Glimpses of Evolution of Micro-ear Surgery

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ABSTRACT

Chronic suppurative otitis media (CSOM) is a chronic inflammatory condition of the middle ear cleft. It is of two types: mucosal and squamosal, and it can present with life-threatening complications.

A surgery of very small structure, like inner and middle ear, is very difficult to do accurately with naked eyes and this led to the evolution of magnifying devices, like loupes, microscopes, and endoscopes. With time, electronic devices came into picture and a trained coordinated move of the hand under microscope-assisted eyes gave accurate and better surgery results.

The use of microscopes has crossed the territory of otology and many other surgical specialties are also using like neurosurgery, plastic surgery, and ophthalmology.

Keywords: Chronic suppurative otitis media, Loupes, Microscopes, Otoendoscope.

INTRODUCTION

Chronic suppurative otitis media (CSOM) is a chronic inflammation of the middle ear and mastoid cavity. Clinical features are recurrent otorrhea through a tympanic perforation, with conductive hearing loss of varying severity.

The tympanic membrane is perforated in CSOM. If this is a pars tensa perforation, it is “mucosal,” while pars flaccida perforation is “squamosal.” Mucosal or squamous depends on the presence of cholesteatoma:

Mucosal CSOM is CSOM without cholesteatoma. It can be subdivided into active or inactive, depending on whether or not infection is present.

Squamosal CSOM involves cholesteatoma. Cholesteatoma is a nonmalignant but destructive lesion of the skull base.

COMPLICATIONS

Complications of CSOM are rare but potentially life-threatening. Intratemporal complications include petrositis, facial paralysis, and labyrinthitis. Intracranial complications include lateral sinus thrombophlebitis, meningitis, and intracranial abscess. Sequelae include hearing loss and tympanosclerosis.

A loupe (loop) (Fig. 1) is a simple, small magnification device used to see small details more closely. Unlike a magnifying glass, a loupe does not have an attached handle, and its focusing lens(es) are contained in an opaque cylinder, or cone, or fold into an enclosing housing that protects the lenses when not in use.

Loupes are also called hand lenses.

The history of the surgical microscope dates back to 1876, when simple loupes that attach to the spectacle frame or to a headband became available. These were made of convex lenses that were decentered to allow convergence and to use the prismatic effects of the periphery.

C Von Hess used such a loupe together with an electrical illumination device attached to a headband. This instrument gave a magnification of 5 to 6×, but had to be worn on a headband, which was one of the drawbacks of these original surgical magnifiers.

The instrument was heavy and, although Westien tried to reduce the weight of these loupes to facilitate their use, it remained too heavy for the surgeon, and hence, never became popular.

These are the common problems encountered when wearing them:

- Slippage of the glasses down the nose: This can be decreased by using tape to attach the browbar of the glass frame to the forehead. Another trick is the...
use of a long cord or band attached to the earpieces and tightened behind the head. This can be difficult to work with if you add a headlamp into the mix. The newer loupes have a built-in or clip-on headlamp.

- **Postauricular pain:** This can be helped by preventing slippage and by padding the earpieces.
- **Discomfort on the nasal bridge:** This is dependent on the nosepiece, the weight of the loupes, and the length of the procedure. If possible, change the nosepiece or pad it.
- **Fogging of the glasses:** This is caused by breathing behind the mask (which cannot be helped). You can decrease or prevent the fogging by taping the top of the mask to your skin by creating a barrier in this area. It is best to use paper tape to prevent skin irritation from the tape/adhesives.

The development of observation techniques in science gradually led to dissatisfaction with the relatively poor resolution of the naked eye, and this paved the way for the development of optical aids, such as the microscope.

The microscope, as with all other scientific instruments, followed an evolutionary process, influenced by different factors.

### HISTORY OF THE MICROSCOPE

The first real appreciation of the action of a lens, in particular the ability of a convex form to produce a magnified image of an object, appears to be credited to the Arabian scholar Ibn al Haitham (Alhazen) in the 11th century.

When only a single lens is used, as in the reading glass or watchmaker’s magnifier, it is termed a simple microscope; and the compound microscope is where two (ocular and objective lenses) or more lens systems are used (Fig. 2).

The word microscope was created in 1618 from two Greek words, micro and scope, to define a system using a combination of lenses for magnification, and it must be used only for the compound microscope.

The important role in the evolution of first microscope was by the Dutchmen Hans and Zacharias Janssen, Hans Lippershey, Cornelius Drebbel, and Wilhelm. But the exact person who took the first step is not known, as the invention spread very quickly, by Marcello Malpighi in Italy and with Robert Hooke in Great Britain, where great progress was made. Antony van Leeuwenhoek is probably the best known, for using a simple microscope.

Resolution is the ability to distinguish two separate points of light or details on an object as separate points, and it was clearly understood in the 17th century.

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**Fig. 2:** Compound microscope
It was Carl Olof Nylen, who first recognized the need for more magnification in ear surgery and he advised the adaptation of the first dissecting microscope (Fig. 3) for use in otology since 1921.3

Some authors, such as Brownlie Smith, doubted that a microscope was actually used for ear surgery at this time: “I [Brownlie Smith] have the impression, more than 30 years later, that while he [Holmgren] used a microscope, this was not an operating microscope but was used for examination of the fenestra after it was made.”4

This impression is also found in an article by Nylen published in 1923: “In order to facilitate the taking of closer observations in a cavity after a radical operation, and particularly to bring to light certain phenomena inside the labyrinth, labyrinthine windows, labyrinthine fistulae, auditory bones, etc., under different acoustic or vestibular tests on the human ear, microscope was constructed.”

The adaptation of the operating microscope led definitively to the use of the electrically driven dental-type burr and continuous suction and irrigation thereby obsoleting the need of mallet, gouge, rongeur forceps, manual dental drill, and cutting burr in ear surgery.

Otologists are considered to be the first surgeons to use this device routinely in the operating room.

PROGRESS IN THE LAST 40 YEARS

A large number of specialized operating microscopes have appeared in the world marketplace after the invention of the operating microscope, and this has led to the spread of microsurgical procedures through various surgical disciplines.

The necessary conditions for a good microscope are:
- Binocular vision
- Magnification range between 6 and 16×
- Ability to change magnification without changing the working distance
- Visual field – 20 mm
- Coaxial illumination system
- Good stability along with total mobility in all axes.

The increasing stability built into the microscope provides feasibility of attaching accessory equipment, such as photographic cameras or other documentation systems.

At present, two fields of research are being followed: The three-dimensional (3D) system and the guidance system.

No branch of medical science has been altered more profoundly, advanced more rapidly and benefited more completely from the use of the binocular microscope than has otology. Only with a microscope can the surgeon discover what will be encountered during an operation.

OTOENDOSCOPES

With the advent of nasal endoscopes, and the steep learning curve of one-handed manipulation of surgical instruments conquered, otolaryngologists have started using endoscopes to diagnose middle ear disorders.

Commonly used otoendoscopes include (Fig. 4):
- 1.7 mm zero-degree otoendoscope
- 1.7 mm 30° otoendoscope

The following minor procedures can be easily performed using otoendoscopy:

ADVANTAGES OF USING RIGID ENDOSCOPES TO PERFORM OTOLOGICAL EXAMINATIONS

- The entire ear drum can be clearly visualized with minimal manipulation.
• The image produced is of excellent resolution, hence, photographing these images provide excellent results.
• Fluid levels in middle ear cavity due to otitis media with effusion is clearly seen in otoendoscopy than in routine otoscopy.
• Every nook and corner of external auditory canal and middle ear cavity if tympanic membrane perforation is present can easily be examined with minimal manipulation of the endoscope.
• It is easy to clear the debris from the external auditory canal under visualization with an otoendoscope.

REFERENCES