CLINICAL RECORDS

OPEN COCHLEAR AQUEDUCT IN OVAL WINDOW SURGERY

By TAUNO PALVA (Turku)

OVAL WINDOW surgery is now being employed in one form or another in all otolaryngologic clinics. There are surgeons who still stick to mobilization procedures only, others use oval window fenestration in an occasional case, while some consider oval window fenestration the operation of choice.

The risks associated with these various operations are well known and it is clear beyond doubt that oval window fenestration is the one requiring the greatest perfection of technique in order to be safe for the patient. On the other hand, our results (Meurman and Palva 1961) and those of others (Shea, Portmann, Schuknecht, 1961) amply demonstrate that very good long-term results as regards hearing are obtained by this method of oval window surgery.

An unusual anatomical feature in the form of an open communication between the perilymphatic space and the spinal fluid system is reported in this paper. It was not included in our recent oval window fenestration series but occurred earlier during the mobilization period. In one ear of the patient mobilization was attempted twice but had to be abandoned; the other ear was successfully fenestrated by the oval window technique.

Report of a Case

The patient was an electrician, 33 years of age. The history revealed bilateral normal hearing in childhood. At the age of 16 hearing in the left ear began to deteriorate and the impairment gradually increased. At the age of 30 there was a considerable drop of hearing in the left ear, and a mild hearing loss had also developed in the right ear. There was a positive Paracusis Willisi and a constant high-pitched tinnitus in the left ear.

On examination, the ear canals were of normal width and the drums thin and mobile. Audiometric data (Fig. 1) revealed a loss of about 25 db. in the right ear while the left ear was lowered to the 80 db. level. Bone conduction showed some reduction in the right ear and a more severe loss in the left ear, in which, however, the conductive type of lesion still dominated. Speech audiometry showed 30 db. loss in the right ear with normal discrimination; the threshold in the left ear was 79 db. with a severe discrimination loss of 70 per cent. Masking was employed in all these tests according to the principles described earlier (Palva 1954, 1958).

Although it was felt that the left ear was not well suited for mobilization, the patient was admitted and prepared for surgery. On *February 10th, 1959*, a left

* From the Department of Otolaryngology, University of Turku, Finland.

https://doi.org/10.1017/S0022215100059119 Published online by Cambridge University Press

tympanotomy was made under local xylocain anæsthesia. The stapes was found to be solidly fixed at both ends, with a slightly thicker than normal middle area. Mobilization with various spikes proved unsuccessful; the Heermann chisels were employed and the posterior part of the footplate was felt to move. During work at the anterior pole, the chisel perforated the footplate slightly and a profuse flow of perilymph followed. The middle ear filled so rapidly that even liberal use of suction failed to provide safe working conditions at the window. The area of the footplate perforation was covered with pieces of gelfoam and the drum replaced. The ear canal was packed somewhat tighter than usual.

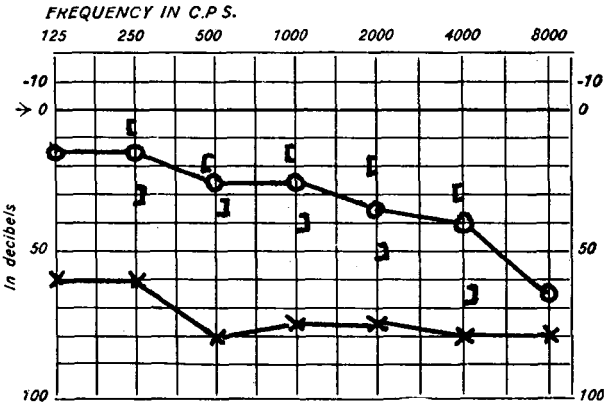


FIG. 1.
Initial audiogram. Mobilization of the left footplate was attempted.

There was no noticeable leak of perilymph post-operatively, and recovery was entirely uneventful. Post-operative audiograms, however, showed that there was no improvement in hearing. This was assumed to be due to the nonliberated anterior end of the footplate.

A new attempt at mobilization was made on *June 8th, 1959*. It was thought that by careful technique the anterior pole of the footplate could be loosened without creating a leaking fistula. Prying with spikes as well as the use of the Heerman chisels was unsuccessful and in preparation for anterior crurotomy, the anterior crus was cut. A delicate straight chisel was then placed immediately behind the otosclerotic focus and an attempt was made to perform superficial transverse cutting of the footplate. However, the chisel slightly perforated the footplate and as brisk a flow of perilymph as at the earlier operation ensued. Visibility was again lost, and the window niche was packed with gelfoam and the drum replaced. Perilymph continued to pour into the ear canal which was tightly packed.

Post-operatively there was no further leakage of perilymph and the recovery was uneventful. Hearing remained at the pre-operative level.

Attempts at mobilizing the left ear were abandoned. The patient could still get along without a hearing aid, although with some difficulty.

https://doi.org/10.1017/S0022215100059119 Published online by Cambridge University Press

In the spring of 1960 an external otitis developed, with fluid in the right middle ear. The disease was fairly resistant to treatment but in 2 months a healthy state was reached. However, hearing in the right ear had badly deteriorated, and the patient was fitted with a hearing aid (Fig. 2). He could hear well with the aid but wearing of the ear piece caused recurring troubles in the form of external otitis.

The patient later requested that an operation be performed on his right ear to enable him to do without a hearing aid. This was the only functioning ear, and having the recent experience with the left ear in mind, I refused at first but finally consented owing to the insistence of the patient.

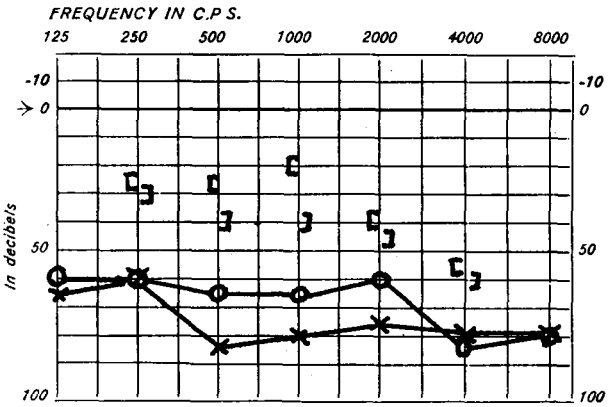


FIG. 2.
Follow-up audiogram. There is now footplate fixation on both sides.

At the time I had more than one year's experience with oval window fenestration as a method of choice, so I decided to use this method, provided that no excessive flow of perilymph would occur in this ear. On *December 20th, 1960*, a right tympanotomy was made: the stapes was found to be thicker than normal and fixed to both poles. The middle part of the footplate was thin. Fracturing of the stapes resulted in short crura and it was decided to discard the stapes and insert an artificial columella.

The middle part of the footplate was cautiously perforated with a spike and there was only normal leakage of perilymph. The middle portion of the footplate and its posterior pole were then removed totally; a very firm fixation at the anterior pole caused much difficulty and, for the sake of safety of the operation, a part of it was left in place. The window nevertheless became larger sized; it was covered with a piece of temporal muscle fascia according to our usual technique (Meurman and Palva 1961) and a polyethylene-prosthesis was inserted.

The post-operative course was normal and the packing was removed on the fifth day. There was only a slight initial improvement in hearing but in a week air conduction reached the level of bone conduction. The patient was able to dispose of the hearing aid, and his hearing has remained good since (Fig. 3).

https://doi.org/10.1017/S0022215100059119 Published online by Cambridge University Press

Discussion

Excessive flow of perilymph during mobilization or oval window fenestration procedures is very rare, and it has been mentioned only in passing in some discussions. Naturally, it is caused by an open communication between the perilymphatic space and the spinal fluid system, most probably in the form of an open cochlear aqueduct. Though open during fetal life and in early infancy, it usually becomes filled with a meshwork of arachnoid type connective tissue hindering free flow of spinal fluid into the perilymphatic space.

It is known that the cochlear aqueduct may remain open in some adults; indeed, Dandy has demonstrated fresh blood in the scala tympani after

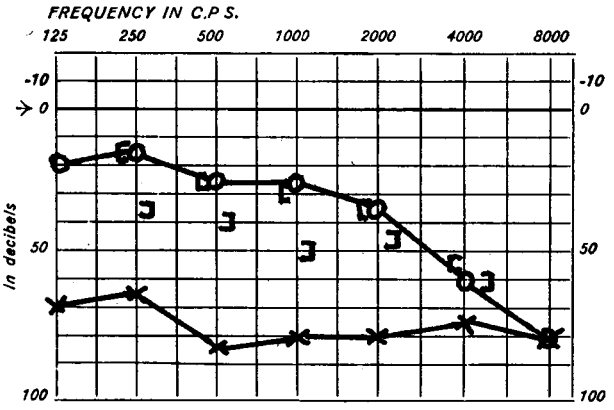


FIG. 3.
Final audiogram one year after fenestration of the right oval window.

intracranial operations, and others that Indian ink injected into the spinal system found its way to the scala tympani. The observations of Meurman (1930), however, suggest that open communications are rare exceptions.

In the discussion on the problems on oval window fenestration at the recent Paris conference, Portmann also felt that the ear, showing a profuse flow of perilymph, should be packed with gelfoam and the operation discontinued. Another speaker, not known by the present author, described a case in which fenestration of the oval window was successfully made in spite of a profuse perilymph flow. There had been great difficulties in getting the flap to stay in the fenestra, but once the columella was successfully inserted the flow decreased. There was good improvement of hearing although the pre-operative level had been very low, with poor discrimination.

The present case is the only one seen at this department: our series of fenestrations of the oval window now include 150 cases, and the number of mobilizations during the earlier years amounts to some 500 cases. Considering the rarity of this condition, I am in favour of a cautious approach in these cases, leaving the footplate in place rather than removing it. Since oval window fenestration has now become a dependable and safe procedure, operation in the better ear can be performed, if necessary. Hitherto, no one has described a

https://doi.org/10.1017/S0022215100059119 Published online by Cambridge University Press

patient with bilaterally open cochlear aqueducts in otosclerosis patients.

Another very interesting feature in these patients is their very poor pre-operative audiogram. This applies to the present case (Fig. 1) and also to the one described at the Paris meeting cited above. In the latter, in spite of poor pre-operative hearing the successful operation was found to restore the hearing to nearly the normal level. The probable explanation is that pre-operatively, as the oval window is firmly fixed and the greater part of the sound energy enters the round window, the accessory yielding tube, *viâ* the cochlear aqueduct, renders the movement of the basilar membrane inadequate. Once the oval window route is again established, stimulation from the scala vestibuli causes normal movements of the basilar membrane and it does not matter whether the round window or the cochlear aqueduct acts as a yielding membrane.

In the present case, the good hearing until the age of 16 does not support the view that the leakage of perilymph would have its origin at the internal acoustic meatus. The presence of an extra yielding "window" at the same side and close to the oval window, would hardly be compatible with normal hearing.

Summary

A case of otosclerosis with open cochlear aqueduct in the left ear is described. Owing to excessive perilymph flow from this ear, the operations were unsuccessful; in the other ear, however, oval window fenestration was uneventful. The cause of the great pre-operative hearing loss is discussed briefly.

REFERENCES

MEURMAN, O. H., and PALVA, T. (1961) *Acta oto-laryng.* (*Stockh*), (in press).
MEURMAN, Y. (1930) *Acta Soc. Med. Duodecim*, **1**, 3 Ser. B, article 1.
PALVA, T. (1954) *Acta oto-laryng.* (*Stockh.*), suppl. **118**, 156.
——— (1958) *Acta oto-laryng.* (*Stockh.*), **49**, 229.
PORTMANN, M. (1961) Proc. VIIth Int. Congress of Otorhinolaryngology, Paris.
SCHUKNECHT, H. (1961) Proc. VIIth Int. Congress of Otorhinolaryngology, Paris.
SHEA, J. (1961) Proc. VIIth Int. Congress of Otorhinolaryngology. Paris.

Kaskenk 4,
Turku,
Finland

https://doi.org/10.1017/S0022215100059119 Published online by Cambridge University Press