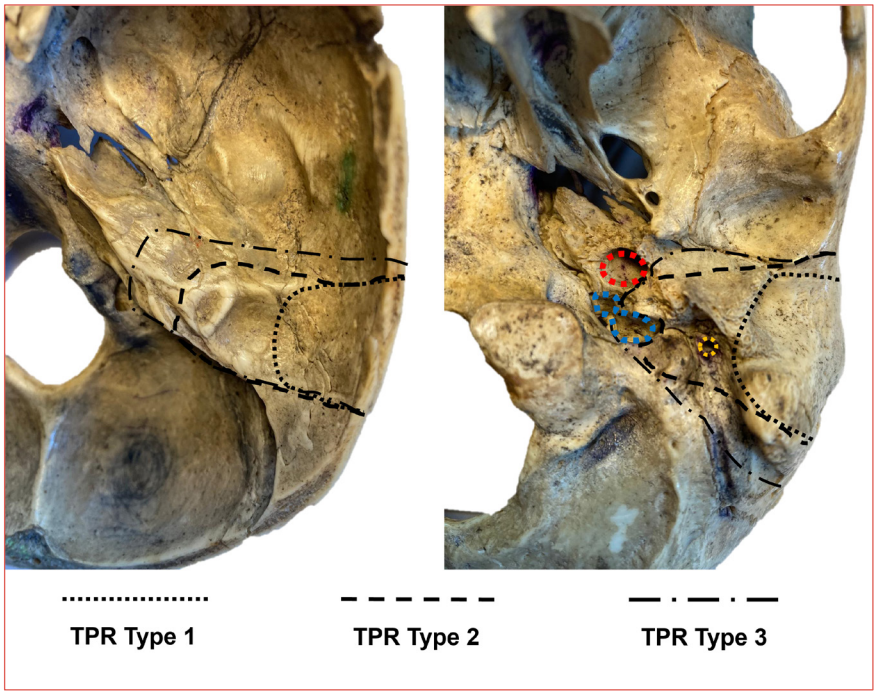
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En bloc temporo-parotid resection for malignant tumours of the parotid: surgical technique

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Cover figure. Endocranial and exocranial views of the skull base highlighting the osteotomy lines for temporo-parotid resection (TPR) type 1, type 2, and type 3, respectively. Red dotted line: carotid foramen; blue dotted line: jugular foramen; yellow dotted line: stylomastoid foramen.

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Summary

Objective. Advanced malignant tumours of the parotid gland often extend to the skull base and adjacent soft tissues. Conventional extended parotidectomy has shown limitations in achieving radical margins. Temporo-parotid resection (TPR) was developed to ensure oncological continuity of the specimen in an en bloc fashion and to achieve reliable surgical margins. A detailed description of the surgical technique has not been reported in the literature to date and is the aim of the present work.
Methods. Thirty-four patients with malignant parotid tumours were treated with TPR between 2019 and 2025. The surgical technique is detailed step-by-step herein. The procedure begins with a combined cervico-parotid incision, followed by total parotidectomy with preservation or sacrifice of the facial nerve according to tumour involvement. A selective or modified radical neck dissection is carried out en bloc. Temporal bone resection is then performed according to 3 reproducible osteotomy patterns: type 1 (partial tympano-mastoidectomy running lateral to fallopian canal); type 2 (partial mastoidectomy, radical tympanectomy medial to fallopian canal and lateral to the labyrinth); type 3 (radical tympano-mastoidectomy, medial to fallopian canal and variably extending to the spheno-temporal bone, labyrinth, jugular fossa, carotid canal). The parotid, neck and temporal bone components are removed in continuity, without specimen disruption, thereby ensuring accurate deep margin assessment.
Results. TPR type 1 was performed in 10 cases (29.4%), type 2 in 20 cases (58.8%), and type 3 in 4 cases (11.8%). Outcome analysis was beyond the scope of the present study and will be reported separately.

Conclusions. TPR provides a reproducible en bloc approach to parotid malignancies with skull base extension, optimises oncological radicality, facilitates processing and assessment of surgical specimens, and enables standardisation of bone resections.

Keywords: head and neck cancer, advanced parotid cancer, oncological margin, temporal bone resection, temporal-parotid resection

Introduction

Malignant tumours of the parotid gland may invade various anatomical adjacent spaces, as the prestyloid and upper carotid space, abutting the skull base, particularly the tympanic bone as well as other temporal bone subsites, the sphenoid and the glenoid fossa. When tumours grow along these trajectories, the surgical approach necessitates a total parotidectomy extended to adjacent structures [1].

Historically, surgical outcomes were hindered by a high rate of local recurrence, indicating that a suboptimal resection had been performed. This has led to the adoption of a composite en bloc resection of the parotid gland, neck and skull base [1], with the aim of ensuring removal of a cuff of tumour-free tissue around the lesion.

While management of the parotid gland and neck is well established, resection of the skull base, particularly in this region, remains challenging due to complex anatomical relationships and a limited understanding of the microscopic tumour spread [2]. The tympanic bone, which is commonly involved in malignant parotid tumours extending posteriorly, should be considered the centre of skull base resection. Factors influencing surgical planning include the peculiarities of regional anatomy and tumour characteristics such as location, biological behaviour, size, radiological patterns of growth, and extension of bony involvement [3].

This paper describes the surgical technique of temporo-parotid resection (TPR), which comprises en bloc resection of the parotid gland, neck, and skull base, with specific emphasis on the different types of bony resection involving the skull base.

Methods and results

Between November 2019 and May 2025, a total of 34 consecutive patients with parotid malignancies underwent TPR, i.e. en bloc resection of the parotid gland, temporal bone, and skull base. All procedures were performed with curative intent, according to our institutional criteria and indications. The present work focuses on the surgical steps of the procedure. Reporting of outcome analysis was beyond the scope of the present study and will be pursued separately.

Surgical technique

TPR can be performed using 3 main approaches, as detailed in Table I.

Some key skull base anatomical landmarks, useful for orientation during surgery, are reviewed below (Cover figure). The mastoid-pterygoid line runs from the mastoid tip to the styloid root, extending toward the sphenoid spine and the groove of the pterygoid process. The jugular foramen

Table I. Classification of the 3 types of temporo-parotid resection according to their progressive extension.

	Temporo-parotid resection		
Subsites	**Type 1**	**Type 2**	**Type 3**
Temporal bone	En bloc partial tympano-mastoidectomy running lateral to the fallopian canal	En bloc partial mastoidectomy, radical tympanectomy medial to fallopian canal, lateral to the labyrinth	En bloc radical tympano-mastoidectomy, medial to fallopian canal and variably extending to the spheno-temporal bone, labyrinth, jugular fossa, carotid canal
Parotid gland	Total or radical parotidectomy	Radical parotidectomy	Radical parotidectomy
Neck dissection	Elective or curative ND	Elective or curative ND	Elective or curative ND
Possible extension to one or more adjacent sites*	Mandibular condyle, mandible, masseter muscle, pterygoid muscles, skin, parapharyngeal space	Mandibular condyle, mandible, masseter muscle, pterygoid muscles, skin, temporal muscle, parapharyngeal space, jugular vein, internal carotid artery	Mandibular condyle, mandible, masseter muscle, pterygoid muscles, temporalis muscle, skin, parapharyngeal space, jugular vein, internal carotid artery

*ND: neck dissection. *Mandibular condyle, mandible, masseter muscle, pterygoid muscles, skin, and parapharyngeal space.*

and carotid canal orifice lie medial to this line, whereas the stylomastoid (fallopian) foramen, foramen spinosum, and foramen ovale are located laterally. Another critical aspect is the close spatial relationship between 3 key landmarks: the styloid process, the jugular fossa, and the external opening of the carotid canal. These structures are separated by only 2-3 mm of bone. This anatomical configuration makes osteotomy of the carotid canal a crucial step when a safe en bloc resection with tumour-free margins is planned.

TPR begins with a superficial parotidectomy, with retrograde identification and dissection of the peripheral facial nerve branches, followed by neck dissection carried out in a caudal to cephalic direction. Subsequently, temporal bone resection proceeds anteriorly from the sigmoid sinus toward the skull base, where it connects with the parotid and cervical dissection planes. Mastoidectomy is a critical first step in all 3 types of TPRs, creating a wide cavity through removal of the air cells as dictated by the type of bony resection. The parotid gland, dissected neck tissues and temporal bone are removed as a continuous anatomical unit. Additional structures, such as the mandibular condyle, glenoid fossa, ascending ramus of the mandible, temporalis, masseter, and pterygoid muscles may be included depending on tumour extent.

Skin and muscle flaps

Skin and muscle flaps are shown in Figure 1. A wide retroauricular C-shaped skin incision is performed extended inferiorly to the lateral neck for neck dissection and superiorly towards the temporal squama. The extension of the retroauricular and temporal skin flaps varies according to TPR type, the amount of skin to be removed, or the presence of scars from previous surgery. A fibromuscular flap is designed to include the full-thickness posterior soft tissues within the resection bloc. Similarly, the temporalis muscle may either be preserved with its coronoid insertion or partially included in the resection. The cartilaginous external auditory canal can either be transected and sutured with a cul-de-sac technique, or – if the auricular and periauricular skin is included in the resection – left attached to the underlying parotid gland, musculoperiosteal flap, and bone.

Types of procedures

En bloc TPR type 1

TPR type 1 represents the least extensive procedure, involving a lateral temporal bone resection with preservation of the otic capsule, labyrinth, and facial nerve (Figs. 2A,D,G).

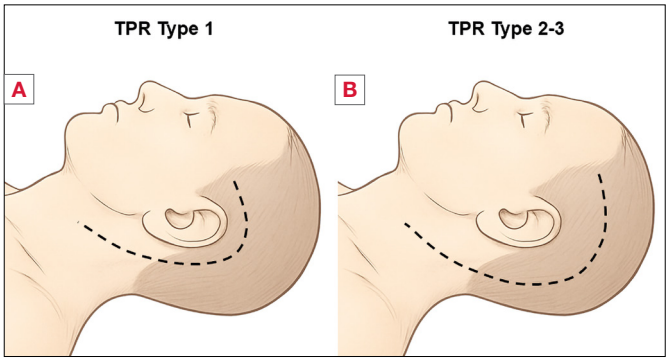


Figure 1. Skin incision. (A) TPR type 1, (B) TPR types 2 and 3. Dashed lines indicate the incision line.

1. Neck dissection: it is performed first, from the lower neck upwards.
2. Parotidectomy: a superficial parotidectomy is performed, with identification of the facial nerve branches at the anterior parotid margin, followed in a retrograde direction to the stylomastoid foramen. The facial nerve is identified within its mastoid tract and followed anterogradely to the stylomastoid foramen. The entire parotid gland, along with the soft tissues of the retromandibular fossa, is preserved in continuity with the mastoid-tympanic bone and included in the en bloc specimen.
3. Temporal bone: mastoidectomy is performed by drilling off the cellularity up to the digastric groove. The tympanic bloc is then delivered through osteotomies.

The osteotomies in TPR type 1 include:

- a posterior osteotomy running along the anterolateral mastoid squama to the digastric groove and, turning upwards, crossing lateral to the facial nerve to the fossa incudis; the middle ear cavity is exposed via hypotympanotomy. The styloid process and its muscles are left in place;
- a superior osteotomy extending across the epitympanum to the zygomatic root. The anterior wall of the external auditory canal is exposed after removal of the incus, head of malleus and transection of the tensor tympani tendon;
- an anterior osteotomy running from the styloid process across the anterior tympanic wall to the hypotympanum, at a safe distance from the carotid artery.

The facial nerve at the stylomastoid foramen is dissected in an antegrade direction toward its distal parotid branches. Mobilisation of the parotid gland and adjacent soft tissues lateral to the facial nerve, up to the main trunk bifurcation facilitates the release of the inferior aspect of the specimen and provides the necessary space to perform the final osteotomy (Fig. 3).

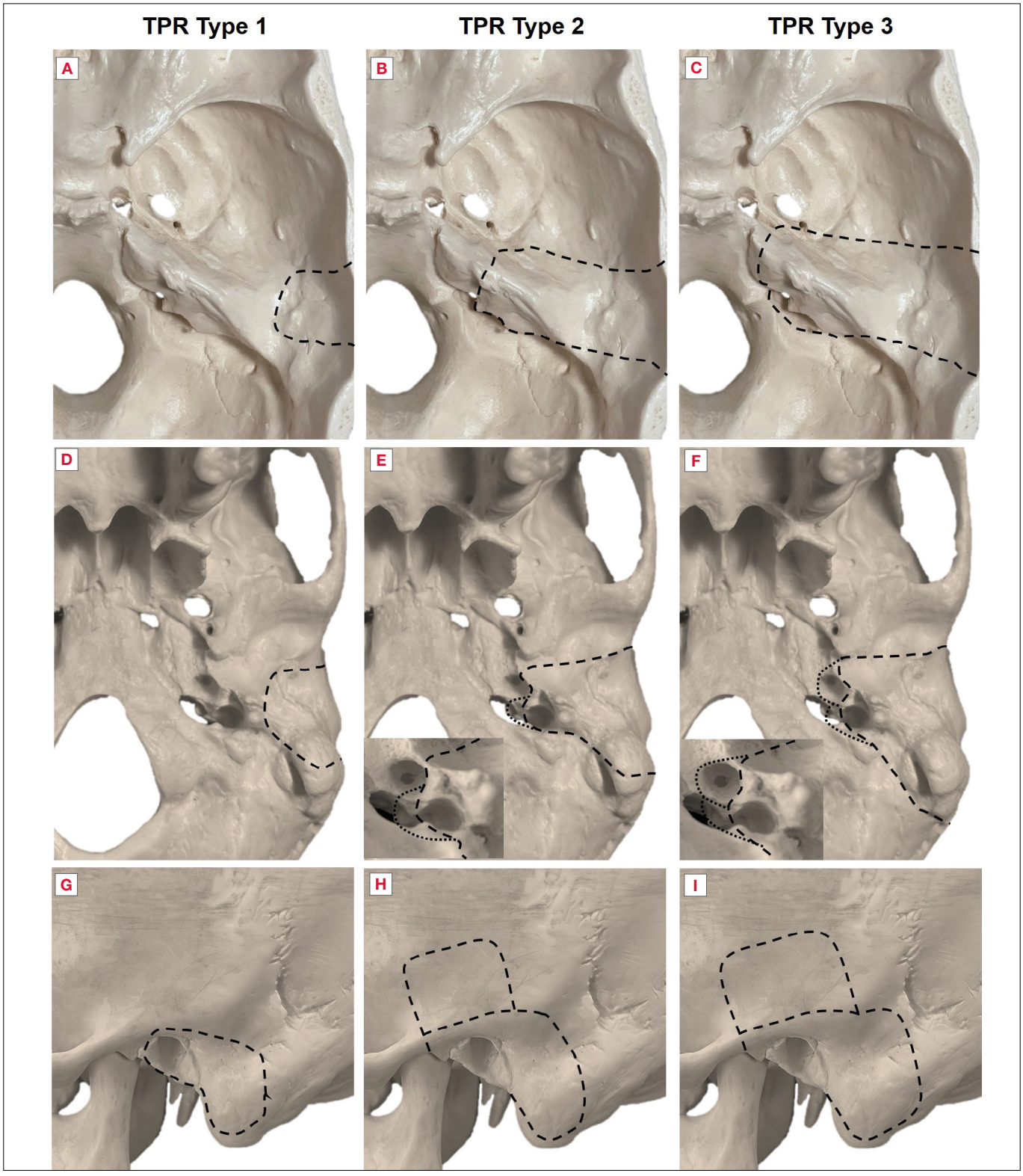


Figure 2. Endocranial view: (**A**) TPR type 1, (**B**) TPR type 2, (**C**) TPR type 3. Dashed lines indicate the corresponding osteotomy planes. Exocranial view: (**D**) TPR type 1, (**E**) TPR type 2, (**F**) TPR type 3. Dashed lines indicate the plane of osteotomies. In panels **B** and **C**, a magnified detail of the deep osteotomy margin is also provided. Lateral view: (**G**) TPR type 1, (**H**) TPR type 2, (**I**) TPR type 3. Dashed lines indicate plane of osteotomies.

En bloc TPR type 2

TPR type 2 extends medially compared to type 1 and includes a radical tympanectomy and partial petrous bone resection medial to the facial nerve and lateral to the labyrinth (Figs. 2B,E,H).

1. Neck dissection: as in type 1.
2. Parotidectomy: a radical parotidectomy is performed. The peripheral branches of the facial nerve are identified and transected at the anterior and superior margins, and the resection may include the masseter muscle up to the ascending ramus of the mandible. Superiorly, the dissection may extend to the zygomatic arch, glenoid fossa, pterygoid muscles and temporal squama, incorporating variable portions of the temporalis muscle. The facial nerve remains entirely within the specimen, and the inferior part of the parotid is kept continuous with the neck dissection.
3. Temporal bone: the mastoid and adjacent occipital bone are exposed. The sternocleidomastoid muscle is either transected caudal to the mastoid tip and included in the specimen with its cranial end or detached from its bony insertion and reflected posteroinferiorly.

Drilling at the mastoid-occipital junction exposes the sigmoid sinus in its compact bone canal from its lower half to the blue-lined jugular bulb. Mastoid cellularity is drilled to the digastric groove and extended superiorly to the antrum and aditus ad antrum. The incus and head of the malleus are removed and the tensor tympani tendon is transected. The facial nerve is divided at its mid-tympanic segment.

En bloc resection of the tympanic bone with adjacent sites of the sphenopetrous cranial base relies on 4 osteotomy lines (Fig. 4) as follows.

The posterior osteotomy begins at the fossa incudis and the genu of the facial nerve and is directed downward, drilling the tympanic bone medial to the facial nerve but lateral to the labyrinth, up to the posterior aspect of the styloid root. It then turns anteriorly up to the external opening of the carotid canal. The styloid process and its muscle bundle remain attached and are removed en bloc. The jugular foramen and jugular vein are kept under direct vision. Any thin residual shell of bone over the jugular bulb or carotid canal can be removed with a 3-4 mm diamond burr.

Anterior osteotomy on carotid canal is performed as follows: a 4 × 4 cm temporal craniotomy is centred at the zygomatic root, and the dura is dissected off the superior petrous surface to identify the horizontal segment of the ICA, which is followed to the genu and transition to the vertical segment. The anterior osteotomy starts with a 4-5 mm diamond burr and runs downward along the anterolateral

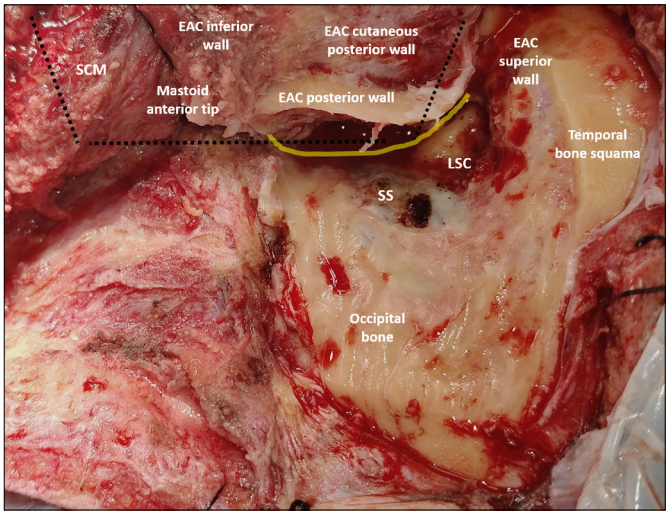


Figure 3. Harvesting phase of TPR type 1. Intermediate intraoperative view following posterior and superior osteotomies. The dotted line indicates the planned limits of resection, ensuring oncological safe margins. The yellow line indicates the facial nerve tract. Critical structures within the specimen are labeled, emphasising the temporal, parotid, and cervical components relevant for TPR type 1. EAC: external auditory canal; LSC: lateral semicircular canal; SCM: sternocleidomastoid muscle; SS: sigmoid sinus.

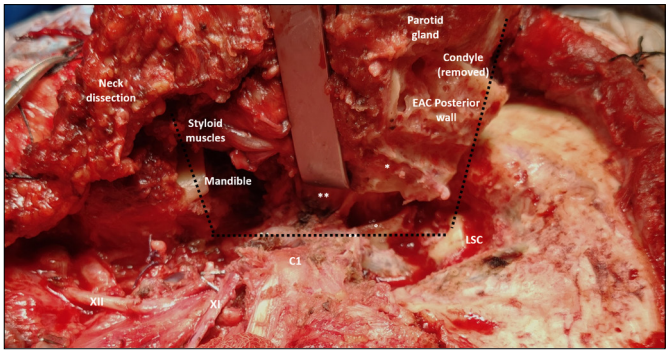


Figure 4. Harvesting phase of TPR type 2. Focused intraoperative view of the posterior and superior osteotomy lines during the bone demolition phase. The en bloc specimen is rotated anteriorly, exposing the medial and deep aspects of the temporal and parapharyngeal regions. The surgical specimen remains partially attached, while the posterior osteotomy along the mastoid-tympanic complex and the superior osteotomy across the epitympanum and zygomatic root are completed, delineating the skull base component of the en bloc resection under direct visualisation. The dotted line indicates the planned limits of resection, ensuring oncological safe margins. Key anatomical landmarks within the specimen are labelled: *Petrous bone: medial wall of the specimen; **Parapharyngeal space; °Residual tympanic ring; °°Residual tympanic bone. This view illustrates the spatial relationships of the skull base, parapharyngeal, and temporal structures during specimen mobilisation, highlighting areas critical for safe en bloc resection and oncological margin assessment. EAC: external auditory canal; LSC: lateral semicircular canal.

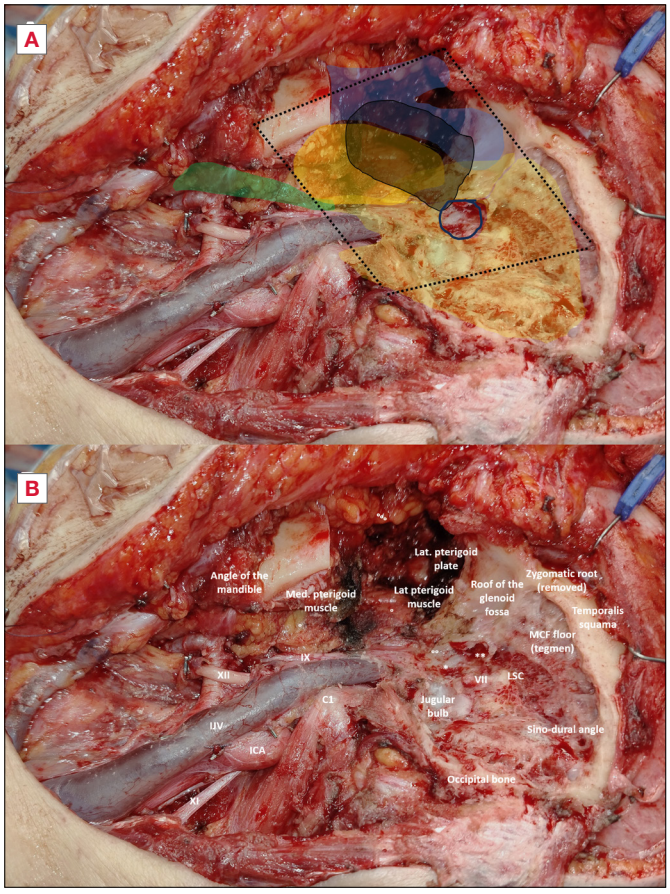


Figure 5. Schematic representation of the surgical field and key anatomical structures in TPR type 2. Wide surgical field at the end of TPR, following extended parotidectomy with inclusion of the mandibular condyle and completion of en bloc neck dissection. The operative field allows simultaneous visualisation of the temporal, parotid, and cervical components, clearly identifying the main skull base and cervical landmarks (mastoid and tympanic bone, styloid region, carotid and jugular spaces) after final specimen mobilisation: **(A)** Colour-coded depiction of the main anatomical regions and tumour location: Blue area: mandible (including condyle and coronoid process); Light yellow area: petrous portion of the temporal bone; Circled area: external auditory canal; Green area: styloid muscles at their insertion on the styloid process; Dark yellow area: parotid gland. Planned limits of resection are indicated with a dotted line, illustrating the en bloc resection boundaries. **(B)** Final view of the surgical field after tumour removal with labelled anatomical landmarks within the operative specimen, highlighting neurovascular and soft tissue structures. *Vertical carotid canal; **Eustachian tube; °Parapharyngeal fat; °°Residual tympanic bone; °°°Buccal (Bichat's) fat; ICA: internal carotid artery; IJV: internal jugular vein; LSC: lateral semicircular canal. This panel emphasises spatial relationships relevant for safe and oncologically adequate en bloc resection.

aspect of the carotid canal up to its cervical orifice located just anterior to the styloid root, where it joins with the posterior osteotomy. The anterior carotid sheath is exposed at this level.

The previously described craniotomy may not be necessary when the tumour is safely distant from the tympanic bone. In such cases, if the resection needs to include the carotid artery, the carotid canal osteotomy can be performed via a lateral approach. The posterior wall of the tympanic bone is drilled away or detached by drilling medial to the facial nerve up to the posterior aspect of the styloid root. The wall is then displaced anteriorly, exposing the promontory and the carotid entry. Drilling along the lateral aspect of the carotid canal, from its cervical orifice to the anterior surface of the petrous bone, completes the anterior osteotomy.

The superior osteotomy consists of 2 branches: one extending from the carotid canal to the glenoid fossa, and the other crossing the tegmen tympani to the protympanum and epitympanum. The zygomatic arch may be sectioned to improve exposure.

The inferior osteotomy involves the sigmoid sinus, jugular bulb, and jugulo-carotid bony septum. The sigmoid sinus and jugular bulb are completely uncovered and either preserved or opened and packed. If the jugular bulb is opened, careful preservation of its medial wall and gentle packing of the petrosal sinus orifices are essential to protect cranial nerves IX-XI. The jugulo-carotid bony septum is drilled with a 3-4 mm diamond burr to connect with the carotid canal.

The temporal bone bloc is finally freed from any residual soft-tissue attachments (muscles, tendinous insertions) and removed in continuity with the parotid and neck specimen (Fig. 5).

En bloc TPR type 3

TPR type 3 represents the most extensive procedure, including a more medial resection of the petrous bone, that can include the labyrinth and petrous apex (Figs. 2C,F,I).

1. Neck dissection, parotidectomy and resection of adjacent tissues are performed as in TPR type 2.
2. Temporal and retrosigmoid corridors. TPR type 3 requires 2 complementary surgical corridors, a superior one, via a temporal craniotomy, and a posterior one, via a retrosigmoid craniotomy.

Mastoidectomy is performed to expose the sigmoid sinus, jugular bulb and presigmoid dura. The temporalis muscle is incised vertically or with a question mark-shaped incision and retracted. When infiltrated or tightly adherent to the tumour, it is included full thickness in the resection. The zygomatic arch is removed.

Osteotomy of the carotid canal is performed as in TPR type 2 and the artery is skeletonised and mobilised to allow subsequent steps, which resemble those of a subtotal

temporal bone resection (STBR) used in surgery for ear cancer [4].

From the exposed genu of the carotid canal, 2 superior osteotomies are carried out.

A lateral branch runs from the carotid genu to the anterior limit of the glenoid fossa and a medial one crosses the tegmen tympani and antrum. Depending on tumour extension, it traverses either the labyrinth or the internal auditory canal (IAC), reaching the posterior surface of the temporal bone.

A retrosigmoid craniotomy (Fig. 2C) enables delivery of the petrous bone from the sigmoid sinus and the presigmoid dura. The petrous dura is lifted from the bone to connect, at the jugular fossa, with the medial osteotomy previously performed from the temporal craniotomy through either the labyrinth or the internal auditory canal. Opening and packing of the sigmoid sinus complete the jugular fossa step. The bone bridge between the jugular fossa and carotid canal is drilled out, and the temporal bone bloc is released. Internal carotid artery and jugular vein can be preserved or included in the resection according to oncological requirements. The medial wall of the jugular bulb is preserved whenever possible, but can be removed if cranial nerves IX-XI must be sacrificed (Fig. 6).

Neck dissection

Neck dissection involves dissection of the carotid space from the lower neck upwards, following the internal carotid artery and internal jugular vein to their skull base foramina. At the level of the styloid process, the carotid space transitions into a thick fascial plane formed by the fusion of the styloid and pharyngeal sheaths, described by Schachtel et al. as the anterior carotid sheath [5]. This plane is reached and divided in continuity with the carotid canal osteotomy. The posterior belly of the digastric muscle is divided at its tendinous insertion on the hyoid bone. Neck dissection thus provides adequate room at the cervical skull base for temporal bone osteotomies and en bloc removal of the specimen.

Fallopian canal and facial nerve

The main stem of the facial nerve, its peripheral branches, and proximal collaterals (such as the auricular branch of the vagus nerve and the chorda tympani) may be included in the resection [6-8], taking into account the radiological perineural spread. The mastoid segment of the facial nerve and the fallopian canal are managed according to their relationship with the tumour: if the nerve is invaded or must be resected to achieve an adequate margin, it is left within the en bloc specimen, and the residual stump is assessed histologically with frozen sections [6-8]. Once a safe nerve stump is obtained, transection is performed at a level suitable for subsequent grafting to peripheral branches in the parotid space.

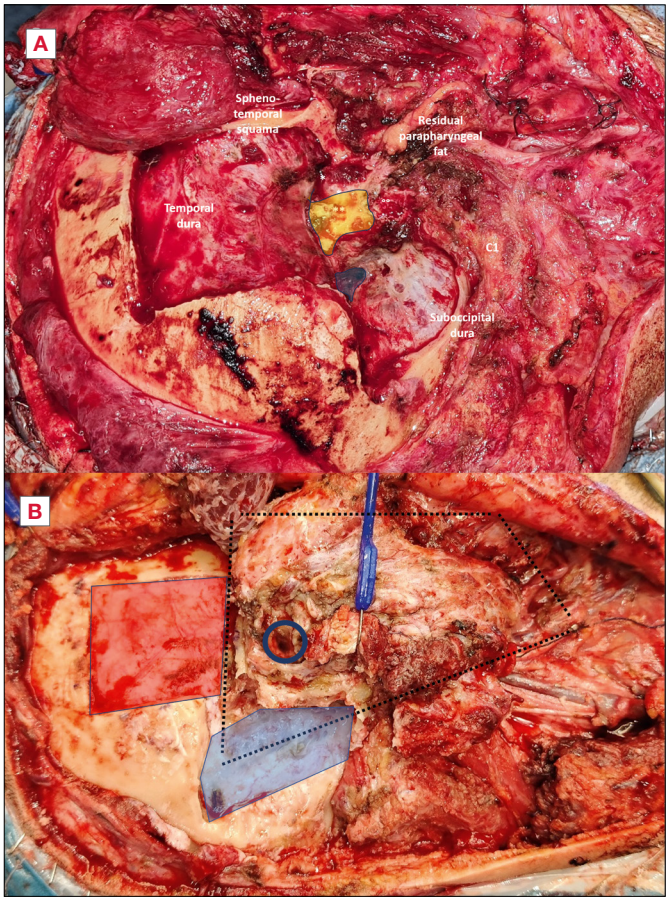


Figure 6. Schematic representation of the surgical field and key anatomical structures in TPR type 3. Advanced surgical field depicting en bloc resection of parotid malignancies extending to the medial temporal bone and skull base. The procedure integrates temporal craniotomy, retrosigmoid craniotomy and skull base osteotomies to achieve safe oncological margins. (**A**) Wide surgical field at the end of TPR type 3. Wide surgical exposure after final mobilisation of the en bloc specimen, showing both the temporal and suboccipital dura. Key anatomical landmarks within the specimen are labelled: *Petrous apex; **ICA (genu and horizontal tract); °Jugular bulb removed and packed; °°Carotid orifice at the skull base; yellow area: residual petrous bone; blue area: sigmoid sinus (SS) packed. This panel highlights the deep skull base structures managed during type 3 resection and the relationship between temporal, parotid, and neurovascular components. (**B**) TPR type 3 during harvesting phase. Intermediate intraoperative view prior specimen rotation anteriorly, exposing medial and anterior osteotomy planes. Planned lines of resection are indicated by a dotted line. Key landmarks and surgical corridors are highlighted: blue area: retrosigmoid craniotomy; red area: temporal craniotomy; circled: external auditory canal (EAC). This panel emphasises the spatial orientation of the skull base, temporal, and parapharyngeal structures, illustrating the en bloc resection boundaries and the anatomical relationships critical for safe and oncologically adequate TPR type 3.

The trigeminal nerve may also be affected by perineural spread via the masseteric or mandibular branches, and is managed accordingly.

Discussion

The umbrella term TPR groups together 3 different types of en bloc resections, which are performed in a wide anatomical region that includes the internal carotid artery, parotid gland and prestyloid space, the tympanic bone, styloid process, and, secondarily, the inferior aspect of the mastoid and petrous bone at the carotid canal, jugular fossa, and glenoid fossa. These procedures represent a major surgical challenge, as they must reconcile skull base surgery principles with anatomical constraints, heterogeneous tumour histology, incomplete understanding of microscopic tumour spread, and the limitations of preoperative morphological imaging [1,9,10].

Lateral skull base surgery for oncological indications has evolved gradually, with numerous contributions addressing specific technical aspects [10]. In a prescient article published in 1966, Allen [11] proposed en bloc resection of the parotid and neck together with the skull base, pioneering the concept of skull base surgery. Later, Fisch in 1988 [12] introduced a system of approaches in this area describing partial and total mastoid-tympanectomies and total petrosectomy, with dissection extending to the internal carotid artery, jugular bulb and glenoid fossa. However, early adoption of these techniques in parotid surgery remained limited. Subsequent series reported the use of lateral and subtotal temporal bone resections, originally developed for ear cancer, in tumours extending from the auricle and periauricular skin to the parotid and skull base [13-23]. Schachtel et al. [5] proposed a 5-level classification for resections in the temporo-parotid region in cases of advanced skin cancers and emphasised the role of the anterior carotid fascia as a multifascial plane used in the deep part of the resection as well as a limit for resectability. Nevertheless, these reports did not provide a unified framework describing how to integrate temporal bone, parotid, and neck resections into a single en bloc procedure, nor did they consistently clarify whether the temporal bone was part of the access, the specimen, or both. In addition, many of these techniques were primarily tailored to ear cancer [8,13,21,23], whereas parotid malignancies tend to extend toward the exocranial skull base with a different pattern [15,16,22]. For parotid tumours that abut the temporal bone without bony invasion, a trans-mastoid identification of the facial nerve and limited resection of the temporal bone have been proposed to overcome tumour spillage and facilitate achievement of free margins [24]. When tumours directly extend through the temporal bone, the concept of TPR comes into play, the tympanic bone being the cornerstone of the resection.

The present work focused on the skull base component of TPR, detailing the temporal bone steps and the rationale for osteotomy planning. The underlying oncologic principle is that the resection should be conceived as a 3-dimensional volume encompassing the tumour, an intact peritumoural envelope of normal tissues and the surrounding space where resectioning has been performed.

This approach is intended not only to optimise local control, but also to enable comprehensive histopathologic assessment of the specimen with macrosections that depict the relationships between tumour and surrounding structures.

The osteotomy lines were planned to fulfill these principles. Side-cutting burs were used to create reproducible cuts between well-defined bony landmarks, facilitating standardisation within and across surgical teams. The medial osteotomy of the vertical carotid canal [4] and jugular fossa was designed to expand the medial extent of the resection and reduce the high rate of positive margin on the deep side of the surgical bloc. The carotid canal osteotomy proceeds across tumour-free bone by 2 steps, one by the temporal craniotomy to reach the artery, and the other by running the medial cuts on the carotid canal away from potential violation of the tumour area. Similarly, the bone cut from the jugular fossa to the carotid canal through a retrosigmoid craniotomy and the sigmoid sinus allows controlled access to the deep aspect of the specimen.

Furthermore, the osteotomy from the carotid canal to the glenoid fossa addresses tumour growth toward the mandibular condyle and glenoid structures, as well as along the fissures connecting the squamous and tympanic portions of the temporal bone, such as the petrotympanic (Glaser) fissure and its branches (petrotympanic and petrosquamous fissures). Taken together, these osteotomies are designed to encompass the pathways of microscopic tumour spread within a continuous bony and soft-tissue envelope, thereby increasing the likelihood of achieving “free” surgical margins.

The issue of “free” and “close” surgical margins in the temporo-parotid and skull base region has received little attention compared with other head and neck subsites in view of the rarity of the different tumours, the anatomical complexity and, last but not least, the histological heterogeneity which affects the patterns of local spread. Consequently, quantitative thresholds defining close *versus* free margins are lacking, and the prognostic significance of margin status is generally reported only in a simplistic dichotomous (yes/no) manner [25].

Conclusions

TPR is indicated in malignant parotid tumours, primary or metastatic, extending beyond the gland into the retromandibular, prestyloid and upper carotid spaces, and abutting or invading the skull base. Three types of resection, with increasing extent in relation to tumour size, pattern of spread, and involvement of the temporal bone and adjacent structures, were designed.

Oncologically adequate surgery in this setting requires resection of the bony skull base (tympanic bone, mastoid, styloid process, jugular fossa, and carotid canal) together with the parotid and neck dissection as a single composite en bloc specimen. In this way, the skull base approach serves a dual purpose: it provides access to an otherwise difficult-to-expose area, and ensures an envelope of uninvolved tissue around the tumour. A further key objective of TPR is to enable a detailed histopathologic analysis of a single specimen, through the use of macrosections. Correlation of microscopic findings with preoperative imaging may significantly contribute to enhancing the diagnostic and predictive value of radiological studies, refining the assessment of resectability, and guiding the 3-dimensional design of resections.

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Conflict of interest statement

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Author contributions

EZ, AM: conceptualization; EZ, AM, AD, DC: methodology and software; EZ, PN, AM: validation, writing - original draft preparation, visualization and supervision; AD, DC: formal analysis and investigation; EZ, AM, AD, DC: resources; EZ, AM, AD, DC, PN: writing - review and editing. All authors have read and agreed to the published version of the manuscript.

Ethical consideration

The research was conducted ethically, with all study procedures being performed in accordance with the requirements of the World Medical Association's Declaration of Helsinki.

Written informed consent was obtained from each participant/patient for study participation and data publication.

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