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%), spinal vertigo (3.7%), transient facial nerve paralysis (3.7%), 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

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 Pittsburg 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. Otalgia 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                             | Offensive discharge     | 12               | 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 Granulations and aural polyp | No          | Grade V H&B (classification) | Normal |
| 6           | 66  | Female | Recurrent parotid          | No                             | Swelling                | 7                | Otalgia             | Firm to hard mass Granulations and aural polyp | No          | 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 Granulations and aural polyp | Grade V H&B (classification) | CHL     |
| 9           | 54  | Male   | Parotid                    | No                             | Swelling                | 6                | Otalgia             | Otorrhea Granulations and aural polyp | No          | CHL         |         |
| 10          | 40  | Female | Parotid                    | No                             | Swelling                | 8                | Otalgia             | Firm to hard granulations | No          | Normal       |         |
| 11          | 66  | Male   | Parotid                    | No                             | Swelling                | 8                | Otalgia             | No Granulations and aural polyp | No          | Normal       |         |
| 12          | 50  | Female | Recurrent parotid          | No                             | Facial palsy            | 6                | Offensive discharge | Hard granulations Granulations and aural polyp | 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 Granulations and aural polyp | No          | Normal       |         |
| 15          | 63  | Male   | EAC                        | Yes                            | Bloody discharge        | 5                | Otalgia             | No Granulations and aural polyp | No          | CHL         |         |
| 16          | 60  | Female | EAC                        | Yes                            | Bloody discharge        | 4                | Otalgia             | No 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)
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.

**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 | Negative | T2     |
| 2           | CT+MRI                 | Positive | Positive | Negative | Negative | Negative | Negative | Negative | Negative | Negative | T3     |
| 3           | CT+MRI                 | Negative | Negative | Negative | Negative | Negative | Negative | Negative | Negative | Negative | T1     |
| 4           | CT+MRI                 | Positive | Positive | Negative | Negative | Negative | Negative | Negative | Negative | Negative | T3     |
| 5           | CT+MRI                 | Negative | Negative | Positive | Negative | Positive | Negative | Positive | Negative | Negative | T4a    |
| 6           | CT+MRI                 | Positive | Positive | Negative | Positive | Negative | Positive | Negative | Negative | Negative | T4a    |
| 7           | CT                     | Negative | Negative | Positive | Negative | Negative | Positive | Negative | Negative | Negative | T1     |
| 8           | CT                     | Positive | Positive | Negative | Negative | Negative | Negative | Negative | Negative | Negative | T3     |
| 9           | CT                     | Negative | Negative | Positive | Negative | Negative | Negative | Negative | Negative | Negative | T4a    |
| 10          | CT+MRI                 | Negative | Negative | Positive | Negative | Negative | Negative | Negative | Negative | Negative | T2     |
| 11          | CT                     | Positive | Positive | Negative | Negative | Negative | Negative | Negative | Negative | Negative | T1     |
| 12          | CT+MRI                 | Positive | Positive | Negative | Negative | Negative | Negative | Negative | Negative | Negative | T4b    |
| 13          | CT                     | Positive | Positive | Negative | Negative | Negative | Negative | Negative | Negative | Negative | T3     |
| 14          | CT                     | Negative | Negative | Positive | Negative | Negative | Negative | Negative | Negative | Negative | T2     |
| 15          | CT                     | Positive | Negative | Negative | Negative | Negative | Negative | Negative | Negative | Negative | T2     |
| 16          | CT+MRI                 | Positive | Negative | Negative | Negative | Negative | Negative | Negative | Negative | Negative | T4     |
| 17          | CT                     | Positive | Negative | Negative | Negative | Negative | Negative | Negative | Negative | Negative | T4     |
| 18          | CT+MRI                 | Positive | Positive | Negative | Negative | Negative | Negative | Negative | Negative | Negative | T3     |
| 19          | CT                     | Positive | Negative | Negative | Negative | Negative | Negative | Negative | Negative | Negative | T1     |
| 20          | CT                     | Positive | Negative | Negative | Negative | Negative | Negative | Negative | Negative | Negative | T2     |
| 21          | CT+MRI                 | Negative | Positive | Negative | Positive | Negative | Positive | Negative | Negative | Negative | T4     |
| 22          | CT                     | Negative | Negative | Negative | Negative | Negative | Negative | Positive | Negative | Positive | T3     |
| 23          | CT+MRI                 | Negative | Negative | Negative | Negative | Negative | Negative | Negative | Negative | Negative | T2     |
| 24          | CT+MRI                 | Positive | Negative | Positive | Negative | Negative | Negative | Negative | Negative | Negative | T3     |
| 25          | CT+MRI                 | Positive | Negative | Positive | Negative | Negative | Negative | Negative | Negative | Negative | T3     |
| 26          | CT+MRI                 | Positive | Negative | Positive | Negative | Negative | Negative | Negative | Negative | Negative | T3     |
| 27          | CT+MRI                 | Positive | Negative | Negative | Negative | Negative | Negative | Positive | Negative | Positive | T4     |

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

Follow-up
The overall 3-year survival was 73%; 21 (77.8%) patients showed no evidence of the disease, and four
| 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 | T3            | RND      | MLTBR+superficial parotidectomy | Temporalis MF | Negative | Transient vertigo | Preserved | Yes | No | No | NED24 months |
| 2           | Negative         | Positive    | Negative   | Negative | T3            | MRND     | MLTBR+total parotidectomy | Temporalis MF | Negative | Transient vertigo | Preserved | Yes | No | No | NED24 months |
| 3           | Negative         | Negative    | Negative   | T1          | Upper ND     | LTBR+superficial parotidectomy | Temporalis MF | Negative | Transient vertigo | Preserved | Yes | No | No | NED24 months |
| 4           | Positive         | Positive    | full thickness | 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    | Positive   | T4a         | RND          | Lewis en-block+radical parotidectomy | PMMCF | Dural Tear | Transient vertigo | Yes | No | No | NED18 months |
| 6           | Positive         | Negative    | Positive   | T4a         | Upper ND     | Total parotidectomy+TMJ, segmental mandiblection +MLTBR | Free flap | Negative | Transient vertigo | Yes | No | Yes | DOD10 months |
| 7           | Negative         | Positive    | Negative   | Negative | T2            | MRND     | LTBR+superficial parotidectomy | Temporalis MF | Negative | Transient vertigo | Preserved | Yes | No | No | NED20 months |
| 8           | Positive         | Positive    | Negative   | T4          | RND          | SUBTBR+total parotidectomy | PMMCF | Dural Tear | Transient vertigo | Positive SNHL | Yes | No | Yes | DOD14 months |
| 9           | Negative         | Positive    | Negative   | T4a         | MRND         | Total parotidectomy +MLTBR | LDMCF | Negative | Preserved | No | No | No | NED18 months |
| 10          | Negative         | Negative    | Negative   | T2          | Upper ND     | Total parotidectomy+LTBR | Temporalis MF | Negative | Preserved | No | No | No | NED22 months |
| 11          | Negative         | Positive    | Negative   | T4a         | MRND         | Total parotidectomy+LTBR | Temporalis MF | Negative | Preserved | No | No | No | NED20 months |
| 12          | Positive         | Positive    | Negative   | T4b         | MRND         | Total parotidectomy+TMJ, segmental mandiblection +MLTBR | PMMCF | Dural tear (ICE) | Negative | Positive | Preserved | Yes | No | Yes | DOD |
| 13          | Negative         | Positive    | Positive   | Negative | T4            | Supraomohyoid ND | SUBTBR+superficial parotidectomy | Temporalis MF | Dural tear | Transient vertigo | Negative SNHL | No | No | No | NED18 months |
| 14          | Negative         | Negative    | Negative   | T2          | Supraomohyoid ND | Total parotidectomy+LTBR | PMMCF | Dural Tear | Transient vertigo | No | No | No | NED22 months |
| 15          | Negative         | Positive    | Full thickness | Negative | T3            | RND      | MLTBR+superficial parotidectomy | Temporalis MF | UV ligation | Transient vertigo | Preserved | Yes | No | No | NED20 months |
| 16          | Negative         | Positive    | full thickness | Negative | T3            | MRND     | MLTBR+superficial parotidectomy | Temporalis MF | Negative | Transient vertigo | Preserved | Yes | No | No | NED24 months |
| 17          | Negative         | Positive    | Negative   | T4a         | MRND         | Lewis en-block+radical parotidectomy | Temporalis MF | Negative | Transient Vertigo | Preserved | Yes | No | Yes | NED18 months |
| 18          | Positive         | Positive    | Negative   | T4          | MRND         | Dural tear | PMMCF | Dural Tear | Positive SNHL | Yes | No | No | NED20 months |

(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 | Transient vertigo | Negative | Preserved | Yes | No | No | NED18 months |
| 20           | Negative         | Positive full thickness | Negative | Negative | T2 | MRND | LTBR+superficial parotidectomy | Temporalis MF | Transient vertigo | Negative | Preserved | Yes | No | No | DOC12 months |
| 21           | Negative         | Negative | Negative | Negative | T3 | MRND | LTBR+superficial parotidectomy | Free flap | Transient vertigo | Negative | Preserved | Yes | No | No | Patient lost 9 months |
| 22           | Negative         | Negative | Negative | Negative | T3 | RND | Lewis en-block+radical parotidectomy block | PMMCF | Dural resection | Negative | Preserved | Yes | N0 | Yes | DOD12 months |
| 23           | Negative         | Negative | Negative | Negative | T2 | MRND | LTBR+superficial parotidectomy | Free flap | 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 | Upper ND | LTBR+superficial parotidectomy | Free flap | Negative | Negative | Positive | Preserved | No | No | Yes | NED20 months |
| 26           | Negative         | Positive | Positive | Negative | T3 | Upper ND | SUBTBR+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 myocutaneous flap; LTBR, lateral temporal bone resection; MLTBR, modified lateral temporal bone resection; MRND, modified radical neck dissection; N0, negative neck (no lymph node involvement); ND, neck dissection; NED, no evidence of the disease; PMMCF, pectoralis major myocutaneous flap; RND, radical neck dissection; SNHL, sensorineural hearing loss; SUBTBR, subtotal temporal bone resection; T, tumor; temporalis MF, temporalis myocutaneous 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]. Otalgia 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, Bassiouney 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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