Transmandibular Approach in Head and Neck Oncological Surgery

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Objective: *To evaluate the advantages and disadvantages of the transmandibular approach to the posterior area of the maxilla, oropharyngeal region and the hypopharynx in head and neck surgery.*

Methods: *A series of 42 patients who underwent a lip-split mandibulotomy procedure to access malignant tumours affecting deep areas of the head and neck region between 2008 and 2018 in the Department of Oral and Maxillofacial Surgery at the Ramón y Cajal University Hospital (Madrid, Spain) were retrospectively reviewed. The diagnosis and operations data of the patients were collected and analysed.*

Results: *Using the transmandibular approach, 42 patients were operated on to access malignant tumours located in the oropharynx (n = 23, 54.76%) including the posterior third of the tongue, tonsil and soft palate, retromolar trygone (n = 9, 21.43%), floor of the mouth (n = 3, 7.14%), skull base (n = 2, 4.76%), superior maxilla (n = 3, 7.14%) and deep lobe of the parotid gland (n = 2, 4.76%). Primary reconstruction was carried out in all cases. The most used flap reconstruction method was the forearm fasciocutaneous flap in 48.71% of cases, followed by the anterolateral thigh flap in 20.51% of cases. The remaining cases were treated with other methods. The most frequent complication was surgical wound infection.*

Conclusion: *The transmandibular approach is a good alternative to provide access for the removal of complex tumours affecting the oropharyngeal region. This approach facilitates direct visualisation of the lesion and bleeding control, allowing tumour resection with wide margins and making primary reconstruction easier. Although further progress in the transoral robotic approach could be a good option in selected cases, given the current state of knowledge, the transmandibular approach is a good option to access tumours affecting deep areas of the oral cavity and oropharynx.*

Key words: *block resection, head and neck tumours, mandibulotomy, transmandibular approach*

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Despite the recent progress in surgical techniques such as the transoral robotic approach, it is still difficult for head and neck surgeons to approach complex lesions located in deep areas of the oropharynx such as the base of the tongue, posterior floor of the mouth, posterior region of the upper maxilla, retromolar trigone and parapharyngeal space[1]. Access to such tumours is difficult due to their poor exposure; for this reason, resection with wide oncological margins may be difficult. A high recurrence rate and low survival rate with significant postoperative changes in the function of speech and swallowing problems are common in these patients[2].

Symptoms related to these types of tumours are dysphagia, odynophagia, the feeling of a foreign body in the throat or the presence of a cervical mass. Pain and haemoptysis may also be present in the early stages of the disease. Moreover, due to the lack of specific symp-

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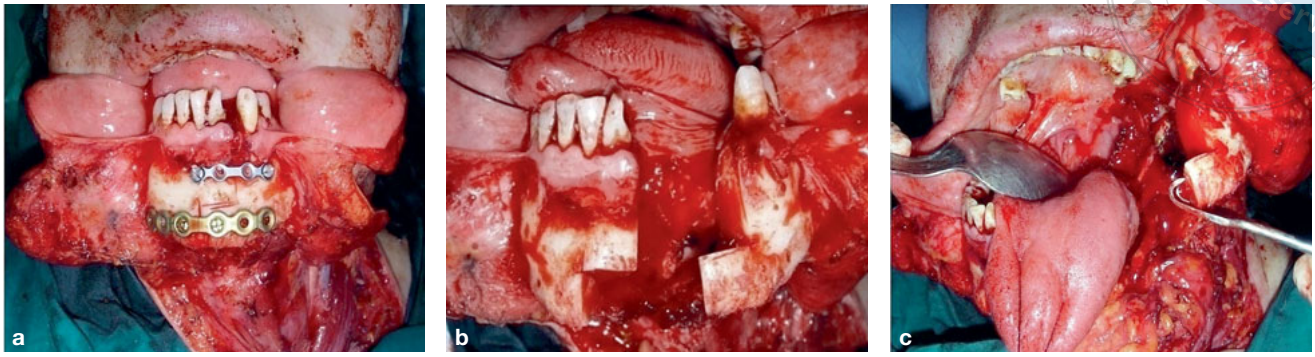

Fig 1 Transmandibular surgical technique. **(a)** Lip split and pre-plating approach. **(b)** Mandibular split. **(c)** Wide surgical field after transmandibular approach.

tomatology, diagnosis is frequently delayed, resulting in the tumour being in a more advanced stage when it is diagnosed[2].

The most prevalent histological type of neoplasia affecting these areas is squamous cell carcinoma, but minor salivary gland tumours can also be found. Some tumours originating in the cervical spine can appear as submucosal masses in the oropharynx (chordoma, chondrosarcoma, dermoid tumours, meningiomas, etc.). It is of critical importance to have a precise histological diagnosis and to perform appropriate staging of the tumour in order to select the best treatment[3]. Adequate visualisation of tumours located in the oropharyngeal region can be limited, thus endoscopic and imaging techniques are primary methods for diagnosis and assessment of patients. The main objective is to determine the extension of the disease and to evaluate its resectability while establishing the relationship between the tumour and the neck vessels, base of the skull or other critical structures[4].

The intraoral approach for the excision of these tumours provides limited exposure, increasing the risk of tumour dissemination and neurovascular damage, and is associated with poor prognosis due to the lack of safe resection margins. The main limiting anatomical factor to accessing the oropharyngeal region is the mandible[5]. The surgical navigation system has been widely used in maxillofacial operations and has proven to be an effective adjunct to maxillofacial surgery. It can provide surgeons with precise planning and real-time intraoperative navigation, as well as reliable ways to avoid vital structures. However, there is little information about its application in parapharyngeal space tumour surgery[6].

Anterior lip-split mandibulotomy with paralingual extension provides an excellent access to the posterior oral cavity, oropharynx and parapharyngeal space, although there is some controversy about its morbidity compared with less invasive techniques that can achieve survival rates similar to those obtained by this approach[7].

The aim of this study was to review our experience concerning the lip-split transmandibular approach in the resection of wide tumours in deep areas of the oral cavity and oropharynx, to evaluate the morbidity related to this approach and to assess its potential influence in achieving safe surgical margins of resection.

Materials and methods

Patients

A total of 42 patients affected by tumours located in the posterior oral cavity, oropharynx and parapharyngeal region treated with wide excisions through a transmandibular approach (Fig 1) in the Department of Oral and Maxillofacial Surgery at the Ramón y Cajal University Hospital (Madrid, Spain) from 2008 to 2018 were studied retrospectively. None of the patients included in the study had received previous therapy for the tumour. Postoperative radiation or chemoradiation were applied during the postoperative period in indicated cases.

Malignant lesions were staged according to the Tumor-Node-Metastasis (TNM) Classification set out by the American Joint Committee on Cancer (8th edition). All patients underwent full laboratory examinations. In all cases, a biopsy specimen of the tumour was taken prior to surgery. Endoscopic examination, a computed tomography (CT) scan and/or MRI were used to determine the exact location and size of the tumour.

A midline translabial transmandibular approach was used in all cases following a midline lip-mental-transcutaneous incision and a medial or paramedial man-

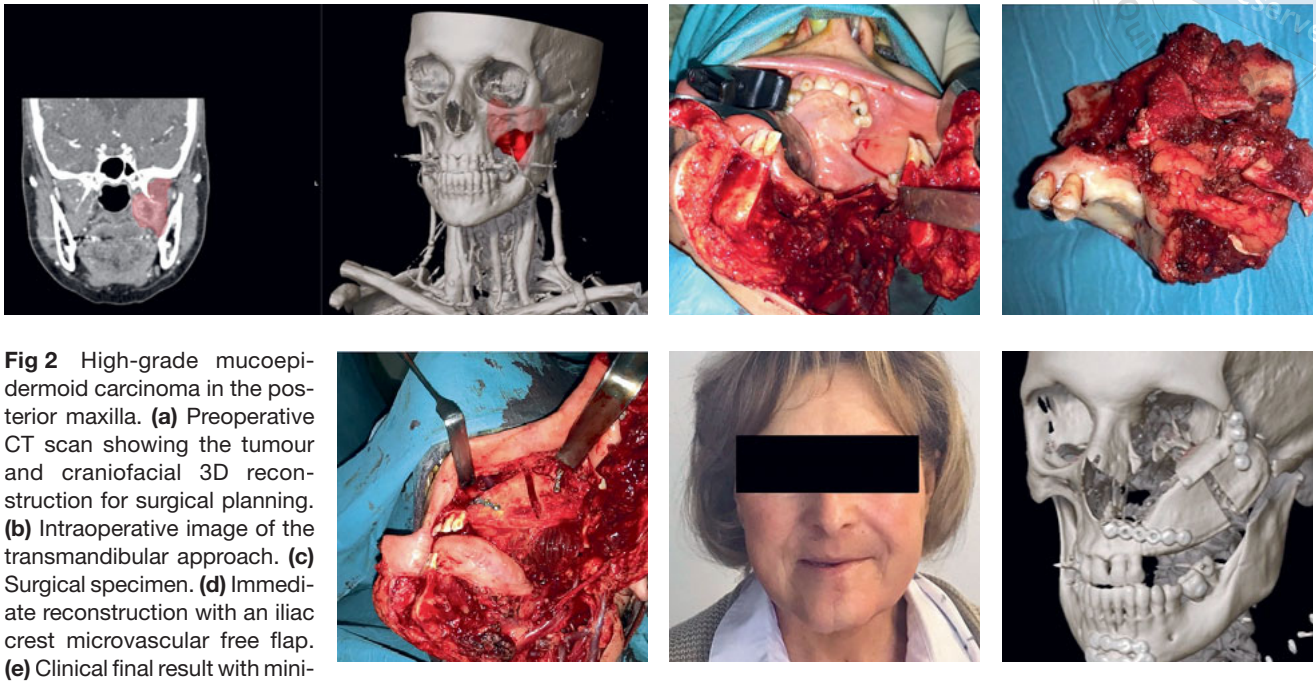

Fig 2 High-grade mucoepidermoid carcinoma in the posterior maxilla. **(a)** Preoperative CT scan showing the tumour and craniofacial 3D reconstruction for surgical planning. **(b)** Intraoperative image of the transmandibular approach. **(c)** Surgical specimen. **(d)** Immediate reconstruction with an iliac crest microvascular free flap. **(e)** Clinical final result with minimal mental scar. **(f)** CT scan of final result.

dibulotomy, depending on the patient's dental status, after preplating the mandibular osteotomy using two titanium plates, one in the basal zone and one in the mandibular alveolar area. Soft tissue dissection along the paralingual area was performed in all cases to complete the approach. Once the tumour had been widely exposed, resection with wide oncological margins was performed.

Primary reconstruction was performed in all cases. In 39 cases (92.85%), reconstruction was performed with microsurgical flaps due the complexity of the defect. Parameters such as age, sex, comorbidities, tumour location and surgical technique including type of resection, neck dissection and reconstruction technique, as well as postsurgical complications, were registered. Histopathological findings were reviewed and incidence of affected margins was registered.

Postoperative findings including neural disturbances and complications related to the osteotomy approach were registered. Other complications, such as surgical wound infection, mandibular osteoradionecrosis, orocutaneous fistulae and intolerance to osteosynthesis materials, were also evaluated.

Results

From 2008 to 2018, the transmandibular approach was used in 42 patients to access malignant tumours located in the oropharynx (n = 23, 54.76%) including the posterior third of the tongue, tonsil and soft palate, retromolar trygone (n = 9, 21.43%), floor of the mouth (n = 3, 7.14%), skull base (n = 2, 4.76%), superior maxilla (n = 3, 7.14%) and deep lobe of the parotid gland (n = 2, 4.76%) (Table 1). Of the 42 patients, 27 (64.29%) were men and 15 (35.71%) were women. Their age ranged from 39 to 80 years, with a mean age of 56.35 years.

Besides the 33 cases with final diagnosis of squamous cell carcinoma, 9 cases were diagnosed as other cancers, with one or two patients respectively (Table 1). Of those patients diagnosed with squamous cell carcinoma, according to the TNM classification (AJCC, 8th edition), one (1/33, 3.03%) had T1 squamous cell carcinoma, sixteen (16/33, 48.48%) had T2, seven (7/33, 21.21%) had T3 and nine (9/33, 27.27%) had T4. Ten patients (10/33, 30.30%) showed absent lymph nodes (N0) while 13 patients (13/33, 39.39%) were classified as N1 and 10 patients (10/33, 30.30%) as N2 or major. Of the total 42 patients, 21 (50.00%) received an intraoperative tracheostomy.

The translabial transmandibular approach with midline mandibulotomy allows a wide access for excision of the tumour and reconstruction thereafter in all cases (Fig 2). Primary reconstruction with a microsurgical free flap or pedicled flap was performed in 39 patients (39/42, 92.86%), of whom 19 (48.72%) underwent treatment with a forearm fasciocutaneous microvascular flap, eight (20.51%) with an anterolateral thigh flap, two (5.13%) with an osteomyocutaneous fibula

Table 1 Details of patients who underwent a transmandibular approach at the University Hospital Ramón y Cajal (Madrid, Spain).

Case	Age/ sex	Site	Histopathology	Tumour stage	Procedure	Reconstruction	Complications related to approach
1.	50/M	Soft palate	Squamous cell carcinoma	T2N2cMx	Hemiglossectomy, tonsillectomy and partial maxillectomy, bilateral FND	Antebrachial fasciocutaneous flap	
2.	43/M	Left tonsil	Squamous cell carcinoma	T2N0M0	Tonsillectomy, hemiglossectomy, posterior partial maxillectomy and hemimandibulectomy, left FND	Antebrachial fasciocutaneous flap	Surgical wound infection
3.	63/M	Minor salivary gland	Pleomorphic carcinoma of minor salivary gland	T2N0M0	Hemimandibulectomy, partial maxillectomy and tonsillectomy, right FND	Antebrachial fasciocutaneous flap	
4.	56/M	Tongue	Squamous cell carcinoma	T2N1M0	Hemiglossectomy, left FND	Antebrachial fasciocutaneous flap	Surgical wound infection
5.	76/M	Oropharynx and right soft palate	Squamous cell carcinoma	T2N1M0	Posterior maxillectomy, right FND	Antebrachial fasciocutaneous flap	
6.	68/M	Left retromolar trigone	Squamous cell carcinoma	T2N1M0	Hemimandibulectomy, tonsillectomy, partial maxillectomy, left FND	Antebrachial fasciocutaneous flap	
7.	55/M	Left retromolar trigone	Squamous cell carcinoma	T2N0M0	Marginal mandibulectomy, hemiglossectomy, oropharynx resection, left FND	Antebrachial fasciocutaneous flap	
8.	72/M	Tongue and oropharynx	Squamous cell carcinoma	T3N1M0	Tonsillectomy and oropharynx resection, bilateral FND	Antebrachial fasciocutaneous flap	
9.	40/M	Tongue	Squamous cell carcinoma	T4N1M0	Tonsillectomy and oropharynx resection, bilateral FND	Anterolateral thigh flap	
10.	39/M	Left retromolar trigone	Squamous cell carcinoma	T2N1M0	Hemimandibulectomy, tonsillectomy, oropharynx and floor of mouth resection, left FND	Antebrachial fasciocutaneous flap	Surgical wound infection
11.	60/M	Tongue	Squamous cell carcinoma	T4N2M0	Total glossectomy, oropharynx resection, epiglottoplasty, bilateral FND	Rectus abdominus flap	
12.	52/F	Tongue	Squamous cell carcinoma	T2N2M0	Hemiglossectomy, oropharynx and floor of mouth resection, right FND	Antebrachial fasciocutaneous flap	Orocutaneous fistulae
13.	52/F	Right oropharynx	Squamous cell carcinoma	T2N0M0	Partial maxillectomy, hemiglossectomy, tonsillectomy and oropharynx resection, right FND	Antebrachial fasciocutaneous flap	
14.	60/F	Tongue	Squamous cell carcinoma	T3N1M0	Tonsillectomy, hemiglossectomy, oropharynx and floor of mouth resection, partial maxillectomy, right FND	Antebrachial fasciocutaneous flap	Surgical wound infection
15.	50/M	Tongue	Squamous cell carcinoma	T2N2M0	Right hemiglossectomy, right tonsillectomy, right FND	Antebrachial fasciocutaneous flap	
16.	59/F	Left retromolar trigone	Squamous cell carcinoma	T4N0M0	Left hemimandibulectomy, left FND	Osteomyocutaneous fibula flap	
17.	48/M	Left retromolar trigone	Squamous cell carcinoma	T4N0M0	Left hemimandibulectomy, left FND	Osteomyocutaneous fibula flap	Intolerance to osteosynthesis materials, bone sequestration

Case	Age/ sex	Site	Histopathology	Tumour stage	Procedure	Reconstruction	Complications related to approach
18.	48/M	Oropharynx	Squamous cell carcinoma	T3N1M0	Partial maxillectomy, oropharynx and floor of mouth resection, hemiglossectomy, right FND	Anterolateral thigh flap	Surgical wound infection, orocutaneous fistulae, post–radiotherapy osteoradionecrosis
19.	38/M	Tongue	Squamous cell carcinoma	T4N2M0	Total glossectomy, right RND	Pectoral flap	
20.	61/F	Left oropharynx	Squamous cell carcinoma	T2N0M0	Partial maxillectomy, oropharynx and floor of mouth resection, hemiglossectomy	Temporal flap	
21.	60/F	Right retromolar trigone	Squamous cell carcinoma	T2N0M0	Hemimandibulectomy, oropharynx and floor of mouth resection	Anterolateral arm flap	
22.	73/M	Tongue	Squamous cell carcinoma	T3N2cM0	Total glossectomy, partial maxillectomy, oropharynx and floor of mouth resection, bilateral FND	Anterolateral thigh flap	
23.	63/M	Oropharynx	Squamous cell carcinoma	T3N1M0	Oropharynx and floor of mouth resection, hemimandibulectomy, hemiglossectomy, right FND	Anterolateral thigh flap	
24.	66/M	Floor of mouth	Squamous cell carcinoma	T4N1M0	Left hemiglossectomy, partial maxillectomy, marginal mandibulectomy, oropharynx and floor of mouth resection, left FND	Anterolateral thigh flap	Intolerance to osteosynthesis materials, post-radiotherapy osteoradionecrosis
25.	69/M	Right tongue	Squamous cell carcinoma	T2N2M0	Tonsillectomy, partial glossectomy, right FND	Antebrachial fasciocutaneous flap	
26.	54/M	Right tongue and left tonsil	Squamous cell carcinoma	T2N1M0	Right hemiglossectomy, oropharynx and floor of mouth resection, left tonsillectomy, bilateral FND	Anterolateral thigh flap	
27.	79/F	Tongue	Squamous cell carcinoma	T1N2M0	Partial maxillectomy, glossectomy, tonsillectomy, bilateral FND	Pectoral flap	Post-radiotherapy osteoradionecrosis of jawbone
28.	47/M	Floor of mouth	Squamous cell carcinoma	T2N1M0	Oropharynx and floor of mouth resection, partial tonsillectomy, bilateral FND	Antebrachial fasciocutaneous flap	
29.	61/M	Retromolar trigone and oropharynx	Squamous cell carcinoma	T4N0M0	Marginal mandibulectomy tonsillectomy, partial maxillectomy, left FND	Anterolateral thigh flap	
30.	54/F	Retromolar trigone	Mucoepidermoid carcinoma	T2N0M0	Marginal mandibulectomy	Bichat bag	
31	67/M	Floor of mouth	Squamous cell carcinoma	T4N0M0	Oropharynx and floor of mouth resection, partial mandibulectomy, bilateral FND	Osteomyocutaneous fibula flap	
32	80/F	Tongue	Squamous cell carcinoma	T2N0M0	Partial glossectomy	Antebrachial fasciocutaneous flap	
33	32/F	Right maxilla	Chondroblastic osteosarcoma	T4N0M0	Right amplified (III-d) maxillectomy, orbital exenteration	Scapular osteomyocutaneous flap	Mandibular osteomielytis after chemoradiotherapy
34	43/F	Right parotid gland	Pleomorphic adenoma of deep lobe	-	Total conservative parotidectomy		

Case	Age/ sex	Site	Histopathology	Tumour stage	Procedure	Reconstruction	Complications related to approach
35	70/M	Left maxilla	Squamous cell carcinoma	T4N0M0	Left maxillectomy, orbital exenteration	Iliac crest osteomuculocutaneous flap, scapular osteomuculocutaneous flap	Wound infection, orocervical fistula
36	52/M	Deep lobe of left parotid gland	Pleomorphic adenoma	-	Total conservative parotidectomy		Postsurgical bleeding
37	65/M	Left retromolar trigone	Squamous cell carcinoma	T3N2bN0	Partial left maxillectomy, left oropharynx resection, marginal mandibulectomy	Antebrachial fasciocutaneous flap	Wound infection, orocervical fistula
38	46/F	Oropharynx – base of tongue	Adenoid cystic carcinoma	T2N0M0	Oropharynx and base of tongue resection	Antebrachial fasciocutaneous flap	Wound infection, orocervical fistula
39	68/F	Left maxilla	Clear cell carcinoma	T3N1M0	Left maxillectomy	Iliac crest osteomyocutaneous flap	Mandible osteomyelitis post-RT
40	18/M	Clivus	Chondroid chondroma	-	Tumour exeresis	No free flap	
41	70/F	Left retromolar trigone and oropharynx	Squamous cell carcinoma	T3N1M0	Left oropharynx, partial glossectomy, marginal mandibulectomy	Lateral brachial fasciocutaneous flap	
42	40/F	Anterior skull base	Meningioma	Grade I (OMS)	Tumour resection		

F, female; FND, functional neck dissection; M, male; RND, radical neck dissection; RT, radiotherapy.

flap, two (5.13%) with a myocutaneous pectoralis flap, one (2.56%) with a rectus abdominus muscle flap, one (2.56%) with a temporalis muscle flap, two (5.13%) with an anterolateral arm flap, two (5.13%) with an osteomyocutaneous iliac free flap, one (2.56%) with an osteomyocutaneous scapular free flap and one (2.56%) with a Bichat fat pad flap. All of these 39 patients showed histological free disease margins in the pathological postsurgical analysis.

Complications related to the approach were registered in 14 of the 42 patients (33.33%). The most frequent was surgical wound infection, affecting eight patients (57.14%) while osteoradionecrosis of the mandible was registered in five patients (35.71%), orocutaneous fistulae also in five patients (35.71%), intolerance to osteosynthesis materials in two patients (14.29%) and bone sequestration in one patient (7.14%). Some patients suffered more than one complication at the same time; this is why there are more complications than patients.

Discussion

The prognosis for tumours in the posterior oral cavity, oropharynx and parapharyngeal area can be considered poor due to the anatomical complexity of these regions, and is frequently associated with late diagnosis with extension to neighbouring regions such as the infratemporal fossa and chewing space. Moreover, due to the lack of a direct access, adequate tumour resection in this area can be difficult[8].

McMahon et al reported that extension to the infratemporal fossa is a frequent cause of recurrence[9]. Physical examination can be difficult due to the deep location of the tumour and the trismus associated, so the use of CT and MRI are essential[10].

Several techniques have been described to access this anatomical region including transoral, transcervical, transparotid, transmandibular and infratemporal. The goal is to obtain adequate tumour visualisation to ensure complete tumour removal with preservation of the surrounding nerves and vessels and to control any bleeding[11]. Conservative approaches, such as transoral or transcervical, in the treatment of tumours in this location frequently offer limited exposure and do not allow block resection of the lesion with safe oncological margins, nor control of large cervical vessels[12].

A mandibulotomy can be performed to improve surgical access as part of tumour ablative surgery[13]. The

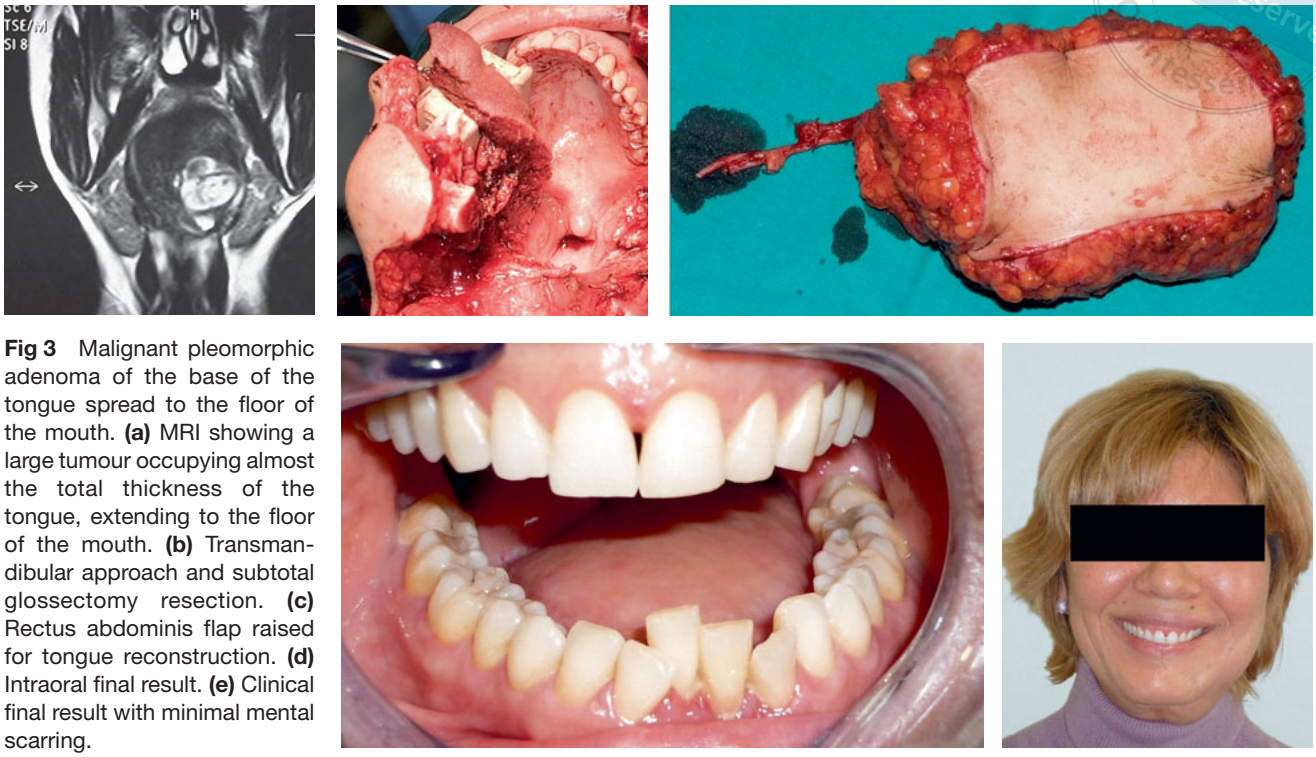

Fig 3 Malignant pleomorphic adenoma of the base of the tongue spread to the floor of the mouth. **(a)** MRI showing a large tumour occupying almost the total thickness of the tongue, extending to the floor of the mouth. **(b)** Transmandibular approach and subtotal glossectomy resection. **(c)** Rectus abdominis flap raised for tongue reconstruction. **(d)** Intraoral final result. **(e)** Clinical final result with minimal mental scarring.

transmandibular approach to the retromaxillary region was originally described by Barbosa el al in 1961[14]. This approach was primarily performed through an osteotomy of the ascending ramus of the mandible and did not gain popularity. The transmandibular approach to the skull base was described by Biller et al[15] in 1981 and later adopted by Krespi et al[16] in 1984. They summarised that the access facilitates good exposure to the lateral and midline compartments of the middle cranial base and offers good vascular control in the neck, and also proposed that the parapharyngeal space, infratemporal fossae, clivus, nasopharynx and cervical spine could be exposed using this approach[15,16]. In 2001, Tiwari described the transmandibular approach for total maxillectomy[17].

The median mandibular osteotomy dramatically changed the surgical removal of malignant tumours in the oral cavity and deep areas of the pharynx. The combination of total excision, visual control of the tumour and the possibility of an easy primary reconstruction modified the algorithms in the treatment of cancers of the oral cavity and oropharynx, although the introduction of modern endoscopic techniques and transoral robotic surgery (TORS) is opening up new horizons in the management of tumours in these regions[18]. Controversy remains concerning the use of new endoscopic and robotic techniques in the management of this type of tumour located in deep areas, in terms of obtaining safe margins of resection and the possibility of reconstruction for large defects and primary reconstruction with free flaps if necessary[19,20].

The adequate 3D access for tumour resection provided by the translabial transmandibular approach offers significant advantages. It allows complete removal of the tumour in a single procedure with wide exposure of the surgical area (Fig 3). The lack of incisions in the midface reduces morbidity, with mandibular incision having a more aesthetic result than other types of scars[21]. Our results showed that the translabial transmandibular approach is a safe oncological procedure with clear resection margins in 93% of cases. This procedure allows the identification of major cervical vessels and appropriate control of bleeding in complex resections. It also facilitates primary and adequate reconstruction of the defects after removal with safe margins, enabling early and complete rehabilitation and early treatment with radiation therapy[7].

Therefore, if unexpected bleeding occurs during dissection, this approach offers an adequate surgical field to control the bleeding. Although some surgeons may have concerns about possible facial, lingual or hypoglossal nerve injuries during osteotomy and dissection of the soft tissue surrounding the mandible, experienced surgeons can avoid these complications. Other disad-

vantages are the longer hospital stay and the additional risks of mandibular healing and temporomandibular joint dysfunction[8].

Conclusion

The translabial transmandibular approach for the removal of complex tumours in the oropharynx, parapharynx and other deep areas of the head and neck facilitates the direct visualisation of the anatomical structures, allowing safe oncological resection in complex cases. This technique also allows primary microvascular reconstruction without major complications in the majority of the cases reported.

Conflicts of interest

The authors declare no conflicts of interest related to this study.

Author contribution

Dr Fernando ALMEIDA PARRA contributed to the data collection, statistical analysis, surgical intervention and manuscript writing; Drs Ángela BUENO DE VICENTE and Álvaro RANZ COLIO contributed to the data collection and provided surgical assistance; Drs De Patricia DE LEYVA MORENO, Jorge NÚÑEZ PAREDES and Manuel PICÓN MOLINA provided surgical assistance; Dr Julio ACERO SANZ contributed to the coordination, review and correction and surgical intervention.

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