World Journal of Otorhinolaryngology-Head and Neck Surgery (2017) xx, 1–7

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Research Paper

# Endoscopic transcanal modified canal-wall-down mastoidectomy for cholesteatoma

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Received 5 August 2017; accepted 17 August 2017

**KEYWORDS**
Cholesteatoma;
Inside-out technique;
Attico-antrotomy;
Sclerotic mastoid;
Attic obstruction;
Middle ear cholesteatoma;
DWI MRI;
Propeller MRI for cholesteatoma;
Ossicular chain reconstruction;
Cartilage repair of attic

**Abstract** Attic cholesteatoma with antral extension in tight sclerotic mastoid cavities is a common presentation that creates difficult decision-making intraoperatively. Drilling through a sclerotic and small mastoid cavity, keeping the canal wall intactis often difficult and increases the risk of serious injury. Consequently, a canal-wall-down mastoidectomy is often performed. The endoscopic transcanal modified canal-wall-down mastoidectomy approach allows the benefits of an open cavity for cholesteatoma resection and the benefits of a closed cavity for better long-term care and a more normal ear canal and middle ear reconstruction.


## Introduction

One of the most common presentations of temporal bone cholesteatoma is secondary acquired attic cholesteatoma.[1] Left untreated, attic cholesteatoma often spreads into the antrum and mastoid as it engulfs the ossicles and extends into the hypotympanum and sinus tympani. Early in its presentation, attic cholesteatoma can be found confined to the Prussak's space of the epitympanic recess and lateral to the malleus and incus.

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Peer review under responsibility of Chinese Medical Association.

Production and Hosting by Elsevier on behalf of KeAi

http://dx.doi.org/10.1016/j.wjorl.2017.08.003


Please cite this article in press as: Sajjadi H, Endoscopic transcanal modified canal-wall-down mastoidectomy for cholesteatoma, World Journal of Otorhinolaryngology-Head and Neck Surgery (2017), http://dx.doi.org/10.1016/j.wjorl.2017.08.003

For decades, otologic surgeons have felt uncomfortable operating on early attic cholesteatoma with no clinical symptoms, especially if the hearing was normal, lest surgery would make the patient worse. Surgeons would tell patients to keep observing the cholesteatoma and intervene if the ear drained or developed more "significant" conductive hearing loss. This was usually because the traditional microscopic approaches require extensive and difficult drilling of dense sclerotic mastoids, often with removal of ossicles, and thus causing maximum conductive hearing loss. For theses reasons and more, many earlier surgeons shunned away from operating on asymptomatic "early" attic cholesteatoma. However, early attic cholesteatoma is best treated before it extends out of the epitympanic recess and the endoscopic approach provides the best platform for ossicular preservation.[2]

Once cholesteatoma spreads beyond the epitympanic recess, it engulfs the head of the malleus, malleus-incus joint and the Cog area. Subsequently, cholesteatoma erodes and passes through the anterior superior ligament of the malleus, extending into the antrum. After crossing the antrum, there is no resistance to the spread of cholesteatoma into any and all aerated mastoid air cells. At this later stage, endoscopic atticotomy would not be sufficient and the antrum or the mastoid cavity need to be opened up. This is where the decades old controversy starts: Should the mastoid extension of disease be addressed using a canal-wall-up or a canal-wall-down approach. Many modifications to each approach have been utilized over the years.[3,4]

The main problem is that attic and antral cholesteatoma is often associated with densely sclerotic mastoids with minimal to no aeration. Consequently, drilling from the outer mastoid cortex to the antrum is often very difficult and tedious, making conventional postauricular intact canal wall mastoidectomy in such sclerotic mastoids undesirable and fraught with potential serious complications, such as tegmen or lateral semicircular canal labyrinthine injury and, in rare cases, injury to the facial nerve or sigmoid sinus.

Thus, the preferred surgical approach, in tight sclerotic mastoid cavities with attic cholesteatoma, has been to proceed with a canal-wall-down mastoidectomy, resection of the attic cholesteatoma and leaving either a large or small, obliterated mastoid cavity to heal.[5] This is a fine operation in competent hands and should result in a relatively small and even sometimes self-cleaning mastoid cavity. However, we all have seen and taken care of poorly epithelized and draining mastoid cavities, or those that collect huge amounts of keratin debris and must be cleaned professionally on a regular basis every few months.

Canal-wall-down mastoid cavities are not "physiologic" and most, if not all, need professional care for the life of the patient. Especially large or poorly done mastoid cavities end up needing routine annual or semiannual mastoid cavity cleaning lifelong. Patients have to prevent water exposure and wear earplugs in the shower or when swimming. To avoid such lifelong issues, surgeons either attempt to do an intact canal wall mastoidectomy in tight sclerotic mastoids, or do a canal-wall-down mastoidectomy with obliteration of most of the mastoid cavity.[6]

Numerous remedies have been offered for decades, for mastoid obliteration in these cavities. All previous attempts at these remedies have required either a postauricular or an endaural incision and have required extensive drilling in dense bone before reaching the antrum where the disease often resides and "hides".[7]

In this paper, a new twist to an *old approach* is offered. The **Endoscopic transcanal modified canal-wall-down mastoidectomy (ETM-CWD)** is a natural extension of the old "inside-out" technique. The old "inside-out" technique has been around for decades and has been largely forgotten in the era of intact canal wall mastoidectomy and canal wall preservations.[8]

However, in this version, the old "inside-out" atticoantrotomy resection is performed *completely transcanal* with one-handed drilling using high definition rigid video endoscopes. This approach allows for limited drilling to expose and remove cholesteatoma, and then repair the canal wall defect.

## Materials and methods

The Endoscopic transcanal modified canal-wall-down mastoidectomy (ETM-CWD) surgical technique steps are as follows:

1. A preoperative temporal bone computed tomography (CT) scan is mandatory when contemplating this approach, to evaluate the extent of the attic disease, the degree of mastoid pneumatization, the surgical anatomy and to formulate a plan of action.[9]
2. If the CT scan shows a widely pneumatized mastoid with extensive soft tissue, then a traditional postauricular intact canal wall mastoidectomy, with or without endoscopic assistance, could be used safely and effectively, and would be preferred.[10]
3. The ETM-CWD approach is best suited in cases where the mastoid antrum is involved with dense cholesteatoma and the entire mastoid outer cortex is sclerotic.
4. A high definition 3-chip video camera system, with the high resolution 3 mm diameter, 14 cm long rigid endoscopes using zero, 45 and 70° angulation is utilized.
5. Keep the light intensity output of the endoscope at 50% or less.
6. Must have a complete set of endoscopic ear instruments, allowing access to far angled spaces.
7. Hypotensive general anesthesia with systolic blood pressure around at or $<$90 mmHg and 90 mmHg and MAP of 75—80 mmHg.
8. Keep patient's head elevated at 15—30° to reduce bleeding.
9. Use of a facial nerve EMG monitor is highly advised.
10. Meticulous injection of the ear canal, meatus and concha with 1% lidocaine with epinephrine 1:100,000 using a fine 27 gauge needle. Do not over-inject since the facial nerve could be affected.
11. Use epinephrine-soaked cotton balls during ear canal flap elevation liberally.
12. Standard incisions for the tympanomeatal flap are made at 6 and 12 o'clock positions with interconnection midway in the bony canal. Fig. 1.

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