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Severe postoperative dysphagia as an early predictor for decreased overall survival in patients with oral cancer

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ABSTRACT

Objectives: The aim of this retrospective study was to analyze the early postoperative swallowing outcome in oral cancer patients considering risk factors and localization.
Materials and methods: Four hundred patients with primary cases of oral cancer were included. Tumors' locations were categorized into four main groups (central, lateral, anterior and posterior). Swallowing function was evaluated at day 7 after surgery.
Results: Ninety-eight percent (393/400) of the patients had a swallowing impairment including 41 (10.2%) patients who were unable to swallow. Strong risk factors with p values of 0.001 were tumor size, nodal stage, tracheotomy, insufficient dental status and reconstruction with a flap. The inability to swallow was increased at T1 und T2 patients, if they were reconstructed with a flap compared to patients who had a primary wound closure ($p = 0.04$). Decreased swallowing function was determined if the tumor was located central ($OR = 1.8$; $p = 0.141$) and additionally posterior ($OR = 5.8$; $p = 0.110$). Inability to swallow, even at that early point in time, ($p = 0.001$) was as significant as tumor size ($p = 0.009$) and nodal stage ($p = 0.020$), referring to overall survival.
Conclusion: The impact of early dysphagia should not be underestimated. By considering swallowing impairment at the primary therapy patients can profit concerning survival and comorbidity.

1. Introduction

The treatment of squamous cell carcinomas of the oral cavity with surgery or radiotherapy impairs the quality of life of affected patients (Gillespie et al., 2004). Dysphagia and speech problems are the most frequent side effects from which these patients suffer after the initial therapy (Mittal et al., 2003). Complex reconstructions with customized microvascular transplants enable increasingly radical resections to obtain the best outcomes concerning survival and function. Todays standardized free flaps are able to reconstruct hard and soft tissue in the oral cavity. Due to the reliable anatomy and perfected microvascular techniques the survival rate of these flaps is about 95% (Suh et al., 2004). However, flap reconstruction is supposed to be adapted to patients' needs and conditions.

Results referring to the swallowing outcome after surgery of head and neck cancers are contradictory because patients' tumors are often hardly comparable due to different localization, sizes and reconstructions (Kao et al., 2016). When a reconstruction with a free flap was the treatment of choice, excellent swallowing outcomes are rarely reported (Moerman et al., 2003; Sinha et al., 2004). The majority of investigators found various impairments of function of swallowing mostly dependent on the size of the defect (Haughey et al., 2002; Winter et al., 2004; Dziegielewski et al., 2013; Kao et al., 2016). But only limited information is available regarding differences in swallowing function due to localizations of tumors within the oral cavity (Nicoletti et al., 2004).

Dysphagia is not just an impairment of the quality of life. It can cause life-threatening complications like aspiration pneumonia (De Felice et al., 2018). After radiotherapy of advanced head and neck carcinomas, 10–15% of the patients died due to aspiration (Nguyen et al., 2004). Therefore a comprehensive therapy should address this complication by securing a follow-up including a phoniatrician and a speech therapist. Therapeutic interventions like postural strategies (head positioning), supraglottic or Mendelsohn swallowing maneuvers and exercises that target the strength of muscles

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and range of motion are crucial for aspiration prophylaxis (Rosenthal et al., 2006).

The aim of this study was to investigate the early swallowing outcome in our cohort of 400 patients with cancer of the oral cavity in relation to tumor site and stage, primary lymph node metastasis, flap reconstruction and dental status. Furthermore, we wanted to analyze whether the early impairment of the swallowing function has an impact on long term survival.

2. Material and methods

This retrospective single center study comprises 400 patients with primary cases of squamos cell carcinoma of oral cavity. Patients were treated in the Department of Oral and Maxillofacial Surgery University Hospital Regensburg between November 2003 and March 2018. The study was approved by the local ethical committee (No. 17-693-104). Clinical data were obtained from patients' records, the hospital data base system (SAP), and the tumor registries. All patients underwent an operation with curative intention. Pathological TNM classification was recorded according to the guidelines defined by the Union for International Cancer Control (UICC 7th edition). Tumors were categorized referring to their localization in 25 sub-groups on the basis of standardized photographs. Subgroups were merged in a central zone and a lateral zone. The border between central and lateral zone was the transition of the alveolar process to the floor of the mouth. If a tumor extended to the central zone it was considered as central located. Additionally, within the central zone, an anterior and posterior area was distinguished. Anterior located was considered if the tumor was ahead of a virtual line between premolar and molar teeth. Posterior located was considered if the tumor was behind that line or extended beyond that line. Information referring to tumor localization is provided in Table 2. Standardized dysphagia examination was performed by a phoniatrician 7 days after operation. Fiberoptic endoscopic evaluation was used to detect laryngeal penetration, residuals and aspiration. Additionally, the examination included the assessment of the oral preparation and transport phase. According to the results of examination, patients were categorized in four groups of dietary modifications: (i) full diet, (ii) soft food and fluids, (iii) only thickening fluids, (iv) no oral food intake. Dental status was evaluated on panoramic radiographs postoperatively, and was distinguished as (i) all supporting zones well preserved (anterior and posterior teeth of the upper and lower well preserved), (ii) one adequate supporting zone well preserved (posterior teeth of the upper and lower jaw of one side well preserved), (iii) no adequate supporting zone well preserved (no teeth remaining or single teeth with no counterpart remaining).

Data were analyzed with SPSS for Windows, version 25.0 (SPSS, IBM, Ehningen Germany). Relationships between parameters were examined using the Chi-squared tests ($p < 0.05$) and Fisher's exact tests ($p < 0.05$) for dichotomized variables. Overall survival was calculated with the Kaplan Meier method; distributions were compared by means of the log-rank test. Cox proportional hazards model was used in multivariate analyses. Multivariate logistic regression analysis was conducted to identify independent predictors for overall survival ($p < 0.05$).

Table 1
Patient characteristics.

Characteristics	Number (%)
Age	
Mean (range)	62.3 (27.7–92.4); SD:11.2
Sex	
Male	265 (66.3)
Female	135 (33.8)
T-stage	
T1	175 (44.0)
T2	108 (27.1)
T3	24 (6.0)
T4	91 (22.9)
N-stage	
N0	257 (65.1)
N1	52 (13.2)
N2	84 (21.3)
N3	2 (0.5)
Treatment	
Resection and primary closure, granulation or local flaps	178 (44.5)
Resection and reconstruction with locoregional flap	54 (13.5)
Resection and reconstruction with microvascular flaps	168 (42.0)
Neck dissection	
No	33 (8.2)
Level 1–3	279 (69.7)
Level 1–5	88 (22.0)
Tracheotomy	179 (44.7)

3. Results

Detailed patient characteristics are provided in Table 1. 98% (393/400) of the patients had a swallowing impairment 7 days after initial surgery. In detail, 7 patients received full diet, 176 (44.0%) patients were allowed to eat soft food and fluids and 176 (44.0%) patients only received thickening fluids. 41 (10.2%) patients were unable to swallow, consequently an oral food intake was not possible. Strong risk factors relevant to inability to swallow with p values of 0.001 were initial tumor and nodal stage, neck dissection, tracheotomy, an insufficient dental status and reconstruction with microvascular or locoregional flaps (Table 3). Patients who were reconstructed with bulky pectoralis major flaps had a higher risk of inability to swallow compared to radial forearm flaps (OR = 2.3; $p = 0.167$). Matched to the size of tumor, subgroup analysis of T3/T4 tumors showed even a higher risk, if the tumor was located at the central zone (OR = 4.0; $p = 0.175$) (Table 3). Furthermore, the subgroup analysis of T1 und T2 patients showed that the risk of inability to swallow is increased, if they were reconstructed with a microvascular flap compared to patients who had a primary wound closure or a secondary wound granulation ($p = 0.04$). Localization of the tumor was no strong risk factor for impairment of swallowing (Table 3). T1 and T2 tumor patients showed a decreased function of swallowing if the tumor was located at the tongue or the floor of the mouth compared to lateral located tumors (OR = 1.8; $p = 0.14$). If the tumor was located at the posterior part of the tongue or the posterior floor of the mouth, the risk increased further in this subgroup (OR = 5.8; $p = 0.11$). T3 and T4 patients showed independent from the location (OR = 1.2; $p = 0.43$) a worse outcome in function of swallowing ($p < 0.01$). Soft palate tumors had no higher risk for inability to swallow (OR = 1.1; $p = 0.53$). Central defects were more often reconstructed by primary wound closure ($p = 0.048$). In contrast, local flap reconstruction was frequently used for lateral defects ($p = 0.051$). If a central defect had to be closed with a microvascular flap, ALT flaps ($p = 0.043$) and fibula flaps ($p = 0.049$) were used more often than radial forearm flaps. The latter was used proportionally more often for reconstruction of lateral defects ($p = 0.047$). But the overall use of microvascular flaps for reconstruction of lateral and central defects showed no significant difference ($p = 0.800$). The same applies to local treatment (primary wound closure, secondary granulation, local flap) ($p = 0.522$). Detailed information about flap reconstruction relating to site of tumors is provided in Table 5.

Overall survival was affected by the function of swallowing in general. Patients with inability to swallow had a worse overall survival than patients with normal or limited function ($p < 0.01$) (Fig. 1). There was no significant difference concerning overall

Table 2
Localization of tumors.

Primary localization	Number (%)	Zone		Area of central zone	
Tip of the tongue	1 (0.3)	central		anterior	
Dorsum of the tongue	3 (0.8)	central		posterior	
Buccal surface	21 (5.3)	lateral			
Soft palate	10 (2.5)	central		posterior	
Angle of the jaw	31 (7.8)	lateral			
Labial vestibule	2 (0.5)	lateral			
Alveolar process of the mandible	11 (2.8)	lateral			
Anterior edge of the tongue	29 (7.2)	central		anterior	
Anterior floor of the mouth	89 (22.3)	central		anterior	
Posterior edge of the tongue	49 (12.3)	central		posterior	
Posterior floor of the mouth	8 (2.0)	central		posterior	
Edge of the tongue and floor of the mouth (anterior)	6 (1.5)	central		anterior	
Edge of the tongue and floor of the mouth (posterior)	10 (2.5)	central		posterior	
Alveolar process and floor of the mouth (anterior)	41 (10.3)	central		anterior	
Alveolar process and floor of the mouth (posterior)	22 (5.5)	central		posterior	
Alveolar process, floor of the mouth and edge of the tongue (anterior)	3 (0.8)	central		anterior	
Alveolar process, floor of the mouth and edge of the tongue (posterior)	3 (0.8)	central		posterior	
Vestibule and alveolar process of mandible	17 (4.3)	lateral			
Hard palate	3 (0.8)	central		anterior	
Hard palate, alveolar process of the maxilla and vestibule	3 (0.8)	central		anterior	
Anterior floor of the mouth with extent to the posterior floor of the mouth on one side	8 (2.0)	central		anterior	
Anterior floor of the mouth with extent to the posterior floor of the mouth on both sides	3 (0.8)	central		anterior	
Tuber of maxilla	16 (4.0)	lateral			
Tumor extended over a complete side of maxilla or mandible	3 (0.8)	central		[a]	
Alveolar process of maxilla	8 (2.0)	lateral			
Total	400 (100.0)	central	lateral	anterior	posterior
		294 (73.5)	106 (26.5)	186 (46.5)	105 (26.3)

[a]A differentiation between anterior and posterior was not possible, due to size of tumor.

survival between patients who are able to eat soft food and fluids and patients who can only eat thickening fluids (Fig. 1). Inability to swallow was an independent risk factor for a worse overall survival in Cox regression analysis comparable to higher T-stage or primary lymph node metastasis (Table 4). Additionally, there was no different outcome between T2, T3 and T4 tumors if patients were unable to swallow (Fig. 2). Overall survival also was not different between initial nodal negative and nodal positive patients in this subgroup ($p = 0.10$). Disease specific survival was not significantly influenced by function of swallowing ($p = 0.11$).

4. Discussion

It is intuitive that patients with extended tumors and radical surgery would also be the patients most likely to develop severe dysphagia as well as decreased survival rates (McConnel et al., 1998; Pauloski et al., 2004; Borggreven et al., 2007). However, our findings suggest that inability to swallow is an independent risk factor for a poor prognosis by equalizing outcome differences between tumor and nodal stages. Patients with T2 tumors had the same worse overall survival as patients with T3 or T4 tumors, if they were unable to swallow. Additionally, there was no significant difference between nodal positive and negative patients in this subgroup referring to overall survival. Although the dysphagia examination was performed only 7 days after operation, inability to swallow at that point in time was a paramount predictor for patient survival. Hence, the impairment of swallowing should be avoided, if possible. The surgeon has only limited influence on the function of swallowing during the primary healing process. Size and localization of the tumor are given and the defect often requires a flap for reconstruction. In cases with complex and large defects after tumor removal, individualized flaps are a basic requisite for restoration of swallowing and speaking. The choice of the flap depends on multiple factors (e.g. extension and complexity of defects, hard or soft tissue reconstruction and morbidity of the patient). The decision regarding therapy and which flap is best in each individual case is up to the experienced surgeon. However, T1 or T2 tumors of the oral cavity with favorable localization should be checked for local reconstruction to avoid using a microvascular flap. Our results indicate that these patients had worse function of swallowing if they were reconstructed with a microvascular flap compared to a primary wound closure or secondary granulation. Especially, tumors with less depth of invasion which generate only superficial defects should be taken into consideration, because microvascular flaps are in these cases often too bulky and impair the swallowing function. Furthermore, if large defects (T3/T4) were reconstructed with bulky flaps (pectoralis major flap), patients had also a higher risk of inability to swallow. Especially in the central zone, if a pectoralis major flap was used, patients had a worse outcome concerning swallowing compared to patients who were reconstructed with a radial forearm flap. Mc Connel et al. interpreted their results likewise by showing no improvement of oropharyngeal swallowing efficiency if a flap was used and a resection of less than 30% of the tongue or less than 60% of the tongue base was necessary. Additionally, patients with primary closured had even better results on liquid swallows (McConnel et al., 1998). If the size of the tumor makes a hemiglossectomy necessary, patients benefit concerning movement of the tongue and swallowing function by reconstruction with a microvascular flap (Hsiao et al., 2003). Shin-Teng Kao et al. also reported in their review paper of 15 studies a poor swallowing outcome when the reconstruction of the tongue was performed with a microvascular flap. But the function improved to a postoperative level at 1 year posttreatment (Kao et al., 2016).

Although there is a wide range (Heijnen et al., 2016), dysphagia is examined in most studies after an initial healing phase of a few months after treatment (Borggreven et al., 2007; Farace et al., 2007; Longo et al., 2013). If necessary, adjuvant therapy, like radiation or radio/chemotherapy, takes place within this period of time. Hence, the comparability of patient cohorts, which is a problem due to different tumor sites and reconstructions, continues to deteriorate. Toxicity of radiotherapy alone or radio/chemotherapy affects the

Table 3
Analysis of risk factors relevant for function of swallowing.

Characteristics N (% within the characteristics)	Swallowing possible	Inability to swallow	Odds ratio	95% CI		Univariate p
Smoking			1.551	0.787	3.055	0.133
no	160 (92.0)	14 (8.0)				
yes	199 (88.1)	27 (11.9)				
Alcoholism			1.689	0.883	3.232	0.077
no	213 (91.8)	19 (8.2)				
yes	146 (86.9)	22 (13.1)				
Psychiatric disease			2.175	0.695	6.805	0.157
no	342 (90.2)	37 (9.8)				
yes	17 (81.0)	4 (19.0)				
Dental status			[a]			**0.022**
all supporting zones well preserved	37 (92.5)	3 (7.5)				
One adequate supporting zone well preserved	155 (93.3)	10 (6.1)				
No adequate supporting zone preserved	166 (85.6)	28 (14.4)				
Tumor stage			4.127	2.122	8.027	**>0.001**
pT1+pT2	266 (94)	17 (6)				
pT3+pT4	91 (79.1)	24 (20.9)				
Nodal stage			2.518	1.300	4.878	**0.005**
pN0	239 (93.0)	18 (7.0)				
pN+	116 (84.1)	22 (15.9)				
Localization			1.240	0.350	1.649	0.312
central	262 (89.1)	32 (10.9)				
lateral	97 (91.5)	9 (8.5)				
Posterior vs lateral	93 (88.6)	12 (11.4)	1.300	0.289	1.7	0.315
Reconstruction with flap of the mandible, floor of the mouth, tongue and the lower half of the buccal surface			6.922	2.397	19.995	**>0.001**
no	146 (97.3)	4 (2.7)				
yes	174 (84.1)	33 (15.9)				
Reconstruction with microvascular flap of the mandible, floor of the mouth, tongue and the lower half of the buccal surface			6.128	2.066	18.172	**>0.001**
no	146 (97.3)	4 (2.7)				
yes	137 (85.6)	23 (14.4)				
Reconstruction with flap of the maxilla, palate and the upper half of the buccal surface			0.758	0.071	8.118	0.654
no	25 (89.3)	3 (10.7)				
yes	11 (91.7)	1 (8.3)				
Reconstruction of central zone with flap concerning bulkiness (T3/T4)			4.000	0.575	27.819	0.175
Pectoralis major flap	4 (57.1)	3 (42.9)				
Radial forearm flap	16 (84.2)	3 (15.8)				
Reconstruction of lateral zone with flap concerning bulkiness (T3/T4)			[a]			0.421
Pectoralis major flap	4 (100.0)	0 (0)				
Radial forearm flap	10 (76.9)	3 (23.1)				
Tracheotomy			2.953	1.480	5.889	**0.001**
no	207 (94.1)	13 (5.9)				
yes	151 (84.4)	28 (15.6)				
Neck dissection (ND)			2.862	1.463	5.599	**0.002**
Level 1-3	256 (91.8)	23 (8.2)				
Level 1-5	70 (79.5)	18 (20.5)				
No ND (vs. ND)	33 (100.0)	0 (0.0)	1.126	1.086	1.167	**0.024**

[a]Risk cannot be calculated.
Bold highlights the significant numbers with p-values 0.05.

Table 4
Cox regression analysis: Multivariate analysis of influencing factors of overall survival.

	Hazard ratio	95% CI		Multivariate p
T-stage T1+T2 vs. T3+T4	1.721	1.146	2.586	**0.009**
N-stage N0 vs. N+	1.627	1.078	2.455	**0.020**
G	1.430	0.912	2.244	0.120
L	1.154	0.640	2.079	0.635
V	2.414	0.842	6.919	0.101
Swallowing possible vs. inability to swallow	1.345	1.126	1.606	**0.001**
Diabetes	1.517	0.874	2.634	0.139
Heart disease	1.601	1.076	2.381	**0.020**

Bold highlights the significant numbers with p-values 0.05.

function of swallowing by causing side effects like mucositis, xerostomia, or muscle fibrosis (Langendijk et al., 2008; Heijnen et al., 2016). Long-term follow up showed that radio/chemotherapy leads to a persistence of reduced swallowing function and can lead to severe swallowing difficulties even after 6 years of treatment (Kraaijenga et al., 2015; Patterson et al., 2018). Patients normally benefit from early swallowing exercises which are designed to improve the strength of muscles and the precision of movement (Rosenthal et al., 2006). However, the training of patients depends on their compliance and general conditions and may lead to different outcomes even when patients had similar defects and received similar treatments. We tried to reduce the

Table 5
Flap reconstruction of different localizations.

Reconstruction n (%)	central = 294	anterior n = 186	posterior n = 105	lateral n = 106	p (central vs lateral)
primary wound closure	103 (35.0)	62 (33.3)	41 (39.1)	26 (24.5)	**0.048**
secondary granulation	10 (3.4)	6 (3.2)	4 (3.9)	7 (6.6)	0.682
Local flap	17 (5.7)	8 (4.3)	9 (8.6)	15 (14.1)	**0.051**
Radial forearm flap	80 (27.2)	52 (28)	28 (26.7)	36 (33.9)	**0.047**
Pectoralis major flap	11 (3.7)	10 (5.3)	1 (1)	8 (7.5)	**0.030**
Fibula flap	22 (7.4)	15 (8.1)	7 (6.7)	2 (1.9)	**0.049**
Scapula flap	1 (0.3)	1 (0.5)		1 (0.9)	0.403
Platysma flap	12 (4.0)	11 (5.9)	1 (1)	0 (0)	**0.001**
Antero lateral thigh flap	19 (6.4)	11 (5.9)	8 (7.6)	1 (0.9)	**0.043**
Submental flap	2 (0.6)	1 (0.5)	1 (1)	3 (2.8)	0.223
Nasolabial flap	9 (3)	5 (2.7)	4 (3.8)	3 (2.8)	0.527
Latissimus dorsi flap	2 (0.6)	1 (0.5)	1 (1)	1 (0.9)	0.403
Upper arm flap	1 (0.3)	1 (0.5)		2 (1.9)	0.523
Sternocleidomastoideus flap				1 (0.9)	[a]

[a]Statistical analysis not possible.
Bold highlights the significant numbers with p-values 0.05.

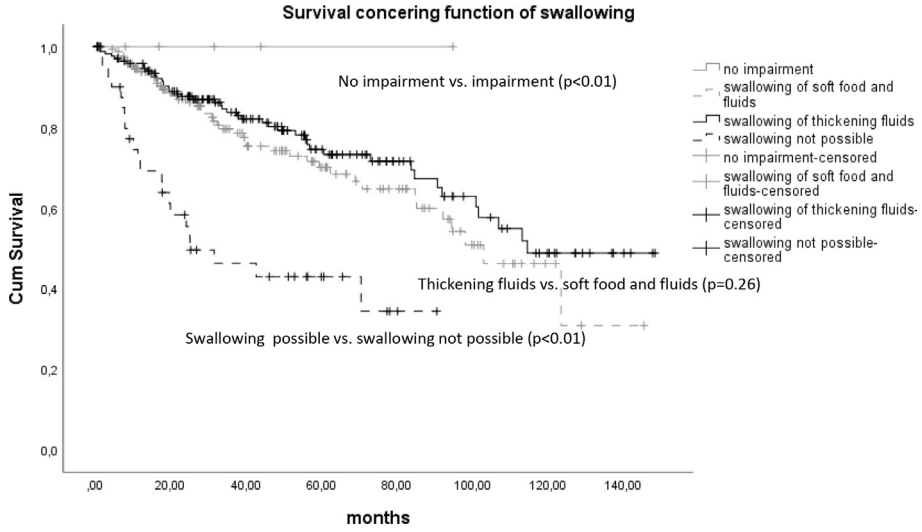

Fig. 1. Survival was excellent if patients had no impairment of swallowing. There was no significant difference between patients who were able to eat soft food and fluids and patients who could only eat thickening fluids. Survival was significantly decreased if patients were unable to swallow.

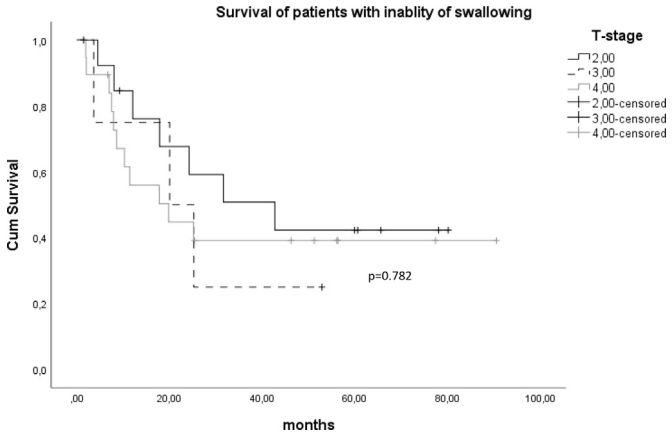

Fig. 2. Inability to swallow equalizes survival curve differences between tumor stages. No significant differences between T2, T3 and T4 tumors were evaluated.

heterogeneity in our cohort by only including tumors of the oral cavity and using the results of our standardized examination of the swallowing function 7 days postoperatively. As the intervention of the speech therapist, who routinely exercise with the patient after day 7 in our hospital, or a potential adjuvant therapy have an influence on the outcome, we favored this point in time, knowing that wound healing and shrinking of the flaps will have an impact on swallowing.

Dysphagia after tumor therapy of the oral cavity is often underestimated, although the negative influence on survival and life quality is well documented (Shune et al., 2012; Hunter et al., 2014; Yang et al., 2015; Kao et al., 2016). However, detailed information about how the localization of the tumor in the oral cavity influences the function of swallowing is still missing. We showed that patients with lateral located tumors had a better function of swallowing than patients with central located tumors. Furthermore, the highest risk for inability to swallow was posterior within the central zone. This includes tumors of the posterior tongue and posterior floor of the mouth. However, there was no significant difference between the different zones and areas. There was a correlation between size of the tumor and a worse functional outcome of swallowing. Concerning the localization, it is comprehensible that a resection of a big tumor at the vestibule or the alveolar process can affect the function of the tongue muscle like a resection of a smaller tumor directly at the tongue. However, subgroup analysis of only small tumors showed also no significant difference between central and lateral zones. These might be explained by the ability of the remaining

functional tissue to take charge of the excised muscles' function when a smaller tumor is excised at the tongue. In general, central defects were reconstructed similar to lateral defects. Summarizing local reconstruction techniques, there was no significant difference between the different zones. The same applied for microvascular flaps. Therefore, it is unlikely that the decision of the chosen reconstruction was based on the localization of the tumor. Consequently, we assume that the localization of the defect itself is a predictor for a reduced swallowing function. Our results confirm Nicoletti's self-questionnaires survey, which also found the posterior area of the oral cavity (retromolar trigone and base of the tongue) as most impaired concerning swallowing function after tumor resection (Nicoletti et al., 2004). Tumors of the oral cavity are functionally more easily compensated than oropharyngeal carcinoma. Borggreven et al. observed significantly worse swallowing function with videofluoroscopic and scintigraphy tests, if the resection included the base of the tongue and the pharynx compared to tumors of the body of the tongue including the base of the tongue (Borggreven et al., 2007).

The dental status was also important for swallowing. Of course a sufficient dental status is imperative for chewing the food but it is also necessary for the swallowing process by giving the tongue a resistance, and consequently supports the directed oral transit of the food. If patients had no adequate supporting zones, which means that only teeth with no counterparts remained after resection, the risk for inability to swallow was significantly increased in our cohort. Teeth were removed during primary resection if they were within the margin of resection or they were not considered worthy of preservation due to caries, periodontitis etc. Therefore, there was no correlation between existences of supporting zones and size of tumor. Mastication contains fine coordinated movements and depends of the interaction of multiple muscles (Peyron et al., 2017). In our cohort resection of the tumor includes these muscles just in very rare cases. Therefore, limitations in chewing are in general caused by loss of supporting zones. Dental wear compensates the decreased surface of occlusal contact and is an important component of mastication (Mioche et al., 2004). Often patients were unable to use their dental prothesis in the first healing phase, because it interfered with the microvascular flap or supporting teeth had to be removed. During follow up, rehabilitation of chewing function should be pursued, but manufacturing a dental prosthesis is very challenging due to the changed hard and soft tissue conditions after operation. Hence, it is not uncommon that patients remain without prosthetic rehabilitation.

5. Conclusion

Most of the patients in the present study had a swallowing impairment after an initial healing phase of 7 days. Reconstruction with a flap had a negative influence on swallowing function, and also if subgroup analysis of tumor stage was considered. We also showed that larger tumors, positive nodal stage and an insufficient dental stage were significant factors for inability to swallow. If the tumor was located at the posterior tongue or floor of the mouth, the risk of dysphagia was increased compared to other tumors within the oral cavity. Referring to overall survival, our results illustrate that inability to swallow is as significant as tumor size and nodal stage even when evaluated at an early point in time at therapy. Therefore, the impact of dysphagia should not be underestimated by the surgeon. Including this knowledge in the therapy plan of the patient may increase overall survival.

Declarations of interest

None.

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