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Ossicular lesions

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THE recognition of ossicular damage as a treatable cause of conductive deafness following head injury dates back little more than twenty years. However, it would seem that even in 1866 Toynbee was aware of the possibility for in a report of a discussion recorded in the Medical Times Gazette (1866) he observed that ossicular lesions may be of traumatic origin.

Kelemen (1944) described ossicular disruption in the post-mortem examination of temporal bone fractures, and Cawthorne and Hayner (1956) recorded disclocation of the incus in six out of seven ears explored for traumatic facial palsy but made no comment on the hearing in these cases. Schuknecht and Davison (1956) described the association of conductive deafness and longitudinal fractures of the temporal bone and attributed the deafness to damage of the tympanic membrane and ossicles, as well as the presence of blood in the meatus and middle ear; but at that time he felt that the conductive deafness usually resolved with healing. It was not until 1957 that Thorburn reported the first case of conductive deafness due to dislocation of the incus found at operation and successfully treated.

Hough reported a similar case in 1958 but he described this as a rare skeletal abnormality, although there was a history of a preceding head injury, and he considered this to be the most likely cause. However, in the absence of previous reports he discussed the possibility of it being due to developmental abnormalities.

In 1966 Ballantyne reviewed the published cases of traumatic conductive deafness and was then only able to find 45.

In reviewing the literature I have found records of 169 cases (Andersen, Jepsen and Ratjen, 1962; Anklesaria, 1963; Bauer, 1958; Cremin, 1969; Cummings, 1976; Does and Bottema, 1965; Elbrønd and Aastrup, 1973; Flisberg and Floberg, 1960; Freeman, 1959; Gisselsson, 1958; Hough and Stuart, 1968; Murphy, 1972; Robinson, 1961; Røhrt, 1973; Sadé, 1964; Schuknecht and Trupiano, 1957; Seltzer, 1962; Spector, Pratt and Randall, 1973; Tos, 1973) attributable to previous skull trauma, and to these I have added 33 cases of my own. Some of these have been recorded previously (Hammond, 1964) but it would be reasonable to assume that the majority of cases are no longer reported and this figure bears no relationship to the true incidence of the condition.

Fractures of the temporal bone can be classified into two main types—longitudinal and transverse, although not infrequently mixed types occur (Proctor *et al.*, 1956).

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Most authorities agree that about 80 per cent of all temporal bone fractures are longitudinal. It is with this type of fracture that ossicular damage is usually associated.

Longitudinal fractures usually occur as a result of blows to the temporal or parietal region of the skull. The fracture line usually passes from the squama along the postero-superior wall of the bony meatus, tears the tympanic membrane and passes across the tegmen and then along the anterior aspect of the petrous pyramid anterior to the bony labyrinth and usually antero-superior to the geniculate ganglion. The canal of the tensor tympani muscle is often involved. The fracture line continues along the anterior surface of the petrous pyramid involving the carotid canal and terminating in the region of the foramen spinosum or foramen lacerum.

Transverse fractures are most commonly brought about by occipital injuries and the fracture line runs from the foramen magnum across the petrous pyramid to the middle fossa, the pyramid being most frequently transected at its medial end near the porus acousticus. The second most common site is through the vestibule and the cochlea.

Transverse fractures generally result in either total hearing loss or severe sensorineural deafness.

Conductive deafness due to ossicular dislocation may occur but is extremely rare in this type of injury (Roche, 1975).

When a conductive deafness occurs following a temporal bone fracture this may be due to traumatic rupture of the tympanic membrane, blood in the middle ear and meatus or if the tympanic membrane remains intact to a haemotympanum. The majority of these cases will undergo healing and complete resolution and the hearing will have returned to normal within three months of the injury.

If the conductive deafness persists it is almost certainly due to a lesion of the ossicular chain.

A great number of cases are not seen by the otologist in the early stages and often present many years after the original incident with a conductive hearing loss. The correct diagnosis will usually depend on a history of head injury with associated unconsciousness and often but not always a definite diagnosis of a skull fracture. There may be a history of bleeding from the ear or facial weakness and possibly of some vertigo after the accident.

Examination after some interval from the original trauma usually reveals an intact and mobile tympanic membrane. There may be some scarring. In many cases there is an irregularity of the postero-superior meatal wall to be seen indicating the site of the original longitudinal fracture.

Tests of hearing will demonstrate a conductive deafness; this is usually unilateral although a few cases of bilateral lesions have been reported (Flisberg and Floberg, 1960; Gisselsson, 1958).

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Tympanometry may be helpful in establishing a diagnosis but due to the complexity of the lesions that may occur results are often unreliable in making a true prediction of the condition of the middle ear. However, as many cases have medico-legal implications tympanometry studies should be carried out.

Radiology

Within the immediate post-traumatic period it is not always possible to demonstrate the fracture of the temporal bone on X-ray. In a series of 248 petrosal fractures Tos (1973) found positive radiological confirmation in 69 per cent of transverse fractures and 50 per cent of longitudinal fractures. Røhrt (1973) gave a positive figure of 75 per cent for all types of fracture in a group of 120 cases. This figure rose to 86 per cent when special views were taken.

It is generally agreed that longitudinal fractures are particularly difficult to visualize on plain X-rays and tomography is essential if they are not to be missed (Wright, 1974).

In cases seen at a later stage longitudinal fractures will usually have healed and there will be little or no radiological evidence of the fracture line.

Transverse fractures involving the labyrinthine capsule may still be visible many years after the original injury.

Displacement of the malleus or incus can often be demonstrated by polytomography or meticulous linear tomography but these investigations would appear to be of no value in demonstrating stapedial lesions.

The real value of this type of investigation would again appear to be medico-legal as, generally speaking, if the condition does not require treatment the precise lesion is of no importance to the patient and, if it does require treatment, exploratory tympanotomy is the only reliable way of demonstrating the lesions.

Ossicular lesions

A wide variety of ossicular lesions have been described and the figures given are based on the author's personal series and from a survey of the published literature. Cases which were caused by local direct trauma to the ear or previous surgery have been excluded.

On the 202 cases analysed, involvement of the incus occurred in 73·25 per cent, of the malleus in 15·7 per cent and of the stapes in 28·75 per cent. Some of these were mixed lesions involving more than one ossicle. Of the three ossicles, the incus is the most frequently involved. This is hardly surprising in view of its relatively insecure attachments.

The commonest abnormality encountered is a separation of the incudo-stapedial joint. This is usually the result of antero-superior displacement of the long process of the incus and there may be complete

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separation, or a loose fibrous or membraneous connection may persist. Posterior displacements of the long process also occur.

Less commonly there is a complete dislocation of the incus. At times the incus appears to be totally absent. Fractures of the long process and lenticular process have also been encountered.

Displacement of the incus is not infrequently associated with fixation in the attic. In three of the author's cases freeing the fixed incus in the attic produced an immediate flow of C.S.F. Fortunately in all three this ceased spontaneously in the post-operative period.

Lesions of the stapes occur in almost a third of all reported cases. Fractures of the crura are most frequently encountered but fragmentation, subluxation and avulsion of the footplate have all been reported.

Footplate injuries may be associated with a perilymph fistula.

Several authors have commented on the high incidence of stapedial lesions in childhood. This is generally attributed to the greater flexibility of the child's skull (Does and Bottema, 1965; Elbrønd and Aastrup, 1973).

An association between crural fracture and otosclerosis involving the footplate has been noted on several occasions, in particular by Hough and Stuart (1968), Murphy (1972) and Cremin (1969). It is difficult to say whether the fixation of the footplate or thinning of the crura is responsible for this.

The malleus is the ossicle least frequently involved. Displacements and fractures of the malleus have been reported but attic fixation of the malleus head would appear to be the commonest lesion.

In any one case more than one ossicle may be involved and it would appear that about 20 per cent of all lesions involve more than one ossicle.

Treatment

The tympanotomy approach is ideally suited to this problem but the precise management of the individual case is very much a matter of the surgeon's personal inclinations.

Some lesions may be so gross as to make any attempt at reconstruction unwise but in general the techniques applied to reconstructive surgery apply here as they do for the treatment of post-inflammatory conditions.

A survey of the methods recommended since Thorburn's first reported case represents a brief history of the methods employed in tympanoplasty over this period. Thorburn (1957) successfully treated his first case by using a Type III Wüllstein technique. Polythene tubing was much used to restore ossicular continuity in the early 1960's but most authorities would now favour the use of either autogenous or homogenous bone, although no doubt some would now favour the use of a TORP.

Attempts to reposition the ossicles in their normal position rarely prove successful. For minor degrees of incudo-stapedial joint separation the

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insertion of a fragment of autogenous bone taken from the posterior meatal wall is effective. With greater degrees of separation and fixation the removal of the incus and if necessary the head of the malleus using the re-shaped incus to establish continuity would seem to be the most satisfactory technique.

With crural fractures some form of interposition is preferable to stapedectomy. There seems no doubt that stapedectomy on the normally mobile footplate carries a higher risk of sensorineural damage than when the footplate is fixed by otosclerosis. However, when the footplate is fractured or displaced, or when pre-existing otosclerosis is present, a stapedectomy technique employing a tissue graft and prosthesis is indicated.

The problems encountered often tax the ingenuity of the surgeon but the results of surgery are generally good. Hough and Stuart (1968) reported closure of the air-bone gap to within 10 db in 78 per cent in a series of 31 cases with only one case being made worse. Spector, Pratt and Randall (1973) reported 85 per cent of a series of 28 patients, showed a significant hearing improvement one year after surgery. However, they found that on long term follow-up only 50 per cent of these cases maintained the improvement, the most stable results being found as one might expect in dislocation of the incudo-stapedial joint.

In the author's series of 33 cases, 25 (75 per cent) showed improvements to within 10 db of the bone conduction level, 28 (84 per cent) had an overall improvement in hearing, 2 (6 per cent) were worse, and 3 (9 per cent) unchanged.

However, the majority of these cases have been lost to follow-up and no reliable figure for the long-term results can be given. We must pay heed to Spector *et al's* (1973) observations and as with all middle ear surgery give a guarded long-term prognosis.

Conclusion

It is inevitable in a presentation of this type that the emphasis has been on those cases which have come to surgery. Many more cases are encountered where although there is little doubt about the diagnosis surgical exploration never takes place.

This may be due to the degree of sensorineural involvement, the extent of the other disabilities resulting from the original head injury or other factors relating to the patient's general health.

At times it is due to the natural reluctance of the patient to undergo a further period of hospitalization after recovering from a major accident. However, given the right indications, surgery has much to offer these patients and, saving a major international shortage of petrol and the disappearance of the motor car, unlike many areas of middle ear surgery, the demand is likely to increase.

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