Chapter 30

Face, Palate, Lips, Maxillo-Facial injuries

Embryology of the Face

The buccopharyngeal membrane lies between the forebrain and the developing heart in the pericardial sac. Bending of the brain at the midbrain flexure brings the anterior end of the neural crest above the buccopharyngeal membrane and ectomesenchyme migrates downwards beneath the epithelium and over the forebrain to form a prominence, the frontonasal process. Further neural crest cells migrate by a longer route between the buccopharyngeal membrane and the heart to form a series of ridges, the first two of which are substantial and form the mandibular and hyoid arches. Ectomesenchyme from the dorsal end of the mandibular arches migrates forwards subepithelially to raise prominences, the maxillary processes, on either side of the buccopharyngeal membrane which, as a result, lies at the bottom of a pit, the stomatodeum. At this stage the buccopharyngeal membrane perforates.

The epithelium on the lateral aspects of the frontonasal process thickens to form the olfactory placodes and frontonasal ectomesenchyme proliferates to raise a horseshoe-shaped ridge medial to, above and lateral to the placode. The medial part of the ridge is called the medial nasal process and the lateral part the lateral nasal process. Mandibular arch mesenchyme on each side proliferates medially merging in the mid-line to smooth out the notch between the two sides and establish a single complete arch.

During the sixth week the medial nasal processes enlarge, bulging down between the maxillary processes and towards one another. They merge in the mid-line smoothing the furrow between them. The maxillary elevations also enlarge substantially, maintaining a relationship with the medial nasal processes also advancing medially below the lateral nasal processes and the olfactory pits. As the olfactory placodes sink below the surface they maintain contact with the epithelium between maxillary and medial nasal mesenchyme which, at this stage, cannot mingle.

The maxillary and medial nasal processes bulge forward together and the epithelium on their surfaces fuse to form a sheet, the nasal fin. Subsequently this breaks down and maxillary and medial nasal mesenchyme intermingle. The epithelial fins behind this fusion are stretched laterally to form the bucconasal membranes and break down to form the nasal choanae connecting the nasal pits and the stomatodeum. The tissues below the nasal pits now form the primary palate or intermaxillary segment. The posterior part will form the premaxillary part of the definitive palate, the intermediate zone the premaxillary alveolar process and teeth and the anterior zone the medial portion of the upper lip.

During the seventh week shelf-like processes grow medially and downwards from the maxillary processes, which form the sides of the stomatodeum, so as to embrace the developing tongue. The tongue disengages itself from between them from before backwards, they reorientate medially, their edges touch in the mid-line and the covering epithelium adheres, fuses and then breaks down. These processes forming the secondary palate also fuse with the primary palate.

The nasal choanae are stretched upwards by growth of the surrounding tissues and a nasal septum appears in the roof of the stomatodeum behind them and grows downwards. Both frontonasal and maxillary mesenchyme via tectoseptal extensions contribute to the septum. It fuses with the palatine shelves soon after they unite.

Congenital Abnormalities

Cleft lip and palate

These are two separate entities. Cleft lip results from abnormal development of the medial nasal and maxillary processes at the time that they bulge downwards in front of and below the nasal pit and when their surfaces should touch, the epithelium over them fuse and then break down. (In experimental animals such as the rat the lateral nasal processes rather than the maxillary processes are involved.) In minor degrees of clefting the deficiency appears to be mainly of tissue from the medial nasal process. More severe degrees are deficient on both sides and the cleft involves the alveolar process, between the primary and secondary palates. The presence of a cleft lip appears to interfere with dislocation of the tongue from between the palatal shelves so producing the combined cleft lip and palate deformity. Cleft palate results from a failure of fusion of the two palatine processes or, in the case of the soft palate, of a merging process to carry the union backwards from the site of initial fusion.

Bilateral cleft lip and alveolar process may occur on its own, or again in combination with a cleft of the secondary palate. When this happens the palatal cleft is often wide and the nasal septum not attached to either side.

A failure of merging of the medial nasal processes can lead to a medial cleft lip, with sometimes, in addition, a deficiency of the nasal tip. Various deficiencies of frontonasal development can lead to an absence of the premaxilla (but not necessarily a median cleft of the lip), absence of the nose, or cyclopia (which is not compatible with life).

Experimentally, a variety of insults to the embryo can result in the production of a cleft lip or cleft palate depending upon the timing of the event. There is little evidence to link specific aetiological factors with these deformities when they occur spontaneously. There are likely to be a variety of aetiologies and several mechanisms which can result in one or the other of these defects. For example, cleft palate could result from a failure of the tongue to dislocate from between the palatal shelves at the appropriate time, a failure of reorientation of the palatal shelves, a failure of the rapid medial growth which usually precedes fusion, or a failure of the fusion process itself.

In a proportion of cases, which varies with the closeness of the relationship, a family incidence of clefting is found. Cleft lip and cleft lip and palate occur with increased frequency among relatives and isolated cleft palate similarly, but as a separate relationship.

Caucasians have a higher incidence of cleft lip than Negroes, and Japanese than Europeans. Certain communities such as in Iceland have a high incidence.

After a study of records of 703 Danish patients, P. Fogh-Anderson (Poul Fogh-Andersen. Plastic Surgeon, Deaconess Hospital, Copenhagen, Denmark.) found a relative incidence as follows:

Cleft lip alone	25%	(60% males)
Cleft palate alone	25%	(59% females)
Cleft lip and cleft palate combined	50%	(70% males).

In 75% of patients the cleft was unilateral.

In most series of unilateral cleft lip the cleft is on the left side in 60% of cases.

Classification of Cleft Lip and Palate Defects

A classification based on those of Kernahan (D. A. Kernahan, Contemporary, St. Luke's Hospital, New York.) and Starke (R. B. Starke, Contemporary, St. Luke's Hospital, New York.) is simple and generally useful:

1. *Clefts of Primary Palate only*

Unilateral (right or left)	Median	Bilateral
(a) Complete	(a) Complete (premaxilla absent)	(a) Complete
(b) Incomplete	(b) Incomplete (premaxilla rudimentary)	(b) Incomplete

2. *Clefts of Secondary Palate*

(a) Complete	(b) Incomplete	(c) Submucous

3. *Clefts of both Primary and Secondary Palates*

Unilateral (right or left)	Median	Bilateral
(a) Complete	(a) Complete	(a) Complete
(b) Incomplete	(b) Incomplete	(b) Incomplete.

In addition, where clefts of the secondary palate are involved the nasal septum may or may not be attached to one of the palatal shelves and where the cleft is incomplete the cleft may involve only the soft palate.

Effect upon Function

Sucking and eating.- Because the infant takes a substantial part of the areola as well as the nipple into its mouth, sucking is not greatly affected by a cleft lip. Where bottle feeding is used the hole in the teat may have to be enlarged with a hot needle. Cleft palate

babies have been successfully fed with a spoon, but a special plate which covers the cleft facilitates bottle feeding. It would be assumed that an unrepaired cleft palate was incompatible with successful eating, but from time to time adults are seen, often with quite large clefts who have grown up in places where surgery was not available and who are well nourished. A denture with a special extension can be made to occlude the cleft, even that between the soft palate.

Speech.- A person with a cleft palate is unable to make the consonant sounds B, B, K, P, T and the hard G. Various arguments are advanced about the optimum time at which palatal repair should be effects, and the degree to which early surgery reduces the growth potential of the maxilla. However, closure before serious attempts are made by the child to speak is an important consideration. Speech therapy is almost always needed after surgery for the best results. Unfortunately once nasal speech has developed as a result of delayed closure, a nasal intonation may persist despite speech training. The aim of surgery is a long, flexible soft palate which can be elevated to seal off the nasopharynx. Even if this is not managed surprisingly good speech can be achieved by dedicated speech therapy. Because the child mimics the parents, a mother or father with cleft palate speech is a hindrance to the development of good speech in the child.

The teeth.- The alveolar cleft interferes with the dental lamina and the upper lateral incisor may be small, absent or even duplicated with a supernumerary lateral incisor on the canine side of the cleft. All the incisors in bilateral cleft cases may be badly displaced. The maxilla tends to be smaller than average, particularly the lesser segment and the latter is often at a higher level at the anterior end than the canine region on the other side. The teeth, particularly the adults ones, therefore tend to be crowded and the maxilla retroposed, giving a relative mandibular prognathism. In the past unskillful surgery damaged the unerupted teeth. Orthodontic treatment is required to ensure correctly aligned arches.

The nose.- The upper respiratory mucous membranes are contaminated with oral organisms through a cleft palate or via a residual defect after repair. The nostril and ala on the cleft side are inadequately supported by a defective anterior bony aperture to the nose.

Hearing.- If a palatal repair is not attempted and sometimes even if a good palatal repair is achieved, acute and chronic otitis media, 'glue' ear and hearing problems ensure. Inflammatory oedema of pharyngeal mucosa and defective muscular activity impeded the ventilation and drainage of the middle ear via the Eustachian tube (Bartolommeo Eustachi (Eustachius), 1520-1574. Professor of Anatomy, Rome.) with retention of inflammatory exudate and deafness.

Treatment

Aims.- The aims are a normal appearance, swallowing without nasal regurgitation, normal sounding speech, well aligned teeth in normal occlusion and no loss of hearing.

A normal appearance.- An infant with a cleft lip, even a unilateral one, appears grotesque to the parents. Much trouble should be taken to reassure them and particularly the mother and to establish a normal parent-child bonding. Fortunately lip repair soon creates a normal looking face. A cleft palate baby requires intensive pre-surgical treatment and presents

feeding problems which need to be overcome. These put an additional strain on the parents. After the primary surgical treatment (David Ralph Millard, Jr, Contemporary. Plastic Surgeon, Miami, Florida, USA.), revision to deal with various aesthetic problems is required as growth proceeds. If the maxilla is hypoplastic and retroposed a maxillary osteotomy may be required as soon as skeletal growth has ceased to advance the mid face downwards and forwards. The level at which this is effected depends upon the degree to which the nose and infraorbital rims also are hypoplastic. Even where the facial skeleton is generally well formed secondary procedures to produce symmetrical nostrils and alae are often required in early adolescence: sometimes with lengthening of the columella to raise the nasal tip. Revision of lip scars at the same time may be needed. If there is a genuine inequality of size between upper and lower lip and not just a postural effect due to a small maxilla, an Abbé flap may be needed to reduce the lower lip size and increase that of the upper.

Well aligned teeth.- Orthodontic help is required to achieve this once the adult dentition starts to erupt. Tooth movement, preceded sometimes by extractions to balance tooth size and arch size is usually started around age 10 or 11. Minor inequalities of jaw size between maxilla and mandible may be disguised. Where greater discrepancies are likely to appear in adolescence future corrective surgery must be borne in mind. Crowning of unsightly upper incisors is sometimes needed in the late teens.

Sucking and swallowing.- Sound surgical repair of the palatal cleft, or of the alveolar cleft and labial sulcus fistula if only an alveolar cleft is present is the definitive answer to feeding problems.

Normal hearing.- Again the solution is a functional soft palate repair and good speech therapy. Well aligned teeth are helpful.

It is obvious that many specialists are involved in a team effort from birth until perhaps 20 years of age if the best results are to be obtained. The detailed problems are many and special texts should be consulted about them. Where possible these children should be cared for by those who have a special interest in this work and who have had special training.

An outline of the sequence of treatment.- Soon after birth the cleft palate child should be seen by an orthodontist or paedodontist experienced in cleft palate work. A plate is constructed which will cover the cleft to facilitate feeding and which will mould the parts of the palate into the optimum position for surgical repair. Fresh plates will be constructed at intervals to continue the moulding until the alveolar processes are aligned and related correctly in space to the lower arch. If there is a bilateral cleft lip, facial strapping will be applied to the outside of the lip and premaxilla which is usually markedly displaced forwards under the tip of the nose, so as to mould it back into place.

The lip is normally repaired at about 10 weeks after birth. The repair should be relatively simple and sacrifice the minimum of tissue. The aim should be a long scar that will not contract and create a notch, accurate alignment of the mucocutaneous junction, conservation of a cupid's bow, correction of the shape of the nostril and repair of the nasal floor. Above all the two parts of the orbicularis oris must be joined together. In cleft lip patients the ends of the muscle are inserted into the adjacent bone and have to be mobilised before a complete oral sphincter can be achieved. If necessary, closure of the alveolar cleft

can be left to a subsequent occasion. Bone grafting of the alveolar cleft in infants is probably not beneficial. Bilateral cleft lips are repaired one side at a time so that tension created by the closure of one side helps to reposition the premaxilla.

Repair of the palatal cleft is usually undertaken between the ages of 12-18 months. The soft palate is closed in layers, first separating the abnormal insertions of the tensor palati into the back edge of the hard palate; rotating the ends medially and sewing them together in the mid-line. Flaps should be raised gently and with precision to avoid unnecessary damage to growing tissues. Repeated operations lead to scarring, bony deformity and poor soft palate function.

Speech therapy, ENT and orthodontic supervision follow. Around age 10-11 bone grafts are sometimes placed in the alveolar cleft to permit movement of the permanent canine into a good position. During the teenage period the need for and timing of further orthodontics, surgery of the facial skeleton, revision of lip scars and correction of residual nasal deformity are considered.

Other Developmental Abnormalities

Preauricular sinus.- The auricle develops from the fusion of six tubercles grouped around the external auditory canal. Failure of successful merging of the anterior tubercles leads to the formation of one or more narrow, blind pits. The opening leading into a preauricular sinus may become occluded, whereupon a cyst forms. If the cyst becomes infected and bursts or is incised a preauricular ulcer may follow. The ulcer refuses to heal as the infection is maintained from the sinus. The treatment is complete excision of the sinus.

Preauricular dermoid cyst. These dermoid cysts extend out from under the pinna as a fluctuant swelling, usually posteriorly. They should be differentiated from a postauricular sebaceous cyst. They result from inclusion of epithelium as two adjacent auricular tubercles merge.

Large upper labial frenum

In the child the deciduous maxillary central incisors are often separated from one another by a diastema and the labial frenum extends between them to the palatine papilla. With the eruption of the permanent incisors the diastema usually closes and a normal adult frenum is established. In some children the frenum remains thick and fleshy between the centrals and the diastema cannot be closed. The palatal extension of the frenum is dissected out from between the incisors and advanced up the labial side of the alveolar process as a V-Y procedure. Following this, orthodontic treatment to approximate the incisors may be successful.

Sinuses of the lower lip.- Demarquay described a pair of developmental sinuses, one either side of the mid-line of the lower lip. A mucoid material from adjacent mucous glands may discharge through them. Van der Woude (Anne van der Woude, Contemporary. Institute of Human Biology, University of Michigan, Ann Arbor, USA. Described this syndrome in 1954.) drew attention to a familial syndrome in which lower lip sinuses are associated with a cleft upper lip and palate. It is suggested that the sinuses may develop from transient

paramedian grooves in the developing lower lip. The sinuses may be excised with a wedge of lip but the wound must be closed in eversion to prevent notching.

Prolapse of the mucous membrane of the upper lip.- This produces a condition described as double lip. The patient may also have a sagging of the chin and of the upper eyelids and a non-toxic goitre (Ascher syndrome).

Micrognathism.- Relative mandibular retrognathism is common but in some instances the mandible is excessively small. Pierre Robin (Pierre Robin, 1867-1950. French histologist and stomatologist.) was interested in such cases and devised a monoblock orthodontic appliance to try to correct the small mandible. He drew attention to the respiratory obstruction which can affect neonates with micrognathism because the deformity results in backwards displacement of the tongue. Lenstrup reported three cases which all had cleft palates. It is suggested that dislocation of the tongue from between the palatal shelves is prevented because the mandible, and therefore the oral cavity is so small. In some instances the mandible is simply compressed in utero and may, to a degree, subsequently 'catch up' in size postnatally. Special airway plates prevent obstruction and now make unnecessary the sewing of the tip of the tongue to the lower lip as a temporary manoeuvre to pull it forward.

Hemifacial microsomia.- Haemorrhage near the developing ear in the foetus leads to varying degrees of tissue destruction producing the so-called first and second branchial arch syndrome. There may be a degree of hypoplasia or absence of the condyle and ramus of the mandible, the masticatory muscles, and external, middle and inner ear producing degrees of unilateral facial hypoplasia. Rarely both sides are affected, but if so the deformity is not symmetrical.

Treacher Collins (Edward Treacher Collins, 1862-1932. Surgeon, Moorfields Eye Hospital, London.) syndrome.- Mandibulo-facial dysostosis results from a symmetrical loss of neural crest cells destined to migrate by the longer posterior route into the face (Poswillo) (Daved E. Poswillo, Contemporary. Professor of Oral Surgery, The United Medical & Dental Schools (Guys Hospital Dental School), London. Formerly Professor of Teratology, Royal College of Surgeons of England). There is hypoplasia of the zygomatic bone and a deficiency or absence of the arch. As a result there is an antimongoloid slant to the palpebral fissure. There may be a coloboma of the lower eyelid with absence of lashes lateral to the notch and hypoplasia of the mandible resulting in a lack of chin and an anterior open bite. The ears are set low and the auricles and middle ear structures may be deficient in severe cases. The abnormality tends to run in families.

Mandibular prognathism.- The mandible may be larger than average producing a true mandibular prognathism or the maxilla may be hypoplastic producing a relative mandibular prognathism. Conditions which interfere with growth at the spheno-occipital synchondrosis will also produce a retroposed maxilla. Enlargement of one side of the mandible can result from unilateral condylar hyperplasia.

Surgical correction of deformity of the facial skeleton.- Many abnormalities may now be corrected or improved by a variety of osteotomy procedures. The mandible may be lengthened or shortened, as appropriate, and the chin increased or reduced in size by a genioplasty. Segments of alveolar process such as the premaxilla may be moved to correct,

for example, prominence of the upper incisors. The maxilla may be advanced at various levels; just the teeth, alveolar process and palate by an osteotomy at a Le Fort I level, the maxilla including the nose and infra orbital rims (Le Fort II level osteotomy), or including also the lateral orbital rim and zygomatic bone (Le Fort III level osteotomy). The palate and upper alveolar process may be raised by a Le Fort I osteotomy to correct the 'long face' appearance in which the whole upper alveolar process is exposed when the patient smiles and the mandible is prevented from rotating up into a normal position as it gags on the posterior teeth.

Craniofacial surgery.- Paul Tessier (Paul Louis Tessier, Contemporary. Head of Department of Plastic Surgery, Foch Hospital, Suresnes, Paris, France.) established a major advance by carrying similar corrective surgery inside the cranial cavity to mobilise the orbits. Many severe facial deformities involving maxilla, orbits and cranial vault are now treated by combined intracranial and extracranial operations.

Lesions of the Palate

Swellings of the palate may be mid-line or lateral.

A mid-line swelling:

(a) just behind the incisive papilla may be a cyst of the papilla or, beneath the papilla and in the bone, of the incisive canal (nasopalatine cyst);

(b) a bony hard swelling in the centre of the hard palate is likely to be a torus palatinus, a developmental bony excrescence;

(c) a diamond shaped group of miniature white cysts seen at the junction of the hard and soft palate in infants which are called Epstein's (Alois Epstein, 1849-1018. Director of Children's Clinic and Professor of Pediatrics, Prague. Described Epstein's pearls 1880.) pearls. They are cell rests at the line of fusion of the palatal shelves and disappear spontaneously.

A lateral swelling:

(a) behind an upper lateral incisor is likely to be an abscess or apical cyst arising from that tooth;

(b) opposite the molars a periodontal abscess or cyst from an upper molar;

(c) medial to the tuberosity and extending back towards the soft palate a salivary neoplasm arising in palatal salivary glands or more rarely a neurofibroma of the greater palatine nerve;

(d) a malignant neoplasm of the maxillary sinus extending downwards, usually in the region of the tuberosity;

(e) primary squamous cell carcinoma of the palate, usually of the soft palate.

Perforations of the palate may also be mid-line or lateral.

A mid-line perforation:

(a) a gumma producing first a swelling and then a perforation in the centre of the palate is rarely seen these days, a complication of congenital rather than acquired syphilis;

(b) suckers on the fitting surface of an upper denture causing ulceration and eventual perforation of the palate either at the rim of the rubber sucker or over the metal retaining stud. These perforations too are now rarely seen.

A lateral perforation:

(a) may be created during the removal of a malignant neoplasm or may occur as a result of necrosis of a malignant neoplasm;

(b) may rarely occur through the socket of a palatally misplaced tooth.

Palatal perforations may be covered by a denture or if conditions are favourable, repaired by flaps based on one or both palatine arteries; raised if necessary as island flaps.

Lesions of the Lips

Pigmentation of the lips and buccal mucous membranes.- Blotchy brown pigmentation of the oral mucous membranes is usually racial and of no importance. A more uniform pigmentation is seen in Addison's (Thomas Addison, 1793-1860. Physician, Guy's Hospital, London.) disease. Accidentally implanted dental amalgam will produce a dark bluish spot. Small bluish black spots on the lips, on the skin about the eyes and on the buccal and palatal mucous membranes is seen in Peutz-Jeghers (John Law Augustine Peutz, 1886-1957. Chief Specialist for Internal Medicine, St. John's Hospital, The Hague, Holland.) (Harold Jos Jeghers. Professor of Internal Medicine, New Jersey College of Medicine and Dentistry, Jersey City, USA.) syndrome. The condition is inherited as an autosomal dominant and includes adenomatous polyps of the small bowel. These may cause intussusception or intestinal colic, but rarely undergo malignant change.

Macrocheilia.- Recurrent, chronic or persistent swelling of the upper lip may be due to the Melkersson-Rosenthal syndrome. A Bell's palsy (Sir Charles Bell, 1774-1842. Surgeon, The Middlesex Hospital, London.) may precede or accompany the swelling. Granular hyperplasia of palatal and cheek tissues similar to that associated with oral Crohn's disease (Burrill Bernard Crohn, Contemporary. Gastroenterologist, Mount Sinai Hospital, New York, USA.) may be seen. Cavernous haemangioma and less often lymphangioma can produce enlargement of the lips.

Cracked lips.- An indolent crack in the mid-line of the lower lip can occur as a result of exposure to cold weather. A patent lip salve ointment and protection of the lip is advised. Cracks at the angles of the mouth are described in Chapter 32.

Herpes simplex infections (see Chapter 32).- Doctors, dentists and nurses should protect their hands while touching these lesions to avoid herpetic whitloes and should particularly avoid transferring the virus to their eyes. A preparation containing 'acyclovir' promises to bring speedy relief if applied early.

Chancre of the lip presences as a painless ulcer with a dull red, clean base. As in other sites there is a sufficient local infiltrate to produce a button like sensation to the gloved fingers. The regional lymph nodes are substantially enlarged, unlike the situation with genital chancres.

Neoplasms of the lip

Salivary neoplasms arise in minor mucous glands, usually of the upper lip. Firm, slow growing, lobulated, mobile tumours may be excised *in toto* on the assumption that they are pleomorphic adenomas. Less well defined, fixed or rapidly enlarging tumours should be biopsied by the shortest route of access, which is usually through the mucous membrane. Treatment is determined by the type of neoplasm.

Carcinoma of the lip tends to occur in older individuals and typically in men who follow an outdoor occupation. The lower lip is involved in over 90% of cases and it is believed that exposure to sunlight is an important aetiological factor. The lip first develops a whitish tinge then suffers repeated cracking and desquamation to form erosions (actinic cheilitis). Initially the carcinoma may appear as a persistance of an erosion at a particular site. A dry, red granular appearance with whitish flecks then replaces the yellowish crusting of exuded serum. As the tumour develops the centre becomes ulcerated and the margin everted. With deeper invasion of the lip the skin over the tumour becomes red and vascular, then breaks down here and there over areas of necrosis. The unwary at this stage may mistake the lesion for a carbuncle.

Some smokers develop a hyperkeratotic patch where a cigarette is held habitually between the lips at one place and may develop a carcinoma at this site. Metastasis is often first to the submental nodes which, as they are buried in fatty fibrous tissue, are less easy to feel than nodes elsewhere in the neck.

Because the early ulcer may resemble a herpetic lesion or other chronic infection lesion a biopsy should be performed for any indolent ulcer slow to show signs of healing. Excision biopsy is not advised as it is unlikely that an adequate curative margin will be taken unless the operator knows the diagnosis for certain.

Around 5% of squamous cell carcinomas of the lip occur on the upper lip and 2% involve the angle of the mouth. These are usually an extension of a carcinoma arising in speckled leucoplacia affecting the mucosal aspect of the cheek and consequently are often more extensive when first seen. Both commissures are usually affected by speckled leucoplacia and bilateral squamous cell carcinomas are not unusual. Not only is the prognosis less good because the lesion is larger at diagnosis, but metastasis to both sub-mental and sub-mandibular nodes may occur.

As the site is easily seen, patients with carcinoma of the lower lip tend to notice the ulcer at an early stage and seek treatment. The tumour tends to be well differentiated and whether treated by surgery or radiotherapy the prognosis is better than average with a five-year survival of 70%. Carcinoma of the lip must be distinguished from a kerato-acanthoma or molluscum sebaceum described in Chapter 10.

Treatment by Radiotherapy.- If the lesion is less than 2 cm in diameter a high rate of cure may be expected. With larger lesions a substantial regression can be expected even if complete disappearance of the tumour is not achieved. External beam irradiation is usually employed, delivering 5500 rads in fractionated doses over four weeks.

Treatment by surgery.- The classical mode of excision is to respect a wedge of lower lip which includes the carcinoma. If the whole red margin shows evidence of pre-malignant change the affected mucosa should be included in the specimen as a 'lip shave' and the mucosa of the inner aspect of the lip undermined and advanced up to the cutaneous edge. Care should be taken to plot out with a marking pen the extent of the intended margins to avoid an inadequate excision. Compression of the lip on either side by an assistant will control haemorrhage from the labial arteries until they can be clamped and tied. The defect is closed in layers; first the mucosa, then the muscle and finally the red margin and skin, being careful to align the mucocutaneous junctions. The red margin should be heaped up a little so that a notch does not form as healing occurs.

If a large wedge needs to be removed the deficiency can be shared with the upper lip by rotating an Estlander flap (Jakob August Estlander, 1831-1881. Finnish Surgeon.) into the excision site. A wedge shaped flap based on one side on the upper labial artery and half the width of the lower lip defect is rotated down. The pedicle is divided after three weeks and the flap set in.

Large rectangular defects may be closed by advancing local flaps from the lower cheek. Textbooks of plastic surgery should be consulted for details. Large tumours soon involve the bone of the chin and their excision involves difficult reconstructive surgery.

Lymph node spread is initially to the sub-mental nodes. Beyond these, spread may be to either side and often direct to nodes beneath the lower half of the sternomastoid. If there is a large carcinoma distinctly involving one side of the lower lip a full block excision on that side, including the submental nodes is indicated. The neck incision should be extended well round to the other side for adequate access. If nodes appear on the other side subsequently and are not fixed, consideration is given to a conservative block, retaining the accessory nerve down to the trapezius and the internal jugular. The sternomastoid is divided between the upper two thirds and the lower third. It too may be preserved and repaired afterwards, provided an adequate clearance is possible. Where there are only suspicious submental nodes and a tumour close to the mid-line, a submental block alone may be appropriate.

To remove the submental nodes a skin flap is raised from an incision over the hyoid bone, from one digastric tendon to the digastric tendon on the other side. Skin and subcutaneous tissue with the anterior parts of the platysma muscles are raised from the submental fat. The submental tissues are separated along the *posterior* margins of both

anterior bellies of the digastric muscles and dissected off the anterior bellies and then off the mylohyoid towards the mid-line. The muscles should be left clean from hyoid to mandible.

Where, because of the advanced nature of the primary, or the general state of the patient, surgery is not appropriate, mega voltage radiotherapy provides a satisfactory alternative and may well control neck metastases. Preoperative radiotherapy with surgery 6 weeks later or post operative radiotherapy not more than 4-6 weeks after a neck dissection reduces the chance of local tumor recurrence. Radiotherapy can be combined with chemotherapy (Mitomycin-C) for advanced cases beyond surgical care.

Maxillo-Facial Injuries

Injuries to the face are extremely common and may involve no more than black eyes or small lacerations over bony prominences. They are often due to sports injuries, domestic accidents or fights. In more severe injuries, such as result from road traffic accidents, trauma to the face and facial skeleton occurs in at least 30% of cases. The unrestrained front seat passenger in a car is thrown forward, the head striking, or passing through the windscreen or hitting the dashboard. Once through the windscreen the face may encounter the crumpling rear end of the bonnet. Toughened glass windscreen shatter on impact causing many lacerations. Fragments of glass may be found in the wounds and conjunctival sacs. Impacts at surprisingly low speed can cause such injuries. Seat belts, now worn compulsorily, reduce the incidence of such injuries. Head restraints reduce whip lash neck injuries from rear impact, but not from frontal impact accidents.

First aid.- The immediate danger to patients with severe injuries of the face is respiratory obstruction, caused by the inhalation of blood, accumulation of clot in the airway, or the falling back of the tongue as a result of bilateral fractures of the body of the mandible. The unconscious person slumped forwards in the car with the face down is safer, as blood will drain out of the mouth, in this position than if removed and laid flat on his back! Such patients should be placed in the semi-prone, tonsil position with the head supported on the bent arm. Great care should be taken not to flex or extend the neck in case there is an unstable fracture of the cervical spine. Bleeding may be brisk but is rarely dangerous and can be controlled by local pressure with pads. Profoundly shocked patients usually have other injuries to account for the blood loss (bleeding into the tissues from a fractured femur or pelvis or rupture of spleen, liver or kidneys if there is no external severe haemorrhage).

Examination of the injuries

The vault of the skull, supra-orbital ridges, nasal bridge, infra-orbital rims and zygomas, condyles via the external auditory meati and the posterior and lower border of the mandible should be palpated in turn for (a) asymmetry, (b) step deformity, (c) localised tenderness, or (d) a localised firm swelling due to haematoma. Fractures of the zygoma are often missed because soft tissue swelling disguises the deformity. So also the fractures of the orbital floor. The ill effects of these can include diplopia which may be difficult to correct if appropriate measures are not undertaken early on.

All road traffic accident patients, including pedestrians, hit perhaps from behind by a vehicle, and who have substantial facial damage should be examined from head to toe, back

and front, lest the startling appearance of the facial wounds causes other injuries to be overlooked. Detailed inspection of the facial injuries may not be possible until the patient is examined in the operating theatre under an anaesthetic.

Soft tissue injuries.- The facial soft tissues have a good blood supply and usually heal well after injury. Only heavily traumatised and obviously dead tissue needs to be excised from wound edges. Normally, even irregular wound margins can be pieced together. Nearly all wounds can be treated by primary suture, even when treatment has been delayed for as long as 24 hours. The major exception is high velocity missile wounds (see Chapter 2).

Great care is taken accurately to replace tissues where they belong, to align cosmetically important landmarks like the mucocutaneous junction of the lips and to avoid ugly stitch marks so preventing unnecessary additional disfigurement for the patient. Rarely can a wide band of deeply cut-in stitchmarks be eradicated by further surgery. Lacerations caused by toughened glass are likely to contain pieces of glass. Tiny fragments of glass may enter the conjunctival fornix and must be irrigated out. Surprisingly large fragments of plastic trim may escape notice as they are radiolucent. If the chin of an unseated motorcyclist hits the ground it may be degloved, scooping up gravel into the interval between the soft tissues and the mandible. Fractured tooth crowns may be embedded in the lips. All wounds should be diligently but gently explored under an anaesthetic and all dirt and foreign bodies removed. Once healed in they may be difficult to locate unless suppuration ensues. Infected wounds tend to produce hypertrophic scars. Dirt embedded in grazes must be removed by gentle, persistent scrubbing as any left behind will cause permanent ugly tattooing. Copious irrigation with sterile isotonic saline solution should precede closure. All layers are carefully reconstituted, mucosa and muscle with 4/0 (2 metric) chromic catgut sutures and skin with 4/0 or 6/0 (1.5 and 0.7 metric) black silk. Sutures should be set close to the wound edge and numerous narrow gauge sutures are better than a few, widely spaced, thick ones. Careful haemostasis should precede closure. Large wounds should be drained with vacuum drains and a firm dressing applied for 24 hours. After that skin wounds need no dressing and should be left open. Often alternate sutures may be removed from clean dry wounds at 48 hours. Sutures in the nose should be removed at 5 days or permanent stitch marks may remain. Usually, elsewhere sutures can be removed at 7 days.

Facial nerve injury.- Primary repair may be indicated (depending on other injuries, the availability of good skin cover and the general state of the patient). Locating divided branches in oedematous tissues, suffused with blood is likely to be difficult and time consuming. Flaps may need to be raised forward and backwards from the laceration over the surface of the deep fascia under normal looking tissues are reached and the branches identified and traced towards the injury. No easy task even for surgeons familiar with the surgical anatomy of the nerve. Substantial recovery may occur without definitive repair over a period of 8-12 months. Attempts at late secondary repair are rarely satisfactory.

Parotid duct.- A divided duct is often easier to suture than expected. A fine polythene cannula is introduced into the orifice in the mouth and threaded back along the distal segment. Approximation of the laceration will indicate where to look for the proximal cut end. The outer side of the distal end and the inner of the proximal are slit up for 2-3 mm and the ends anastomosed side to side to avoid stricture formation. The cannula is left in for 14 days to drain the anastomosis. If the distal end cannot be found the proximal end can be ligated in

the hope of gland atrophy. Accumulation of saliva in the tissues postoperatively should be aspirated at intervals of several days and a pressure dressing applied until they dry up.

Lacrimal apparatus.- Suturing of the lid is performed in layers after cannulating both ends of the injured canaliculus with a fine nylon thread, the distal end of which is passed into the lacrimal sac. This thread is kept in for as long as possible (up to 3 months). Scarred duct systems are best referred to plastic or ophthalmic surgeons for secondary procedures.

Injuries to the Facial Bones and Jaws

Fractured nose.- This is the simplest type of maxillo-facial injury and like other fractures in this region may be missed as the soft tissue swelling may disguise the deformity. Fractures involving the nasal bones and septum and even the frontal processes of the maxillar can be reduced by manipulation and immobilised by fairly simple measures. Delay in treatment of five to seven days may not be a disadvantage. In the face of great swelling a delay of a few days until it subsides may be sensible. A neglected simple nasal fracture can usually be corrected by plastic surgery. Where the nasal bones, often with fragments from the lower part of the frontal bone, are driven into the ethmoids the consequent traumatic telecanthus needs open operative correction and reattachment of the medial canthal ligaments. Delay until partial union or neglect until complete union has occurred will leave the patient permanently deformed.

A lateral injury results in the impaction of one nasal bone under the other. Reduction cannot be effected unless the side away from the impact is elevated first. A frontal injury hinges the nasal bones on a fracture in the region of nasofrontal suture with crumpling of the underlying septum. The nasal bones splay out. Additional force fractures the frontal processes of the maxilla and then impacts the whole into the ethmoids.

Treatment.- Reduction is best undertaken using a general anaesthetic and pharyngeal pack. If there are no other facial injuries an oral tube is used. If there is a fractured maxilla or mandible a nasal endotracheal tube is necessary, but tends to displace the nose after reduction. For a laterally displaced nose Walsham's forceps (William Johnson Walsham, 1847-1903. Surgeon, St. Bartolomew's Hospital, London.) are used first. The external blade is covered with thin, soft, rubber tube to avoid damage to the skin. The nasal bones are rotated first laterally to disimpact them and then medially to realign them. Next the nasal septum is straightened with Asch's forceps (Morris Joseph Asch, 1833-1902. Surgeon, New York Eye and Ear Hospital, New York, USA). The crumpled nose resulting from a frontal injury is lifted with Asch's forceps and again the septum ironed out and reseated in the groove of the nasal crest and vomer. While gently compressing the nasal bones below the bridge Vaseline ribbon gauze is packed lightly up between the nasal bone and the septum on one side. The ribbon gauze is cut off at a suitable length and the other end packed beneath the other nasal bone so that the gauze loops around the columella. It should not occlude the inferior meatus. A nasal plaster may be applied for 14 days but the pack removed after 7 days. Where the reduction is unstable trans-nasal wires may be passed and tied over lead plates.

Fractures of the maxilla are classified according to Le Fort (René Le Fort, Surgeon, Paris, defined these fractures as early as 1901 by macabre research in which he dropped rocks and other heavy objects on the faces of cadavers.):

A Le Fort I level fracture (or Guerin fracture) passes through the thin antral walls, including the lateral wall of the nose below the inferior concha, and across the nasal septum. It results in bony separation of the hard palate and upper alveolar process from the rest of the maxilla. Often the fragment is not impacted, tends to drop down until suspended by the sulcus tissues and 'floats' when the patient bites together or the examining clinician manipulates it.

A Le Fort II fracture (or pyramidal fracture) passes obliquely across the maxilla on each side from the zygomatic process of the maxilla, upwards and medially to the infraorbital margin near the infraorbital foramen and then, either across the root of the nose, or downwards to the articulation of the nasal bones with the frontal process of the maxilla at the anterior bony aperture of the nose. Fracture lines run backwards through the ethmoids and across to the inferior-orbital fissure. Frequently this central block of bone is driven backwards between the zygomatic bones and downwards, fracturing the pterygoid plates. Both maxillary sinuses are filled with blood and radiographically opaque. The fractures are usually well seen in an occipitomental radiograph at the infraorbital margins. Misalignment above and below the fracture through the posterior walls of the maxillary sinuses should be looked for in a lateral sinuses radiograph as well as possible disjunction at the frontonasal suture.

Le Fort III fractures across the root of the nose, join the supra-orbital fissures and pass laterally through the zygomaticofrontal sutures. These high level fractures often involve the cribriform plate and result in CSF rhinorrhoea.

Gross oedema of the face, circumocular ecchymosis, subconjunctival haemorrhage, haemorrhage from the nose, gagging on the back teeth, bruising and a palpable fracture through the zygomatic buttress in the upper buccal sulcus, diplopia due to entrapment of external ocular muscles in the fractured floor of the orbit and anaesthesia of the cheek are a few of the signs of a fractured maxilla.

Treatment is best carried out at a maxillo-facial injuries centre. Prophylaxis with sulphadiazine together with ampicillin and flucloxacillin should be given in case there is an injury to the cribriform plate. A tracheostomy may be required particularly if there is also an injury to the chest or coma due to a cranial injury. Where neurosurgery is required, careful coordination of surgery is important.

Broadly speaking fractured zygomas are disimpacted first, then an impacted central block is mobilised and drawn forward with Norman Rowe (Norman Lester Rowe, Contemporary. Formerly Consultant in Oral and Maxillo-Facial Surgery, Queen Mary's Hospital, Roehampton and Westminster Hospital, London.) disimpaction forceps. Finally the nasal complex is reduced.

Open reduction and direct wiring of the zygomatical frontal suture, the infraorbital rim and the frontonasal region and medial canthal ligaments may be needed. Fixation of the teeth in occlusion by means of eyelet wires, arch bars or silver cap splints, joined by intermaxillary wires helps to immobilise the bone fragments in the correct position and ensures proper articulation of the teeth. Once reduced, the fractured bones of the facial skeleton must be immobilised against the underside of the cranial base. This may be done by wires passed through the soft tissues from holes drilled in the zygomatic process of the frontal bone or the infraorbital rim, or wires looped over the zygomatic arches. These wires are attached at the

lower end to arch bars or splints on the upper teeth. Alternatively they are attached to splints or arch bars on the lower teeth so that the maxilla is sandwiched between the mandible and the base of the skull. Screw pins may be driven into the lateral ends of the supra-orbital ridges and the body of the mandible on each side and joined by rods and universal joints again holding the fractured maxilla between mandible and skull. This is called a Mount Vernon box frame. If silver cap splints are used the upper jaw may be fixed to the skull by means of system of rods jointed to a band of metal or halo which attaches to the outer table of the skull by four pins which engage firmly on the surface of the bone.

The Zygomatic bone and Zygomatic Arch from a prominence on the side of the face and are fractured by heavy, laterally directed blows. There is swelling of the cheek, of both upper and lower eyelids, usually with bruising, and a subconjunctival haemorrhage lateral and below the cornea. If the eye is directed medially the posterior limit of the subconjunctival haemorrhage cannot be seen. The arch should be palpated and compared with the uninjured side while looking at the head from above in order to detect depression. The depressed bone obstructs the coronoid and prevents proper opening of the mouth. There may be diplopia on looking upwards and laterally due to trapping of the inferior oblique muscle in the fractured orbital floor (sometimes this happens with a 'blow out' fracture of the orbital floor in the absence of a fractured zygoma. A compressing injury of the orbit forces the contents against the thin floor and pushes it downwards). There will be haemorrhage from the nostril. Sometimes the coronoid process is fractured. An occipitomental and a 30° occipitomental radiograph will demonstrate the injury.

Failure to reduce a depression of the arch results in a dimple over the injury. Failure to elevate a depressed zygomatic bone results in a flat cheek, enophthalmos, 'hooding' of the upper eyelid with lowering of the lateral canthus, infraorbital anaesthesia, which may be permanent or replaced by painful paraesthesia, and obstruction to full jaw opening.

Treatment.- (i) *Elevation.*- An incision is made at 45° to the arch anterior to the upper part of the pinna and within the (shaved) hair line. It is deepened to the temporal fascia which is incised. A Bristow's periosteal elevator (Walter Rowley Bristow, 1882-1947. Orthopedic Surgeon, St. Thomas's Hospital, London.) may be used to elevate the bones but must not be levered against the temporal bone as a fulcrum. If available a Kilner elevator (T. Pomfred Kilner, 1890-1964. Professor of Plastic Surgery, Oxford.) is preferred. This is hinged like a nutcracker permitting a direct upward pull. The instrument is passed through the incision in the fascia over the surface of the temporalis muscle and down under the arch. A lateral elevation lifts the arch and a forwards and lateral elevation lifts the zygomatic bone. A thumb on the infraorbital margin will feel the fractured bone click back into place.

(ii) *Fixation.*- Simple fractures will be stable provided the patient takes care not to press on the injured side for three weeks. If the bones tend to sag down the zygomatico-frontal suture should be wired with 0.35 mm stainless steel wire. A depressed orbital rim may be wired through an infraorbital incision. If there is trapping of the inferior rectus the orbital floor is explored, the muscle released and the damaged floor repaired with either a thin sheet of silastic or a shaped piece of inner cortex of ilium. If the walls of the antrum are badly comminuted and the zygomatic bone collapsed inwards the antrum is packed through a Caldwell-Luc (George Walter Caldwell, 1866-1946. Otolaryngologist, New York, USA.)

(Henri Luc, 1855-1025. Otolaryngologist, Paris.) incision with one inch ribbon gauze. A finger is inserted to mould the fragments back into place, then, while an assistant holds the zygomatic bone out in place with an elevator, the gauze, soaked in Whitehead's antiseptic varnish (Walter Whitehead, 1840-1013. Surgeon, Manchester Royal Infirmary, Manchester, England.), is packed in. The pack is removed after one month.

Just occasionally, either as a result of the original injury or during reduction, there will be a *haemorrhage* at the back of the orbit which will cause the eye to be proptosed. The optic stalk is stretched and the retinal artery goes into spasm. The light reflex is lost and the pupil dilates. The situation requires urgent action to decompress the back of the orbit or the sight of the eye will be lost. Drainage of the haematoma may be achieved either through a short incision in the lower lid, close to the orbital rim, or through the roof of the antrum.

Fractures of the mandible

The mandible tends to fracture at one of three situations.

1. At the neck of the condyle as this is the weakest part of the bone. Almost always the fracture is an indirect one. A blow to the canine-premolar region can cause a fracture of the condyle neck on the opposite side, a blow to the chin may fracture one or both condyle necks. The condyle is displaced forwards and medially by the pull of the lateral pterygoid and may be dislocated medially. Pain is felt in front of the ear when the jaw is moved, the chin deviates towards the side of the injury as the mouth opens and closure may be impeded by gagging on the molar teeth.

2. At the angle where the abrupt curvature concentrates the force of the blow. If an impacted third molar is present the deeply placed socket constitutes a line of weakness. Fracture lines which are across the upwards, forwards and inwards pull of the muscles are described as favourable as the fragments are little displaced. Fracture lines parallel to the direction of pull are unfavourable and permit considerable displacement. For these, open reduction and either direct wiring or plating of the fragments is usually necessary.

3. In the body of the mandible and often through the canine socket, again because this is a place of marked curvature and where there is a deep tooth socket. A bilateral fracture in this situation may permit the digastric muscles and geniohyoid muscles to pull the chin fragment and the attached tongue backwards, impairing the airway.

Most fractures involving the tooth bearing portions of the mandible are compound into the mouth because the mucoperiosteum is firmly attached to the bone and tears over the injury. There is swelling and bruising over the bony injury and importantly a haematoma in the floor of the mouth if the body of the mandible is fractured (Coleman's sign) (Alfred Coleman, 1828-1902. First dentally qualified doctor to pass the FRCS. Dental Surgeon to St. Bartholomew's and Royal Dental Hospital. Inventor of the mouth gag, commonly known as Mason's). There is tenderness where the fracture reaches the lower border and sometimes a palpable step in the bone. Speech and swallowing may be impaired and a local disturbance in the line of the teeth may mark the upper end of the fracture. Where the inferior dental canal is involved, anaesthesia of the lower lip is likely.

Principles of treatment.- With lack of proper function the mouth quickly becomes dirty and delay in reduction and fixation leads to infection since so often the fracture is compound into the mouth. Chronically infected teeth close to the fracture are also a source of infection and should be extracted. The apical blood vessels of a previously healthy tooth may be torn if a fracture passes through the socket and such teeth also may need to be extracted (unless valuable aesthetically or functionally) to immobilise the fracture. If the bone ends protrude into the mouth infection and necrosis may follow. Early reduction and the covering of bare bone with mucosa is important. Gun show wounds overlying comminuted bone fragments need copious irrigation in preparation for surgical debridement and closure. Mandibular fractures may be immobilised in several ways:

1. By using the teeth both to reduce the fragments and to immobilise them; fixing the mandibular teeth in correct occlusion with those in the maxilla. This may be achieved by (a) direct wiring in which short lengths of 0.45 mm soft stainless steel wire are threaded twice around the necks of the teeth in the form of a clove hitch and twisted tight. The twisted ends of wires around upper and lower teeth are twisted together in pairs. (b) eyelet wiring in which a small loop is twisted in the centre of a length of wire which is threaded between and around a pair of teeth. After eyelets have been applied to most of the upper and lower teeth connecting wires are threaded through the loops to join the jaws together. (c) by means of arch bars. These may be prefabricated lengths of stiff steel tape with hooks on, or rigid half round German silver bar bent to fit on a model. An arch bar is wired to the teeth in each arch and then the bars wired together to effect inter-maxillary fixation. (d) by silver alloy or plastic cap splints which are cemented to the teeth. Hooks on the splints enable them to be joined together by wires or elastic bands. Even if other means of fixation are also used, intermaxillary fixation ensures proper occlusion of the teeth and prevents stress at the fracture lines.

2. By directly fixing the fragments at the fracture lines at open operation using wires or bone plates.

3. By bone pins inserted firmly in pairs into cortical bone on either side of fracture lines and joined with rods and universal joints.

The edentulous mandible may be immobilised by wiring either the patient's own denture or Gunning's splints (Thomas Brian Gunning, 1813-1889. Dentist, New York, USA. Invented a vulcanite jaw splint. Noted for his successful treatment of the fractured jaw of William H. Seward, President Lincoln's Secretary of State.) to the jaws. Gunning's splints are like dental plates, but with plastic bite blocks instead of teeth. Circumferential wires are passed around the mandible and the lower splint. The upper plate may be fixed to the upper jaw by per alveolar wires or circumzygomatic wires. The two plates are wired together or joined with hooks and elastic bands.

Antibiotics are given from admission and until all soft tissue wounds are healed. The mouth is kept clean by irrigation and by the use of a small tooth brush and toothpaste on accessible tooth and splint surface. A fluid diet is required. Except for comminuted or infected fractures immobilisation for four to six weeks is sufficient.

Mandibular dislocation

Instead of fracturing, the mandible may be dislocated at the mandibulo-temporal joint, especially after a blow to the chin with the mouth open. Occasionally, spontaneous dislocation after yawning has been described, and is usually bilateral. Reduction is difficult if trismus has set in and a general anaesthetic with a relaxant may be required. If mandibular fractures are also present, an open reduction of the dislocation may be necessary, and the accompanying fractures can be wired at the same time. The aim should be to restore a 'perfect bite' because misalignment of the temporo-mandibular joint leads to a 'clicking' joint and premature changes of osteoarthritis.

Special Infections of the Face

Boils and pimples in the region of the danger area around the upper lip and nasolabial fold should never be squeezed or pricked with a needle, for by so doing the infection may spread via venous connections to the cavernous sinus causing cavernous sinus thrombosis.

Subcutaneous abscess of dental origin.- A subacute periapical abscess may present as a painless, hemispherical, fluctuant, subcutaneous swelling which may be mistaken for a sebaceous cyst. If it is incised, pus is released, not the pasty contents of a sebaceous cyst and no dissectable lining is found. Unless the tooth of origin is extracted a chronic sinus will result (see Chapter 33).

Anthrax (Chapter 4).

Lupus (Chapter 10).

Leprosy (Chapter 4).

Neoplasms of the Face

Benign and malignant neoplasms of the skin of the face are considered in Chapter 10.