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## Astley Cooper's dramatically effective treatment of deafness

**Martin Burton, Cochrane UK, Summertown Pavilion, 18-24 Middle Way, Oxford, OX2 7LG UK. Email: [martin.burton@cochrane.nhs.uk](mailto:martin.burton@cochrane.nhs.uk)**

In 1800 the British surgeon Astley Cooper read a paper before the Royal Society reporting his observations on the effects of rupture of the ear drum (tympanic membrane) caused by disease (Cooper 1800). The first patient was a medical student from St Thomas's Hospital Medical School whose 'party trick' – performed in front of his medical school class at the behest of Astley Cooper – was an ability to blow air out of his ears in such a way as to agitate 'the hair hanging from his temples'. The compliant student, undoubtedly mindful of his future prospects, allowed Astley Cooper to poke a probe in each ear to feel for the ear drum. This made clear that that he had no ear drum at all on one side and a sizeable perforation on the other. Despite this, he could hear his anatomy lecturers (although he preferred to sit near the front of the lecture room), and he 'played well on the flute'.

The student had developed control over the muscles in front of and behind his ears to such a degree that he could move his ears at will to improve his hearing. The student had also discovered that he became deafer when he had a cold until he had expelled a large lump of wax from his ears, and that he had to protect his ears from water to avoid pain and deafness. A second patient had similar problems in only one ear, but his hearing loss was greater.

Astley Cooper concluded that large perforations of the ear drum sometimes resulted in only a modest loss of hearing. He concluded (rightly) that sound could enter the inner ear even when the ear drum and small bones of the ear (ossicles) are absent. In this situation, vibrations pass through the air directly to the openings into the inner ear – the oval and round windows.

About eighteen months later, in June 1801, Astley Cooper read a second paper before the Royal Society which built on his earlier observations ([Cooper 1801](#)). In it he recounts making similar observations in a further 20 cases. He describes other causes of perforations of the ear drum – from external injuries, or attempts to remove foreign bodies – and noted that the smaller the hole in the ear drum, the less the hearing loss. Nowadays it is thought that if an ear has a hearing loss of more than 30dB and/or the hearing difference between the two ears is more than 15dB, there is a tendency for the bad ear to be 'ignored' by the brain (auditory cortex), and for the patient to derive little benefit from the poorer-hearing ear. This is called the "Belfast rule of thumb" because the rule was developed by a consultant surgeon in Belfast, Gordon Smyth, and reported by him and a statistician colleague in 1985 (Smyth and Patterson 1985).

This may explain Astley Cooper's next observation – that there is a greater degree of deafness in an ear if it is the only ear affected, than if both ear drums are damaged.

All in all, Astley Cooper's observations led him to undertake a new operation – puncturing the ear drum – a myringotomy. He described a situation that we now call otitis media with effusion, or secretory otitis, or 'glue ear'. This may be caused by problems with the (Eustachian) tubes connecting the back of the nose to the middle ears, which results in difficulties 'popping' the ears, for example, when flying. In adults this often follows a 'cold' (upper respiratory infection), but in the nineteenth century scarlet fever frequently led to scarring and loss of function of the Eustachian tubes causing longstanding otitis media with effusion. Other causes described by Astley Cooper included venereal disease affecting the throat. He also mentions a similar, related condition (haemo-tympanum) in which blood clot in the middle ear (from head trauma, for example) has the same effect as an effusion of mucus in the middle ear.

Whatever the cause of the middle ear fluid, Astley Cooper felt that this ought to be relieved by puncturing the ear drum. He undertook the procedure and reported a number of selected cases. As he records that "the following appear to me most worthy of selection and record" (my italics) it is unlikely this was a consecutive case series, but rather a list of successes.

In operating on patients with ear disease it is always wise to operate on the worst hearing ear first (usually the ear most affected by disease). This is what Astley Cooper did in Case 1. Follow-up of 30 minutes (sic) suggested that the operation was successful in restoring hearing in the treated ear. In Case 2, success on the first ear to be operated on led to the procedure being repeated in the other ear three days later. Both procedures were successful.

Case 3 is interesting because the deafness in the 17 year-old patient appears to have been congenital, but conductive (that is, due to a mechanical problem with the middle ear). This is unusual. Those looking after him were sure that he had conductive deafness rather than sensorineural deafness (due to a problem with the inner ear or nerves of hearing) because he could hear a watch ticking when it was placed between his teeth – a clear demonstration of the importance of evaluating 'bone conduction' levels as part of a proper hearing assessment. Bilateral procedures, performed two minutes apart, led to a dramatic improvement in his hearing, which was sustained two months later.

Case 4 refers to a patient who experienced a haemotympanum as a result of head trauma.

Nowadays, there are several ways of performing a myringotomy, of which the commonest is to use a fine knife – a myringotome. Astley Cooper describes using an apparatus comprising a trocar and cannula ([see illustration in the paper](#)), by all accounts not dissimilar to that used today for the procedure to washout a patient's cheek sinuses. The drum is punctured, as it is today, in its antero-inferior quadrant (the part that lies at the bottom and back of the ear drum), this being the part of the drum where it is least likely to damage middle ear structures.

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## **References**

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