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Tympanic Membrane and Ossicular-Sparing Modified Lateral Temporal Bone Resection

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Abstract

A modified lateral temporal bone resection (mLTBR) is a unique technique that spares the tympanic membrane (TM) and ossicles in select patients with squamous cell carcinoma (SCCa). The records of 5 patients with SCCa of the temporal bone with negative frozen-section biopsy at the tympanic annulus were reviewed. The mean follow-up time for the patients was 29.2 months. One patient received postoperative radiation due to cervical nodal extracapsular spread. All patients were recurrence free as of the most recent follow-up (range, 8–50 months). Postoperative audiometry demonstrated an average conductive hearing loss of 9 dB (range, 0–17 dB). The mLTBR with sparing of the TM can be an effective alternative to the traditional lateral temporal bone resection (LTBR) with better hearing results for patients with SCCa involving the bony external auditory canal. In the short term, oncologic results of mLTBR appear equivalent to the LTBR. However, long-term follow-up is needed for >5-year outcomes.

Keywords

lateral temporal bone resection, squamous cell carcinoma, tympanic membrane, ossicles

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Squamous cell carcinoma (SCCa) is the most common temporal bone (TB) malignancy.¹ Different approaches for surgical resection of malignancies of the external auditory canal (EAC) and TB have been described.² Lateral TB resection (LTBR) involves resection of the bony EAC, tympanic membrane (TM), malleus, and incus.² En bloc LTBR is recommended for definitive management of early lesions (T1 and T2), which have excellent survival.¹ Previously, a “sleeve resection” has been described as oncologically sound for periauricular or conchal tumors that do not involve the bony EAC.³ In this study, we present our results using a modified LTBR (mLTBR) that spares the TM

and ossicles as an alternative to the traditional LTBR in a select group.

Materials and Methods

Chart Review

After institutional review board approval from the University of California, Irvine, a retrospective review was performed of 11 patients with SCCa of the TB from 2011 to 2016. All patients had an audiogram, computed tomography (CT), and magnetic resonance imaging (MRI) of the TB and neck. The management decision was based on a multidisciplinary tumor board. Patients with malignancy involving the bony EAC but without evidence of TM involvement on examination or imaging were considered for an mLTBR. The decision to spare the TM and ossicles via an mLTBR was made intraoperatively if frozen sections of the circumferential EAC at the TM were negative for carcinoma. Six patients had their tumors removed using mLTBR. One patient in the mLTBR group that died of a non-disease-related cause was excluded and 5 patients were included in this review. The patients were evaluated every 3 to 4 months postoperatively for the first year and every 3 months thereafter between the head and neck surgeon and the neurotologist with yearly positron emission tomography (PET)/CTs. Pre- and postoperative audiograms were compared.

Operative Details

Initially, a 1- to 2-mm thin sliver of skin was removed transcanal from the medial canal just lateral to the annulus, as a complete ring of skin. This was sent for frozen section, and if returned as negative for SCCa, we proceeded with an

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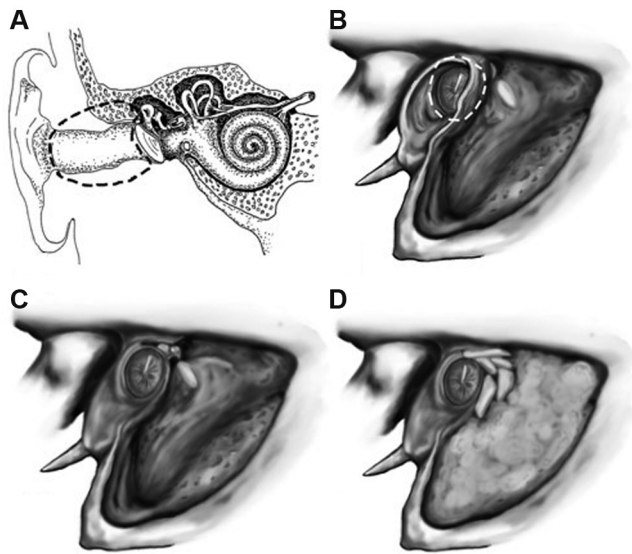


Figure 1. (A) The skin between the black dashed line and the annulus is the skin that is initially biopsied. (B) Dashed line indicates site of osteotomies in modified lateral temporal bone resection (mLTBR) (site of the skin removal). (C) Post-mLTBR with intact tympanic membrane and ossicles. (D) Reconstruction after mLTBR, a combination of cartilage and bone pate used to obliterate the mastoid.

mLTBR. The specific margins and boundaries of surgical resection vary slightly in each patient but are demonstrated in **Figure 1A, B**. A mastoidectomy was then performed with identification of the incus and malleus extending to the temporomandibular joint (**Figure 1C**). Osteotomies were performed using a curved osteotome just lateral to the annulus to enter the EAC posteriorly. The anterior canal osteotomy at the annulus was performed once the posterior canal was opened. A combination of cartilage (when available) and bone pate was used for mastoid obliteration (**Figure 1D**). A long Palva myofascial flap was used to cover the bone pate. A split-thickness skin graft (STSG) was used to

cover the Palva and EAC. Thick silastic disks were placed on the TM to maintain the anterior sulcus angle and prevent canal stenosis and packed with otowicks. Patients were seen 1 week postoperatively for packing removal. The silastic disks were removed when the EAC had entirely healed.

Results

The study population and survival results are described in **Table 1**. Histologically, the tumor was SCCa in all patients, and all patients had negative margins on final histology. The mean follow-up time was 29.2 months (range, 8-50 months). Postoperative audiometric testing was done at 3 months after surgery and every 6 to 12 months thereafter. The latest audiology data were reported. Two patients had no evidence of conductive hearing loss on their last audiogram. The otoscopic image of patient 1 at last follow-up (50 months) is shown in **Figure 2**. All 5 patients had no evidence of disease at the most recent follow-up (**Table 2**). A nondisplaced fracture of the bony annular ring occurred in 1 patient. Granulation tissue occurred in most patients during healing, and all but 1 healed by 8 weeks. All patients have maintained dry cavities.

Discussion

We found that an mLTBR sparing the TM and ossicles can allow for preservation of conductive hearing without sacrificing the oncological outcome. In certain patients, this surgical technique can be preferable to a standard LTBR. Prior modifications to the LTBR with the aim of hearing preservation have been described. Medina et al³ described resection of the bony EAC lateral to the TM for tumors of the concha and periauricular skin that did not involve the skin of the bony EAC. The complete circumference of the bony EAC was resected using a drill, including the entire anterior canal wall. Our method is similar to that of Medina et al³ with the exception that we performed an en bloc resection of the canal with osteotomes. Others have described reconstruction of the EAC to minimize the conductive hearing loss (CHL) after LTBR.^{3,4} We similarly chose to reconstruct

Table 1. Demographics, Presenting Stage, and Extent of Surgery Data for Patients in This Series.

Case	Age (y), Sex	Site of Primary Tumor	Clinical or Pathologic T Stage	Clinical or Pathologic N Stage	Surgery Performed	Positive Lymph Nodes
1	86, M	A/P cartilaginous and P bony EAC	T2 ^a	2b	mLTBR, parotidectomy, ipsilateral neck dissection	1/45
2	84, M	A/P cartilaginous and A bony EAC	T2 ^a	0	mLTBR, parotidectomy	None
3	61, M	A/P bony EAC	T1 ^b	0	mLTBR	N/A
4	73, M	Auricle, A/P cartilaginous and A/P bony	T2 ^a	0	mLTBR	N/A
5	69, M	EAC	T1 ^b	0	mLTBR	N/A
		P cartilaginous and P bony EAC				

Abbreviations: A, anterior; EAC, external auditory canal; F, female; M, male; mLTBR, modified lateral temporal bone resection; N/A, not applicable; P, posterior.

^aDenotes the American Joint Committee on Cancer staging criteria for cutaneous carcinoma.

^bDenotes the Pittsburgh staging system.

Table 2. Pathology and Outcome Data for Patients in This Series.

Case No.	Perineural Spread?	Lymphovascular Invasion?	Positive Margins	Follow-up, mo	Preoperative XRT	Postoperative XRT	Outcome	Preoperative PTA	Postoperative PTA	Postoperative CHL in PTA, dB
1	No	No	No	50	No	Yes	NED	25	78 ^a	15
2	No	No	No	46	No	No	NED	35	40	13
3	No	No	No	24	Yes	No	NED	30	30	0
4	No	No	No	18	No	No	NED	53	56	17
5	No	No	No	8	No	No	NED	20	20	0

Abbreviations: CHL, conductive hearing loss; NED, no evidence of disease; PTA, pure-tone average; XRT, radiation therapy.

^aSensorineural hearing loss due to radiation.



Figure 2. Otoscopic image of patient 1 at his 50-month follow-up.

the EAC with STSG and ultimately removed the bolster packing after 1 week to minimize granulation.

In our experience, when performing the osteotomies, care should be taken to not fracture the bony annular ring. This can cause a perforation or contraction at the TM level, which can contribute to conductive loss. This can be avoided by thinning the EAC medially prior to performing the osteotomies. Also, good technique in placement of the skin graft and early packing removal (after 1 week) helps reduce inflammation and granulation formation.

This study is intended to introduce a new surgical technique that has had utility in our practice. This study is currently limited by the number of patients, due to the rarity of patients fulfilling our inclusion criteria. More patients and a longer term follow-up are necessary to ensure the long-term outcomes of this procedure. Given the small patient cohort, no strong conclusions on the long-term safety can be made.

Conclusion

We present a unique surgical technique of an mLTBR sparing the TM and ossicular chain in 5 patients with SCCa

involving the EAC with uninvolved skin at the annulus on frozen section, providing a less morbid alternative to the traditionally described LTBR.

Author Contributions

Yaser Ghavami, contributed to concept and design of work, drafting of manuscript, and final manuscript approval; **Yarah M. Haidar**, contributed to concept and design of work, drafting of manuscript, and final manuscript approval; **Marlon Maducdoc**, contributed to concept and design of work, drafting of manuscript, and final manuscript approval; **Tjoso Tjoa**, contributed to concept and design of work, drafting of manuscript, and final manuscript approval; **Omid Moshtaghi**, contributed to concept and design of work, drafting of manuscript, and final manuscript approval; **Harrison W. Lin**, contributed to concept and design of work, drafting of manuscript, and final manuscript approval; **Hamid R. Djalilian**, contributed to concept and design of work, drafting of manuscript, and final manuscript approval.

Disclosures

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