

# Cochlear Implantation in Bilateral Chronic Otitis Media: Surgical Issues and Outcomes

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## ABSTRACT

**Aim and objective:** Chronic otitis media (COM) is very commonly dealt with in otolaryngology practice in India. Patients with profound hearing loss due to chronic otitis media are candidates for cochlear implantation. This study aimed to evaluate the management options and to study the effectiveness of cochlear implantation in patients with bilateral severe to profound hearing loss due to COM.

**Materials and methods:** A retrospective study of 25 patients with severe to profound hearing loss due to bilateral chronic otitis media who underwent cochlear implantation was done from July 1998 to July 2018 at a tertiary ENT center in Chennai, India. All patients were postlingual candidates. A protocol was developed to manage otitis media and perform cochlear implantation based on the type of disease and disease activity.

**Results:** Significant hearing improvement after cochlear implantation was noticed in all patients with chronic otitis media. Patients with chronic otitis media posed challenges to cochlear implantation. No operative complications were noticed in any of these patients.

**Conclusion:** Cochlear implantation (CI) is an effective procedure for hearing restoration in patients with profound hearing loss due to chronic otitis media. Meticulous surgical technique in clearing disease and in cochlear implantation is of paramount importance. A two-stage procedure may be required for optimal outcomes.

**Clinical significance:** Patients with profound hearing loss due to chronic otitis media require cochlear implantation which entails special considerations. Awareness of the issues relating to CI in chronic otitis media is vital to ensure successful outcomes.

**Keywords:** Cochlear implantation, Chronic otitis media, Outcomes, Surgical issues.

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## INTRODUCTION

Chronic otitis media (COM) is a common cause of hearing loss in the Indian subcontinent. The natural disease progression in COM involves irreversible damage to the cochlea and resultant profound sensorineural hearing loss. Cochlear implantation (CI) is an established treatment option for individuals with bilateral severe to profound hearing loss. CI involves special considerations in patients with chronic otitis media. Spread of inflammation along the electrode array into the scala tympani with subsequent meningitis, risk of recurrent infection, and extrusion of the electrode array are challenges in these patients. Complete eradication of inflammation and the securing of a strong protective soft tissue layer over the electrode are prerequisites for cochlear implantation in patients with chronic otitis media.<sup>1</sup> The decision regarding canal wall up or canal wall down procedure depends on the type of disease. Subtotal petrosectomy may be required in patients with cholesteatoma and is safe and effective in cochlear implant candidates with chronic otitis media.<sup>2</sup> This study aimed to evaluate the surgical options and to study the effectiveness of cochlear implantation in patients with bilateral severe to profound hearing loss due to chronic otitis media.

## MATERIALS AND METHODS

Twenty-five patients with bilateral severe to profound hearing loss due to chronic otitis media underwent cochlear implantation in a tertiary care setting from July 1998 to July 2018 in a tertiary level ENT center in Chennai, India. Ethical approval for the study was taken from the Institutional review committee. The inclusion criteria included all patients with post-lingual bilateral severe to profound hearing loss due to chronic otitis media. Patients with post-lingual bilateral severe to profound hearing loss due

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to causes other than chronic otitis media were excluded from the study, as were all patients with bilateral pre or peri-lingual hearing loss. In all patients, a hearing aid trial was done; however, patients did not benefit from amplification. A thorough clinical evaluation, otomicroscopy, comprehensive audiological testing and electrophysiology, hearing aid trial, and CT/MRI of the inner ear were done before the procedure. In three patients there was no ear discharge reported for several years, otomicroscopy showed dry central perforation, CT scans showed absence of mastoiditis; hence, a single-stage procedure (myringoplasty and CI) was done. A staged procedure was performed on twenty-two patients. Canal wall up (CWU) mastoidectomy, posterior tympanotomy, and closure of tympanic membrane perforation were done in 12 patients who showed ear discharge, central perforation on otomicroscopy, and mastoiditis on CT scans. After six months, cochlear implantation was done after ensuring the absence of infection and an intact tympanic membrane. Subtotal petrosectomy was done in ten patients who

had cholesteatoma. After one year, cochlear implantation was done. Categories of auditory performance (CAP) score was used to assess the benefit obtained from cochlear implantation.<sup>3</sup> For the statistical analysis, paired t-test was used.  $p$ -value  $< 0.01$  was considered statistically significant. All patients are currently under follow-up with an average follow-up duration of eight years.

## RESULTS

Twenty-five patients with profound hearing loss due to bilateral chronic otitis media underwent cochlear implantation. In our series, there were 17 men and 8 women with an age range of 16–55 years and a mean age of 36 years. Five patients were in the age range of 16–25 years, 7 patients aged between 26 years and 35 years, 9 patients aged between 36 years and 45 years, and 4 patients aged between 46 years and 55 years. All twenty-five patients had bilateral profound hearing loss due to bilateral chronic otitis media. Twenty-two patients had ear discharge at presentation and in three patients there was no ear discharge reported for several years. In three patients myringoplasty and CI were done as a single staged procedure. These patients had good hearing outcomes and TM perforation closure was noted at follow-up. In twelve patients with ear discharge, central perforation on otomicroscopy and mastoiditis on CT scans after CWU mastoidectomy, posterior tympanotomy, and closure of tympanic membrane perforation, the patients were found to be disease-free with an intact tympanic membrane at follow up; hence, CI was performed after 6 months (Figs 1 and 2). In ten patients with cholesteatoma, subtotal petrosectomy was done as a first stage procedure and cochlear implantation was done one year later after ensuring that the patients were disease-free (Figs 3 and 4). All patients underwent unilateral cochlear implantation with MED-EL cochlear implant either as a single-stage or two-stage procedure. A straight electrode array was inserted via a round window in all patients and complete electrode insertion was achieved in all patients. The round window was plugged with a soft tissue seal to prevent electrode movement as well as perilymph leak in all cases. No surgical complications were noticed in any of the patients. The mean preoperative pure tone audiometry (PTA) level in our patients was 90 dB hearing loss (HL). Postcochlear implantation, the mean aided PTA was 35 dB HL. Post-CI, good hearing outcomes were

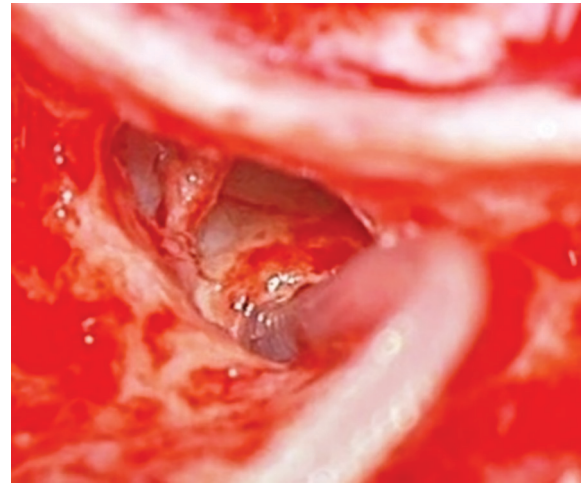


Fig. 2: Second stage CI

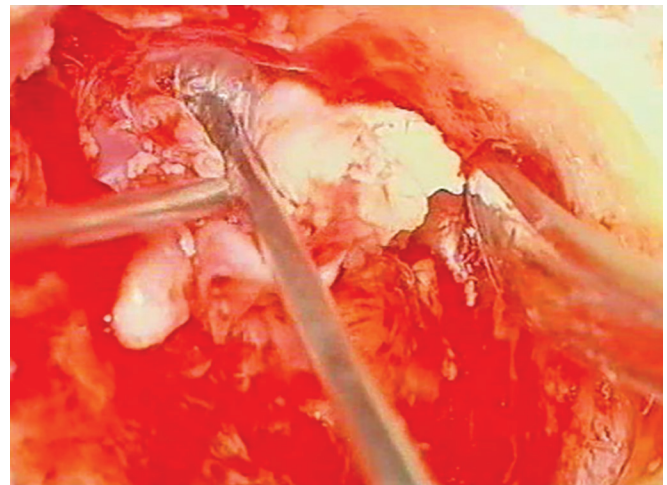


Fig. 3: Subtotal petrosectomy for a patient with cholesteatoma and bilateral profound hearing loss

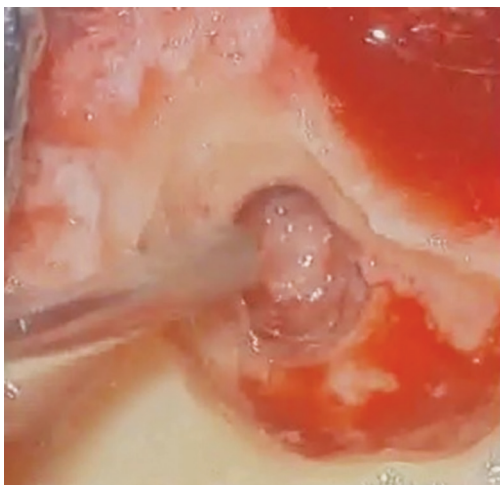


Fig. 1: Granulations being cleared in a patient with COM

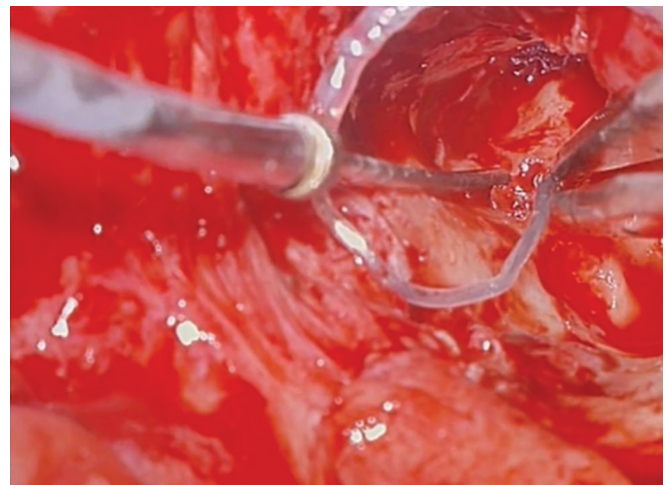
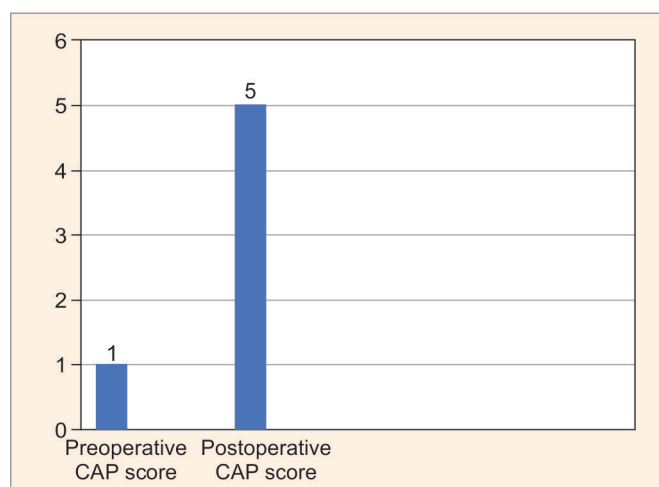


Fig. 4: Second stage CI after subtotal petrosectomy



**Fig. 5:** Pre-CI and post-CI CAP scores in patients with bilateral COM and profound hearing loss

noticed in all patients. The mean preoperative CAP score was 1 and at 1 year the mean postoperative CAP score was 5 (Fig. 5) which was statistically significant ( $p < 0.01$ ), thereby confirming that CI is beneficial in improving hearing in chronic otitis media. The average follow-up period was eight years. No recurrence of otitis media was noticed in any of the patients. There was no incidence of device explantation or extrusion. All patients are on periodic follow-up and they were using the device at the last follow-up.

## DISCUSSION

Profound sensorineural hearing loss (SNHL) can occur in patients with chronic otitis media due to labyrinthitis, labyrinthine fistula, or iatrogenic injury.<sup>4</sup> In patients with severe to profound hearing loss, one of the concerns during the CI candidacy process is the presence of chronic otitis media.<sup>5</sup> In the past, cochlear implantation was contraindicated in patients with otitis media because of the risk of meningitis, tympanic membrane perforation, recurrent cholesteatoma, and extrusion of the electrode in a radical cavity.<sup>6</sup> Over the past few decades, patients with profound hearing loss due to chronic otitis media have been found to be good candidates for cochlear implantation. Schlondorff and Parnes first reported on patients with COM who underwent cochlear implantation.<sup>7</sup> There are several challenges that a CI surgeon faces in the management of these patients. The ear must be rendered safe before CI because the insertion of an electrode in a potentially infected area carries the risks of meningitis and biofilm formation. Intraoperatively, chronically infected hemorrhagic mucosa may render surgery difficult. Disease eradication and secure placement of the cochlear implant electrode are the aims of surgery.<sup>2</sup> There are several options for management and proper patient selection and meticulous surgery are important.<sup>8</sup> Patient management must be individualized and the degree of activity of COM influences the management strategy.<sup>9</sup> Decision whether implantation has to be staged depends on the presence of active inflammation.<sup>10</sup> Elimination of infection, prevention of recurrent infection, and protection of the cochlear implant electrode array are the principal goals.<sup>11</sup> In inactive COM with a simple dry perforation, placement of the cochlear implant and closing of the tympanic membrane

perforation can be performed as a single-stage procedure. In the presence of active infection, cochlear implantation is performed as a staged procedure 3–6 months after disease clearance.<sup>9</sup> The cochlea is sealed at the point of entry of electrodes. Many authors manage COM more aggressively by performing a subtotal petrosectomy with the closure of the EAC.<sup>7</sup> A subtotal petrosectomy involves the complete exenteration of all accessible mastoid air-cell tracts of the temporal bone, sealing the Eustachian tube orifice, and closure of the external meatus. This may be followed by obliteration of the tympanomastoid cleft with a pedicled temporalis flap or with abdominal fat.<sup>9</sup> Cochlear implantation with subtotal petrosectomy is safe and effective.<sup>12</sup> The cavity is isolated from the external environment and the electrode array is adequately protected.<sup>13</sup> Long-term follow-ups for possible extrusion of the electrode or other complications are necessary.<sup>12</sup> The functional outcome in COM patients is similar to cochlear implants in healthy middle ears.<sup>2</sup> If cochlear implantation is contemplated in an ear with a mastoid cavity, some surgeons have proposed to maintain an open technique, while others have suggested reconstructing the posterior canal wall with bone plates and obliterating the mastoid bowl with bone chips. A completely different strategy has been proposed by Colletti et al., who have utilized the middle cranial fossa approach to avoid a septic field through the middle ear.<sup>7</sup> There is a possibility of infection even with a staged operation.<sup>14</sup>

Cochlear implantation is safe and feasible in chronic otitis media with good hearing outcomes. Meticulous disease clearance is vital before CI. Close follow-up is crucial. Cochlear implantation in patients with COM gives excellent outcomes with audiometric scores comparable to the general cochlear implant population.<sup>15</sup> No difference in speech perception has been reported in cases with chronic otitis media.<sup>16</sup> Cochlear implant patients with COM have no increased risk of postoperative infections or complications.<sup>15</sup> In our series, successful treatment of otitis media was possible and cochlear implantation helped in hearing restoration in all patients with bilateral chronic otitis media. A limitation of this study is the lack of a longer postoperative follow-up of patients to detect disease recurrence. Diffusion-weighted magnetic resonance imaging (MRI) is the gold standard for detecting cholesteatoma recurrence after subtotal petrosectomy and blind sac closure of external acoustic canal (EAC); however, an MRI is relatively contraindicated after cochlear implantation, leaving high-resolution computed tomography (HRCT) as the choice for imaging in such cases.

## CONCLUSION

India faces a huge burden of deafness due to chronic otitis media and otolaryngologists should be aware of the issues about cochlear implantation in chronic otitis media. Cochlear implantation is safe and effective in hearing restoration in patients with profound hearing loss due to otitis media. The type of COM and disease activity are factors to consider for the staging of surgery and deciding upon the type of surgical procedure. Complete disease eradication is mandatory before cochlear implantation in chronic otitis media.

## CLINICAL SIGNIFICANCE

Bilateral chronic otitis media is an important cause of disabling hearing loss. Patients with profound hearing loss due to chronic otitis media benefit from cochlear implantation. Otolaryngologists need to be cognizant of the issues relating to CI in chronic otitis media in order to ensure successful clinical outcomes.



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