Modified intact canal wall mastoidectomy technique in chronic suppurative otitis media: A prospective study of 50 cases

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Abstract

Introduction: The classical intact canal wall (ICW) mastoidectomy with tympanoplasty (combined approach tympanoplasty)\(^1,2\) has anatomic constraints for clearance of the disease from the anterior attic and sinus tympani leading to high recidivism. In modified intact canal wall technique, the posterior bony rim is drilled under direct vision and facial recess opened till the base of processus pyramidalis bridging the sinus tympani and posterior sinus tympani into direct vision.

Materials and methods: We report our experience in healing and hearing in 50 cases with special reference to degree of hearing loss, ossicular status, type of disease (cholesteatoma or granulations) and post-operative hearing gain.

Results: All subjects of CSOM attico-antral type with granulation and cholesteatoma will undergo modified intact canal wall mastoidectomy. All the patients had an intact eardrum except three with a small, central hole, which had been seen since the early and late post-operative period. There was no sign of residual or recurrent cholesteatoma. Reduction in air bone gap was recorded during the post-operative period. Pre-operative air-bone gap was 33.85 dB which was decreased to 23.4 dB and 22.1 dB post-operatively at 3\(^{rd}\) month and 6\(^{th}\) months respectively.

Conclusion: The modified intact canal wall technique was found to result in complete and safe removal of disease from the middle ear and provided a durable and resistant reconstruction of the middle ear as a single stage procedure. This technique also resulted in significantly improved hearing outcomes in majority of the patients when compared to various other ICW techniques.

Keywords: Modified intact canal wall mastoidectomy , Closed cavity mastoidectomy
atticotomy with drilling of postero-superior bony annulus (which he termed “otosclerosis drilling”) combined with postauricular mastoidectomy with maximal thinning of posterior and superior bony canal wall. Modified intact canal wall mastoidectomy is an entirely different approach to critical areas in middle ear and anterior attic as compared to classical intact canal wall technique. Sinus tympani and posterior tympanic sinus are difficult or even impossible to view via classical posterior tympanotomy facial recess approach and thus the classical technique becomes a blind technique when clearing disease in the area leading to risk of residual disease. Clearance of disease from anterior attic in classical intact canal wall technique requires extensive transmastoid epitympanotomy with narrow working space and inadequate visualization of supratubal recess especially its anterior end. While in modified intact canal wall mastoidectomy transmeatal atticotomy provides circumferential access to anterior attic with adequate working space and direct vision. Thus the chances of residual cholesteatoma decrease substantially and there is no need for second look surgery. The work was planned:

1. To study the clinicopathological profile of patients with chronic suppurative otitis media.
2. To assess the degree of hearing loss in patients with chronic suppurative otitis media.
3. To periodically assess the post-operative hearing gain after modified intact canal wall mastoidectomy.
4. To periodically assess the post-operative healing after modified intact canal wall mastoidectomy.

Material & methods: The study ‘Modified intact canal wall mastoidectomy technique in chronic suppurative otitis media: A prospective study of 50 cases’ was conducted on the patients of chronic suppurative otitis media attic-antral type with cholesteatoma or granulations admitted in the Department of Otorhinolaryngology, J.L.N. Medical College and associated hospitals Ajmer, Rajasthan from January 2012 to June 2013 to identify the success of this technique in eliminating diseases including cholesteatoma, granulations and to assess the degree of postoperative hearing improvement.

All subjects of CSOM attic-antral type with granulation and cholesteatoma will undergo modified intact canal wall tympanomastoid surgery except –

1. Patient of age less than 10 years.
2. Patients with disease in the only hearing ear.
3. Presence of otogenic intra cranial complications.
4. Large fistula (> 2mm) of lateral semicircular canal.
5. Malignancy of middle ear.
6. Revision ICW and modified ICW mastoidectomy surgery cases.

All patients had undergone thorough history taking and complete ENT examination including tuning fork tests. A battery of investigations including routine blood investigations, urine examination, X ray mastoid (Law’s lateral oblique view), X-ray chest (PA view), ECG, audiometry, tuning fork tests and examination under microscope was done in all patient. Pus for culture and sensitivity, tympanometry, HRCT Scan temporal bone were done in some cases.

Anaesthesia: GA/ LA

Surgical steps were:

1. Post-auricular incision was made and temporal fascia graft harvested.
2. Post-auricular cortical mastoidectomy and removal of polypoid mucosa, diseased cellular system and delineation of cholesteatoma with its sac in the antrum done. Transcanal elevation of posterior meatal and superior and inferior
tympanomeatal flaps and securing the tympanomeatal flaps in anterior sulcus.

3. Transcanal atticotomy until the disease in anterior attic and supratubal recess directly visualized.

4. Widening the bony canal by thinning of posterior canal wall from anterior aspect including removal of the posterior bony rim to expose the sinus tympani and facial recess.

5. Total clearance of cholesteatoma and granulations from the attic, antrum and middle ear including sinus tympani area along with the involved malleus and incus.

6. Reconstruction of tympanic membrane by underlay grafting.

7. Short or long columella ossiculoplasty with autogenic ossicles or cartilage depending on the condition of stapes suprastructure in a particular case.

8. Reconstruction of lateral attic wall with autogenic conchal cartilage.

9. Gelfoam and ointment packing was done, and wound closed in two layers.

10. Stitches and ointment pack removed on 7th post operative day.

The surgical procedure performed with type of ossicular reconstruction and graft placement also noted. Post-operative ear examination was done at 7th and 15th post-operative day, and after 1, 3 and 6 months of surgery to assess healing. Post operative healing of wound, condition of mastoid cavity, type, amount and duration of discharge was noted. Post operative hearing evaluation done in all patients at 3 and 6 month after surgery.

Hearing results were reported using the guide lines recommended by committee on hearing and equilibrium of the American Academy of Otolaryngology for the evaluation of result of treatment of conductive hearing loss. (Guidelines of committee on hearing & equilibrium)12. This included reporting of mean, standard deviation and range of post operative air – bone gap (AB gap), the number of decibels of changes in the air bone gap and the change in high-tone bone condition level.

Results:

In the present study, there were 24 males (48%) and 26 females (52%). Slight female preponderance was recorded in the study.

Table No. 1: Age Distribution of patients

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Age Group (in years)</th>
<th>No. of Patients</th>
<th>Per centage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>≤ 20</td>
<td>21</td>
<td>42%</td>
</tr>
<tr>
<td>2</td>
<td>21 – 30</td>
<td>19</td>
<td>38%</td>
</tr>
<tr>
<td>3</td>
<td>31 – 40</td>
<td>5</td>
<td>10%</td>
</tr>
<tr>
<td>4</td>
<td>&gt; 40</td>
<td>5</td>
<td>10%</td>
</tr>
</tbody>
</table>

The age of the patients included in the study ranged from 8 years to 56 years with a mean age of 24.38 years. The majority of patients included in our study were young adults (Table 1). The commonest symptom in the present study was otorrhoea, seen in 100% of the patients.
Majority of the patients had discharging ear for more than 3 years. 72% of the patients complained of discharge for more than 40 months followed by 12% patients for 20-29 months. Only 2% patients gave a history of discharge for less than 10 months. Of the 50 studied cases, 28 (56%) subjects were operated on left ear while 22 (44%) subjects were operated on right ear. 10 patients have bilateral ear disease among them 6 were operated on left ear and 4 were operated on right ear because of unsafe disease including retraction, cholesteatoma or granulations.

Pre-operative hearing assessment was done using pure tone audiometry. Hearing threshold at 500, 1000, and 2000 Hz was considered for calculation of hearing threshold. Of 50 studied cases, 22 patients had air conduction level between 51 to 60 dB. 14 patients had air conduction level between 41-50 dB followed by \( \leq 40 \) dB in 10 patients and 4 patients had air conduction level above 60 dB. In present study, out of 50 patients, 20 patients had bone conduction level between 11 to 20 dB and 16 patients had bone conduction level \( \leq 10 \) dB. 9 patients had bone conduction level between 21 to 30 dB followed by 5 patients \( > 30 \) dB. In present study most of the patients (21) had air-bone gap between 31 to 40 dB. 18 patients had air bone gap between 21-30 dB followed by 7 patients had \( > 40 \) dB and 4 patients \( \leq 20 \) dB.

Table No.2: Type of lesion based on EUM finding in the operated ear

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Findings</th>
<th>Number of patients</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Granulations</td>
<td>32</td>
<td>64%</td>
</tr>
<tr>
<td>2</td>
<td>Posterosuperior perforation with cholesteatoma</td>
<td>15</td>
<td>30%</td>
</tr>
<tr>
<td>3</td>
<td>Attic Cholesteatoma</td>
<td>9</td>
<td>18%</td>
</tr>
<tr>
<td>4</td>
<td>Polyp</td>
<td>4</td>
<td>8%</td>
</tr>
</tbody>
</table>

Granulations were the most frequently observed pathology in our study, encountered in 64% of the cases. Next to it was posterosuperior perforation with cholesteatoma seen in 30% of the cases. Attic cholesteatoma seen in 18% of the patients. Polyp was found in 8% of the patients (Table 2).
Table No.3: Type of surgery performed

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Type of procedure</th>
<th>No. of patients</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MICT type I</td>
<td>1</td>
<td>2%</td>
</tr>
<tr>
<td>2</td>
<td>MICT type II</td>
<td>29</td>
<td>58%</td>
</tr>
<tr>
<td>3</td>
<td>MICT type III</td>
<td>20</td>
<td>40%</td>
</tr>
</tbody>
</table>

Table No.4: Otoscopic findings during the follow up period

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Otoscopic Findings</th>
<th>Post-operative follow up, n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1 Month</td>
</tr>
<tr>
<td>1</td>
<td>Residual Perforation</td>
<td>3 (6%)</td>
</tr>
<tr>
<td>2</td>
<td>Retracted TM</td>
<td>1 (2%)</td>
</tr>
<tr>
<td>3</td>
<td>Residual Cholesteatoma</td>
<td>0</td>
</tr>
</tbody>
</table>

Table No.5: Hearing outcomes in all patients following MICT

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Mean Air Conduction (in dB)</th>
<th>Mean Bone Conduction (in dB)</th>
<th>Mean Air- Bone gap (in dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pre-operatively</td>
<td>52.1</td>
<td>18.35</td>
</tr>
<tr>
<td>2</td>
<td>Post-operatively, 3 months</td>
<td>42</td>
<td>18.6</td>
</tr>
<tr>
<td>3</td>
<td>Post-operatively, 6 months</td>
<td>41.3</td>
<td>19.2</td>
</tr>
<tr>
<td>4</td>
<td>Change at 3 months</td>
<td>10.1</td>
<td>-0.25</td>
</tr>
<tr>
<td>5</td>
<td>Change at 6 months</td>
<td>10.8</td>
<td>-0.85</td>
</tr>
<tr>
<td>6</td>
<td>Percentage gain at 3 months</td>
<td>19.39%</td>
<td>-1.36%</td>
</tr>
<tr>
<td>7</td>
<td>Percentage gain at 6 months</td>
<td>20.73%</td>
<td>-4.63%</td>
</tr>
</tbody>
</table>

The pre-operative mean air conduction was 52.1 dB which at 3 months post-operatively was reduced to 42 dB. Further at 6 months there was more reduction in the air conduction levels to 41.3 dB. Thus there was a gain in air conduction threshold by 19.39% and 20.73% at 3rd month and 6th months respectively. The bone conduction thresholds on the other hand increased slightly during the follow up period. There was slight worsening of bone conduction.
with an increase of 1.36% and 4.63% at 3rd month and 6th months respectively. Reduction in air bone gap was recorded during the post-operative period. Pre-operative air-bone gap was 33.85 dB which was decreased to 23.4 dB and 22.1 dB post-operatively at 3rd month and 6th months respectively.

**Discussion:** All the patients had unsafe CSOM and underwent Modified ICW mastoidectomy with primary ossiculoplasty, and were followed up for a period of 6 months. Short or long columella tympanoplasty was performed. Autogenic ossicle (incus for short columella and malleus for long columella) and/or conchal cartilage were used for ossiculoplasty.

The demographic and clinical data were collected which included age, sex, diagnosis (chronic suppurative otitis media), prior otologic surgery, details of surgical technique, intra operative findings (middle ear mucosa status, ossicular chain status, and reconstruction), postoperative findings (graft incorporation), hearing and duration of follow-up. The main outcome measures were both anatomical and functional in form of graft incorporation and postoperative hearing function.

Our technique approaches the pathology through postaural approach using transmeatal posterior tympanotomy, transmeatal anterior atticotomy and a simple transcortical mastoidectomy. We have found that this technique gives excellent exposure of the posterior mesotympanum, including sinus tympani, anterior epitympanum transmeatally and of antrum, aditus, and attic transcortically. Reconstruction of the posterosuperior and scutum defect is done with conchal cartilage which is easily harvested because of post-auricular incision. Reaeration of the aditus and antrum is achieved and the anatomical configuration of the middle ear is brought back to normal as nearly as possible.

The classic combined approach tympanoplasty comprises a large mastoidectomy with thin and intact bony canal wall and posterior tympanotomy. Removal of disease from the anterior attic through the cortical mastoidectomy and from the tympanic sinus through the posterior tympanotomy is complicated, especially under narrow anatomical conditions and the large frequency of residual cholesteatoma is therefore not surprising. Since 1970, Tos has used a modification of CAT which is based on a new philosophy. The Tos technique consists of transcanal and transmatoid approach that includes the simple cortical mastoidectomy and transcanal atticotomy, sparing a bridge of bone between the attic and mesotympanum, together with a limited posterior tympanotomy by performing otosclerosis drilling of the posterior bony annulus and posterosuperior canal wall overhang. The technique is no doubt simple but nothing much is gained by preserving the thin bridge of bone of the scutum which could easily be absorbed and eroded away making reconstruction unstable. There could be neoosteogenesis and adhesion formation postoperatively.

Clearance of disease from anterior attic in classical intact canal wall technique requires extensive transmastoid epitympanotomy with narrow working space and inadequate visualization of supratubal recess especially its anterior end. While in modified intact canal wall mastoidectomy transmeatal atticotomy provides circumferential access to anterior attic with adequate working space and direct vision. Thus the chances of residual cholesteatoma
decrease substantially and there is no need for second look surgery.\textsuperscript{11}

All ears were dry. All the patients had an intact eardrum except three with a small, central hole, which had been seen since the early and late post-operative period. Clean and stable attic retraction with a wide access was observed in one ear in early post-operative period (1 and 3 months) and in two ears in late post-operative period (6 months). There was no sign of residual or recurrent cholesteatoma (e.g., persistent otorhoea, hearing deterioration, bulging or lateralization of the palisades) in any patient during the follow-up period or at the final examination.

Mahadevaiah \textit{et al.}\textsuperscript{11} study revealed that postoperative mean air conduction was 41.5 dB and mean air-bone gap was 21.1 dB. Stankovic \textit{et al.}\textsuperscript{18} observed mean air-bone gap of 14.6 dB.

In our study the pre-operative mean air conduction was 52.1 dB which at 3 months post-operatively was reduced to 42 dB. Further at 6 months there was more reduction in the air conduction levels to 41.3 dB. Thus there was a gain in air conduction threshold by 19.39% and 20.73% at 3\textsuperscript{rd} month and 6\textsuperscript{th} months respectively. On applying \textit{t} test it showed that this difference was highly significant (\textit{P} value < 0.002 at 3 months and 6 months post-operatively), thus verifying the efficacy of Modified Intact Canal Wall Mastoidectomy Technique in restoring the distorted sound conduction mechanism of the ear. The bone conduction thresholds on the other hand increased slightly during the follow up period. There was slight worsening of bone conduction with an increase of 1.36% and 4.63% at 3\textsuperscript{rd} month and 6\textsuperscript{th} months respectively. (\textit{P} value >0.5 at 3 months and 6 months post-operatively)

Reduction in air bone gap was recorded during the post-operative period. Pre-operative air-bone gap was 33.85 dB which was decreased to 23.4 dB and 22.1 dB post-operatively at 3\textsuperscript{rd} month and 6\textsuperscript{th} months respectively. On analysing the audiometric parameter of air-bone gap by the same paired \textit{t} test there was again significant improvement in air-bone gap after surgery (\textit{P} value < 0.0002 at 3 months and 6 months post-operatively).

\textbf{Conclusion:} The modified intact canal wall technique was found to result in complete and safe removal of disease from the middle ear and provided a durable and resistant reconstruction of the middle ear as a single stage procedure. This technique also resulted in significantly improved hearing outcomes in majority of the patients.

Residual cholesteatoma was not evident in any case after 6 months of surgery, but retracted tympanic membrane was demonstrated in three patients. This can lead to development of cholesteatoma in these patients in future. Thus a longer follow up period will be required to definitely establish the efficacy of MICT in complete eradication of disease from middle ear. Improvement in hearing was clearly evident post-operatively even after 3 months. There was marked improvement in air conduction thresholds with consequent reduction in air-bone gaps. Majority of the patients have a significant reduction in air-bone gaps of >10 dB, at 6\textsuperscript{th} month post-operatively.

Although modified intact canal wall procedures limit the need for post-operative care, they do not eliminate the need for follow up. This must be emphasized to the asymptomatic post-operative patient. When deciding to perform an modified intact canal wall tympanoplasty with mastoidectomy for cholesteatoma, the decrease
in post-operative care and good hearing results must be weighed against the risk of recurrent post-operative cholesteatoma. These factors must be considered by the otologist and the patients post-operatively.

References: