the parotid gland.

Acinic Cell Tumour.- Almost all acinic cell tumours occur in the parotid gland. They are composed of cells resembling those of serous acini. They occur in women more often than in men. This comparatively rare and usually slow growing neoplasm is important in that like the muco-epidermoid it is invasive, though, if slow growing, to a limited extent. Again, like the muco-epidermoid carcinoma, those with a relatively benign appearance may metastasise unexpectedly. Acinic cell tumours tend to be soft and occasionally cystic.

Adenoid cystic carcinoma consists of myoepithelial cells and duct epithelium cells. The former form sheets of cells within which a basophilic material accumulates in blobs to give them a cribriform, or lace-like appearance. Duct epithelium cells form strands and cords, but tend also to form duct-like structures and microcysts in which an eosinophilic material accumulates. These also add to the cribriform appearance.

Many adenoid cystic carcinomas are comparatively slow growing and difficult to differentiate clinically from the previously described tumours. However, sooner or later pain, areas of anaesthesia of the skin and paralysis of muscles appear due to involvement of related nerves. Unlike the previously described neoplasms, however, the chance of eradicating an adenoid cystic carcinoma is poor because it infiltrates for long distances in the perineural tissues of adjacent nerves and may invade medullary bone for many centimetres or travel over

the periosteum before inducing significant bone resorption. Thus, the tumour is always more extensive than the physical signs or radiographic appearances suggest. The percentage incidence increases from parotid to submandibular to minor salivary glands. The adenoid cystic carcinoma tends to be both hard and fixed.

Adenocarcinomas, Epidermoid Carcinomas and Undifferentiated Carcinomas.- Some salivary carcinoma cells and cell arrangements resemble the various glandular elements seen in salivary glands. These are the adenocarcinomas. Some specialist pathologists subdivide these according to the predominant cell type, but their subdivisions are not of clinical importance. Epidermoid and undifferentiated carcinomas resemble those seen at other sites.

All these neoplasms tend, at an early stage, to produce obvious clinical signs of malignancy. These are fixation, resorption of adjacent bone, pain, anaesthesia of skin or mucous membrane and paralysis of muscles. In the case of the parotid gland, facial nerve irritability occurs first and muscle spasm can be produced if the tissues over the nerve are tapped. Later this gives way to facial paralysis. Limitation of mandibular movement results from invasion of the jaw and masticatory muscles.

Treatment of Salivary Tumours

Treatment of Slow Growing Salivary Neoplasms.- Slow growing *parotid* neoplasms are assessed clinically and are *not biopsied.* Warthin's tumours and pleomorphic adenomas are usually recognisable with reasonable certainty. Both are excised by partial parotidectomy with conservation of the facial nerve. The main trunk is identified proximal to the gland and each branch is traced out in turn. A margin of normal gland and if necessary masseter muscle, is taken with a pleomorphic adenoma. The connective tissue sheath of the nerve is adequate margin at this site and only the occasional branches actually penetrating the tumour need be sacrificed and replaced by a graft. Unusually hard and fixed, slow growing, neoplasms are treated similarly, but a larger margin is taken with a greater readiness to sacrifice nerve branches. Further treatment depends on the histological report and adequacy of the excision. Most muco-epidermoid carcinomas will be effectively managed this way.

Slow-growing *submandibular* gland neoplasms not fixed to the mandible are treated by excising the whole gland with the adjacent connective tissue, but conserving lingual and hypoglossal nerves. To prevent rupture and seeding of the neoplasm the gland must not be grasped with tissue forceps or other instruments, nor biopsied.

Palatal pleomorphic adenomas, after a pre-operative biopsy, are circumscribed with an incision well wide of the obvious swelling as the tumour here is flattened and dish-shaped rather than spherical. The periosteum is raised from the bone, the greater palatine vessels mobilised and drawn down until they can be clamped, divided, and diathermised beyond the tumour. The wound is packed and heals by granulation. Palatal bone need be sacrificed only if obviously invaded clinically or radiographically.

Biopsy?- Salivary neoplasms shed cells if they are incised and will 'seed' readily giving rise to recurrence. Biopsy of the parotid also carries the risk of damage to the facial nerve. Pre-operative biopsy is largely confined to tumours of the sublingual, palatal and minor glands, as these carry the greatest likelihood of being malignant.

Dumb-bell Parotid Tumours.- Some parotid neoplasms arising in the deep part of the gland produce virtually no visible or palpable swelling in the pre-auricular region. The tumour enlarges medially, passing between the styloid process and the mandible to present as a swelling of the soft palate, lateral wall of pharynx and posterior pillar of the fauces. Computerised axial tomography will demonstrate the size and anatomical relations of the mass.

If, on examination under anaesthesia, a lump with a history suggestive of slow growth is palpably lobulated and the lateral pharyngeal wall moves freely over it, the assumption may be made that it is a pleomorphic adenoma and no biopsy performed. Other tumours should be biopsied through a limited incision in the posterior pillar of the fauces and the biopsy site removed with the tumour.

The surgical approach is through a parotidectomy incision with a submandibular extension. After mobilising the facial nerve and its branches from the parotid gland the mandible is divided anterior to the mental foramen and the angle retracted upwards. Division of the styloid process between the origin of the stylopharyngeus and the styloglossus and stylohyoid muscles completes access to the tumour for dissection under direct vision. The parotid gland and the tumour, with a covering of connective tissue, are removed together. The mandible and styloid process are repaired and the wound closed with vacuum drainage.

Treatment of Neoplasms which present with Clinical Signs of Malignancy

Where the neoplasm presents the clinical signs of malignancy, a radical excision is carried out. In the case of the parotid gland the facial nerve is sacrificed, but may be grafted using the great auricular nerve. Such other structures are sacrificed as are both surgically reasonable and necessary. A specimen can be taken for frozen section during the operation and before any irrevocable or mutilating step is carried out. Depending on the pathologist's report on the type of neoplasm and the adequacy of the surgical excision, postoperative radiotherapy is arranged. Unfortunately most salivary neoplasms are relatively radioresistant.

Radical excision of a parotid neoplasm is limited by the internal carotid artery on its deep aspect and the cranial cavity posteriorly. Excision of the parotid including the mandible is straightforward, but inclusion of the temporal bone requires special surgical expertise.

A similar management is followed for the submandibular gland with fewer anatomical restraints. Radical excision of the submandibular gland with, if necessary, the adjacent mandible and tongue and in continuity with a neck node dissection presents no special problems.

In the case of the minor salivary glands a biopsy is made pre-operatively. Excision with a wide margin is carried out. In the case of palatal neoplasms this means a maxillectomy. The cavity in the upper jaw is lined with a split skin graft held in place by a gutta percha bung on a dental plate which is wired to the remaining facial skeleton. Most adenoid cystic carcinomas require post-operative radiotherapy irrespective of their site of origin.

Post-operative Persistent Facial Paralysis

Where nerve grafting is not possible or proves unsuccessful following radical surgery, consideration can be given to transposing the hypoglossal nerve and anastomosing it to the peripheral branches. Fascial slings may also be used to support facial tissues and mask the deformity.

Non-epithelial Tumours

Haemangiomas, lymphangiomas and neurofibromas may involve the parotid salivary gland. Haemangiomas most often present during childhood and account for almost half of the hamartomatous and neoplastic parotid lesions seen in this age group. Excision requires special care, not only because of the problems of haemorrhage, but because the facial nerve is not so deeply placed in the child.

The Auriculotemporal Syndrome (Frey's Syndrome)

In this condition there is flushing and sweating of the skin innervated by the auriculotemporal nerve whenever salivation is stimulated. The condition follows surgery in the region of the parotid gland or temporomandibular joint, but may follow accidental injury of the parotid gland or joint. Some cases are congenital and possibly due to birth trauma. It is thought that following injury to the auriculotemporal nerve, postganglionic parasympathetic fibres from the otic ganglion become united to sympathetic nerves from the superior cervical ganglion destined to supply the vessels and sweat glands of the skin. Mostly the condition is an inconvenience rather than a real disability. Only in severe cases is an intra-tympanic para-sympathetic neurectomy considered. This involves division of the tympanic branch of the glossopharyngeal nerve below the round window in the middle ear.

Sjögren's Syndrome

Sjögren's syndrome is the clinical triad of dry eyes (keratoconjunctivitis sicca), dry mouth (xerostomia) and rheumatoid arthritis. More recently other connective tissue diseases such as systemic lupus erythematosus or scleroderma have been recognised as a possible third component. Such patients are regarded as having secondary Sjögren's syndrome. If only the dry eye and dry mouth aspects of the condition are present the patient is said to have the sicca syndrome or primary Sjögren's syndrome. In these patients the salivary and lacrimal glands are infiltrated with lymphocytes and the acini progressively destroyed. The epithelium of the ducts becomes hyperplastic, forming casts within the lumen and blocking smaller ducts. Mucous gland metaplasia of the duct epithelium leads to the formation of a gelatinous saliva in some patients. Strictures, duct dilatations and ascending infection complicate the picture. The histological changes can be seen in biopsies of the labial mucous salivary glands. Hypergamma-globulinaemia may be detected in an electrophoretic strip and autoantibodies such as rheumatoid factor, antinuclear factor and salivary duct antibody may be demonstrated in the serum. The lack of lacrimal secretion can be shown by the Schirmer test and the keratitis by Rose Bengal and fluorescein staining. Salivary secretion studies are conducted by collecting saliva under standard conditions using small cups applied by a vacuum ring over the parotid papillae. Gland function can also be quantified by $^{99}Tc^{m}$ Pertechnetate scans.

The effect of the disease in the salivary glands is a progressively more severe dryness of the mouth. Rampant, uncontrollable caries of the teeth follows. After the loss of the natural teeth, dentures are almost unwearable and lips, tongue and palate stick together. The tongue becomes cracked and attacks of monilia stomatitis occur.

Intense infiltration of the glands with lymphocytes can result in diffuse enlargement or the formation of localised nodules, which must be distinguished from neoplasms.

Mikulicz Disease.- Mikulicz (Johann von Mikulicz-Radecki, 1850-1905. Polish Surgeon. Described this disease in 1892.) described his triad which constituted (1) Symmetrical enlargement of all the salivary glands. (2) Narrowing of the palpebral fissures due to enlargement of the lacrimal glands and (3) Parchment-like dryness of the mouth. Subsequently Mikulicz disease and Mikulicz syndrome were recognised, both producing the same clinical picture. Mikulicz syndrome is the enlargement of the salivary and lacrimal glands due to leukaemia or some other generalised disease resulting in infiltration of the glands with round cells. Mikulicz disease is due to an autoimmune process in the glands themselves and is generally looked upon as a clinical variant of Sjögren's syndrome.

Treatment.- The dry eyes can be treated by diathermy obliteration of the lacrimal punctum and the instillation of artificial tears composed of methyl cellulose drops. Meticulous oral hygiene with toothbrush and fluoride toothpaste, dental floss and a special 1% chlorhexidine gluconate preparation will help control the caries and periodontal disease and delay tooth loss. Methyl cellulose mouth washes help to keep the mouth moist, but are less successful than artificial tears.

Steroids and immunosuppressive agents will generally alter the course of the disease, but their use is rarely warranted in view of their side effects. In addition, such treatment increases the risk of ascending infection. Radiotherapy will reduce the enlargement of Mikulicz disease, but increases both the dryness of the mouth and any tendency to attacks of infection.

Patients with Sjögren's syndrome are at greater risk than the rest of the population from the development of reticulum-cell sarcoma, either in the glands, or in the related lymph nodes.

Other Causes of Salivary Gland Enlargement

A variety of drugs will cause enlargement of the salivary glands in a percentage of patients, notably those used in the treatment of thyrotoxicosis. Many other drugs reduce the salivary flow, cause dryness of the mouth, and predispose to ascending infection of the salivary glands.

Sialosis is enlargement of the salivary glands for metabolic reasons. It is seen in certain hormonal disturbances such as diabetes and acromegaly, in patients who stick to bizarre diets, and in patients who are overweight. In the case of the latter the glands may be infiltrated with fat. The condition is important in drawing attention to an underlying cause or in the differential diagnosis from other causes of salivary gland enlargement.