

Temporal bone resection for patients with head and neck cancer: surgical modalities and techniques of reconstruction

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Objective

The aim of this article is to present authors' experience of using different modalities of temporal bone resection (TBR) and methods of reconstruction in malignant tumor involving temporal bone.

Patients and methods

For 27 patients scheduled for TBR, computed tomography was done for all patients, whereas complementary MRI for 13 patients. Different indications, TBR types, reconstruction technique, complications, and outcome were documented and analyzed.

Results

This study included 27 patients who had malignancy of or extend to temporal bone, including 11 (40.7%) external auditory canal, eight (29.6%) parotid gland, seven (26%) middle ears, and one (3.7%) lateral skull base tumors. The mean age of the patients was 57±10.4 years. Final histopathology was proved to be squamous cell carcinoma in 15 patients, adenoid cystic carcinoma in eight patients, and adenocarcinoma in four patients. Types of TBR were Lewis en-block technique in seven (26%) cases, lateral TBR in eight (29.6%) cases, modified lateral TBR in eight (29.6%) cases, and subtotal TBR in four cases (14.8%).

Neck dissection (ND) was performed in all patients in the form of modified radical neck dissection (13 cases), radical neck dissection (five cases), supraomohyoid (three cases), and upper neck dissection (six cases).

All preoperative clinicoradiological staging was upstaged postoperatively. Reconstruction of resulting defects was done using temporalis muscle flap (55.5%), pectoralis major myocutaneous flap (26%), latissimus dorsi myocutaneous flap (3.7%), trapezius myocutaneous flap (3.7%), and free flaps (14.8%). Reported complications were dural tears (22.2%), internal jugular vein injury (3.7%), transient vertigo (55.5%), complete facial nerve paralysis (33.3%), and hearing loss (14.8%). Postoperative adjuvant radiotherapy was given to 17 (62.9%) patients. The overall 3-year survival was 73%.

Conclusion

Commonest temporal bone involving malignancy was squamous cell carcinoma. TBR is integral part of radical resection for certain cancers involving temporal bone. Postoperative radiotherapy is usually needed. Operative tumor staging is more advanced than preoperative.

Keywords:

external auditory canal, reconstruction, squamous cell carcinoma, temporal bone resection

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Introduction

Temporal bone carcinoma (TBC) is a rare tumor and represents less than 0.2% of all head and neck cancers. The optimal management of TBC is still controversial, particularly the radiological evaluation of disease extent, the nomenclature of surgical procedures, and the appropriate form and timing of adjuvant therapy [1].

The treatment of squamous cell carcinoma (SCC) of the temporal bone comprises surgical excision followed by irradiation [2,3]. The proper extent of

surgery ranges from piecemeal removal of gross tumor with preservation of vital structures followed by radiation therapy to total en-block temporal bone removal. However, the appropriate extent of surgery as well as the ideal technique of reconstruction is still controversial [3].

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Ideally, the surgical defect should be reconstructed immediately to avoid tissue retraction and fibrosis and allow immediate adjuvant therapy to be given. As TBCs are rare, it is difficult for a single center to obtain sufficient cumulative experience [4], so it is important to describe the management and results of performed cases in each center regularly to allow gathering of data on these rare tumors.

The purpose of this study was to present our experience with use of different modalities of temporal bone resection (TBR) and methods of reconstruction and assess the complications associated with the treatment and final outcomes achieved.

Patients and methods

This study was conducted at the National Cancer Institute, Cairo University, on patients diagnosed to have malignant tumor of or extend to the temporal bone between June 2006 and January 2011. The ethical committee approval was obtained. Written informed consent was signed by all included participants. All patients were subjected to complete general and local physical examination including cranial nerve assessment. Pure-tone audiometry, routine preoperative laboratory investigations, and computed tomography evaluation were done for all patients. MRI was performed in 13 patients and computed tomography with contrast enhancement in eight patients. Chest radiography and abdominal ultrasound were performed to exclude distant metastases.

Biopsy was taken from ulcers, polyps, or granulations for histopathological diagnosis.

The patients were staged according to the Pittsburgh University Classification System (Annex 1) [4]. Patients with nonrespectable locally advanced tumors, distant metastases, or feeble medical condition were excluded from the study as well as patients with tumors that are not treated primarily by surgery, for example, lymphoma.

Results

This study included 27 patients diagnosed to have malignant tumor of or extend to the temporal bone, including 11 (40.7%) external auditory canal (EAC), eight (29.6%) parotid gland, seven (26%) middle ears, and one (3.7%) lateral skull base tumors. The mean age of the patients was 57 ± 10.4 years (range: 32–69 years). The most affected age group was from 61 to 69 years (12 cases, 44.4%), followed by those from 51 to 60 years (six cases, 22.2%) (Table 1).

There were 16 (59.3%) males and 11 (40.7%) females. The most frequent presenting symptom was bloody ear discharge in 10 (37%) patients, followed by swelling in the parotid region in six (22%) patients. Otagia occurred as the most frequent associated symptom in 14 (51.8%) patients. The most common finding on examination was aural polyp in 21 (77.8%) patients. The incidence of conductive hearing loss was 72.7%, mixed hearing loss was 4.5%, and sensorineural hearing loss was 4.5% (Table 1).

Radiologically speaking, tumors of the EAC with bony erosion were detected in 12 (44%) patients, and middle ear was involved in six (22%) patients. Parotid gland affection was detected in eight (29.6%) patients. Internal jugular vein and internal carotid artery (ICA) invasion occurred in one patient each, whereas temporomandibular joint invasion and intracranial extension were found in two (7%) patients each (Table 2).

Final histopathology was proved to be SCC in 15 (55.5%) patients, adenoid cystic carcinoma in eight (29.6%) patients, and adenocarcinoma in four (14.8%) patients. Histopathological assessment of the specimens reported tumor involvement of the EAC in 11 (40.7%) patients, middle ear in seven (26%) patients, denovo parotid tumors in five (18.5%) patients, recurrent parotid tumor in three (11.1%) patients, and lateral skull base in one (3.7%) patient.

Surgical management

Surgical techniques employed depend on the primary site. Types of TBR included Lewis en-block technique in seven (26%) cases, lateral TBR in eight (29.6%) cases, modified lateral TBR in eight (29.6%) cases, and subtotal TBR in four (14.8%) cases.

Regarding the parotidectomy series, 12 (44.4%) patients underwent superficial parotidectomies, eight (29.6%) total parotidectomies with facial nerve preservation (Figs 1–4) and seven (26%) radical parotidectomies. Dural resection was performed in two (7.4%) patients whereas two (7.4%) patients were inoperable owing to intracranial extension and lung metastases.

Neck dissection (ND) was performed in all patients in the form of modified radical ND (13 cases), radical neck dissection (five cases), supraomohyoid (three cases), and upper neck dissection (six cases).

For primary temporal bone tumors, preoperative clinicoradiological staging for T1, T2, and T3

Table 1 Patient characteristics, presenting symptoms, and results of examination

Patient nos	Age	Sex	Site of the primary lesion	History of chronic ear disease	Main presenting symptom	Duration (months)	Associated symptoms	Examination	Facial palsy	Hearing
1	65	Female	EAC	Yes	Bloody discharge	6	Otalgia	Aural polyp	No	CHL
2	63	Female	EAC	No	HL	12	Offensive discharge	Granulations and aural polyp	No	CHL
3	59	Male	EAC	Yes	HL	9	Offensive discharge	Granulations and aural polyp	No	CHL
4	61	Male	Middle ear	Yes	Facial palsy	94	Otalgia	Aura polyp	Grade V H&B (classification)	CHL
5	45	Male	Parotid	No	Swelling	9	Otalgia	Firm to hard mass	Grade V H&B (classification)	Normal
6	66	Female	Recurrent parotid	No	Swelling	7	Otalgia	Firm to hard mass	Grade V H&B (classification)	CHL
7	61	Male	EAC	No	Bloody discharge	6	Otalgia	Hard granulations	No	CHL
8	63	Female	Middle ear	Yes	HL	12	Offensive discharge	Hard granulations	Grade V H&B (classification)	CHL
9	54	Male	Parotid	No	Swelling	6	Otorrhea	Granulations and aural polyp	No	CHL
10	40	Female	Parotid	No	Swelling	8	Otalgia	Firm to hard mass	No	Normal
11	66	Male	Parotid	No	Swelling	8	Otalgia	Hard granulation	No	Normal
12	50	Female	Recurrent parotid	No	Facial palsy	6	Offensive discharge	Hard granulations	Grade V H&B (classification)	CHL
13	67	Male	Middle ear	No	Bloody discharge	6	Offensive discharge	Granulations and aural polyp	No	CHL
14	59	Female	Parotid	No	Swelling	6	Otalgia	Firm to hard mass	No	Normal
15	63	Male	EAC	Yes	Bloody discharge	5	Otalgia	Granulations and aural polyp	No	CHL
16	60	Female	EAC	Yes	Bloody discharge	4	Otalgia	Granulations and aural polyp	No	CHL
17	69	Female	Recurrent parotid	No	Bloody discharge	4	Otalgia	Granulations and aural polyp	Grade V H&B (classification)	CHL
18	51	Male	Middle ear	Yes	Bloody discharge	4	Tinnitus	Granulations and aural polyp	Grade V H&B (classification)	Mixed HL
19	61	Female	EAC	No	Bloody discharge	6	Otalgia	Granulations and aural polyp	No	CHL
20	68	Female	EAC	No	Bloody discharge	6	Otalgia	Granulations and aural polyp	No	CHL
21	32	Male	EAC	Yes	Otalgia	15	Tinnitus	Granulations and aural polyp	No	SNHL
22	58	Male	EAC	No	Bloody discharge	7	Otalgia	Granulations and aural polyp	No	CHL
23	32	Male	EAC	No	Otalgia	8	Tinnitus	Granulations and aural polyp	No	CHL
24	60	Male	Middle ear	Yes	Bloody discharge	15	Offensive discharge		Grade V H&B (classification)	CHL

(Continued)

Table 1 (Continued)

Patient nos	Age	Sex	Site of the primary lesion	History of chronic ear disease	Main presenting symptom	Duration (months)	Associated symptoms	Examination	Facial palsy	Hearing
25	45	Male	Middle ear	Yes	Bloody discharge	10	Offensive discharge	Granulations and aural polyp	No	CHL
26	55	Male	Middle ear	Yes	Bloody discharge	12	Offensive discharge	Granulations and aural polyp	No	CHL
27	68	Male	Lateral skull base	No	Swelling	6	Otalgia	Firm to hard mass	Grade V H&B (Classification)	CHL

CHL, conductive hearing loss; EAC, external auditory canal; mixed HL, mixed hearing loss.

Table 2 The different preoperative radiological findings

Patient nos	Type of radiology used	External canal bone erosion	Middle ear	Parotid gland	Neck	IJV	ICA	TMJ	Intracranial involvement	Staging
1	CT	Positive	Negative	Negative	Negative	Negative	Negative	Negative	Negative	T2
2	CT+MRI	Positive	Positive	Negative	Negative	Negative	Negative	Negative	Negative	T3
3	CT+MRI	Negative	Negative	Negative	Negative	Negative	Negative	Negative	Negative	T1
4	CT+MRI	Positive	Positive	Negative	Negative	Negative	Negative	Negative	Negative	T3
5	CT+MRI	Negative	Negative	Positive	Negative	Negative	Positive	Negative	Negative	T4a
6	CT+MRI	Positive	Negative	Positive	Negative	Negative	Positive	Negative	Negative	T4a
7	CT	Negative	Negative	Negative	Negative	Negative	Negative	Negative	Negative	T1
8	CT	Positive	Positive	Negative	Negative	Negative	Negative	Negative	Negative	T3
9	CT	Negative	Negative	Positive	Negative	Negative	Negative	Negative	Negative	T4a
10	CT+MRI	Negative	Negative	Positive	Negative	Negative	Negative	Negative	Negative	T2
11	CT	Positive	Negative	Positive	Negative	Negative	Negative	Negative	Negative	T1
12	CT+MRI	Positive	Negative	Positive	Negative	Positive	Negative	Negative	Positive	T4b
13	CT	Positive	Positive	Negative	Negative	Negative	Negative	Negative	Negative	T3
14	CT	Negative	Negative	Positive	Negative	Negative	Negative	Negative	Negative	T2
15	CT	Positive	Negative	Negative	Negative	Negative	Negative	Negative	Negative	T2
16	CT+MRI	Positive	Negative	Negative	Negative	Negative	Negative	Negative	Negative	T2
17	CT	Positive	Negative	Positive	Negative	Negative	Negative	Negative	Negative	T4
18	CT+MRI	Positive	Positive	Negative	Negative	Negative	Negative	Negative	Negative	T3
19	CT	Positive	Negative	Negative	Negative	Negative	Negative	Negative	Negative	T1
20	CT	Positive	Negative	Negative	Negative	Negative	Negative	Negative	Negative	T2
21	CT+MRI	Negative	Positive	Negative	Positive	Negative	Positive	Negative	Negative	T4
22	CT	Negative	Negative	Negative	Negative	Negative	Negative	Negative	Positive	T3
23	CT+MRI	Negative	Negative	Negative	Negative	Negative	Negative	Negative	Negative	T2
24	CT+MRI	Positive	Positive	Negative	Negative	Negative	Negative	Negative	Negative	T3
25	CT+MRI	Positive	Positive	Negative	Negative	Negative	Negative	Negative	Negative	T3
26	CT+MRI	Positive	Positive	Negative	Negative	Negative	Negative	Negative	Negative	T3
27	CT+MRI	Negative	Negative	Negative	Negative	Negative	Negative	Negative	Positive	T4

CT, computed tomography; ICA, internal carotid artery; IJV, internal jugular vein; T, tumor; TMJ, temporomandibular joint.

tumors was 21.3, 28.5, and 42.7%, respectively, and they were reduced to 8.3, 25, and 33.3% in the postoperative staging. However, T4 tumors were seen to have increased from 7.1% preoperatively to 33.3% on postoperative assessment. For parotid tumors, preoperative assessments of T1, T2, T3, T4a, and T4b were 12.5, 25, 0, 50, and 12.5%, respectively, and these were upstaged postoperatively to 0, 25, 0, 62.5, and 12.5%, respectively.

Reconstruction of the resulting defects was completed using temporalis muscle flap (15 cases, 55.5%), pectoralis major myocutaneous flap (seven cases, 26%) (Fig. 5), latissimus dorsi myocutaneous flap (one case, 3.7%), trapezius myocutaneous flap (one case, 3.7%), and free flaps (four cases, 14.8%). We faced one perioperative mortality from cerebrovascular stroke owing to intraoperative injury of the ICA.

Figure 1



Skin marking extended to the neck in patient 1.

Figure 2



Patient 1 after total parotidectomy, partial mandibulectomy, resection of temporomandibular joint, and partial temporal bone resection with partial excision of the auricle.

The operative and postoperative complications were dural tears in six (22.2%) cases that were repaired intraoperatively, internal jugular vein injury at its bulb in one (3.7%) case that was ligated, and transient vertigo in 15 (55.5%) cases that was treated by antivertiginous and labyrinthine sedative drugs. Complete facial nerve paralysis occurred in nine (33.3%) cases (grade VI in five cases and grade V in three cases). Hearing loss was encountered in four (14.8%) cases (Table 3).

Adjuvant treatment

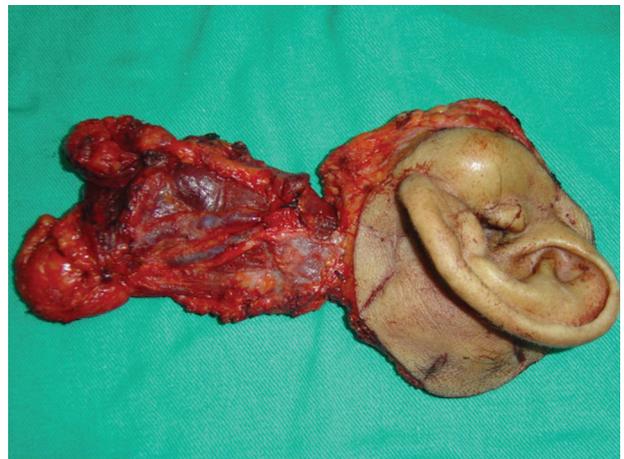
Postoperative adjuvant radiotherapy was given to 17 (62.9%) patients. Palliative radiotherapy and chemotherapy were offered for two patients; one of them had recurrence with intracranial extension and ICA involvement, and the other had lung metastases that were detected 6 months postoperatively.

Figure 3



Another patient after total parotidectomy and partial excision of the auricle.

Figure 4



The whole specimen containing auricle, external auditory canal, and parotid gland removed en bloc of patient 1.

Figure 5



Early postoperative after temporal bone resection and pectoralis major myocutaneous flap reconstruction of patient 1.

Follow-up

The overall 3-year survival was 73%; 21 (77.8%) patients showed no evidence of the disease, and four

Table 3 Comparison of histological findings, operative findings, surgical modalities, complications, adjuvant treatment, and outcome

Patients nos	Surgical margins	Bone erosion	Middle Ear	TMJ	T staging	Neck disease	Surgery	Reconstruction	Immediate complications	Delayed complications	Facial palsy	Hearing	Radiation	Chemotherapy	Recurrence	Outcome
1	Negative	Positive Full thickness	Negative	Negative	T3	RND	MLTBR+superficial parotidectomy	Temporalis MF	Negative	Transient Vertigo	Negative	Preserved	Yes	No	No	NED24 months
2	Negative	Positive	Positive	Negative	T3	MRND	MLTBR+total parotidectomy	Temporalis MF	Negative	Transient vertigo	Negative	Preserved	Yes	No	No	NED24 months
3	Negative	Negative	Negative	Negative	T1	Upper ND	LTBR+superficial parotidectomy	Temporalis MF	Negative	Negative	Negative	Preserved	Yes	No	No	NED24 months
4	Positive	Positive full thickness	Positive	Negative	T4	Upper ND	Lewis en-block+radical parotidectomy	Temporalis MF	Dural Tear	Transient vertigo	Positive	SNHL	No	No	No	NED20 months
5	Negative	Positive	Negative	Positive	T4a	RND	Lewis en-block+radical parotidectomy	PMCMF	Dural Tear	Transient vertigo	Positive	Preserved	Yes	No	No	NED18 months
6	Positive	Positive	Negative	Positive	T4a	Upper ND	Total parotidectomy+TMJ, segmental mandiblectomy +MLTBR	Free flap	Negative	Transient vertigo	Positive	Preserved	Yes	No	Yes	DOD10 months
7	Negative	Positive	Negative	Negative	T2	MRND	LTBR+superficial parotidectomy	Temporalis MF	Negative	Transient vertigo	Negative	Preserved	Yes	No	No	NED20 months
8	Positive	Positive	Positive	Negative	T4	RND	SUBTTBR+total parotidectomy	PMCMF	Dural Tear	Transient vertigo	Positive	SNHL	Yes	No	Yes	DOD14 months
9	Negative	Positive	Negative	Negative	T4a	MRND	Total parotidectomy +MLTBR	LDMCF	Negative	Negative	Negative	Preserved	No	No	No	NED18 months
10	Negative	Negative	Negative	Negative	T2	Upper ND	Total parotidectomy+LTBR	Temporalis MF	Negative	Negative	Negative	Preserved	No	No	No	NED22 months
11	Negative	Positive	Positive	Negative	T4a	MRND	Total parotidectomy+LTBR	Temporalis MF	Negative	Negative	Negative	Preserved	No	No	No	NED20 months
12	Positive	Positive	Negative	Negative	T4b	MRND	Total parotidectomy+TMJ, segmental mandiblectomy +MLTBR	PMCMF	Dural tear (ICE)	Negative	Positive	Preserved	Yes	No	Yes	DOD
13	Negative	Positive	Positive	Negative	T4	Supraomohyoid ND	SUBTTBR+superficial parotidectomy	Temporalis MF	Dural tear	Transient vertigo	Negative	SNHL	No	No	No	NED18 months
14	Negative	Negative	Negative	Negative	T2	Supraomohyoid ND	Total parotidectomy+LTBR	PMCMF	Negative	Transient vertigo	Negative	Preserved	No	No	No	NED22 months
15	Negative	Positive Full thickness	Negative	Negative	T3	RND	MLTBR+superficial parotidectomy	Temporalis MF	UV ligation	Transient vertigo	Negative	Preserved	Yes	No	No	NED20 months
16	Negative	Positive full thickness	Negative	Negative	T3	MRND	MLTBR+superficial parotidectomy	Temporalis MF	Negative	Transient vertigo	Negative	Preserved	Yes	No	No	NED24 months
17	Negative	Positive	Negative	Negative	T4a	MRND	Lewis en-block+radical parotidectomy	Temporalis MF	Negative	Transient Vertigo	Positive	Preserved	Yes	No	Yes	NED18 months
18	Positive	Positive	Positive	Negative	T4	MRND			Dural tear	Vertigo	Positive	SNHL	Yes	No	No	(Continued)

Table 3 (Continued)

Patients nos	Surgical margins	Bone erosion	Middle Ear	TMJ	T staging	Neck disease	Surgery	Reconstruction	Immediate complications	Delayed complications	Facial palsy	Hearing	Radiation	Chemotherapy	Recurrence	Outcome
19	Negative	Positive full thickness	Negative	Negative	T2	MRND	Lewis en-block+radical parotidectomy	Temporalis MF	Negative	Transient vertigo	Negative	Preserved	Yes	No	No	NED18 months
20	Negative	Positive full thickness	Negative	Negative	T2	MRND	LTBR+superficial parotidectomy	Temporalis MF	Negative	Transient vertigo	Negative	Preserved	Yes	No	No	NED20 months
21	Negative	Negative	Negative	Negative	T3	MRND	LTBR+superficial parotidectomy	Free flap	Negative	Negative	Negative	Preserved	Yes (in earlier stage)	Yes	No	Patient lost 9 months
22	Negative	Negative	Negative	Negative	T3	RND	Lewis en-block+radical parotidectomy block	PMMCF	Dural resection	Negative	Negative	Preserved	Yes	NO	Yes	DOD12 months
23	Negative	Negative	Negative	Negative	T2	MRND	LTBR+superficial parotidectomy	Free flap	Negative	Negative	Negative	Preserved	No	No	No	NED18 months
24	Negative	Positive	Positive	Negative	T3	Upper ND	Lewis en-block+radical parotidectomy	PMMCF	Negative	Negative	Positive	Preserved	No	No	No	NED18 months
25	Positive	Positive	Positive	Negative	T3	MRND	LTBR+superficial parotidectomy	Free flap	Negative	Negative	Negative	Preserved	No	No	Yes	NED20 months
26	Negative	Positive	Positive	Negative	T3	Upper ND	SUBTTBR+superficial parotidectomy	PMMCF	Negative	Negative	Negative	Preserved	No	No	No	NED18 months
27	Negative	Negative	Negative	Negative	T4	Supraomohyoid	Lewis en-block+radical parotidectomy	Trapezius muscle flap	Dural resection	Negative	Positive	Preserved	Yes	Yes	Yes	NED22 months

DOC, died of other cause; DOD, died of the disease; IJV, internal jugular vein; LDMCF, latissimus dorsi myocotaneous flap; LTBR, lateral temporal bone resection; MLTBR, modified lateral temporal bone resection; MRND, modified radical neck dissection; NO, negative neck (no lymph node involvement); ND, neck dissection; NED, no evidence of the disease; PMMCF, pectoralis major myocotaneous flap; RND, radical neck dissection; SNHL, sensorineural hearing loss; SUBTTBR, subtotal temporal bone resection; T, tumor; temporalis MF, temporalis myocotaneous flap; TMJ, temporomandibular joint.

(14.8%) patients died of the disease at the 10th, 12th, 14th, and 16th month postoperatively. One (3.7%) patient died of cerebrovascular stroke after 12 months, and one (3.7%) patient was lost to follow-up after 9 months from starting palliative chemotherapy.

Discussion

Primary SCC of the EAC and temporal bone is an uncommon malignancy with an estimated incidence of five cases per million populations [4]. The aim of this study was to evaluate the different surgical modalities of TBR based on a reliable staging system, the different reconstructive techniques, complications of surgical treatment, and its outcome.

In the current study, the mean age of patients at the time of surgery was 57 ± 10.4 years (range: 69–32 years), which is in concordance with the results of McGrew *et al.* [5] and Moffat *et al.* [6,7].

The most frequent presentation in our study was bloody ear discharge (37%), which is similar to the results of Mok and Sim [8]. Otolgia was the most frequently associated symptom (51.8%) in the current study, which is in agreement with the results of Yousem *et al.* [9] and Martinez-Devesa *et al.* [10].

The commonest final histopathological diagnosis in this study was SCC (55.5%), followed by adenoid cystic carcinoma (29.6%) and adenocarcinoma (14.8%). SCC is also reported to be the most common type of carcinoma by McGrew *et al.* [5] and Nyrop and Grontved [4].

SCC affecting the temporal bone has a more aggressive behavior and a worse prognosis than other tumor types [11].

In the current study, there was an obvious postoperative tumor upstaging when compared with preoperative clinicoradiological staging, which is why there is no generally accepted staging system, as reported by Nyrop and Grontved [4], because of the complexity of the disease both anatomically and pathologically.

The same is true for parotid tumors with postoperative upstaging of tumors compared with preoperative staging. This is attributable to invasion of the EAC or temporomandibular joint detected at the time of surgery. This is similar to the conclusion of Gillespie *et al.* [12], who reported that the pathological staging of the University of Pittsburgh closely correlates with the operative stage and patient

outcome and is more sensitive than preoperative radiological staging.

Nyrop and Grontved [4] reported that many authors did not believe that the tumor extent can be judged preoperatively and advocated that surgery should be guided by intraoperative findings in a piecemeal manner.

However, in our study, the preoperative clinicoradiological staging was more true for larger (T3 and T4) tumors than for smaller tumors (T1 and T2).

In our study, no preoperative radiotherapy was applied, which is in contrary to the study of Zhang *et al.* [13]. We agree with Nyrop and Grontved [4] that surgery is almost always performed for temporal bone tumors.

Reconstruction of the resulting defects was completed (81.5%) using mainly temporalis muscle flap (55.5%) and then pectoralis major myocutaneous flap (26%). Temporalis muscle flap was also the most commonly used flap for reconstruction by Lobo *et al.* [11] and Dean *et al.* [14].

In this study, adjuvant radiotherapy was given to 17 (62.9%) patients for positive deep margin. The guidelines from The American Society of Head and Neck Surgery and the Society of Head and Neck Surgeons recommend postoperative radiotherapy when resection margins are close (<5 mm), when proximity of the tumor to important structures precludes adequate resection, or if it shows perineural invasion [10]. These conditions apply for the majority of resections for TBR, thus indicating postoperative radiotherapy in most cases.

The 3-year survival rate was 73% in current study, which nears the rates reported in the study by Okada *et al.* [15], where 2-year and 5-year survival rates were 86 and 78%, respectively. Moreover, it nears to the results of Gidley *et al.* [16], where 2-year disease-free survival was 68%. On the contrary, Bassiouny and Ezzat [17] reported that the 3-year survival rate was 43.8%, Zhang *et al.* [13] reported a 5-year survival rate of 51.7% and Martinez-Devesa *et al.* [10] reported a 3-year survival rate of 38%.

These wide variations in survival rates in the literature and the current study could be attributable to the fact that survival for patients with primary TBC and related head and neck carcinomas as parotid neoplasm had variable staging systems, several

argumental concepts of the treatment modality, and different tumor pathological types. Moreover, some studies were done retrospectively over a long period on a variable number of patients which affects the survival rates.

The temporal bone is a difficult accessible area, and its malignant tumors are rare with an aggressive nature and poor prognosis. The best method of tumor staging and treatment is a matter of debate. Immediate reconstruction of the defect is mandatory to decrease the morbidity and to start adjuvant therapy as early as possible.

However, the technique of resection and optimum reconstruction should respect the patient's safety as well as tumor extent. Therefore, related results needed to be collected in updated meta-analysis and multicenter studies.

Conclusion

The commonest temporal bone involving malignancy was found to be SCC. TBR is an integral part of radical resection for certain head and neck cancers originating from or extend to the temporal bone. Postoperative radiotherapy is usually needed. The operative tumor staging is more advanced than preoperative clinicoradiological staging, so accurate preoperative staging is still a challenge.

Declaration of consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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