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Transoral versus transfacial surgical approach to maxillary tumors: evaluation of outcomes and perspectives

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Abstract. Neoplasms of the maxilla have multiple different origins and histology, and often extend towards the infratemporal fossa, orbit, or skull base. Extensive resection may be required, often leading to poor esthetic and functional results. Usually, these lesions are removed via a transfacial approach. The aim of this study was to compare the outcomes of the transoral versus transfacial approach for maxillary tumors. A single-institution retrospective study was conducted on patients with maxillary-midface tumors, treated between January 2009 and December 2019. The patients were divided into two groups according to the surgical approach, transfacial or transoral, and the following outcomes were assessed: extent of the resection based on Brown's classification; postoperative pathology margin assessment; reconstruction technique; esthetic/functional results. A total of 178 patients were included. A satisfactory resection was obtained in both groups, with the transoral cohort achieving a higher rate of clear oncological margins (positive margins: transoral group 3.7% versus transfacial group 6.8%, $P = 0.389$) and a significantly higher University of Washington Quality of Life score (mean 72.2 versus 67.8, $P < 0.001$). Even large and invasive tumors can be treated successfully with the transoral approach, avoiding unesthetic facial scars while still providing complete resection of the tumor.

Keywords: Maxillary neoplasms; Cancer of maxillary sinus; Cancer of the head and neck; Head and neck neoplasm; Postoperative complications; Ablation techniques.

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Maxillary-midface tumor resection is challenging due to the complex anatomy of this region and the potential for severe esthetic and functional sequelae.[1] The maxillary bone is connected to the anterior and median skull base through the ethmoid and sphenoid bones. This 'border zone' in the middle of the splanchnocranium and close to the neurocranium also contributes to anatomical spaces of great importance: the orbital cavity, maxillary and ethmoidal sinuses, nasal cavities, and infratemporal fossa.[2] It is therefore easy to understand the

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difficulties in the surgical treatment of the many expansive pathologies that can involve the midface.[3–5]

Lesions of the maxilla include tumors of multiple different origins and histology that often extend towards the infratemporal fossa, orbit, or skull base through naso-ethmoidal extension.[6] Squamous cell carcinomas (SCC) originating from the mucosa of the oral and sinonasal cavities are the most common malignant tumors, representing more than 90% of tumors of the maxilla and midface in adults, followed by carcinomas of the minor salivary glands. Tumors originating in this anatomical region are usually removed through a transfacial approach, commonly with the Weber–Fergusson incision, with or without other cutaneous incisions.[3,4] This strategy has long been the primary approach for midface lesions. The transoral approach to the midface was initially described for benign lesions, but its use was later extended to the treatment of malignant lesions.[7,8] This approach can produce better esthetic and functional results, leading to better psychological outcomes and higher quality of life for patients.[9,10]

The goal of any surgical approach is to obtain a complete resection of the tumor, allow subsequent repair of the defect, and to preserve the function and esthetics of the face. The aim of this study was to evaluate all patients who had been treated surgically for tumors of the maxilla in the Department of Oral and Maxillofacial Sciences, Sapienza University of Rome, and to then compare the transoral approach with the transfacial approach regarding the achievement of these stated goals.

Patients and methods

A single-institution retrospective observational study was conducted. The inclusion criteria were (1) patients with malignant lesions of the maxilla, (2) surgically treated in the Department of Oral and Maxillofacial Sciences, Sapienza University of Rome, Italy, (3) between January 2010 and December 2019, and (4) with complete clinical and radiographic documentation. All patients gave their informed consent for inclusion. The study was approved by the Ethics Committee of Sapienza University of Rome, Italy (Prot. n. 0000211).

All patients with maxillary neoplasms extending towards the infratemporal fossa, orbit, or sinonasal cavity, including tumors with different origins and histology, were reviewed. Patients treated with a Brown type I maxillectomy were excluded due to the limited extent of the resection[11]; these are always performed transorally. Brown type IV maxillectomy cases were also excluded, since none were performed by transoral approach. This resection requires orbital exenteration, which was performed using the transfacial technique in the study unit until 2019.

The patients were divided into two groups according to the surgical approach, transfacial versus transoral. The outcomes assessed were (1) the extent of the resection according to Brown's classification[11] and the resection volume expressed in cubic centimeters, (2) the ability to achieve a total tumor resection with tumor-free margins, (3) the reconstruction technique, and (4) esthetic/functional results determined by administering the University of Washington Quality of Life questionnaire (UW-QOL, version 4).[12] Variables describing the patient demographics were recorded.

Patients included in the transoral group were treated by vestibular or facial degloving technique. If necessary, three additional approaches were utilized: (1) a sub-palpebral skin incision to access the orbital floor, (2) the lateral infratemporal fossa approach for management of the posterolateral side of the lesion[13,14], and (3) an endoscopic approach to the ethmoid, sphenoid, and skull base. Hence, the transoral group included patients in whom the transoral approach was applied, associated with more esthetic and minimally invasive incisions that do not divide the upper lip and conserve the intact soft tissue of the nasal and midfacial region. In the group of patients treated by transfacial approach, the Weber–Fergusson incision with or without Dieffenbach's modification was used, with complementary cutaneous approaches such as the Lynch or lateral rhinotomy utilized when necessary. If required, the lateral infratemporal fossa approach, with the transzygomatic approach to the infratemporal fossa, was also utilized.[13,14]

Statistical analysis

Categorical data were analyzed as frequencies, and continuous data as the mean with standard deviation. Comparisons of frequencies were performed with Fisher's exact test, and comparisons of means with the *t*-test; a P-value < 0.05 was considered statistically significant. The variables were analyzed using IBM SPSS Statistics version 27 (IBM Corp., Armonk, NY, USA).

Results

A total of 197 patients met the inclusion criteria, of whom 14 were excluded as they had primary tumors of the infratemporal fossa. Five patients treated by Brown type IV maxillectomy were also excluded because they were all treated with a transfacial approach until 2019. Therefore, 178 patients were included in this study. Of these patients, 134 underwent the transoral approach and 44 the transfacial approach. Demographic data describing the sample are shown in Table 1.

Table 1. Patient demographics ($N = 178$).

	Transoral approach	Transfacial approach	*P*-value
Sample size, *n* (%)	134 (75.3%)	44 (24.7%)	
Sex, *n* (%)			0.374[a]
Male	72 (53.7%)	27 (61.4%)	
Female	62 (46.3%)	17 (38.6%)	
Age (years) mean ± SD	61.9 ± 15.8	60.9 ± 14.1	0.709[b]

SD, standard deviation.
[a] *P*-value calculated with Fisher's exact test.
[b] *P*-value calculated with the *t*-test.

All patients were classified according to the type of maxillary resection based on Brown's classification.[11] The majority of resections were Brown type II (n = 99, 55.6%), followed by type III (n = 69, 38.8%) and type II/III + VI (n = 10, 5.6%). Figs. 1–4 show representative cases for the different subtypes of Brown maxillectomy. The size and complexity of the resections were evenly distributed among the transoral and transfacial cohorts. Details of the maxillectomy type by surgical approach are shown in Table 2. The mean dimensions (cm) and volumes (cm^3) of the resection segments are shown in Table 3; on average, the volume of the segment was larger with the transoral approach.

The analysis of the postoperative pathological margins is presented in Table 4. Five patients in the transoral group (3.7%) and three in the transfacial group (6.8%) had positive margins ($P = 0.389$). When it was surgically possible, patients with positive margins underwent re-excision of the tumor.

The types of reconstruction that the patients in each group underwent are described in Table 5. For loco-regional flaps, the following techniques were utilized: primary closure, local flaps, Bichat flap, palatal advancement flap, and facial artery musculo-mucosal flap. Regarding the osseous microvascular flaps, the following were utilized: fibula, scapula, and iliac crest free flaps. The non-osseous microvascular flaps used were radial forearm, anterolateral thigh, and latissimus dorsi free flaps.

Patient satisfaction was assessed using the UW-QOL version 4.[12] Overall, 117 patients in the transoral group (87.3%) and 42 in the transfacial group (95.5%) replied to the questionnaire. The mean score differed significantly between the groups: 72.2 ± 3.9 in the transoral group and 67.8 ± 6.2 in the transfacial group (maximum score 100 representing the best possible response) ($P < 0.001$, t-test).

Furthermore, there was a statistically significant difference between the groups in the proportion of patients who chose to undergo additional elective surgical treatments to improve their esthetic appearance, with 31.8% in the transfacial group and only 5.2% in the transoral group undergoing such procedures ($P < 0.001$) (Table 6). The different additional surgical procedures performed are reported in Table 6.

Fig. 5 shows the frequency of utilization of each approach at the study institution from 2009 to 2019. There was a clear reversal in trend of the two techniques, with the transoral approach becoming much more utilized during the later years.

Discussion

The maxillary bone is a complex structure. For this reason, surgical procedures in this region are a constant challenge for surgeons.[1]

Even though most tumor resections in this region can be performed transorally, the tumor site and its extension towards the infratemporal fossa or the ethmoid and cranial base sometimes requires a combined approach.[9,13,14] The ability to combine different approaches and surgical techniques allows better access to treat infiltrative pathologies in this region. The current literature shows that the anterior transfacial approach has been the most used for maxillary tumors involving the infratemporal fossa, as described by Schlund et al.[15], and by Guo and Guo[16], because it has been associated with a better overall resection of the tumor. The lack of scientific evidence to support the transoral approach has led to the preferred choice of transfacial surgery, which has been thought to achieve better complete resection

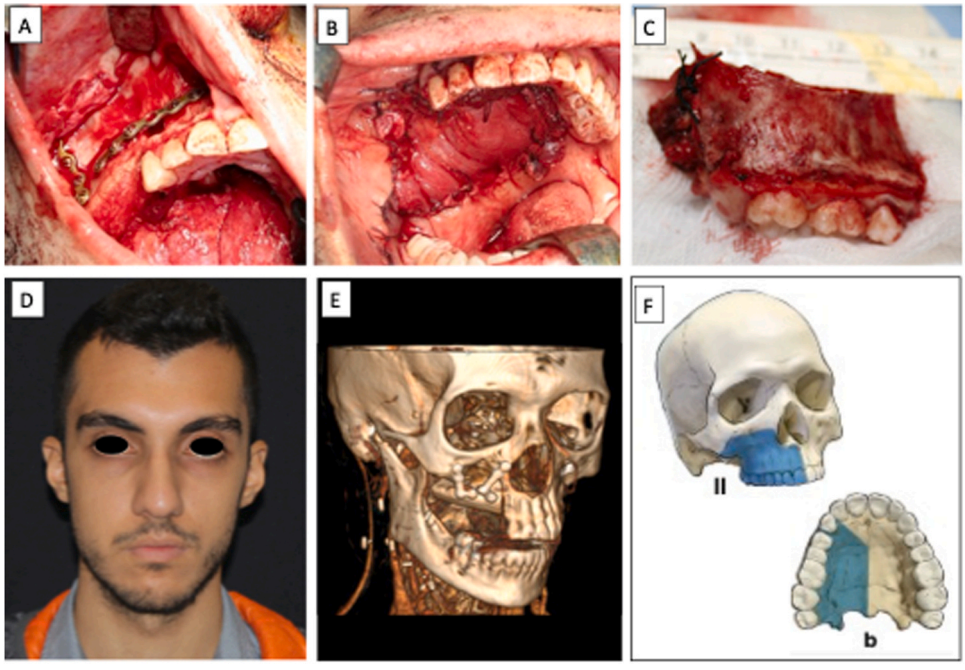

Fig. 1. A 19-year-old male patient with mucoepidermoid carcinoma of the right hard palate. Images A–C show intraoperative views of the defect, with a free DCIA flap inserted and the oblique internal muscle sutured. (D) Postoperative frontal photograph of the patient and (E) 3D CT scan demonstrating the reconstruction with the DCIA flap. (F) Brown type IIb maxillectomy. (DCIA, deep circumflex iliac artery.).

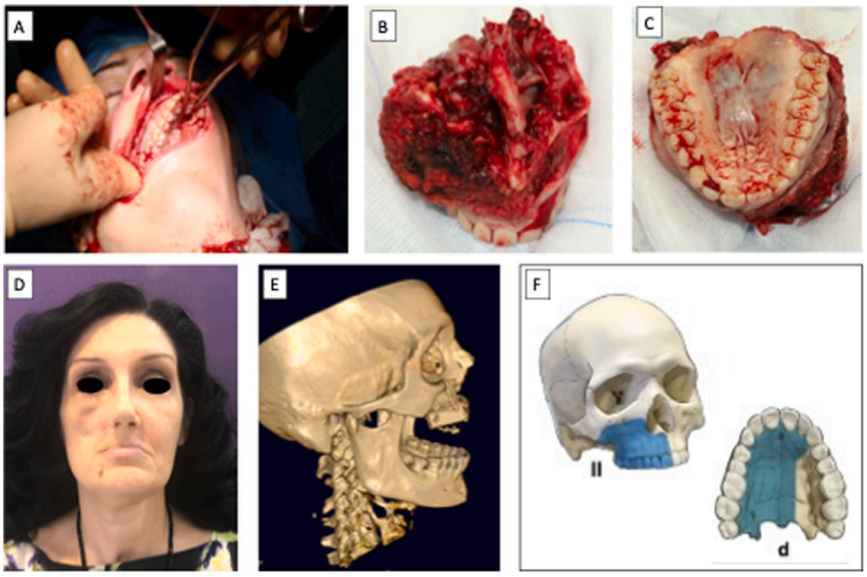

Fig. 2. A 48-year-old female patient with mucoepidermoid carcinoma of the hard palate. Images A–C show intraoperative views. (D) Postoperative frontal photograph of the patient and (E) 3D CT scan demonstrating the reconstruction with a fibula free flap. (F) Brown type IId bilateral maxillectomy.

through better surgical access, despite the radical nature of this approach.

One of the main difficulties when performing reconstruction with free flaps in the midface is the distance to the vessels of the neck, and the transfacial approach can facilitate the passage of the pedicle.[17] Reconstruction with microvascular free flaps was initially also seen as a limitation to the transoral approach; however, as shown in the present sample, there are no contraindications to free flap reconstruction with the transoral technique if the residual deficit requires this.[18,19]

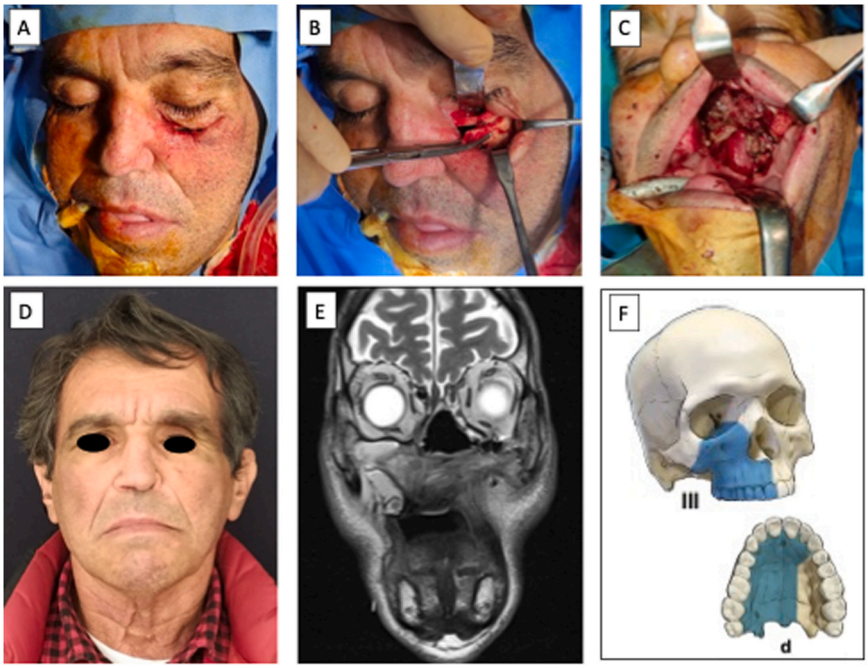

Fig. 3. A 72-year-old male patient with a recurrence of sinonasal undifferentiated carcinoma. Images A–C show intraoperative views, with a left sub-palpebral incision to expose the orbital floor. (D) Postoperative frontal photograph of the patient and (E) MRI demonstrating the reconstruction with a left temporalis muscle flap. (F) Brown type IIId maxillectomy.

As stated above, a satisfactory surgical resection requires the complete removal of the tumor with cancer-free resection margins. For this reason, many surgeons have been skeptical about the use of transoral techniques, as the reduced surgical access has been thought to be associated with a higher probability of positive margins due to neoplastic infiltration.[6,14] However, the present study data show that the transoral approach is a safe and effective technique to treat infiltrative tumors. Considering that the distribution of complex resections based on Brown's classification was approximately equal in the two study groups, the transoral approach proved to be better in terms of the overall resection. Furthermore, many of the patients included in this study had disease of very advanced stage, often with involvement of the infratemporal fossa and/or paranasal cavities, and yet the percentage of positive margins in the group treated transorally was only 3.7%. This was lower than the percentage in the transfacial approach group, which was 6.8%.

In the authors' experience, even neoplasms extending to the infratemporal fossa can be approached efficiently by combining the lateral infratemporal fossa and transoral approaches. This is of course also applicable to those expansive processes involving the infratemporal fossa, which have already been discussed above. It is possible to join the transoral approach with the lateral infratemporal fossa approach, to allow wide control in this region, reducing the anterior skin incisions of the face and resulting unsightly and disfiguring scars, all while still achieving local disease control.[20] This technique cannot be applied to tumors extending to the ethmoid and sphenoid sinuses without the complementary use of the endoscopic technique, which allows the transcranial approach to be avoided. With the introduction of the endoscopic technique, and increased confidence in its use, the transoral approach with endoscopy has become a preferred therapeutic alternative when the tumor extent does not allow satisfactory transoral resection access.[21,22]

Only accurate preoperative radiological evaluation and clinical staging of the patient can allow the best possible surgery to be planned, suited to the patient's specific needs. A careful preoperative analysis of the expected loss of facial projection and esthetic and functional implications should also guide the reconstruction strategy.

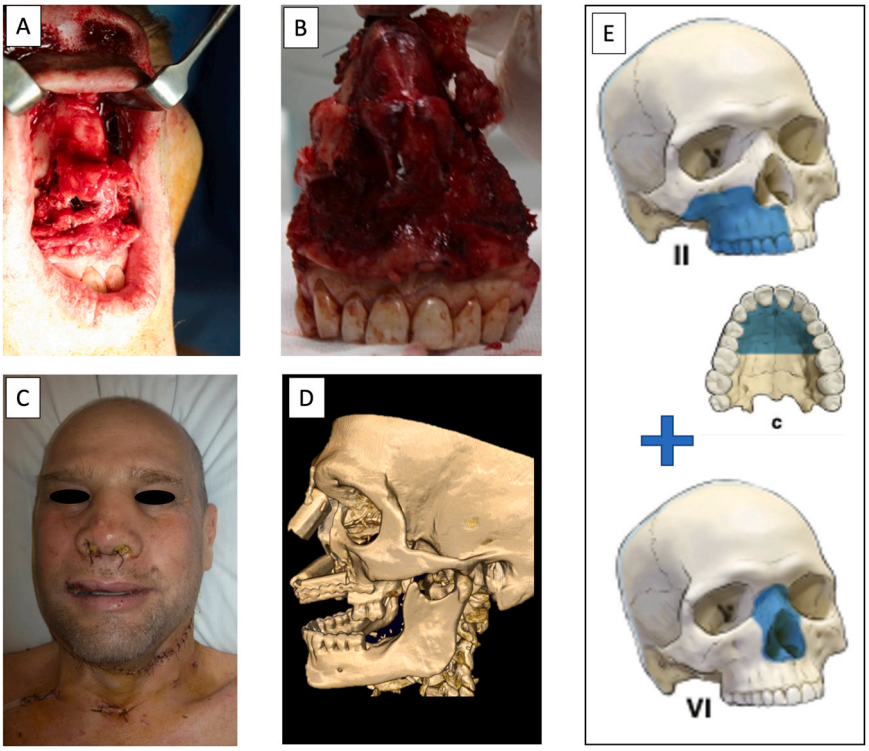

Fig. 4. A 46-year-old male patient with sinonasal squamous cell carcinoma. Images A and B show intraoperative views of the defect, with midfacial degloving approach. (C) Postoperative frontal photograph of the patient 3 days after the surgery and (D) 3D CT scan showing the reconstruction with a fibula free flap. The transoral resection was completed with the aid of the endoscopic technique to access the anterior skull base. (E) Brown type IIc + VI maxillectomy.

Moreover, an analysis of the literature highlights a significant reduction in surgical morbidity when the transoral technique is used,[8–10] as well as a reduction in stigmatizing scars and facial deformities, leading to improved cosmetic results.[23] Indeed, the transfacial approach is associated with unesthetic complications such as unsightly scarring around the nasal vestibule and deviation of the nose, asymmetry or misalignment of the upper lip, and nasolabial groove and ectropion.[10,24] Often these complications reduce the patient's quality of life and require further surgical treatments, as evidenced by the data.

There are currently limitations and contraindications to the use of the transoral approach. In order to guarantee the best results in terms of complete tumor resection, expert surgical teams are required to allow the approach to be integrated with endoscopic treatment if necessary. An absolute contraindication to the use of this procedure is when the skin or nasal bone is involved by the tumor. A relative contraindication is involvement of the orbital contents. Until recently, involvement of the orbital floor represented a limitation to the use of this technique, but with the application of lower sub-palpebral incisions, it is possible to perform a Brown type III maxillectomy and orbital floor reconstruction. In the current study sample, eight patients were treated successfully with a transoral technique combined with a sub-palpebral incision to perform this type of maxillectomy.

A limitation of this study is that it reports a retrospective single-institution

Table 2. Brown's classification of maxillary resection (N = 178).

Brown's classification	Transoral approach, n (%)	Transfacial approach, n (%)	P-value[a]
Type II (n = 99)	75 (56.0%)	24 (54.5%)	0.862
Type IIb	33	11	
Type IIc	23	5	
Type IId	19	8	
Type III (n = 69)	51 (38.1%)	18 (40.9%)	0.742
Type IIIb	34	15	
Type IIId	17	3	
Type II/III + VI (n = 10)	8 (6.0%)	2 (4.5%)	0.709

[a]P-value calculated with Fisher's exact test.

Table 3. Dimensions and volume of the resected segments; mean (± SD) values.

	Transoral approach (n = 134)		Transfacial approach (n = 44)	
	Dimensions (cm)	Volume (cm^3)	Dimensions (cm)	Volume (cm^3)
Brown type II	4.8 (± 0.7) × 3.8 (± 0.6) × 2.7 (± 0.6)	49.2	3.9 (± 0.9) × 3.2 (± 1.2) × 2.4 (± 1.1)	30.0
Brown type III	5.9 (± 0.7) × 4.2 (± 0.9) × 2.8 (± 1.2)	69.4	5.3 (± 1.0) × 3.8 (± 0.9) × 3.2 (± 0.9)	64.4
Brown type II/III + VI	6.7 (± 0.8) × 5.3 (± 0.7) × 3.4 (± 0.5)	120.7	6.3 (± 0.4) × 4.9 (± 1.0) × 2.8 (± 1.1)	86.4

SD, standard deviation.

Table 4. Assessment of positive margins.

	Transoral approach ($n = 134$), n (%)	Transfacial approach ($n = 44$), n (%)	P-value[a]
Positive margins	5 (3.7%)	3 (6.8%)	0.389
Brown type II	1 (0.7%)	0 (0%)	
Brown type III	2 (1.5%)	1 (2.3%)	
Brown type II/III + VI	2 (1.5%)	2 (4.5%)	

[a] P-value calculated with Fisher's exact test.

Table 5. Reconstruction technique.

	Transoral approach ($n = 134$), n (%)	Transfacial approach ($n = 44$), n (%)	P-value[a]
Local flap	81 (60.4%)	23 (52.3%)	0.346
Temporalis flap	42 (31.3%)	13 (29.5%)	0.823
Osteocutaneous free flap	8 (6.0%)	6 (13.6%)	0.823
Soft tissue free flap	3 (2.2%)	2 (4.5%)	0.421

[a] P-value calculated with Fisher's exact test.

Table 6. Need for additional surgeries and details of the additional surgical procedures performed.

	Transoral approach ($n = 134$), n (%)	Transfacial approach ($n = 44$), n (%)	P-value
Second surgery needed	7 (5.2%)	14 (31.8%)	< 0.001[a]
Surgical procedure			
Scar revision	0	6 (13.6%)	< 0.001[b]
Lipofilling	4 (3.0%)	1 (2.3%)	0.809[b]
Plate removal	1 (0.7%)	3 (6.8%)	0.017[b]
Eyelid surgery	1 (0.7%)	4 (9.1%)	0.004[b]
Nasal surgery	1 (0.7%)	0	0.579[b]

[a] P-value calculated with Fisher's exact test.
[b] P-value calculated with the χ^2 test.

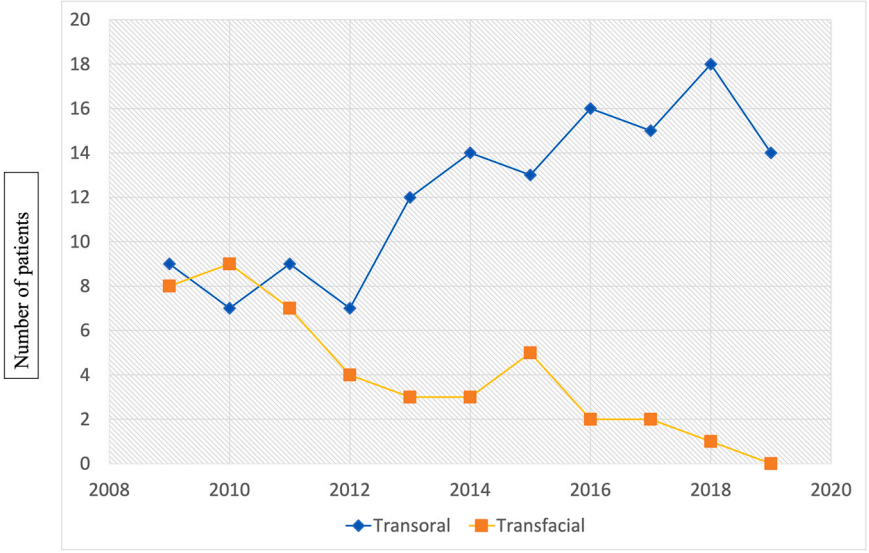

Fig. 5. Performance of the transfacial versus transoral approach from 2009 to 2019.

experience; therefore it is not possible to extrapolate some of the data. In the future, to strengthen the scientific evidence of the results obtained, a prospective study that also evaluates the types and rates of complications is needed.

From the authors' experience, the transoral approach is preferred to the transfacial approach in cases where there is no invasion into the skin, nasal bones, or orbit. Successful treatment of these patients requires multiple criteria to be fulfilled: to obtain an adequate tumor resection, to allow for the best reconstruction technique, and to preserve the function and esthetics of the face. In this study, the transoral approach was found to meet all of these criteria. Even very extensive and invasive tumors were treated successfully with the transoral approach, without facial scars, while still providing complete resection of the tumor.

Ethical approval

Sapienza University of Rome (N. 19/2022 Prot. n. 0000211; approval date 07/02/2022).

Patient consent

Patients gave written informed consent for the use of their clinical data.

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None.

Competing interests

None.

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