Chapter 22: The orbit

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The orbit is an area of considerable interest to the otolaryngologist, but one into which he or she may stray with trepidation. It may be involved in pathology arising in the nose and paranasal sinuses and surgical approaches and procedures can involve this area both intentionally and accidentally. However, armed with a clear understanding of the anatomy and careful clinical and radiological assessment, it is an area in which the otolaryngologist should be confident to operate.

Applied surgical anatomy
(Wolff, 1976; Doxanas and Anderson, 1984)

The importance of the anatomy of the orbit lies mainly in its relationships, rather than its contents, with the anterior cranial fossa lying superiorly, the nasal cavity and ethmoid labyrinth medially, the maxillary antrum inferiorly and the infratemporal and middle cranial fossae laterally. It is described as being a roughly quadrilateral pyramid, with its base directed forwards, laterally and slightly downwards. The average volume of the orbital cavity is 26 mL, 70% of which is occupied in normal individuals by retrobulbar and peribulbar structures. The orbit is a fixed bony cavity and an increase of orbital volume of only 4 mL produces 6 mm of proptosis (Gorman, 1978).

The orbital margin provides a protective boundary for the globe as it is stronger than the orbital walls. If the orbit is struck with a round object which diffuses its impact, the orbital rim will withstand considerable force. However, compression of the orbital contents will produce a 'blow-out' fracture of the inferior or medial walls (Smith and Regan, 1957; Dodrick et al, 1971; Rumelt and Ernest, 1972; Mirsky and Saunders, 1979).

The zygoma itself frequently withstands direct blows, but fractures at sites of potential weakness, namely at the zygomaticofrontal and zygomaticomaxillary sutures. Clinically this fracture is evident by depression or flattening of the orbital rim, inferior deviation of the lateral canthus, localized step deformity of the inferior rim at the zygomaticomaxillary suture, tenderness over the zygomatic arch, pain with mastication and ecchymosis of the buccal mucosa. Varying degrees of floor fracture and displacement may be associated with tripod fractures and because of the significant functional and cosmetic deformity which can result, it is important to diagnose and repair them early.

Superior wall

The roof is composed of the orbital plate of the frontal bone, behind which is the lesser wing of the sphenoid. The bone is thin (generally less than 3 mm) except in the sphenoid area and continues to thin with age so dehiscences may appear. The extent of frontal and ethmoid sinus invasion is variable and may go as far as the zygomatic process or optic foramen which can be surrounded by ethmoidal cells. The superior orbital notch lies about 5 mm from the orbital margin in a parasagittal plane, which connects the mental foramen with the infraorbital foramen.
Incisions must be placed to avoid the superior orbital notch and the levator palpebrae superioris muscle. This is done by planning the incision as high as possible, dissecting at right-angles to the skin down to the superior orbital rim. The superior wall is encountered during frontal sinus trephination, frontoethmoidectomy, orbital decompression, exploration of fractures, lacrimal gland excision and orbital exenteration.

**Medial wall**

This wall is of the most significance to the otolaryngologist. Four bones are united by vertical sutures:

1. the frontal process of the maxilla
2. the lacrimal bone
3. the orbital plate of the ethmoid
4. a small portion of the body of the sphenoid.

The rule of 24-12-6 may be applied to the medial wall of the orbit, representing respectively, the average distance in millimetres from the anterior lacrimal crest to the anterior ethmoidal foramen, from anterior to posterior ethmoidal foramen and from posterior ethmoidal to optic canal (Rontal, Rontal and Guildford, 1979). The situation can, however, be very variable, with 16% of patients having no anterior ethmoidal foramen, 30% multiple ethmoidal foramina (Harrison, 1981), and in 4.6% the ethmoidal foramina are absent bilaterally (Shaheen, 1967). In addition, the level of the cribriform plate is variable so that the anterior ethmoidal foramen can only be taken as an approximate guide.

The thin medial wall is a poor anatomic barrier to infections of the paranasal sinuses with the potential complications of orbital cellulitis and abscess, optic neuritis and cavernous sinus thrombosis. An understanding of the anatomy of this region is the key to a number of operations:

1. ethmoidal vessel ligation
2. exploration of medial wall fracture
3. external frontoethmoidectomy
4. orbital decompression
5. transethmosphenoidectomy and hypophysectomy
6. closure of cerebrospinal fluid leaks
7. lateral rhinotomy.

**Inferior wall**

The floor is composed of three bones:

1. the large orbital plate of maxilla
2. the zygomatic orbital plate anterolaterally
3. the orbital process of palatine bone.

The infraorbital foramen is in line with the superior orbital notch, lying half-way along the rim and continues as the infraorbital canal. Anterior, and occasionally the middle, superior
alveolar nerves are given off from the canal which, if damaged, can lead to denervation of the upper dentition (Harrison, 1971).

Lateral to the nasolacrimal canal is a pit marking the origin of the inferior oblique muscle which is the only extrinsic muscle to take origin from the front of the orbit and is encountered in Patterson’s external ethmoidectomy. In 9% the origin of the muscle is intraperiosteal with no bony attachment which facilitates the operation. Its relationship to the bony opening of the lacrimal sac is also variable and may be up to 5 mm distant. The lateral portion of the orbital floor is safer to explore than the medial since the inferior rectus and inferior oblique muscle are more medially located within the orbit. Thus medial floor blow-out fractures are more likely to cause entrapment (Gozum, 1976).

The distance between the infraorbital foramen and the optic canal also varies considerably with an average distance of 46 mm. The posterior wall of the maxilla is about 25 mm from this foramen, which is of importance when contemplating a transantral orbital decompression. More often it is encountered in orbital fractures or maxillectomy.

**Lateral wall**

This is composed of:

1. the orbital surface of the greater wing of the sphenoid posteriorly and
2. the orbital surface of the zygoma anteriorly.

It may be encountered during orbital decompression, infratemporal fossa surgery, exploration of fractures and modified craniofacial resections involving lateral orbitotomy. In intraorbital procedures the danger of damage to the superior orbital fissure or the optic nerve is minimal. Through the superior orbital fissure at the orbital apex pass cranial nerves III, IV, VI, the ophthalmic branch of V, and the ophthalmic vein. The fissure is found to be no closer than 28 mm from the frontal zygomatic suture at the rim. Due to the curved nature of the orbit and the limited access to this area, it would be difficult and unnecessary to proceed to this depth during any intraorbital procedure. Likewise, the optic nerve lies 8 mm behind the medial edge of the fissure and would also be under minimal danger from this approach. Therefore, as long as a distance of 25 mm from the frontal zygomatic suture is maintained, safe dissection can be carried out on the lateral orbital wall (Rontal, Rontal and Guildford, 1979).

**Changes with age**

Exploration of the orbit in children is fortunately rare. Growth of the orbits occurs with the development of the facial skeleton. Initially the orbital fissures are large, the orbital index high and the volume great so that little change occurs in overall size after 7 years of age. The infraorbital fissure is present at birth, but the groove may remain dehiscent for some years and also reaches adult size by 7 years.

Bone begins to resorb with age so that defects may result allowing contact between orbital periosteum and dura, and the inferior orbital fissure may enlarge. Little discernible difference can be seen between the sexes.
**Periorbita**

The importance of the orbital periosteum lies in its ability to protect the orbital contents and resist the spread of infection and tumour. It is adherent to the orbital margins, sutures, foramina, fissures and lacrimal fossa and is continuous with dura through the superior orbital fissure, optic canal and ethmoidal canals. It is fixed to the posterior lacrimal crest enclosing the lacrimal fossa and traverses the duct as far as the inferior meatus. It must, therefore, be dissected from its attachments with care, at the very least to avoid troublesome prolapse of fat into the operative field.

The extremities of the tarsal plates in the lids are attached to the orbital margin by strong fibrous structures - the palpebral ligaments. Only the medial ligament is important since its deep portion is attached behind the lacrimal sac. Care must be taken to reflect the whole ligament with attached skin during the incision for external ethmoidectomy.

Fascia bulbi (Tenon's capsule) is a thin membrane surrounding the globe from cornea to optic nerve. Inferiorly it is thickened to form the suspensory ligament of Lockwood, the importance of which becomes evident after total maxillectomy (Manson et al, 1985).

**Radiographic evaluation of the orbit**

(Lloyd, 1975; Bilaniuk and Zimmerman, 1980; Dutton, 1984)

In addition to clinical evaluation, important information is provided by radiological assessment of this area. Techniques available include:

1. plain X-ray
2. hypocycloidal tomography
3. computerized tomography
4. magnetic resonance imaging
5. orbital venography
6. carotid angiography
7. ultrasound.

The last three techniques have become less popular with the advent of computerized tomography and magnetic resonance imaging.

Plain X-rays should include an occipitofrontal posteroanterior view and an occipitomental posteroanterior view, both of which were designed to evaluate the paranasal sinuses and with which the otolaryngologist is familiar. In addition, a lateral view, submentovertical view and oblique apical projections of the optic canals are helpful. Plain X-rays of the orbit of patients with proptosis will reveal abnormalities in up to 33%, of which 21% are diagnostic (Lloyd, personal communication). Evidence of increased soft tissue density in the orbit and adjacent structures must be sought and variations in size and shape of bony outlines noted. Tissue emphysema may be apparent, occurring in up to 50% of blow-out fractures (Lloyd, 1966) and evidence of bony dehiscences and destruction may be seen. Occasionally orbital calcification and hyperostosis may be noted, which are always of pathological significance.
Hypocycloidal tomography still has an important role in orbital assessment and may demonstrate abnormalities not readily visualized on plain X-ray or may better demonstrate these abnormalities. It is routinely performed in coronal, lateral and axial planes and to visualize the optic canals a 39° oblique projection may also be requested. However, to a large extent this technique has been superseded by computerized tomography. Bilaniuk and Zimmerman (1980) have gone so far as to say that it is the only diagnostic modality that allows an accurate assessment of the degree of orbital involvement by paranasal sinus disease.

Computerized tomography allows simultaneous examination of bony structures and associated soft tissues with the orbital fat acting as a natural contrast medium and should always be performed in axial and coronal planes. Excellent detail of orbital structures is provided by this technique combined with a highly accurate assessment of paranasal sinus pathology (Lund, Howard and Lloyd, 1983).

More recently, magnetic resonance imaging has been evaluated in this area and is proving to be an important investigative technique (Lloyd et al, 1987).

**Orbital trauma**

A sense organ enclosed within an incomplete bony box is inevitably vulnerable to trauma. Accidental trauma can occur in association with facial injury or as a complication of sinus surgery.

**Accidental surgical invasion**

This can occur during antral lavage, the risk being clearly greatest if a middle meatal route is chosen, and when the procedure is performed under general anaesthesia. An incorrect angle of entry through the inferior meatus can lead to penetration of the orbital floor or, in the presence of a dehiscent infraorbital canal, excessive pressure of lavage may affect the orbital contents. For this reason the eyes should always be uncovered during the procedure and observed closely so that the operation can be abandoned at the first sign of proptosis.

Orbital damage is a constant hazard in intranasal ethmoidectomy. With poorly developed sphenoidal sinuses, the posterior ethmoidal cells extend backwards in intimate relation to the optic nerve so it is often impossible to exenterate completely the ethmoids by this route without jeopardy to the eye. Careful attention to technique with preservation of the middle turbinate for as long as possible is mandatory. The medial canthal ligament forms the lateral boundary and a constant watch must be kept for the appearance of orbital fat, indicative of a breach in the orbital periosteum.

Although Freedman and Kern (1979) reported a 2.8% complication rate in 1000 cases undergoing intranasal ethmoidectomy of which less than 1% were orbital, there is no doubt that this is a difficult operation both to perform well and to teach. Injury to the lamina papyracea may lead to haemorrhage which can result in intraorbital but extraperiosteal bleeding. With anterior tracking this produces a periorbital haematoma.

Eichel (1979) accepted a 25% rate of orbital ecchymosis in his series and haemorrhage was the commonest complication reported by Freedman and Kern (1979) but to regard it as
the sign of a 'successful' operation is to be deprecated. Anterior tracking of blood may cause little harm, but any posterior accumulation may cause proptosis and visual loss, necessitating removal of nasal packing or exploration (Leopold, Kellman and Gould, 1980). Periosteal damage leading to prolapse of fat, which can be packed with gelatin sponge, is especially likely if previous surgery has been performed, but is obviously best avoided as it may also be associated with damage to the medial rectus muscle.

Facial trauma involving the orbit

An early awareness and assessment of orbital function is important to avoid further damage. Fractures of the middle third of the face may involve the orbit or it may be traumatized alone, resulting in 'blow-out' fractures. The zygoma itself is thick but its three attachments to the skull are not, so displacement of the malar complex is often associated with fractures of the orbital floor.

Early signs and symptoms of a 'blow-out' of the orbital floor are restriction of extraocular mobility (particularly in upward gaze), infraorbital anaesthesia (including the canine teeth), orbital swelling and ecchymosis. The patient with a nasoethmoid complex fracture will also present with periorbital ecchymoses, probably secondary to ethmoid artery damage, flattening of the nasal root and widening of the intercanthal distance. Traumatic telecanthus does not always occur but should be excluded and may be difficult to establish when oedema obscures the medial palpebral angle. An alternative is to measure the interpupillary width which is normally twice the intercanthal distance. The medial canthal ligament can be further tested by traction on the lashes which should make lid margin taut. If this does not occur, disruption of the medial ligament has probably occurred.

It is obviously important to carefully assess visual acuity, the pupils, and lid and ocular movement. Surgical emphysema may be palpable and globe displacement indicates retrobulbar haemorrhage in the case of exophthalmos or orbital floor displacement if enophthalmos is present. Epiphora is not a reliable sign of nasolacrimal damage which may need separate assessment once initial oedema has settled (Holt and Holt, 1985). The possibility of cerebral spinal fluid rhinorrhoea should never be overlooked.

Radiological examination is important in determining the site and extent of bony trauma. Waters occipitomental and Caldwell occipitofrontal views will demonstrate orbital fractures in 70% of cases, but false positives are common and tomography is helpful if a 'blow-out' fracture is suspected which will show the classic 'tear-drop' sign in the antrum roof. In these cases and to assess the cribriform plate region, computerized tomography scanning is frequently indicated.

Therapeutic success must be judged in terms of preservation of binocular vision, the prevention or resolution of enophthalmos and the restoration of ocular mobility. Sacks and Friedland (1979) found the commonest presenting signs or symptoms in 100 patients with orbital floor fracture to be hyperaesthesia, infraorbital rim stepping, periorbital swelling and diplopia. Some symptoms such as oedema and hyperaesthesia will often resolve spontaneously, but considerable controversy surrounds the indications and timing of orbital floor exploration.
If there is no evidence of extraocular muscle movement restriction and no diplopia, despite radiographic evidence of a fracture, exploration may be unnecessary (Puterman, Stevens and Urist, 1974). However, combinations of diplopia and enophthalmos usually require immediate exploration once other causes of diplopia such as haematoma of the inferior rectus muscle have been eliminated by forced duction testing. Enophthalmos alone only causes diplopia in extremes of gaze but is unacceptable cosmetically. It may be masked initially by oedema or haematoma so, unless there is any loss of visual acuity, it is advisable to wait 7-10 days before deciding to operate. This is particularly pertinent when one considers the risk of visual loss associated with exploration. In 72 patients with orbital floor fracture who underwent repair, six lost vision as a result of infection or haemorrhage (Nicholson and Guzak, 1971), although it must be remembered that these patients represent a 'high-risk' group of whom 40% have associated ocular complications such as retinal artery damage. It is possible for late enophthalmos to develop due to secondary atrophy of orbital fat.

Surgical management depends on the extent of injury. Collapse of the anterior wall of the maxilla or orbital floor requires intra-antral manipulation, followed by Whitehead's varnish packing to stabilize bony fragments. The use of a Foley catheter to support the orbital floor can result in uneven elevation. Reconstruction of the orbital floor is indicated in enophthalmos, prolapse of orbital fat or with comminuted, hinged or inferiorly displaced bone. A transverse lower lid incision along the malar line gains exposure of the orbital periosteum which can be carefully elevated. The defect can be repaired with a number of substances including bone, tantalum, Teflon and silicone, but Silastic sheeting seems to be well tolerated and most successful. When a synthetic floor implant is used, antral packing is unnecessary and undesirable.

Fractures of the lamina papyracea are seen more frequently in complex midfacial fractures and can be associated with cerebrospinal fluid leak, lacrimal damage, visual loss and severe epistaxis from the anterior ethmoidal artery. In addition, there may be downward displacement of the medial canthus, subcutaneous or subconjunctival emphysema and limitation of lateral movement. If there is evidence of posterolateral displacement of the lacrimal bone and its attached medial canthal ligament, an open repair is indicated to reattach the bone with wires. Bilateral traumatic telecanthus requires bilateral exploration and wiring of the fractured bone. Damage to the nasolacrimal apparatus can be dealt with by splinting using Silastic tubes. In these circumstances early exploration produces the best results as late reconstruction can be difficult. Late complications associated with these injuries include one eye being lower (usually due to inadequate interosseous wiring and reattachment of Lockwood's ligament), diplopia, enophthalmos and occasional dacryocystitis (Reynolds, 1978).

A number of operations are available for access to or for specific procedures on the medial wall of the orbit. These may be considered in the context of particular pathologies which impinge on the orbit.

**Frontoethmoidal mucocoeles**

These mucus-filled cysts occur within the frontoethmoidal complex and most frequently present initially to the ophthalmic surgeon. Their capacity for expansion and erosion of bone results in encroachment on the orbit via the floor of the floor of the frontal sinus or orbital plate of the ethmoid. As a consequence, proptosis was the commonest
presenting symptom in virtually all 98 patients seen between 1962 and 1986 (Harrison, personal communication). The degree of proptosis can vary from 1 to 17 mm and because it is slowly progressive, unless infection supervenes, diplopia only occurs in 65% and at extremes of gaze. In addition to proptosis there is concomitant displacement of the globe laterally and in the case of frontal mucocoeles, inferiorly. Ocular mobility is usually decreased in upward gaze due to the presence of a mass in the upper inner quadrant which often has a characteristic 'egg-shell' crackling sensation on palpation.

The radiological appearances are characteristic with evidence of general loss of translucency, loss of scalloping and definition of the frontal sinus margin and supraorbital depression and/or erosion. Computerized tomographic scanning may give additional information particularly when the ethmoidal complex is involved (Lloyd, Bartram and Stanley, 1974).

The aetiology of the condition has been attributed to a combination of obstruction of the frontonasal duct and inflammation, and this has important implications on the operative management of the condition. There is considerable evidence that a number of bone resorbing substances are produced by the mucocoele lining, including PGE2 and collagenases (Lund, 1986). As a consequence it is important to remove all lining mucosa, the only exception being in areas where erosion of the posterior wall has occurred exposing dura (38%; Harrison, 1980).

The presumed frontonasal obstruction must be overcome by creation of a new channel by exenteration of the anterior ethmoid and insertion of 1 cm indwelling fenestrated Silastic tube for 3-5 months. The inter-sinus septum is intact in 95% of normal subjects, so an additional alternative drainage route should be created by routine perforation of the septum at surgery. All these requirements can be satisfied by the external frontoethmoidectomy (Lynch-Howarth approach) (see Chapter 11). A recurrence rate of 4% can be expected using this procedure, which compares favourably with that quoted for the osteoplastic flap (3-25%) (Zonis, Montgomery, and Goodale, 1966; Bosley, 1972; Sessions et al, 1972; Bordley and Bosley, 1973; Schenck, 1975; Hardy and Montgomery, 1976).

In the immediate postoperative period proptosis and ocular mobility improve, although diplopia may be initially worse due to sudden decompression. However, this can be expected to improve in the long term in the vast majority (96%; Rubin, Lund and Salmon, 1985). While blindness may be a theoretical consideration from rapid decompression, it has not been encountered and most patients (97%) experience no persistent change in visual acuity. Problems resulting from medial canthal ligament or lacrimal sac damage occur extremely rarely.

Osteomata

Osteomata arising in the frontoethmoidal region may encroach on orbital contents. Their origin may be difficult to determine if large, although they are presumed to arise at junctional points of membranous and cartilaginous bone and are composed of a cancellous core with varying amounts of surrounding dense compact bone. In a series of 23 patients (Atallah and Jay, 1981), 10 presented with ocular symptoms of whom six had proptosis.
Osteomata are readily visualized by plain sinus X-ray and are occasionally incidental findings which, if asymptomatic and quiescent, require no treatment.

However, in the presence of symptoms and when associated with mucocoele formation (5%; Lund, 1986), an external frontoethmoidectomy approach is indicated. In the larger osteomata, arising from the lateral ethmoidal complex, a lateral rhinotomy may be required to provide sufficient access, although the pedicle is often narrow. Occasionally large osteomata arising in the maxillary sinus have necessitated partial maxillectomy and, in two cases, craniofacial resection has been performed for anterior cranial fossa invasion (Cousins, Lund and Cheesman, 1987). Adequate access is important to allow complete removal which will result in cure.

**Infection**

The availability of antibiotics has considerably altered the frequency with which orbital complications result from sinusitis but, if they occur, the consequences are serious. In 1969, Jarrett and Gutman reported the figures of the pre-antibiotic era in which 20% of patients with orbital infection completely lost vision, 20% died and 10% had permanent visual damage. Embryological considerations determine that sinusitis in the child under 5 years is confined to the maxillary and ethmoid sinuses, while the frontal sinus is the commonest source of orbital cellulitis in adults. In children relatively minor upper respiratory tract infections can suddenly result in orbital complications, whereas in adults the situation may be more chronic, associated with inadequate oral antibiotic therapy or occasionally conversion of a mucocoele to a pyocele.

Congenital dehiscences or open suture lines in the child, at the lamina papyracea, ethmomaxillary suture or in the orbital wall of the maxilla offer preformed channels and, in general, the bone is softer and more diploic in a child, facilitating spread. The orbital periosteum can easily be detached from the smooth surface of the bone by abscess formation.

The complex venous drainage and absence of valves in ophthalmic veins allows direct communication between the cavernous sinus, orbit and pterygoid plexus. Consequently spread of infection along suture lines can result, by direct invasion of bone or retrograde thrombophlebitis, leading to 159 children developing orbital infection out of 6770 with sinusitis (Fearon, Edwards and Bird, 1979). In 1937, Hubert classified orbital complications of sinusitis into five groups:

1. inflammatory oedema of the eyelids with or without oedema of orbital contents
2. subperiosteal abscesses with
   - oedema of the lids or
   - spread of pus to the lids
3. abscess of orbital tissues
4. mild and severe orbital cellulitis with phlebitis of ophthalmic veins
5. cavernous sinus thrombosis.

Rarely, superior orbital fissure involvement leads to ophthalmoplegia, anaesthesia of the ophthalmic division of the trigeminal nerve and in combination with optic nerve damage an 'orbital apex syndrome' results.
Orbital cellulitis presents with oedema of the lids and chemosis with varying degrees of proptosis and globe displacement. Visual acuity may be difficult to assess due to lid swelling. Rapid administration of intravenous antibiotics must be instituted or the situation will progress with abscess formation and ultimately compression of the central retinal artery. Constant careful monitoring of visual acuity (in particular of colour vision) and ocular mobility will rapidly indicate when surgical intervention is appropriate. While the majority respond, antral lavage or frontal trephination may be indicated at a later date. Spontaneous discharge may occur through the upper lid from the frontal sinus or near the medial canthus from the ethmoid.

Failure to improve or any clinical deterioration requires external drainage with insertion of a drain and possibly irrigation often in combination with antral lavage. Forty-eight hours of irrigation suffice without the danger of actually introducing further infection. Frontoethmoidectomy may be indicated if this treatment fails to produce dramatic resolution, when the abscess is not superficial or there is clinical evidence of visual deterioration. Adequate elevation of the orbital periosteum posteriorly is necessary to locate the pus and removal of the orbital plate of the ethmoid allows intranasal drainage.

The potential severity of orbital complications of sinusitis should not be underestimated and may constitute one of the surgical emergencies facing the otolaryngologist.

**Orbital decompression**

The otolaryngologist with an interest in head and neck surgery may occasionally be called upon to decompress orbital contents. Malignant exophthalmos is the commonest indication, although pseudotumours, Wegener's granulomatosis and the palliation of metastatic deposits have also been reported (Harrison, 1980; Sobol, Druck and Wolf, 1980).

In malignant exophthalmos characterized by hypertrophy of orbital muscle and fat, the thyroid metabolism must be treated first and is often followed by steroid therapy. Failure of this to result in permanent improvement necessitates surgical decompression. In 1911, Dollinger first described orbital decompression by removal of the lateral wall of the orbit (attributed to Kronlein) allowing swollen orbital contents to herniate into the temporal fossa. Two decades later, Naffziger (1931) published an account of decompression into the anterior cranial fossa via a transcranial route.

Sewall (1936) first described the use of the paranasal sinus cavities for decompression by removing the medial orbital wall, while Hirsch (1950) later reported inferior decompression into the maxillary antrum. Ogura (1978) advocated a combination of these two methods, but this technique is difficult due to limited access and Harrison (1981) has suggested that the Patterson's transorbital approach is a safer and more effective alternative (see Chapter 11). This allows removal of the entire orbital wall medial to the infraorbital nerve and can if necessary be combined with a lateral orbitotomy to remove the lateral wall and floor lateral to the nerve.
Lateral rhinotomy

The virtues of this surgical approach to the medial wall of the orbit have been more recently appreciated (Harrison, 1977; Schram and Myers, 1978). This procedure has undergone little modification since it was first described in 1902 by Moure, Professor of Otolaryngology in Bordeaux, offering a combination of excellent access and postoperative cosmesis. It allows inspection and resection of the entire lateral nasal cavity, septum and most of the medial orbital wall and is, therefore, applicable to the management of a variety of pathologies but most notably that of malignant melanoma (Lund, 1982), angiofibroma (Harrison, 1986), and inverted papilloma.

The incision should reach superiorly to just below the medial palpebral ligament, thus avoiding detachment of this important structure. Elevation of the skin above this point is easy and allows further bone removal if necessary. The incision then follows the nasomaxillary groove, curving round the ala to enter the nose. Detachment of the nose from the pyramidal opening allows the nasal framework to be swung away, exposing surrounding bone. The underlying pathology will determine how much of this bone is removed, but can include frontonasal process, anterior wall of maxilla as far laterally as a vertical plane through the inferior orbital foramen, lacrimal fossa and lamina papyracea, preserving the infraorbital rim and the complete lateral wall of the nose with nasal septum. No matter how large the underlying bone defect, primary closure presents no problem with good cosmetic result. Resection is inevitably limited superiorly by the cribriform plate but this can at least be reached in safety, with no risk to vision or extraocular musculature. If there is any doubt as to the patentcy of the nasolacrimal apparatus, the lacrimal sac can be opened and the lining everted.

Management of the orbit in antroethmoidal neoplasia

The orbit is threatened by a variety of neoplasms originating in adjacent structures, because of its anatomical relationship to skin, skull, palate, salivary glands, nasal glands, nasal cavity and, in particular, the antroethmoidal complex. The importance of the eye, both as a sensory organ and for its aesthetic value, makes the management of this area particularly pertinent to both surgeon and patient.

Preservation of orbital contents must be based on the unemotional decision that it will not jeopardize prognosis and that the eye will have aesthetic and functional capabilities if preserved. This is of particular relevance if postoperative radiotherapy is contemplated which may result in cataract, glaucoma and loss of vision.

Invasion of the orbit from the anterior ethmoidal complex occurs early and in a number of ways. Visual symptoms of epiphora, proptosis and diplopia are commonly reported in a series of patients with malignant tumours of the nasal cavity and paranasal sinus (Lund, 1983; Weber and Stanton, 1984). Invasion commonly occurs through the thin or dehiscent bone of the lamina papyracea or through the region of the inferior orbital canal, both areas readily accessible to surgery. Distinction must be made between intraorbital spread which is extraperiosteal and that in which the periosteum is breached as this has important implications on management.
Of more sinister prognostic importance is invasion of the posterior medial wall from the posterior ethmoids to involve the optic canal directly or infiltration of the retrobulbar structures from below, with spread in either case via the orbital apex to the middle cranial fossa. High resolution computerized tomographic scanning in axial and coronal planes with wide window width settings offers important preoperative assessment (Lund, Howard and Lloyd, 1983) to which magnetic resonance imaging is now contributing.

Finally, in the case of adenoid cystic carcinoma, in addition to direct and perineural spread, the possibility of embolic phenomena must be considered as demonstrated in a section of optic nerve taken some distance from an ethmoidal tumour (Howard and Lund, 1985).

The presence of proptosis and limitation of ocular movement usually indicates extensive invasion which is often associated with involvement of the cribiform plate and pterygopalatine fossa. Orbital involvement like anterior cranial fossa invasion was once considered to indicate a poor prognosis, but it is failure to control local disease which has escaped through the orbital apex, which is more important than the actual point of entry into the orbit. In Harrison's (1978) series at least 50% of patients required orbital exenteration. However, the palliative role of orbital exenteration is also of importance as it prevents painful proptosis and, in combination with total maxillectomy, allows control of residual tumour by laser or cryosurgery.

Before the advent of the craniofacial procedure, total maxillectomy and orbital exenteration in combination with radiotherapy was the treatment of choice for most tumours arising in this area. Any evidence of anterior cranial fossa extension would now indicate craniofacial resection.

When total maxillectomy is performed with orbital exenteration, the lids may be preserved as they are not implicated in lymphatic dissemination nor usually in direct tumour spread. Removal of the lash margins and tarsal plates with suturing together of the lids to close the orbital defect results in a layer of thin, well-vascularized elastic skin which lines the empty socket, a situation which is only compromised by overzealous preoperative radiotherapy. The eventual use of a high quality prosthesis supported by spectacle frames precludes the need for reconstructive techniques which are not only difficult but may compromise cure (Conley and Baker, 1979).

In the absence of orbital involvement with total maxillectomy, the globe is left supported by the suspensory ligament of Lockwood. There may be some prolapse, often several weeks later, and a proportion of these patients require reinforcement of the area with nylon mesh or Silastic sheeting.

Accurate evaluation of orbital involvement is possible with the craniofacial procedure (see Chapter 180. The osteotomies in the floor of the anterior cranial fossa encompass the cribiform plate and orbital roofs laterally and extend backwards to the jugum, stopping just anterior to the optic chiasma. The orbit is entered to ensure adequate removal of the medial wall and anteriorly the osteotomies are completed with a fissure bur through the frontonasal duct, uniting intra- and extracranial cuts.
In cases in which the medial bony wall of the orbit has been breached but the periosteum is intact, the compromised area of periosteum can often be resected and grafted with a split-skin graft, preserving the globe and its musculature. Contraction of the graft results in remarkably little disturbance of ocular function. Ketcham et al (1973) believed that their attempts to conserve orbital contents in 24 patients required re-evaluation as the survival figures in this group were 32% compared with 30 patients in whom unilateral orbital exenteration had been performed and whose survival was 62%. However, in a recent series of 60 patients (Cheesman, Lund and Howard, 1986), resection of involved periosteum and frozen section control of adjacent orbital contents (with the possibility of future surgery if tumour recurs in this area) has not been associated with a poorer prognosis. Seventy-six percent of patients who had orbital exenteration are dead compared with 38% of those in whom orbital periosteum alone was removed. This may, however, merely reflect extensive disease with an associated poorer prognosis.

Occasionally tumours of the orbit itself such as meningiomata may become sufficiently large to impinge on the sinuses necessitating total maxillectomy and orbital exenteration. Similarly infratemporal fossa disease (for example neurolemmomata) can extend into the infraorbital fissure or breach the inferior and lateral walls requiring lateral orbitotomy in combination with an infratemporal resection. Finally, large neglected basal cell carcinomata of the surrounding orbital skin occasionally present to the head and neck surgeon who may need to employ rotation, myocutaneous or free microvascular flaps for reconstruction.