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Surgical corridors to the infratemporal fossa: a systematic review of the anatomical and clinical evidence

Andrei Cristian Albu[1] · **Bogdan Vintilă**[1] · **Mugurel Constantin Rusu**[1]

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Abstract

Purpose The infratemporal fossa (ITF) is a deep, neurovascularly dense compartment reached through a growing array of open and endoscopic corridors that have been studied too heterogeneously to compare easily. We systematically reviewed the anatomical and clinical evidence on ITF corridors to compare, corridor by corridor, their exposure, the targets they reach and their attendant morbidity.

Methods Following PRISMA 2020, cadaveric-anatomical, radio-anatomical and clinical studies were identified in PubMed/MEDLINE, Scopus, Embase and Web of Science from inception to 20 January 2026, with reference-list screening; only English-language reports were eligible. Two reviewers screened and extracted data independently. Cadaveric studies were appraised with the QUACS scale and clinical studies with the Joanna Briggs Institute checklists. Given the heterogeneity of reported metrics, a structured narrative and tabular synthesis was performed without meta-analytic pooling.

Results Twenty-nine studies were included. Endoscopic endonasal corridors gave direct, incision-free access to the medial ITF and pterygopalatine fossa but limited control of the parapharyngeal internal carotid artery and lateral ITF; incremental maxillectomy and multiportal combinations enlarged exposure. Lateral and transcranial routes maximised surgical freedom and vascular control at the cost of higher cranial-nerve and cosmetic morbidity. Reported gross- or near-total resection ranged from approximately 57% to 88% but was strongly corridor- and pathology-dependent and, given the clinical heterogeneity, is not comparable across corridors; trigeminal dysfunction was the most frequently reported morbidity.

Conclusion Corridor selection is target-driven: medial and paramedian pathology favours endonasal routes, whereas lateral, posterior or vascular-encasing disease favours lateral or combined approaches. The evidence is dominated by cadaveric feasibility work; anatomical feasibility should not be read as clinical efficacy.

Keywords Infratemporal fossa · Surgical anatomy · Endoscopic endonasal approach · Transpterygoid approach · Skull base surgery · Surgical corridor

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Introduction

The infratemporal fossa (ITF) is one of the most anatomically demanding compartments of the deep face and lateral skull base. It is bounded laterally by the ramus of the mandible, medially by the lateral pterygoid plate, anteriorly by the posterior wall of the maxilla and superiorly by the greater wing of the sphenoid; medially it is continuous with the pterygopalatine fossa (PPF) through the pterygomaxillary fissure, and it communicates with the middle cranial fossa through the foramen ovale and foramen spinosum [13, 15]. Within this confined space lie the pterygoid muscles, the pterygoid venous plexus, the maxillary artery and its branches, the mandibular nerve (V3) and its divisions, the otic ganglion and the chorda tympani. Immediately beyond its medial and posterior boundaries lie the eustachian tube, the styloid diaphragm and the parapharyngeal internal carotid artery (ICA) — structures the fossa borders but does not contain, and which define the deep limit of dissection for corridors reaching this region [7, 18]. Lesions reaching this region are diverse — juvenile nasopharyngeal angiofibroma, trigeminal and lower-cranial-nerve schwannomas, meningioma, adenoid cystic and other carcinomas, paraganglioma and fibro-osseous lesions — and each may displace or encase the neurovascular contents differently [18, 19, 28]. Although malignant ITF disease accounts for under 3% of head and neck tumours, surgery remains central to its control, and access has historically demanded collaboration between skull-base and maxillofacial teams [12]. Historically, access was achieved through open lateral and anterior routes such as the Fisch infratemporal-fossa approaches and the transzygomatic, orbitozygomatic, transmandibular and facial-translocation techniques, which provide wide exposure and vascular control but at the cost of mandibular, temporomandibular-joint, facial-nerve and cosmetic morbidity [1, 23, 24]. Over the past two decades, endoscopic endonasal and endoscopic-assisted corridors have been developed to exploit the natural sinonasal and oral air spaces, reducing external morbidity while raising new questions about the completeness and safety of the exposure they provide [6, 29].

The proliferation of corridors has, however, outpaced their comparative evaluation. Existing overviews of ITF access have been predominantly narrative and experience-based, organised around a single team's operative material rather than a systematic, appraised comparison across corridors [12]. Anatomical studies quantify exposure with non-identical metrics — area of exposure, surgical freedom, angle of attack, working depth or resection volume — measured against different landmarks, while clinical reports are predominantly small, single-institution series with heterogeneous pathology and follow-up. As a result, surgeons lack a consolidated, corridor-by-corridor picture of which route best reaches a given ITF subregion and at what anticipated cost. The objective of this systematic review was therefore to collate the available anatomical and clinical evidence on surgical corridors to the ITF, to compare them by exposure, targets reached and morbidity, and to make explicit the boundary between anatomical feasibility and demonstrated clinical efficacy.

Materials and methods

Protocol, reporting and review type

This review was conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement. A protocol defining the objective, eligibility criteria, search strategy, extraction schema and appraisal tools was drafted a priori and is available from the corresponding author. Because all analysed data derive from previously published, de-identified cadaveric and clinical studies, no new ethical approval was required.

This work was designed and conducted as a systematic review with structured narrative synthesis, not as a scoping review. It shares two features with scoping reviews: an aim that maps corridors onto ITF subregions, and a decision not to pool results because of heterogeneity. It differs from one in three respects: eligibility was applied restrictively to primary studies with extractable corridor-level data; a formal item-level risk-of-bias appraisal was

undertaken for every included study; and a specific comparative question was addressed — which corridor best reaches which ITF subregion, and at what morbidity — rather than a broad evidence-mapping aim.

Eligibility criteria

Studies were eligible if they described one or more surgical corridors to the ITF and reported anatomical exposure metrics, targets or landmarks reached, and/or clinical outcomes. Eligible designs were cadaveric-anatomical dissections, radio-anatomical (imaging-based) analyses, comparative anatomical studies, and clinical series or case reports of ITF corridors. Both open (microscopic) and endoscopic variants, and unilateral, bilateral, multiportal and combined approaches, were eligible. Only reports published in English were eligible; the resulting language restriction is acknowledged as a potential source of bias. Studies were excluded if the ITF was not a primary target, if no extractable corridor-level data were reported, or if a full-text source could not be obtained for verification. Narrative reviews and technical notes were retained for background but were not used as primary quantitative evidence.

Information sources and search strategy

PubMed/MEDLINE, Scopus, Embase and Web of Science were searched from database inception to 20 January 2026 (the search date). The strategy combined the concept 'infratemporal fossa' with a block of corridor descriptors, using Title/Abstract field tags for reproducibility. The complete PubMed/MEDLINE search string was: *"infratemporal fossa"[Title/Abstract] AND ("endoscopic endonasal"[Title/Abstract] OR transpterygoid[Title/Abstract] OR transmaxillary[Title/Abstract] OR prelacrimal[Title/Abstract] OR Denker[Title/Abstract] OR transoral[Title/Abstract] OR transvestibular[Title/Abstract] OR transorbital[Title/Abstract] OR preauricular[Title/Abstract] OR transzygomatic[Title/Abstract] OR orbitozygomatic[Title/Abstract] OR transmandibular[Title/Abstract] OR parapharyngeal[Title/Abstract] OR "surgical approach"[Title/Abstract] OR "surgical corridor"[Title/Abstract])*, restricted to English-language records. The same concept blocks were translated into the native syntax and field tags of Scopus, Embase and Web of Science. Because bibliographic databases are updated continuously, all record counts reported in the PRISMA flow diagram (Fig. 1) correspond to the search date. Reference lists of eligible articles and relevant reviews were hand-searched to identify further reports. To keep the evidence base auditable, a study contributed to the synthesis only after its full text had been obtained and read; no datum was extracted from an abstract or a bibliographic record alone.

Study selection and data extraction

Records retrieved from all sources were de-duplicated and imported into a screening log. Two reviewers independently screened titles and abstracts against the eligibility criteria; reports judged potentially eligible by either reviewer were retrieved and assessed independently in full text by the same two reviewers. Disagreements at the title/abstract and full-text stages were resolved by discussion and, where consensus could not be reached, by adjudication by the senior author; reasons for exclusion at full text were recorded. For each included study, one reviewer extracted and a second verified: study identifier and source; design and level of evidence; corridor(s) evaluated (open versus endoscopic; unilateral/bilateral; multiportal); number of specimens or patients; ITF subregions and landmarks reached; quantitative anatomical metrics (area of exposure, surgical freedom, angle of attack, working depth, resection volume); clinical outcomes (pathology, extent of resection, operative time, blood loss); complications, with emphasis on cranial-nerve morbidity (V2/V3, facial nerve), trismus, vascular injury and cerebrospinal-fluid (CSF) leak; recurrence and follow-up; and the authors' stated advantages and limitations.

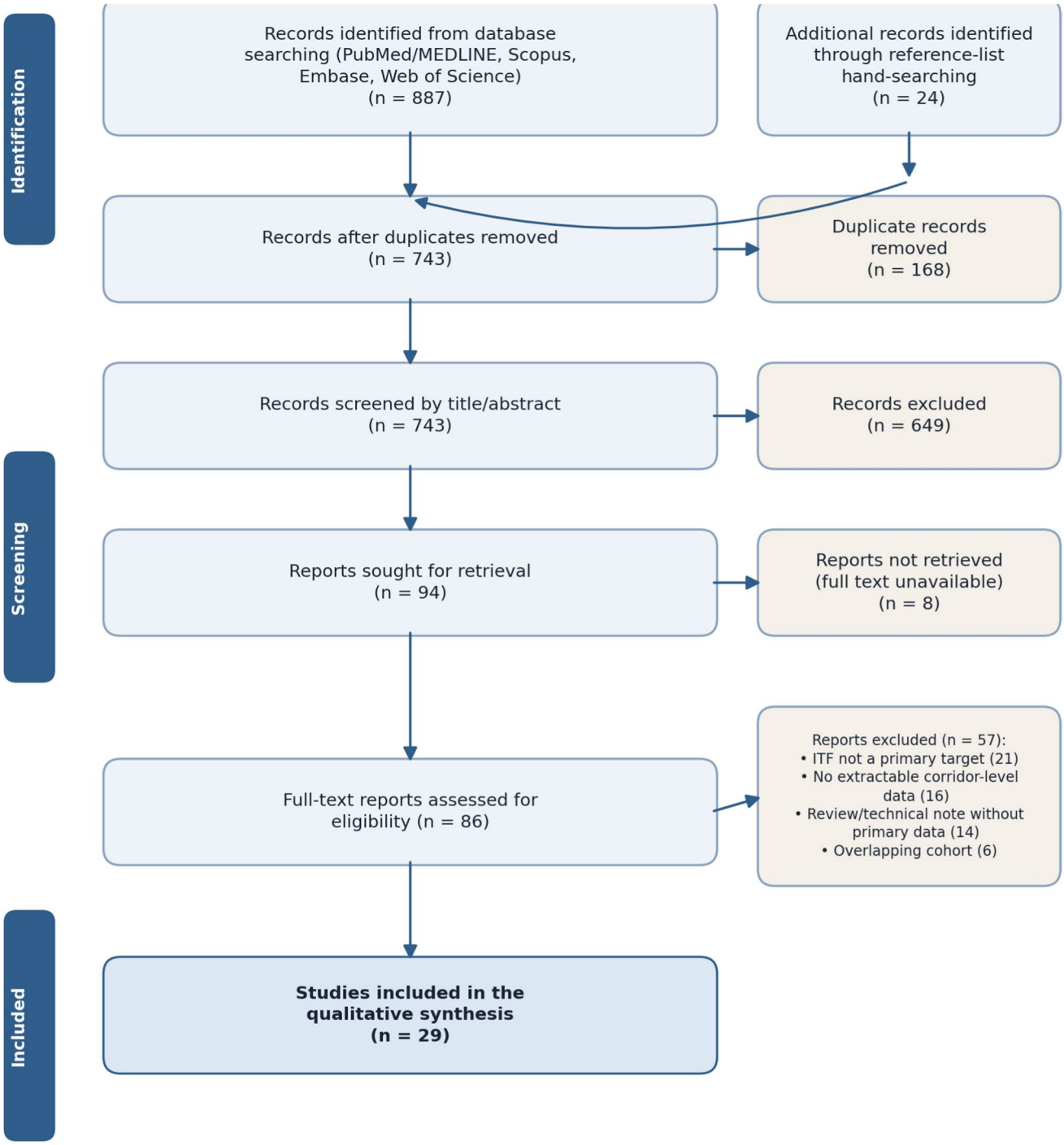


Fig. 1 PRISMA 2020 flow diagram for the identification, screening and inclusion of studies. Records were identified through database searching and reference-list hand-searching; reports whose full text could not be obtained were excluded to preserve verifiability of every extracted datum

Risk-of-bias and quality appraisal

Cadaveric-anatomical studies were appraised with the Quality Appraisal for Cadaveric Studies (QUACS) scale, and clinical series and case reports with the Joanna Briggs Institute (JBI) critical-appraisal checklists for case series and case reports, respectively. Each study was appraised independently by two reviewers at item level,

with disagreements resolved by consensus; the item-level judgements are summarised as an overall judgement in Table 4.

Because the QUACS scale contains items specific to cadaveric material, its application to the three radio-anatomical (imaging-based) studies was defined explicitly rather than left as an unspecified adaptation. The two QUACS items concerning cadaveric specimen preparation — the reporting of specimen preservation/embalming and of specimen demographic characteristics — were recorded as not applicable for imaging studies, and the item appraising reproducibility of the dissection technique was interpreted as the reproducibility of the imaging measurement protocol; all remaining items (rationale, aims, definition of structures, measurement instrument, observer reliability, completeness of results, statistics, limitations and conclusions) were applied unchanged. A design-specific instrument for anatomical studies (the Anatomical Quality Assessment, AQUA, tool) was considered as an alternative for these three studies and yielded concordant overall judgements.

Synthesis methods and certainty of evidence

A structured qualitative synthesis was performed for all included studies, organised by corridor family. Reported anatomical metrics and clinical proportions differed too greatly — in targets, landmarks, instrumentation, units, corridor, indication and unit of analysis — to support a defensible meta-analysis; findings are therefore summarised descriptively and tabulated rather than combined into pooled estimates, and no summary statistic was generated that is not directly derivable from the numbers reported in the source articles. The likely sources of this heterogeneity are considered in the Discussion.

Because the evidence base was predominantly anatomical and no meta-analytic effect estimates were generated, a formal Grading of Recommendations, Assessment, Development and Evaluations (GRADE) assessment of the certainty of evidence was not applicable. The certainty of the anatomical and single-arm clinical findings is instead conveyed narratively through the item-level risk-of-bias appraisal and through the explicit distinction drawn throughout between anatomical feasibility and demonstrated clinical efficacy (Fig. 2).

Figure preparation

The illustrative anatomical figures accompanying this review were generated from cone-beam computed tomography (CBCT) datasets, visualised and reconstructed — including multiplanar and three-dimensional volume renderings of the infratemporal fossa and its bony boundaries — using Planmeca Romexis Viewer (Planmeca Oy, Helsinki, Finland). The resulting images were imported into Adobe Photoshop (Adobe Inc., San José, CA, USA), where they were cropped, contrast-adjusted, annotated and composited into the final labelled schematics. These schematics (Figs. 3, 4, 5) serve anatomical orientation only: colour is used as a labelling device to identify the compartments, bony boundaries and neurovascular structures related to a corridor, and is not a measure of exposure. For Fig. 5 the mandibular ramus and the dentition were cut away from the three-dimensional reconstruction to expose the infratemporal fossa; because CBCT resolves bone only, the vessels and nerves shown are schematic overlays projected onto the bony reconstruction from their respective foramina, and are not themselves imaged. Comparative exposure is presented separately, in Fig. 2 and Tables 2 and 5.

Results

Study selection

Systematic database searching identified 887 records, with a further 24 identified by hand-searching reference lists. After removal of 168 duplicates, 743 records were screened by title and abstract and 649 were excluded as clearly off-topic. Ninety-four reports were sought for retrieval; eight could not be obtained in full text and were

Surgical corridor ↓ / Target →	Medial ITF & PPF	Anterolateral maxilla	Inferomedial ITF / parapharyngeal	Superolateral ITF / GSW / lat. MCF	Posterior ITF / ICA / lower cranial n.	Meckel's cave / paramedian base
Endonasal transpterygoid / transmaxillary	●	◑	◑	○	○	◑
Prelacrimal / incremental maxillectomy (Denker)	●	●	◑	○	○	○
Transoral (transvestibular–paramandibular)	◑	○	●	○	◑	○
Transorbital	◑	○	○	●	○	◑
Lateral / transcranial open	◑	◑	◑	●	●	●
Combined / multiportal	●	●	●	●	●	●

● Well exposed / primary target ◑ Partial — with extension or as adjunct ○ Poorly reached / not a target

Fig. 2 Corridor-to-subregion exposure matrix for the infratemporal fossa. Filled circles denote subregions a corridor exposes well as a primary target; half-filled circles subregions reached only partially, with an extension of the corridor or with the corridor used as an adjunct; and open circles subregions poorly reached or not targeted. The matrix is a qualitative synthesis of the anatomical and clinical evidence presented in §3.3 and Table 5; cells summarise reported exposure and are not a quantitative metric. ITF, infratemporal fossa; PPF, pterygopalatine fossa; GSW, greater sphenoid wing; MCF, middle cranial fossa; ICA, internal carotid artery

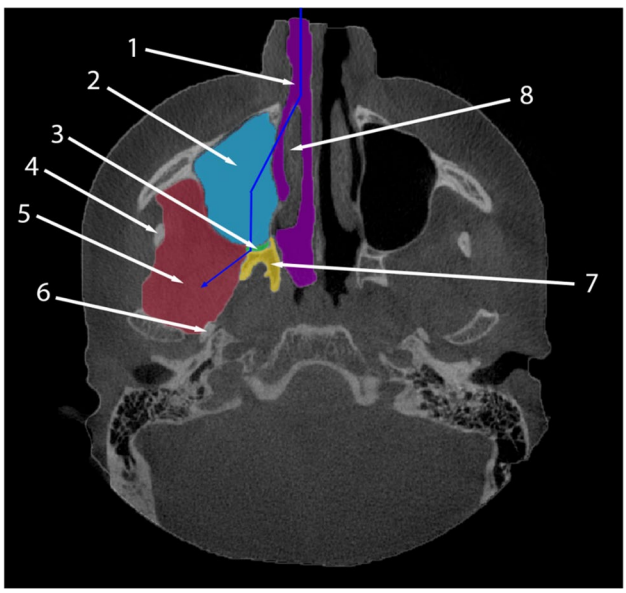


Fig. 3 Anatomical orientation for the endoscopic endonasal transpterygoid and transmaxillary corridor, on an axial CBCT slice. Shading labels the compartments the corridor traverses, in the order in which they are entered: 1, nasal cavity (purple); 2, maxillary sinus (light blue); 3, pterygopalatine fossa (green); 5, infratemporal fossa (red). Unshaded bony landmarks are numbered 4, coronoid process of the mandible; 6, styloid process; 7, pterygoid process of the sphenoid; 8, inferior turbinate. The blue arrow indicates the trajectory. Colour identifies structures and their sequence along the corridor and does not indicate how well each is exposed; exposure is summarised in Fig. 2, Tables 2 and 5

excluded to preserve verifiability. Of the 86 reports assessed in full, 57 were excluded — the ITF was not a primary target ($n = 21$), no extractable corridor-level data were reported ($n = 16$), the report was a review or technical note without primary data ($n = 14$), or the cohort overlapped a study already included ($n = 6$). Twenty-nine studies

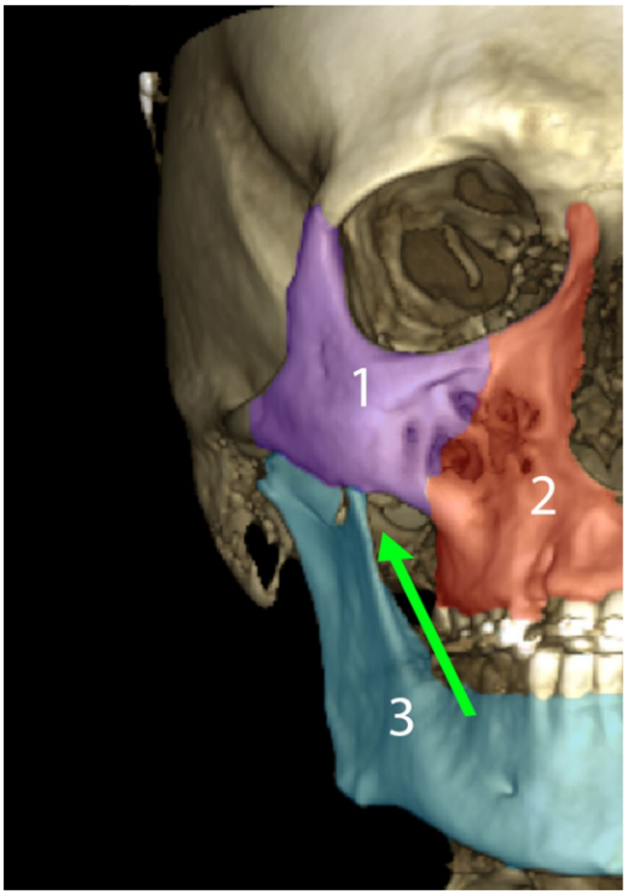


Fig. 4 Anatomical orientation for the transoral (transvestibular–paramandibular) corridor, on a three-dimensional CBCT reconstruction. Shading labels the bony boundaries the corridor passes between: 1, zygomatic bone (purple); 2, maxilla (red); 3, mandible (teal). The green arrow indicates the trajectory. As in Fig. 3, colour identifies structures for orientation and does not indicate extent of exposure

were included (Fig. 1), dominated anatomically by cadaveric feasibility work and clinically by small single-centre series of mixed pathology; their characteristics are given in Table 1.

Characteristics of the included studies

Corridor-by-corridor synthesis

The included corridors clustered into six families. Across them one pattern is consistent and forms the practical message of this review: corridor choice is target-driven rather than hierarchical. Endonasal and transoral routes give the most direct, lowest-external-morbidity access to the medial, pterygopalatine and inferomedial portions of the fossa and suit displacing or benign lesions; the transorbital route adds a superolateral line of sight to the greater sphenoid wing and lateral middle cranial fossa; lateral, orbitozygomatic, transmandibular and transcranial routes provide the wide exposure and the vascular and lower-cranial-nerve control required for lateral, posterior, vascular-encasing or invasive disease, at higher cranial-nerve and cosmetic cost; and combined multiportal strategies approach whole-fossa coverage by distributing morbidity across several small ports. Figure 2 and Table 5 map each family onto the subregions it best reaches and name the studies supporting each mapping, Fig. 5 shows the neurovascular structures at risk together with the trajectories of the minimal-access corridors, and §3.7 states the resulting corridor-by-corridor picture in full; the sections below give the evidence specific to each corridor.

Endoscopic endonasal transpterygoid and transmaxillary corridor The endoscopic endonasal transpterygoid approach (Fig. 3) widens the maxillary ostium, removes the posterior maxillary wall and the pterygopalatine contents and drills the

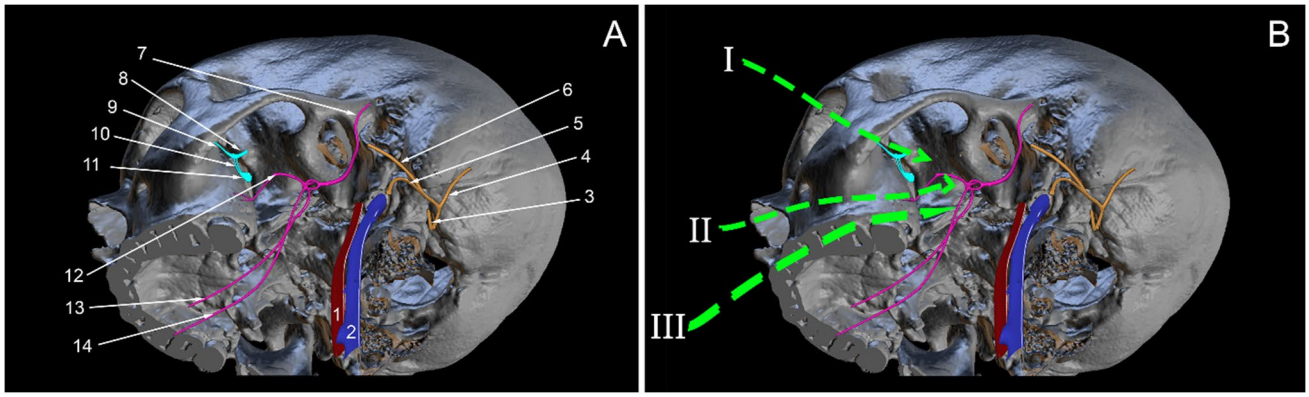


Fig. 5 Neurovascular structures at risk in approaches to the infratemporal fossa, and the trajectories of the minimal-access corridors, shown on a single three-dimensional CBCT reconstruction of the left side viewed from the inferolateral aspect, with the mandible and the dentition cut away to expose the fossa. **A** Structures at risk: 1, internal carotid artery; 2, internal jugular vein; 3, facial nerve emerging from the stylomastoid foramen; 4, posterior auricular nerve; 5, cervicofacial division of the facial nerve; 6, temporofacial division of the facial nerve; 7, auriculotemporal nerve; 8, maxillary nerve (V2); 9, infraorbital nerve; 10, ganglionic branches of the maxillary nerve to the pterygopalatine ganglion; 11, pterygopalatine ganglion; 12, buccal nerve; 13, inferior alveolar nerve; 14, lingual nerve. The internal carotid artery is shown in red and the internal jugular vein in blue; the facial nerve and its branches in orange, the mandibular nerve and its branches in magenta, and the maxillary nerve with the pterygopalatine ganglion and its branches in cyan. **B** The same projection with the trajectories of three minimal-access corridors indicated by dashed green arrows: I, the endoscopic transorbital corridor; II, the endoscopic endonasal transpterygoid and transmaxillary corridor; III, the transoral (transvestibular–paramandibular) corridor. The prelacrimal and incremental-maxillectomy extensions share the endonasal trajectory shown and are not arrowed separately. The lateral and transcranial open corridors approach the fossa from the viewer's aspect in this projection and are therefore not arrowed; their exposure and morbidity are described in §3.3.5. Because CBCT resolves bone only, the vessels and nerves are schematic overlays projected onto the bony reconstruction and positioned from their respective foramina — the carotid canal, jugular foramen, stylomastoid foramen, foramen rotundum and foramen ovale — and are not themselves imaged. The arrows indicate the direction of approach, not the extent of exposure; comparative exposure is given in Fig. 2 and Tables 2 and 5. ITF, infratemporal fossa

pterygoid base, carrying the exposure toward Meckel's cave, the middle cranial fossa and the petrous apex [5, 7, 10]. Its distinctive contribution is direct, incision-free visualisation of midline and paramedian structures superior to that offered by lateral routes [5, 15], planned from the vidian nerve and canal, foramen rotundum and pterygoid base, which also locate the anterior genu of the parapharyngeal ICA [7, 10].

Its recurring limitation is control of the parapharyngeal ICA and lateral ITF, reached only after mobilising the medial pterygoid muscle, eustachian tube and styloid diaphragm; the corridor therefore suits lesions that displace rather than invade, with transcervical proximal control held in reserve [7]. Cadaveric work delimits it in both directions: it reaches the medial parapharyngeal compartment well but yields to open dissection laterally and posteriorly [26], and is shorter and more direct to the medial ITF than the open preauricular route at the cost of a narrower lateral working angle [29]. Clinically it has been applied to ITF and upper parapharyngeal tumours [2] and to trigeminal schwannomas [28]; trismus, dry eye and palatal hypoaesthesia are its characteristic approach-specific morbidities [27].

Prelacrimal recess and incremental-maxillectomy (Denker) extensions Exposure of the medial ITF can be enlarged incrementally by extending the maxillectomy anterolaterally. In a staged cadaveric study, progression from a medial maxillectomy through an anteriorly extended maxillectomy, a contralateral transseptal 'cross-court' angle and an endoscopic Denker (Sturmann–Canfield) maxillotomy increased both area of exposure and surgical freedom at every stage, the Denker stage yielding the largest area of exposure (8.46 ± 1.56 cm^2) and a lateral reach comparable to that of a sublabial anterior maxillotomy [25]; radio-anatomical modelling quantified the septal resection or anteromedial maxillotomy required for the lateral access a standard medial maxillectomy cannot attain [21]. A controlled cadaveric comparison confirmed that the Denker window exposes a significantly larger area than a medial maxillectomy (729 ± 49 mm^2 versus 568 ± 46 mm^2; $p < 0.0001$), but no more than a transpterygoid corridor (677 ± 35 mm^2; $p = 0.09$) [27].

Table 1 Characteristics of the 29 included studies

Study (year)	Design	Corridor(s) evaluated	Specimens/patients	Modality
Prosser et al. (2011) [21]	Radio-anatomical	Medial maxillectomy, transseptal, Denker	CT scans	Endoscopic (imaging)
Hosseini et al. (2012) [7]	Radio-anatomical	Endonasal transpterygoid (ITF)	Cadaveric + CT	Endoscopic
Chan et al. (2011) [3]	Anatomical + clinical	Transvestibular paramandibular (transoral)	Cadaveric + cases	Endoscopic
Hofstetter et al. (2010) [5]	Anatomical	Transmaxillary transpterygoid	Cadaveric	Endoscopic
Ohue et al. (2012) [19]	Clinical series	Orbitozygomatic/zygomatic	31 patients	Open (microscopic)
Hosseini et al. (2013) [6]	Radio-anatomical	Transpterygoid nasopharyngectomy	Cadaveric + CT	Endoscopic
Timoshenko et al. (2013) [23]	Clinical series	Preauricular transmandibular–transzygomatic	Patient series	Open
Kasemsiri et al. (2013) [10]	Anatomical	Endonasal transpterygoid (landmarks)	Cadaveric	Endoscopic
Van Rompaey et al. (2013) [26]	Comparative anatomical	Endoscopic vs open parapharyngeal	Cadaveric	Both
Battaglia et al. (2014) [2]	Clinical series	Endonasal transpterygoid transmaxillary	Patient series	Endoscopic
Youssef et al. (2015) [29]	Comparative cadaveric	Endoscopic transpterygoid vs open preauricular	5 heads	Both
Upadhyay et al. (2016) [25]	Staged cadaveric	Incremental maxillectomy incl. Denker	10 heads (20 sides)	Endoscopic
Nonaka et al. (2016) [18]	Clinical series + anatomy	Middle-ITF transcranial extradural (V3–TMJ)	17 patients	Open (microscopic)
Zhou et al. (2016) [30]	Clinical	Prelacrimal recess (transmaxillary)	Patient series	Endoscopic
Huang et al. (2017) [8]	Anatomical/clinical	Prelacrimal recess	Cadaveric + clinical	Endoscopic
Yang et al. (2018) [28]	Clinical series	Endonasal endoscopic (trigeminal schwannoma)	39 patients	Endoscopic
Patwa et al. (2018) [20]	Anatomical	Far-medial transoral	Cadaveric	Endoscopic
Fang et al. (2019) [4]	Cadaveric	Transvestibular (transoral)	Cadaveric	Endoscopic
Khong et al. (2020) [11]	Cadaveric/technical	Prelacrimal recess	Cadaveric	Endoscopic
Li et al. (2020) [15]	Anatomical	Anatomy-based endonasal corridors	Cadaveric	Endoscopic
Lee et al. (2019) [14]	Clinical comparative	Endonasal vs transorbital (middle fossa)	21 patients	Endoscopic
Lin et al. (2021) [16]	Cadaveric comparative	Contralateral endonasal, Caldwell-Luc, transorbital	Cadaveric	Endoscopic
Yacoub et al. (2021) [27]	Cadaveric comparative	Lateral endoscopic-assisted vs endonasal (MM, Denker)	5 heads (10 sides)	Endoscopic/assisted
Konuthula et al. (2021) [13]	Clinical + modelling	Paramaxillary transoral	10 patients	Endoscopic
Torres-Gaya et al. (2019) [24]	Case report	Transoral (transvestibular–paramandibular)	1 patient	Endoscopic
Soriano et al. (2023) [22]	Case report	Combined endonasal + transoral/transorbital	1 patient	Endoscopic
Mongkolkul et al. (2024) [17]	Cadaveric	Multiportal (transpterygoid, sublabial, transorbital, transoral)	5 heads (10 sides)	Endoscopic
Aydin et al. (2025) [1]	Comparative cadaveric	Orbitozygomatic vs transmandibular	5 heads (10 sides)	Open (microscopic)
Jriyasetapong and Bawornvaraporn (2026) [9]	Cadaveric + clinical	Subtemporal infratemporal (ESITA) vs endonasal (EEMP)	5 heads (10 sides) + 22 patients	Both

ESITA extradural subtemporal infratemporal approach, *EEMP* endonasal endoscopic transmaxillary transpterygoid approach, *ITF* infratemporal fossa, *TMJ* temporomandibular joint. Level of evidence is not applicable to anatomical studies; clinical series correspond to level IV

The prelacrimal recess approach reaches the anterolateral maxilla and the lateral PPF and ITF while preserving the inferior turbinate and nasolacrimal duct [8, 11], the width of the recess being the limiting factor; clinically

it has permitted intranasal endoscopic removal of pterygopalatine and infratemporal schwannomas with preserved nasolacrimal function [30]. Neither the prelacrimal nor the Denker variant reaches the superolateral ITF, the parapharyngeal ICA or the paramedian skull base, for which a transpterygoid extension or a lateral route is required (Fig. 2).

Transoral (transvestibular–paramandibular) corridor Transoral corridors (Figs. 4 and 5B) reach the ITF and parapharyngeal space through a gingivobuccal or vestibular incision along the natural plane between the maxilla and the mandible, without external scarring and with minimal bone removal [3, 4, 24]. Cadaveric and clinical analysis has delineated their boundaries. The primary corridor is bounded medially by the maxillary tuberosity, laterally by the mandible and temporalis muscle, superiorly by the zygomatic process and inferiorly by the medial pterygoid muscle, and divides into two secondary triangles. The superomedial triangle — bounded medially by the lateral pterygoid plate and the posterolateral maxillary sinus wall, superiorly by the greater sphenoid wing and inferolaterally by the lateral pterygoid muscle — reaches the pterygomaxillary fissure and the terminal branches of the maxillary artery and, with dissection carried anterior to that vessel, the inferior orbital fissure, the foramen ovale and the eustachian tube. The inferolateral triangle — bounded superiorly by the lower head of the lateral pterygoid muscle, inferiorly by the medial pterygoid muscle and laterally by the mandible — exposes the buccal nerve, the posterolateral branches of V3, the middle meningeal artery, the deep lobe of the parotid gland and the styloid diaphragm, and through the last the parapharyngeal space; a mean surgical freedom of 231 mm vertically and 161 mm horizontally was recorded with a 19-mm endoscope [13, 20]. The distinctive advantage of the corridor is early access to the maxillary artery. Its limitations are consistent across reports: the working corridor is narrow, particularly in the horizontal axis, so that the endoscope, an aspirator and only a single dissecting instrument are comfortably accommodated unless the coronoid process and the posterolateral maxillary wall are resected; partial division of the lateral pterygoid muscle is required to enter the superomedial triangle, with a consequent risk of trismus; the pterygopalatine fossa is incompletely exposed without further maxillary and pterygoid bone removal; and access to the parapharyngeal space below the mandibular angle, and control of the C1 segment of the internal carotid artery, are limited [3]. The corridor is therefore unsuited to disease requiring wide oncological margins or control of an encasing carotid artery [4, 24].

Transorbital corridor The endoscopic transorbital corridor (Fig. 5B), via a superior eyelid or transconjunctival incision, gives a superolateral line of sight to the greater sphenoid wing, the lateral middle cranial fossa and the superolateral ITF. In cadaveric comparison it exposed a larger middle-cranial-fossa area (731 ± 80 mm^2) than a Caldwell-Luc (468 ± 60 mm^2) or a contralateral endonasal corridor (267 ± 47 mm^2), with comparable ITF exposure across the three but the widest angles of attack and the shortest working depth to the foramina ovale and rotundum [16]. Clinically, gross-total resection of middle-cranial-fossa tumours was numerically but not significantly higher through the transorbital corridor than through the endonasal route (71.4% versus 33.3%; $p = 0.286$), the two reaching complementary compartments; its limitations in that series were those of a single narrow portal — dissection constrained by crowding of the endoscope and instruments within one corridor — together with orbital and periorbital morbidity: transient ptosis in 3 of 9 patients (33.3%) and keratitis with temporary deterioration of visual acuity in 2 (22.2%), all resolving, and new facial numbness or pain in 8 of the 21 patients of the series overall (38.1%), unimproved at last follow-up [14]. The corridor affords no proximal vascular control and does not reach the inferomedial ITF or the parapharyngeal space; it is therefore best regarded as an adjunct that supplies superolateral reach where the endonasal trajectory is constrained (Fig. 2).

Lateral and transcranial open corridors Open lateral and transcranial routes remain central where wide exposure or vascular control is required. The preauricular transmandibular–transzygomatic approach exposes the entire ITF and, with facial-nerve dissection and preservation, permits resection of extensive and malignant lesions; in the reported series facial palsy, frequently pre-existing, and the trade-offs of mandibular and zygomatic osteotomy were the salient morbidities [23]. Orbitozygomatic and zygomatic osteotomies with middle-fossa drilling achieved gross-total resection in most of 31 patients of a mixed-pathology series, trigeminal palsy being the most frequent new deficit [19].

Cadaveric comparison shows these routes to be complementary rather than competing: the orbitozygomatic approach gives wide anterior and middle ITF exposure with minimal brain retraction but limited access to the posterior ITF, maxillary artery and lower cranial nerves, whereas the transmandibular approach extends visualisation posteriorly with superior maxillary-artery and lower-cranial-nerve control [1]. A less-invasive transcranial extradural 'middle-ITF' corridor between V3 and the TMJ allows exposure to be tailored from minimal retrotrigeminal drilling to full V3 skeletonisation, and achieved gross-total resection in 12 of 17 patients (70.6%),

with complications in 53%, new cranial neuropathies in 47.1% and dysphagia the most frequent of these (23.5%) [18]. Directly compared, the extradural subtemporal route removed a greater proportion of the anterior ITF (92% versus 78.7%; $p = 0.043$) with wider surgical freedom, whereas the endonasal transmaxillary transpterygoid route cleared the pterygopalatine fossa more completely (100% versus 73.1%; $p = 0.043$) [9].

Combined and multiportal corridors Because no single minimal-access route controls the entire ITF, combined multiportal strategies have been quantified cadaverically. Adding sublabial transmaxillary, transorbital (through the infraorbital foramen) and transoral ports to the endonasal transpterygoid corridor produced the largest area of exposure of any configuration tested, significantly exceeding an isolated endonasal transpterygoid corridor (combined pterygopalatine-fossa area 8.75 ± 1.40 cm^2 versus 4.40 ± 0.86 cm^2; difference $+4.25 \pm 0.85$ cm^2; $p < 0.001$), each port contributing a distinct advantage — superolateral reach and a middle-fossa line of sight transorbitally, caudal reach and early maxillary-artery control transorally, and greater exposure and surgical freedom sublabially [17]; the order of preference among ports follows the tumour's vascular supply and extension rather than a fixed sequence [17]. Combined endonasal–transoral and endonasal–transorbital resection has been reported clinically for trans-spatial disease of the maxillary sinus, ITF and masticator space [22].

Quantitative anatomical metrics across corridors

Reported metrics are collated in Table 2, which shows incremental maxillectomy and multiportal combination enlarging endonasal exposure, lateral and transorbital routes shortening the working depth and widening the angle of attack to the skull-base foramina, and transcranial routes maximising surgical freedom.

Clinical outcomes and morbidity

Clinical outcomes are reported per study in Table 3. Because the series differ in corridor, pathology and unit of analysis, they are presented to characterise each corridor's typical indication and morbidity rather than to compare resection efficacy between corridors. Extent of resection was generally high but strongly corridor- and pathology-dependent: gross-total resection was achieved in 12 of 17 patients (70.6%) in the transcranial extradural middle-ITF series, with complications in 53% and new cranial neuropathies in 47.1% [18]; in most of 31 patients of an

Table 2 Reported quantitative anatomical metrics by corridor (as published; not statistically pooled)

Study (year)	Corridor/target	Reported metric
Upadhyay et al. (2016) [25]	Endoscopic Denker, medial ITF	Area of exposure 8.46 ± 1.56 cm^2 (largest of the staged endonasal stages); Denker ≈ sublabial anterior maxillotomy for lateral reach
Yacoub et al. (2021) [27]	Denker (DA), transpterygoid (TTFA), medial maxillectomy (MM)	Area of exposure DA 729 ± 49 mm^2 > MM 568 ± 46 mm^2 ($p < 0.0001$); DA vs TTFA 677 ± 35 mm^2 ($p = 0.09$); greatest surgical freedom for the lateral three-hand corridor (TTFA 109.3 ± 19 cm^2)
Mongkolkul et al. (2024) [17]	PPF area of exposure	EETA 4.40 ± 0.86; sublabial transmaxillary 6.11 ± 1.02; combined multi-portal 8.75 ± 1.40 cm^2 (combined vs EETA $+4.25 \pm 0.85$ cm^2, $p < 0.001$)
Mongkolkul et al. (2024) [17]	Surgical freedom (targets)	Foramen rotundum: EETA 0.79 ± 0.34 vs sublabial transmaxillary 3.25 ± 1.23 cm^2; mandibular condyle: transoral 4.18 ± 1.18 vs transorbital 0.94 ± 0.41 cm^2
Lin et al. (2021) [16]	MCF/PPF/ITF area, angles, depth	MCF area: transorbital 731 ± 80 > Caldwell-Luc 468 ± 60 > contralateral endonasal 267 ± 47 mm^2; ITF area comparable across the three; transorbital gave the widest angles of attack and shortest working depth to foramina ovale and rotundum
Jriyasetapong and Baworn-varaporn (2026) [9]	Resection volume (AITF, PPF)	AITF: subtemporal 92% vs endonasal 78.7% ($p = 0.043$); PPF: endonasal 100% vs subtemporal 73.1% ($p = 0.043$); subtemporal wider surgical freedom and angles of attack

EETA endoscopic endonasal transpterygoid approach, *PPF* pterygopalatine fossa, *MCF* middle cranial fossa, *AITF* anterior ITF. Values are reproduced as reported and are not statistically combined

Table 3 Clinical outcomes and complications of ITF corridors (as reported)

Study (year)	Corridor	Extent of resection	Predominant morbidity	Follow-up
Ohue et al. (2012) [19]	OZ/zygomatic (open)	Gross-total in most of 31 patients	Trigeminal nerve palsy (several)	Series
Timoshenko et al. (2013) [23]	Preauricular TM–TZ (open)	Adequate resection incl. malignant disease	Facial palsy (often pre-existing); recurrence in malignancy	≥ 5 yr in survivors
Nonaka et al. (2016) [18]	Middle-ITF transcranial	GTR 12/17 (70.6%), NTR 3, STR 2	Complications 53%; dysphagia 23.5%; new CN deficit 47.1%	1–7 yr
Yang et al. (2018) [28]	Endonasal (schwannoma)	GTR intended; STR in a minority	New CN V deficit in a minority; most recover ≤ 12 mo; persistent dry eye	Mean 38 mo
Lee et al. (2019) [14]	Endonasal vs transorbital	GTR 12/21 (57.1%); TOA 71.4% vs EEA 33.3% (ns)	Approach-dependent CN morbidity	Series
Konuthula et al. (2021) [13]	Paramaxillary transoral	Feasibility across 10 patients	Low external morbidity; rapid mucosal healing	≥ 2 yr
Jriyasetapong and Bawornvaraporn (2026) [9]	Subtemporal vs endonasal + combined	GTR/NTR 56%/88%/60%	Minor endoscopic (crusting, transient numbness); rare meningitis	Mean 26.2 mo

OZ orbitozygomatic, *TM–TZ* transmandibular–transzygomatic, *GTR/NTR/STR* gross-/near-/sub-total resection, *CN* cranial nerve, *TOA* transorbital approach, *EEA* endoscopic endonasal approach, *ns* not significant

orbitozygomatic and zygomatic series, trigeminal palsy being the principal new deficit [19]; in 12 of 21 patients overall (57.1%) in the endonasal-versus-transorbital comparison, 71.4% transorbitally against 33.3% endonasally ($p = 0.286$) [14]; and gross- or near-total resection in 56%, 88% and 60% of transcranial, endoscopic and combined cases respectively in the comparative cadaveric-plus-clinical study [9]. Across the series reporting explicit numerators and denominators, gross- or near-total resection ranged from approximately 57% to 88% — a spread that reflects clinically meaningful heterogeneity of corridor, indication and unit of analysis rather than sampling error, and one reason a single pooled estimate was judged uninformative. Trigeminal dysfunction was the most frequent new deficit, and most trigeminal palsies recovered within twelve months [28].

Risk of bias and methodological quality

Appraisal judgements are summarised in Table 4. Cadaveric studies (QUACS) were generally of moderate-to-good methodological quality, with clear aims and reproducible dissection protocols, but shared the intrinsic limitations of small specimen numbers, absence of pathology and inability to capture bleeding, oedema or healing; incomplete reporting of specimen demographics and of formal observer reliability were the commonest item-level shortcomings. Clinical series (JBI) were uniformly retrospective, single-centre and heterogeneous in pathology and follow-up, indicating a high risk of selection and reporting bias and precluding causal inference between corridor and outcome.

Corridor-to-subregion suitability

Table 5 pairs each corridor family with the ITF subregions it best reaches and with its characteristic morbidity and — so that every cell can be audited — names the included studies supporting the mapping. Stated in full, and read together with Fig. 2, the resulting picture is as follows. The endoscopic endonasal transpterygoid and transmaxillary corridor exposes the medial ITF, the pterygopalatine fossa and the paramedian skull base well, and Meckel's cave with a transpterygoid extension, but reaches the superolateral ITF and the parapharyngeal ICA poorly; its characteristic costs are palatal hypoaesthesia, trismus, dry eye and nasal crusting, with CSF leak

Table 4 Risk-of-bias and quality appraisal of the included studies

Study (year)	Design	Appraisal tool	Overall judgement
Prosser et al. (2011) [21]	Radio-anatomical	QUACS (imaging items n/a)	Moderate
Hosseini et al. (2011) [7]	Radio-anatomical	QUACS (imaging items n/a)	Moderate
Chan et al. (2011) [6]	Radio-anatomical	QUACS (imaging items n/a)	Moderate
Hofstetter et al. (2010) [5]	Cadaveric anatomical	QUACS	Good
Kasemsiri et al. (2013) [10]	Cadaveric anatomical	QUACS	Good
Youssef et al. (2015)[29]	Comparative cadaveric	QUACS	Good
Upadhyay et al. (2016) [25]	Staged cadaveric	QUACS	Good
Yacoub et al. (2021) [27]	Comparative cadaveric	QUACS	Good
Lin et al. (2021) [16]	Comparative cadaveric	QUACS	Good
Mongkolkul et al. (2024) [17]	Cadaveric	QUACS	Good
Aydin et al. (2025)[1]	Comparative cadaveric	QUACS	Good
Van Rompaey et al. (2013)[26]	Comparative anatomical	QUACS	Good
Patwa et al. (2018) [20]	Cadaveric anatomical	QUACS	Good
Fang et al. (2019) [4]	Cadaveric anatomical	QUACS	Good
Khong et al. (2020) [11]	Cadaveric anatomical	QUACS	Good
Li et al. (2020) [15]	Cadaveric anatomical	QUACS	Good
Ohue et al. (2012) [19]	Clinical series	JBI case series	Moderate
Timoshenko et al. (2013) [23]	Clinical series	JBI case series	Moderate
Nonaka et al. (2016) [18]	Clinical series	JBI case series	Moderate
Battaglia et al. (2014) [2]	Clinical series	JBI case series	Moderate
Zhou et al. (2016) [30]	Clinical series	JBI case series	Moderate
Huang et al. (2017) [8]	Anatomical/clinical	QUACS + JBI	Good/Moderate
Chan et al. (2011) [3]	Anatomical + clinical	QUACS + JBI	Good/Moderate
Yang et al. (2018) [28]	Clinical series	JBI case series	Moderate
Lee et al. (2019) [14]	Clinical comparative	JBI case series	Moderate
Konuthula et al. (2021) [13]	Clinical + modelling	JBI case series	Moderate
Torres-Gaya et al. (2019) [24]	Case report	JBI case report	Adequate
Soriano et al. (2023) [22]	Case report	JBI case report	Adequate
Jriyasetapong and Bawornvaraporn (2026) [9]	Cadaveric + clinical	QUACS + JBI	Good/Moderate

QUACS Quality Appraisal for Cadaveric Studies, *JBI* Joanna Briggs Institute checklist. 'Imaging items n/a' denotes the two QUACS items on cadaveric specimen preservation and demographics recorded as not applicable for radio-anatomical studies

much reduced by vascularised nasoseptal reconstruction. Prelacrimal and incremental (Denker) maxillectomy extensions add the anterolateral maxilla and widen lateral reach into the medial and mid-ITF, at the price of nasolacrimal and turbinate risk or, with a Denker window, alar collapse, while leaving the superolateral ITF, the parapharyngeal ICA and the paramedian base out of reach. The transoral corridor exposes the inferomedial ITF and the parapharyngeal space directly and offers early maxillary-artery control, but is narrow in the horizontal axis, carries a risk of trismus, and gives only limited control of the parapharyngeal internal carotid artery. The transorbital corridor is the only minimal-access route that reaches the superolateral ITF, the greater sphenoid wing and the lateral middle cranial fossa well; it does not reach the inferomedial or posterior compartments, provides no proximal vascular control, and carries orbital and periorbital morbidity. Lateral and transcranial open corridors are alone in exposing the posterior ITF, the parapharyngeal ICA and the lower cranial nerves together with wide lateral access, at the cost of facial-nerve, temporomandibular, trismus-related, cosmetic and cranial-nerve morbidity. Combined multiportal strategies approach whole-fossa coverage by distributing these costs across several small ports, the choice and order of ports being dictated by the tumour's vascular supply and extension rather than by a fixed sequence. The matrix should be read with the caveats of §4.4.

Table 5 Corridor-to-subregion suitability matrix, with the included studies supporting each row

Corridor family	ITF subregions best reached	Characteristic morbidity	Principal supporting studies (included)
Endoscopic endonasal transpterygoid/transmaxillary	Medial ITF, pterygopalatine fossa, paramedian skull base, nasopharynx, Meckel's cave (with extension)	Palatal hypoaesthesia, trismus, dry eye, nasal crusting, CSF leak (reduced by nasoseptal flap)	Hosseini et al. (2012); Hofstetter et al. (2010); Kasemsiri et al. (2013); Li et al. (2020); Yang et al. (2018); Yacoub et al. (2021); Patwa et al. (2018) [5, 7, 10, 15, 20, 27, 28]
Prelacrimal/incremental maxillectomy (Denker)	Anterolateral maxilla, lateral PPF and medial-to-mid ITF	Nasolacrimal/turbinate risk (mitigated by prelacrimal preservation); alar collapse with Denker	Upadhyay et al. (2016); Prosser et al. (2011); Yacoub et al. (2021); Khong et al. (2020); Huang et al. (2017); Zhou et al. (2016) [8, 11, 21, 25, 27, 30]
Transoral (transvestibular–paramandibular)	Inferomedial ITF, parapharyngeal space, early maxillary-artery control	Narrow corridor, restricted lateral exposure, possible trismus; low external morbidity	Chan et al. (2011); Patwa et al. (2018); Fang et al. (2019); Torres-Gaya et al. (2019); Konuthula et al. (2021) [3, 4, 13, 20, 24]
Transorbital	Superolateral ITF, greater sphenoid wing, lateral middle cranial fossa	Orbital and periorbital morbidity; adjunct role	Lin et al. (2021); Lee et al. (2019) [14, 16]
Lateral/transcranial open (preauricular, transzygomatic, OZ, transmandibular)	Middle and posterior ITF, parapharyngeal ICA, lower cranial nerves, wide lateral exposure	Facial-nerve, TMJ, trismus, cosmetic and cranial-nerve morbidity	Timoshenko et al. (2013); Ohue et al. (2012); Nonaka et al. (2016); Aydin et al. (2025); Jriyasetapong and Bawornvaraporn (2026) [1, 9, 18, 19, 23]
Combined/multiportal	Whole-fossa coverage; superolateral, caudal and vascular targets simultaneously	Morbidity distributed across small ports; port order tumour-driven	Mongkolkul et al. (2024); Soriano et al. (2023) [17, 22]

ICA internal carotid artery, *OZ* orbitozygomatic, *PPF* pterygopalatine fossa, *TMJ* temporomandibular joint, *CSF* cerebrospinal fluid. Each morbidity and subregion mapping is supported by the included studies named in the final column

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Discussion

This synthesis of anatomical and clinical evidence supports a target-driven, rather than a universally 'best', choice of corridor to the ITF. The consistent message across cadaveric and clinical work is that the corridors are complementary: each trades exposure of one ITF subregion, and one class of morbidity, against another. Table 5 summarises this mapping for operative planning.

Endonasal versus lateral: exposure and its price

Endonasal corridors excel at the medial ITF, PPF and paramedian skull base and avoid the skin incisions, osteotomies, temporalis manipulation, TMJ dysfunction and facial-nerve-branch injury inherent to lateral routes [7, 24]. Their weakness is the lateral and posterior ITF and, above all, the parapharyngeal ICA, which is reached only after mobilising the medial pterygoid, eustachian tube and styloid diaphragm — so endonasal routes are best suited to lesions that displace rather than invade, with transcervical proximal control held in reserve [7, 26]. The quantitative literature shows this limitation can be partly offset: incremental maxillectomy and, especially, the Denker maxillotomy enlarge lateral reach and surgical freedom [21, 25, 27], and multiportal combinations approach or exceed the exposure of wider dissections while distributing morbidity across small ports [17]. Conversely, lateral and transcranial routes buy wide exposure, maximal surgical freedom and vascular and lower-cranial-nerve control at the price of osteotomy-related and cranial-nerve morbidity [1, 19, 23].

Indications by pathology and extension

The clinical series map onto this anatomical logic. Benign, displacing, vascular lesions such as juvenile angiofibroma and nerve-sheath tumours are frequently amenable to endonasal or transoral corridors, whereas invasive malignancy, disease encasing the carotid artery, or lesions with wide lateral, posterior or intracranial extension favour lateral, transcranial or combined approaches to secure margins and vascular control [18, 23, 28]. The transorbital port's superolateral line of sight and the transoral port's early maxillary-artery control illustrate how adjunct corridors are selected by tumour geometry and vascular supply rather than by preference [14, 17].

Morbidity trade-offs

Trigeminal (V2/V3) dysfunction was the most frequently reported neural morbidity across corridors, reflecting the nerve's central position in the fossa; palatal hypoaesthesia, dry eye and trismus recurred with endonasal transpterygoid dissection, dysphagia and lower-cranial-nerve deficits with posterior and transcranial dissection, and facial-nerve risk with cosmetic and TMJ sequelae characterised the lateral open routes [7, 18, 23, 27, 28]. The structures that account for this pattern — the internal carotid artery, the internal jugular vein, the maxillary (V2) and mandibular (V3) divisions of the trigeminal nerve together with the pterygopalatine ganglion, and the facial nerve — and their relation to the minimal-access trajectories are shown in Fig. 5. Encouragingly, several series reported substantial recovery of trigeminal deficits over six to twelve months and low CSF-leak rates with vascularised-flap reconstruction [28]. These are, however, single-arm observations from heterogeneous cohorts and should not be read as head-to-head safety comparisons.

Anatomical feasibility is not clinical efficacy

A recurring caution is warranted. Most quantitative evidence is cadaveric: it measures what a corridor can expose in a fixed, bloodless, disease-free specimen, not what it achieves against a vascular tumour in a living patient, where bleeding from the pterygoid plexus, oedema, adhesion of nerve to tumour and the need for oncological margins all intervene [28, 29]. Area of exposure and surgical freedom are surrogate constructs; larger values do

not entail higher resection rates or lower morbidity. The clinical series, for their part, are small, retrospective and heterogeneous and cannot causally attribute outcomes to corridor choice. The two literatures should therefore be read together but not conflated.

Limitations of the evidence and of this review

The evidence base is limited by the predominance of cadaveric feasibility studies, small clinical cohorts, absent randomisation, and non-standardised metrics and outcome definitions, which together precluded meaningful quantitative pooling and mandated a narrative-plus-tabular synthesis. Where future series adopt common anatomical targets and standardised outcome definitions, a proportion meta-analysis with random-effects modelling and I^2 reporting would become defensible; at present the assumptions required for pooling are not met, which is why per-study values are reported throughout. This review has its own limitations. It was restricted to English-language reports whose full text could be verified, which favours auditability over exhaustiveness and may introduce language and retrieval bias, under-representing corridors reported only in other languages or in sources that could not be retrieved; the corpus also over-represents endonasal work relative to open and transcervical routes. The review was not prospectively registered. The field would benefit from consensus targets and landmarks for anatomical measurement, standardised complication reporting, and prospective, ideally multicentre, outcome registries that record corridor, pathology, extent of resection and cranial-nerve function uniformly.

Conclusion

Surgical corridors to the infratemporal fossa are best understood as a complementary set rather than a hierarchy. Endonasal and transoral routes provide direct, low-external-morbidity access to the medial, pterygopalatine and paramedian portions of the fossa and suit displacing, benign or well-selected lesions; incremental maxillectomy and multiportal combinations extend their reach. Lateral, orbitozygomatic, transmandibular and transcranial routes provide the wide exposure, surgical freedom and vascular and lower-cranial-nerve control required for lateral, posterior, vascular-encasing or invasive disease, at the cost of greater cranial-nerve, functional and cosmetic morbidity. Corridor selection should follow the target subregion, the tumour's vascular relationships and the required margins. Because the current evidence is dominated by cadaveric feasibility work and small heterogeneous series, anatomical exposure must not be equated with clinical efficacy, and standardised anatomical metrics and prospective outcome data are needed to place these corridors on a firmer comparative footing.

Authors' contributions [ACA] conceived and designed the review; [ACA] and [BV] conducted the searches, study selection and data extraction; [ACA] and [BV] performed the risk-of-bias appraisal; [MCR] supervised the work and provided the anatomical framing; [ACA] drafted the manuscript; all authors critically revised it and approved the final version.

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Data availability The data supporting the findings of this study are derived from previously published studies, all of which are cited in the article and listed in the reference list. Additional data extracted during the review, including the item-level risk-of-bias assessments and the full electronic search strategies, are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate Not applicable. This study is a systematic review of previously published, de-identified studies and did not involve any new studies with human participants, human material, or animals performed by any of the authors; accordingly, no ethical approval or informed consent was required.

Consent for publication Not applicable.

Competing interests The authors declare no competing interests.

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Authors and Affiliations

Andrei Cristian Albu[1] · Bogdan Vintilă[1] · Mugurel Constantin Rusu[1]

✉ Bogdan Vintilă
bogdan.vintila2024@stud.umfcd.ro

Andrei Cristian Albu
andrei-cristian.albu2023@stud.umfcd.ro

Mugurel Constantin Rusu
mugurel.rusu@umfcd.ro

[1] Division of Anatomy, Department 1, Faculty of Dentistry, 'Carol Davila' University of Medicine and Pharmacy, 8 Eroii Sanitari Boulevard, 050474 Bucharest, Romania