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Indications and outcomes of subtotal petrosectomy: our experience and review of literature

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Abstract

Background Subtotal petrosectomy (STP) has attracted massive interest over last two decades. The aim is to present our experience of this uncommon surgery. The indications, outcomes, and our variation in surgical technique would be presented and literature reviewed.

Methods A retrospective observational study of all patients who underwent STP at a tertiary care center in India was analyzed.

Results A total of 9 ears (in 8 patients) underwent STP over last 5 years at our center. The pathological conditions for which STP was done included chronic otitis media squamous (four ears), middle ear tumors (three ears), petrous apicitis (one ear), and traumatic cerebrospinal fluid (CSF) otorhinorrhea (one ear). The indication of STP included disease clearance (eight ears), unserviceable hearing (seven ears), hearing rehabilitation with otological implants (six ears), and intraoperative CSF gusher (one ear). Intraoperative indications included CSF gusher, large tegmen defect with erosion of apical turn of cochlea, and erosion of anterior bony wall of external auditory canal. The mean follow-up period was 36 months (range of 6 months to 60 months). None of the patients had any dehiscence of blind sac closure or secondary acquired cholesteatoma on imaging.

Conclusions STP facilitates disease clearance by providing unmatchable exposure in difficult otological scenarios and additionally isolates middle ear cleft from external environment, thereby eliminating problems of mastoid cavity. Furthermore, it also prepares ear for second stage otological implants. It is a safe surgery with minimal complications.

Keywords Cochlear implantation, Bone conduction implantation, Middle ear cholesteatoma, Lateral skull base surgery, Canal wall down mastoidectomy, Subtotal petrosectomy

Background

The first ever mention about STP is credited to Rambo et al. wherein temporalis muscle pedicled flap was utilized for cavity obliteration, without obliterating the EAC and ET [1]. The surgical technique of subtotal petrosectomy (STP) was first described in late 1950s, but the term was formally introduced for the first time by Ugo Fisch in 1965 [2]. He recounted STP as total exenteration of all temporal bone cells which included retrofacial, rectosigmoid, antral, perilabyrinthine, peritubal, and pericarotid cell tracts. This procedure has attracted massive interest amongst otologists over the last two decades which has also translated into an increase in its indications. The inceptive account of STP mandated preservation of the otic capsule. However, recent times have witnessed needful expansion of this surgery to exenterate inner ear and internal auditory canal (IAC). Consequent to an obscure initial elucidation of STP and its

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inclusion as first step in various lateral skull base surgeries (LSBS), there is lack of clarity about its correct terminology and actual scope of bony resection. The literature appraisal brings out that authors tend to label any middle ear (ME) occlusion surgery followed by blind sac closure (BSC), viz., transotic, transcochlear infratemporal fossa approach, skull base surgeries for middle/posterior fossa tumors, and parotid surgeries such as STP [3, 4]. Prasad et al. (2017) published the largest case series comprising of 460 cases of STP and clarified upon its definition and differentiation from subtotal temporal bone resection (STBR) and other LSBSs [5]. This article aims to present our experience of this uncommon surgery yet an important armamentarium for a skull base surgeon. The indications and outcomes of STP would be also presented and literature reviewed. The variations in surgical technique of STP would be briefly elaborated and discussed.

Methods

Ours is a retrospective study that included review of patients' charts who had undergone STP (by the same surgeon) from two different tertiary care centers in Indian subcontinent from April 2018 to March 2023 (5 years). All cases of STP were performed by the neurootologist of our center as this surgery requires good surgical expertise and fair amount of experience. This was just circumstantial and beyond the control of the authors. It is a rare surgery, and therefore, ours is a retrospective study and not a case control study. So, maintaining a control group was not possible. The exclusion criteria constituted expansions into skull base operations, viz., transotic, transcochlear, translabyrinthine, and infratemoral fossa approaches and STBRs. Data was collected from hospital records. Since it is a retrospective study, blinding was not possible. Data collected included clinical history, clinicoradiological examination, surgical technique, perioperative complications, and follow-up details of patients who underwent STP. Informed consent from patients was obtained. Institutional ethical committee clearance was also sought.

All patients undergoing STP included four major surgical steps as described by Prasad et al. [5]: (1) BSC of external auditory canal (EAC); (2) canal wall down mastoidectomy (CWDM) with complete removal of ME pathology and all epithelium; (3) exenteration of all mastoid, perisigmoid, perilabyrinthine, perifacial, and hypotympanic cells with preservation of otic capsule, fallopian canal, and middle/posterior fossa plates; and (4) obliteration of the surgical cavity with abdominal fat. Patients additionally undergoing partial removal of otic capsule, removal of middle fossa dural plate, sigmoid sinus dural plate, or fallopian canal for disease clearance were also included. Follow-up was done using magnetic resonance imaging of brain and inner ear (MRI-B&IE).

Collected data was analyzed for epidemiology, presenting complaints, and audiometric results. We also compiled the data for indications of STP, perioperative complications, duration of surgery, length of hospital stay, duration of follow-up, and outcomes. Data was analyzed using SPSS software version no. 21 (IBM, USA).

Surgical procedure

Large C-shaped post-auricular incision was given 2 cm above and behind the pinna. Superiorly based musculoperiosteal flap with a separate small anteriorly based Palva's flap was elevated. Transection of EAC skin was done at bony cartilaginous junction followed by diligent separation of skin from underlying cartilage and its outward eversion. Skin was closed in layers with 3–0 silk and monocryl sutures as depicted in Fig. 1. Palva flap was folded backwards (anteriorly) and sutured to anterior canal cartilage perichondrium to provide layered closure and tensile strength. Tympanomeatal flap and annulus were elevated circumferentially and excised under microscope ensuring that no epithelial remnants were left behind. ME inspection was done and findings were noted. Trans-canal inside out CWDM was performed as depicted in Fig. 2. This step is different from what has been described in literature for STP although it is one of the standard way to perform CWDM. This was followed by disease eradication along with removal of ossicular chain leaving behind stapes footplate. The exenteration limits of temporal bone cell tracts were governed by extent of disease and indication for STP. Mucosa around protympanum was elevated and inverted into the bony Eustachian tube (ET) orifice and reinforced with head of

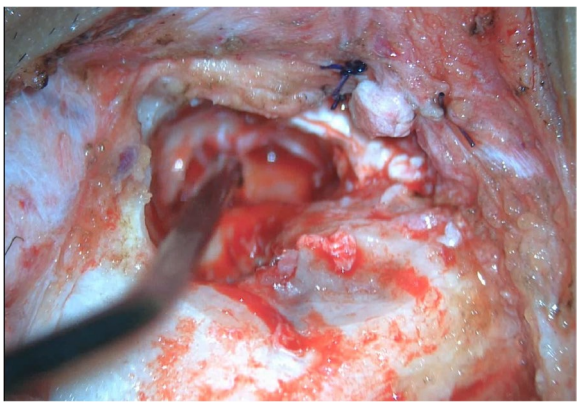

Fig. 1 Superiorly based musculoperiosteal flap with a separate small anteriorly based Palva's flap was elevated. Transection of EAC skin was done at bony cartilaginous junction followed by diligent separation of skin from underlying cartilage and its outward eversion. Skin was closed in layers with 3-0 silk and monocryl sutures

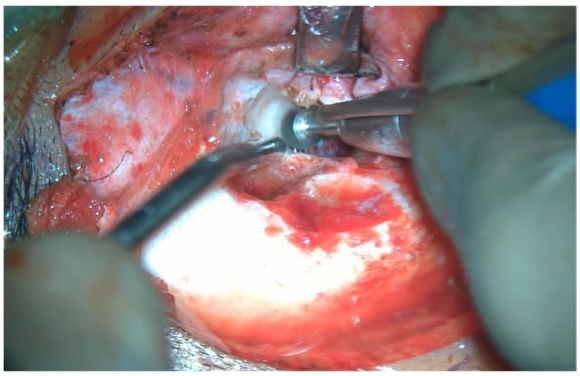

Fig. 2 Inside out canal wall down mastoidectomy

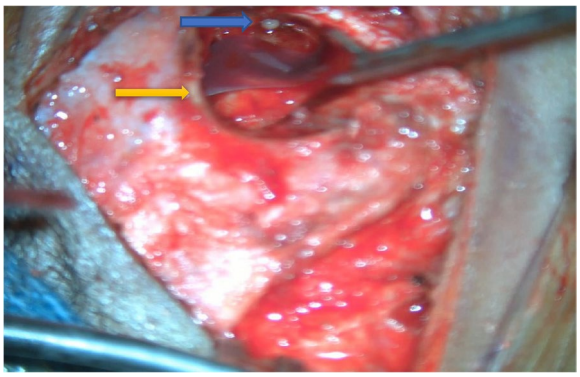

Fig. 3 Mucosa around protympanum was elevated and inverted into the bony Eustachian tube orifice and reinforced with head of malleus (blue arrow), free muscle plug and periosteum. In cases where second stage cochlear implantation was planned, a thin 2 x 1 cm silastic sheet (thickness- 0.1 mm) was placed over the medial wall of resultant cavity to cover the round window niche and fallopian canal. This helps in identifying round window niche and protecting facial nerve during second stage surgery for CI

malleus, free muscle plug, and periosteum as depicted in Fig. 3. In cases where second stage cochlear implantation (CI) was planned, a thin 2×1 cm silastic sheet (thickness, 0.1 mm) was placed over the medial wall of resultant cavity to cover the round window niche and fallopian canal as depicted in Fig. 3. According to author and primary surgeon, this step helps in identifying round window niche and protecting facial nerve during second stage surgery for CI. ME cavity was obliterated using harvested free muscle or free fat from the anterolateral aspect of the thigh. Retro-auricular surgical wound was closed in layers.

Results

In the present study, STP was carried out in 9 ears (8 patients) as collated in Tables 1 and 2. One patient underwent bilateral sequential STP for bilateral chronic otitis media (COM) active squamous ear disease (patient serial nos. 1 and 2). Mean age was 36.6 years with a range of 17–56 years. The female to male ratio was 1:1 (4 patients were males and 4 were females). In 6 cases (66.67%), STP was performed on right ear and in 3 cases (33.33%) on left ear. Out of 9 ears, 4 ears (44.4%) had history of previous surgery (3 in the setting of squamous disease and 1 for neuroendocrine tumor of EAC). Hearing loss was the commonest symptom at presentation which was reported by all patients followed by otorrhea in 4 ears (44.44%). Giddiness and facial weakness was reported by 50% of patients (4 out of 8 patients) and 37.5% of patients (3 patients) respectively. The other uncommon presenting complaints were CSF otorhinorrhea, retro-orbital pain, and double vision. Audiological evaluation revealed that 6 out of 9 ears (66.67%) had sensorineural hearing loss (SNHL), 2 ears (22.2%) had conductive hearing loss (CHL), and 1 ear had mixed hearing loss (11.1%) as collated in Table 1. It is submitted that pre-operative hearing thresholds were important in decision-making. In case a patient had SNHL (unserviceable hearing), decision for STP became justified. CHL excluded this surgery. Also, in STP, we performed blind sac closure which did not enable calculation of post-operative air conduction thresholds. The pathologies and indications for STP in our case series are as enumerated in Table 2. The most common pathology to undergo STP was COM squamous which was seen in 4 ears (44.44%) followed by ME tumors in 3 ears (33.33%). Other pathologies were inflammatory lesion (petrous apicitis) and traumatic CSF otorhinorrhea. The most common indication of STP was disease clearance ($n=8$) in 88.89% followed by unserviceable hearing ($n=7$) in 77.78%. One patient underwent STP for traumatic CSF otorhinorrhea secondary to otic capsule involving temporal bone fracture. Preoperative decision for STP was taken in 6 ears all of whom were considered for hearing rehabilitation in the form of either staged CI or active bone conduction implantation (AcBCI). While 3 patients underwent STP based on intraoperative findings. This included a patient with intraoperative CSF leak from IAC dural breach during clearance of cholesteatoma which contributed to intraoperative decision. Additionally another patient had extensive tympanic paraganglioma with erosion of anterior and superior bony EAC wall erosion which lead to decision of STP. Furthermore, a third patient had a large tegmen defect because of tumor extension from ME and apical turn of cochlea.

In our reported cases, average surgical time was 3.77 h with a range of 3–5 h which excludes time required for intubation and extubation by anesthesiologist. The average length of hospital stay was 7.2 days (range 4–14 days). The post-operative period was uneventful in our case series. The mean follow-up was 36 months (range: 6–60 months) as tabulated in Table 2. None of

Table 1 Epidemiology, clinicoradiology and audiology findings of patients undergoing subtotal petrosectomy

Patient no.	Age and gender	Presenting complaints	Clinical findings	Audiometry	Imaging
1	24 years; female	Known case of bilateral COM squamous (two previous surgeries each in both ears) Bilateral persistent otorrhea and progressive hearing loss X 5 years	Bilateral CWDM status with cholesteatoma recidivism	Bilateral profound SNHL	High resolution computed tomogram temporal bone (HRCT-Tb): soft tissue attenuation in both MECs
2	25 years; female	Known case of bilateral COM squamous (two previous surgeries in right ear) Bilateral persistent otorrhea and progressive hearing loss X 5 years	Right ear CWDM status Left ear: STP status	Bilateral profound SNHL	HRCT-Tb: soft tissue attenuation in both MECs
3	53 years; male	Known case of carcinoid tumor (neuroendocrine tumor) of right EAC (1 previous surgery) Hearing loss right ear × 2 years Right sided facial weakness × 2 years Vertigo and bleeding from right ear × 1 week	Aural polyp right ear; Right facial palsy	Profound SNHL right	HRCT-Tb: soft tissue density in right MEC MRI-B&IE: increased signal intensity in right MEC with post contrast enhancement Biopsy of aural polyp: fibroepithelial polyp
4	17/M	Known case of bilateral COM squamous (one previous surgery each in both ears) Persistent otorrhea and hearing loss right X 2 years Vertigo × 1 month Right facial weakness × 1 month	Bilateral mastoidectomy status with cholesteatoma Right facial paresis Head impulse test positive on right side	Right profound SNHL and left moderate SNHL	HRCT-Tb: soft tissue density in right MEC extending into petrous apex eroding tegmen tympani, superior semicircular canal and IAC Left ear: soft tissue density in MEC MRI-B&IE: bilateral MEC cholesteatoma with no intracranial extension
5	37/M	Hearing loss right with salty nasal discharge post road traffic accident	Clear fluid behind intact right tympanic membrane (TM)	Profound SNHL right	HRCT-Tb: otic capsule involving fracture of right temporal bone
6	42/M	Persistent otorrhea left X 3 months, left retro-orbital headache, diplopia X 7 days	Small central perforation in pars tensa Left lateral rectus paresis	Moderate CHL left	HRCT-Tb: soft tissue density in left MEC and petrous apex with bony erosion MRI-B&IE: diffuse enhancement in left MEC and petrous apex without ring enhancement
7	31/F	Bilateral progressive hearing loss X 1 year Recurrent episodic giddiness × 1 year Scanty mucopurulent otorrhea right × 1 year	Bilateral posterosuperior retraction pocket	Bilateral profound SNHL	HRCT-Tb: soft tissue density in both MECs with bony erosion
8	56/F	Progressive facial weakness right × 1 year Progressive hearing loss right × 3 months Rotatory vertigo × 15 days	Pinkish mass behind intact right TM; facial palsy right	Profound mixed hearing loss right (unserviceable)	MRI-bie: 17 × 10 mm extradural lesion in relation to tympanic segment of facial nerve and geniculate ganglion extending towards petrous apex and indenting dura of middle cranial fossa HRCT-Tb: soft tissue density as described above with erosion of tegmen tympani and apical turn of cochlea right

Table 1 (continued)

Patient no.	Age and gender	Presenting complaints	Clinical findings	Audiometry	Imaging
9	45/F	Progressive hearing loss left intermittent blood tinged otorrhea left X 7 months	Pinkish mass arising from anterior wall of left EAC; facial palsy left	Severe CHL left	HRCT-Tb: soft tissue in left EAC and MEC eroding anterior and superior wall bony EAC walls, tegmen tympani, petrous apex, and facial canal at first genu MRI-bie: intensely enhancing lesion in left EAC & MEC extending along petrous carotid artery without intradural extension DOTA NAC PET: suggestive of neuroendocrine tumor Computed tomographic angiography: blood supply predominantly from left ascending pharyngeal artery (embolized 24 h before surgery)

Table 2 Indications and outcomes of patients undergoing subtotal petrosectomy

Patient no.	Diagnosis	Indication for STP	Duration of surgery	Perioperative complication	Length of hospital stay	Follow-up period	Follow-up
1	Bilateral recurrent COM squamous with bilateral profound SNHL	Disease clearance Preparing patient ear for CI	3 h	Nil	4 days	3.5 years	BSC intact MRI-B&IE showed no residual cholesteatoma Underwent CI in left ear
2	Bilateral recurrent COM squamous with profound SNHL	Disease clearance Preparing patient ear for CI	3 h	Nil	4 days	3.25 years	BSC intact MRI-B&IE showed no residual cholesteatoma Patient awaiting CI surgery
3	Recurrent Neuroendocrine tumor right temporal bone (Grade 2) with right facial nerve palsy (House Brachmann Grade 5) and profound SNHL	Disease clearance	4 h	Nil	5 days	3 years	BSC intact MRI-B&IE showed no recurrence
4	Bilateral recurrent COM squamous active with right labyrinthitis and facial paresis and superior semicircular canal fistula	Disease clearance Intra-operative CSF leak	5 h	Intra-operative CSF leak from IAC dural breach	7 days	3.5 years	BSC intact MRI-B&IE showed no recurrence in right ear
5	Otic capsule involving fracture right temporal bone with CSF otorhinorrhea and profound SNHL	Traumatic CSF otorhinorrhea with unserviceable hearing Preparing ear for active bone conduction implant (AcBCI)	3 h	Nil	12 days	4 years	BSC intact Patient planned for AcBCI for hearing rehabilitation
6	Left COM mucosal active with petrous apicitis (Gradenigo Syndrome)	Petrous apex extradural lesion Preparing ear for AcBCI	4 h	Nil	14 days	3.5 years	BSC intact Patient planned for AcBCI for hearing rehabilitation
7	Bilateral COM squamous with bilateral profound SNHL	Disease clearance Preparing patient ear for CI	3 h	Nil	4 days	6 months	BSC intact Bilateral simultaneous CI planned as second stage
8	Right facial nerve hemangioma of temporal	Disease clearance Intracranial extradural extension of tumor Erosion of tegmen tympani and apical turn of cochlea	5 h	Repair of 2 cm × 1 cm size tegmen tympani defect with underlay cartilage	5 days	5 years	BSC intact
9	Left tympanic paraganglioma (FISCH stage C3)	Disease clearance Bony EAC erosion (anterior and superior wall) Planned for AcBCI	4 h	Nil	10 days	1 year	BSC intact Planned for AcBCI

the patients were lost to follow-up. Out of the 6 ears for hearing rehabilitation with otological implants, only one has had undergone CI (patient serial nos. 1 and 2). This patient is satisfied with CI outcomes in one ear and does not want to undergo another surgery, while the second patient for CI is planned in recent future. All the remaining 3 ears for AcBCI are awaiting surgery because of delay in procurement being a government institute.

All patients are under regular follow with a mean follow-up period of 36 months (range of 6 months to 60 months). None of the patients had any dehiscence of BSC or secondary acquired cholesteatoma on imaging.

Discussion

Gacek (1976) managed cases of complicated COM involving exposed dura and CSF leak, by modifying this technique with a retro-auricular incision and additional closure of EAC and ET along with cavity obliteration with abdominal fat [6]. Coker et al. in 1986 first employed the term "subtotal petrosectomy" [2]. Subsequently over approximately six decades, it has now become a well-established surgical technique, and its indications have expanded to include diverse situations like CI and bone conduction implants (BCI) [7, 8]. Ugo Fisch (1988) furnished distinction between STP and other lateral skull base surgeries (LSBS). He projected STP as a relatively conservative approach wherein all cell tracts of middle ear cleft (MEC) are exenterated while preserving cortical bone plates over middle and posterior cranial fossae and sigmoid along with otic capsule and fallopian canal for disease clearance [2]. Another confusing term in LSBS is subtotal temporal bone resection (STBR) which is performed for EAC malignancies. It is, however, different in the aspect that drilling of temporal bone entails en-bloc removal of tympanic bone including anterior canal wall combined with diverse extent of parotidectomy and lymph nodes dissection. It is therefore recommended that all trans-temporal surgeries managed with BSC of EAC should not be labelled as STP [5].

The largest case series ($n=460$) on STP available in literature is by Prasad et al. [5]. The mean age of patients was 51 years (range = 5–87 years) with slight male preponderance (approximately 55% in males versus 45% in females). In our case series ($n=8$ patients), the mean age was 36.6 years (range 17–56 years) with equal male to female ratio. The lower mean age of STP in our reported series could be because of increased awareness among the present day surgeons regarding this surgical option and also because our center also offers hearing rehabilitation with otological implants free of cost being a government institute.

The indications for STP on literature review include extensive cholesteatoma of middle ear cleft (MEC), large tumors without intradural extensions, intra-operative meningo-encephalic herniation, CSF leak, and preparing the ear for auditory implants [5, 9]. The present reported case series though small ($n=9$ ears) encompassed pathologies ranging from extensive cholesteatoma of MEC, acute petrous apicitis, traumatic and intraoperative CSF leak, ME tumors without intradural extension, and preparing patient ear for auditory implants as collated in Tables 1 and 2. In present case series, intraoperative decision for STP were taken for uncontrolled CSF gusher, large tegmen defect along with erosion of apical turn of cochlea, and extensive erosion of superior and anterior bony EAC in a stage C3 tympanic paraganglioma resulting in large cavity. The primary surgeon and author is of the opinion that absence of 3 walls of bony EAC (anterior, superior and posterior) would lead to collapse of soft tissues and acquired EAC stenosis and its resultant sequelae. We are of the opinion that in a patient undergoing CWDM, if either of anterior wall or floor of bony EAC is found to be eroded or needs to be removed for disease clearance, then the surgeon must opt for STP to avoid iatrogenic canal stenosis and its sequelae.

CWDM done for tumor excision or extensive cholesteatoma clearance had problems arising from large mastoid cavity. Additionally a patient with a large open mastoid cavity is unsuitable for CI or AcBCI (like Bone Bridge from Med El, Austria). A STP prepares a patient for second stage otological implants. Also, STP evades the drawbacks of a large mastoid cavity, and the patients has no restriction of indulging into water-related activities like water sports and swimming. Furthermore, in patients of CSF otorrhea with unserviceable hearing, STP encompassing obliteration of MEC with BSC of EAC and plugging of ET can be a robust technique for control of CSF gusher and also preparing ear for hearing rehabilitation. Last but not the least, STP has a more definitive positive outcomes and can avoid unnecessary revision surgeries. A publication by Issing et al. (1998) mentions a patients who had undergone surgery 26 times before STP [10]. While in the largest available case series of STP, Sampath et al. (2017) had reported about a patient having up to 8 previous surgeries before undergoing STP. In the present case series, one patient had undergone two previous surgeries in both ears for extensive bilateral cholesteatoma with profound hearing loss before we performed bilateral sequential STP followed by staged CI in one ear (patient nos. 1 and 2). Patient though satisfied with the surgical outcome and auditory rehabilitation is unwilling for CI in second ear because of her experience of multiple previous surgeries.

As per contemporary literature, results of STP can be improved by ensuring an adequately wide post-auricular incision so as to prevent a mastoid fistula. Additionally, musculoperiosteal flap should be elevated with a posterior pedicle. While to strengthen the BSC, underlying conchal and tragal cartilages can be approximated to create an additional layer of support. During CWDM, it is pertinent to ensure that there is no residual disease. Moreover, skin, annulus, and tympanic membrane with malleus and incus should be removed in toto to lower risk of leaving behind residual epithelium and prevent recurrent cholesteatoma [5]. It has also been reiterated that peritubal cells must be exenterated as they can act as pathway for CSF egress to nasopharynx bypassing the closed ET. The closure of ET is an important step, and it must be done meticulously to seal off the tympanic cavity. The stapes superstructure should also be removed as leaving it behind could allow fat to exert a piston like pressure on the stapes leading to postoperative vertigo [11]. The primary surgeon at our center employs a superiorly based musculoperiosteal flap with a small anterior based Palva flap raised from mastoid cortical bone. This allows us to use the Palva flap to support the BSC by suturing it anteriorly onto perichondrium of the cartilage. The superiorly based musculoperiosteal flap can be extended superiorly into temporal fossa to raise a larger flap to be either rotated inferiorly to provide additional muscular support to skin flap and prevent development of a mastoid fistula. Secondly, we perform an inside out CWDM for all cases for disease clearance which optimizes size of resultant tympanomastoid cavity depending on extent of disease. Thirdly, we use a thin silastic sheet with approximate size 10 mm × 20 mm × 0.1 mm (yellow arrow in Fig. 3) to cover promontory, RW niche, and facial canal whenever patient is eligible for second stage CI as shown in Fig. 3. The primary surgeon is of the opinion that this allows ease in identifying the RW niche and protects facial nerve while releasing the soft tissue from tympanomastoid cavity. The authors admit that since our experience with this surgery included eight patients (nine ears), ours is a small sample size, and therefore our findings may not be generalized to larger population size. STP was done in patients upon indication. Ours is a government institute where treatment is given free of cost to all patients. Therefore, cost-effectiveness of this rare surgery has not been addressed in our study. In view of small sample size, detection of statistically significant outcomes was not feasible. Despite, these limitations, the authors have attempted to share their experience of this uncommon surgery as this surgery is increasingly being accepted as a preferred option for expanding clinical scenarios.

Conclusion

STP facilitates disease clearance by providing unmatchable exposure in difficult otological scenarios and also enables to isolate MEC from external environment thereby eliminating problems of mastoid cavity. Additionally, it prepares the ear for second stage CI or AcBCI. Furthermore, it has useful surgical options for uncontrolled CSF gusher. The threshold for performing STP is decreasing, and its indications are expanding as more and more otoneurologists and skull base surgeons are gaining knowledge and experience about the nuances of this surgery. In our experience, it is a safe surgery with minimal complications in experienced hands.

Abbreviations

STP	Subtotal petrosectomy
CSF	Cerebrospinal fluid
IAC	Internal auditory canal
ME	Middle ear
BSC	Blind sac closure
STBR	Sub-total temporal bone resection
LSBS	Lateral skull base surgery
EAC	External auditory canal
CWDM	Canal wall down mastoidectomy
MRI-B&IE	Magnetic resonance imaging-brain & inner ear
ET	Eustachian tube
CI	Cochlear implant
COM	Chronic otitis media
SNHL	Sensorineural hearing loss
CHL	Conductive hearing loss
AcBCI	Active bone conduction implant
MEC	Middle ear cleft
HRCT-Tb	High resolution computed tomogram-temporal bone
TM	Tympanic membrane

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Authors' contributions

SG: conceptualization, formal analysis, methodology, project administration, supervision.
RC: data curation, formal analysis. TM: data curation, formal analysis, methodology, project administration, supervision, writing original draft. GD: supervision, formal analysis. VB: supervision. PV: investigation. All authors have read and approved the final manuscript.

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Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

This study was approved by the Institutional Ethics Committee, Command Hospital, Kolkata, Alipore Road, Kolkata 700027, India, dated 01 November 2023.
Informed written consent to participate in the study was provided by all participants.

Consent for publication

Written and well-informed consent for the publication was obtained from all the participants.

Competing interests
The authors declare that they have no competing interests.

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