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Long-term speech and swallowing function after primary resection and sentinel node biopsy for early oral squamous cell carcinoma

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ABSTRACT

Objectives: Analysis of long-term speech and swallowing function and subjective quality of life (QOL) after primary resection and sentinel node biopsy (SNB) in patients with early stage (cT1/T2) oral squamous cell carcinomas (OSCC).

Material and Methods: Eighty-one consecutive patients treated primarily by transoral resection without flap reconstruction and SNB for a cT1/T2 OSCC were included. Completion neck dissection (CND) was indicated in case of occult disease in the sentinel nodes. Adjuvant radiation (aRT) was administered according to the ultimate lymph node status. All patients showed no evidence of disease at time of analysis. Speech and swallowing function were assessed using standardized clinical examinations (11-item, articulation test) and validated questionnaires on subjective QOL (MDADI, FIGS). Median follow-up was 60 months (range 13–159 months) after initial treatment.

Results: In all assessments for speech and swallowing, the entire study cohort achieved very high scores, with mean values located in the highest 10% of the scales. Neither tumor size nor site, age, pN-category, CND, and aRT had significant impact on functional outcomes and subjective QOL with the exception of lower scores in the global and physical scores of MDADI after CND or aRT, and articulation in the population over 60 years of age.

Conclusion: Transoral resection without reconstruction and SNB for early OSCC achieves excellent outcome with regard to speech, swallowing and subjective QOL.

Introduction

Oral squamous cell carcinoma (OSCC) is the most common head and neck cancer worldwide [1,2]. The primary treatment strategy in early stages (cT1/T2 cN0) consists of resection of the primary tumor and elective neck dissection (END) of the lymph node levels at risk for occult disease [3]. During the last decade, sentinel node biopsy (SNB) has emerged as a validated and oncologically sound alternative for the treatment of the clinically negative neck [4,5]. SNB has shown to be associated with significantly lower morbidity than END with regard to surgical complications, shoulder function, and quality of life (QOL) [6,7]. While SNB allows for minimally invasive surgery at the neck site, the approach to the primary site is still a matter of controversy. Surgical resection of the primary tumor may lead to speech and swallowing deficits [8–11]. Various alternative techniques such as primary closure, secondary healing, skin grafts, local grafts, pedicled, and free flaps have been proposed depending on the localization of the primary tumor and the extent of the defect. At our institutions, all OSCCs staged cT1/2 cN0 are approached transorally by local resection without reconstruction of the defect and SNB.

The aim of this study was to assess the speech intelligibility, swallowing function, and subjective quality of life in patients treated for a cT1/2 cN0 OSCC with a minimally invasive approach consisting of transoral tumor resection without reconstruction and SNB.

Material and methods

Patient cohort

All patients treated for early stage (cT1/T2 cN0) OSCC at the Kantonsspital St. Gallen, Switzerland, and the University Hospital of Zurich, Switzerland, between January 2000 and December 2011 with

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an uneventful follow-up period of at least one year after treatment were consecutively enrolled. Out of 81 eligible patients, 63 patients (78%) agreed to participate in the study. The reasons for not participating were lack of interest in 14, restricted mobility in 2, impaired general health not related to the OSCC in 1, and psychological distress in 1 patient, respectively. The demographic and tumor data were comparable to the study cohort (data not shown). All patients were staged corresponding to the seventh edition of the AJCC Cancer Staging Manual by TNM classification [12].

Quality of life assessment

The long-term outcome in speech and swallowing function was assessed using two validated subjective questionnaires as well as two objective clinical examinations.

As subjective questionnaires, the MD Anderson Dysphagia Inventory (MDADI) [13] and the Functional Intraoral Glasgow Scale (FIGS) [14] were used.

The MDADI is a validated self-administered questionnaire consisting of 20 ordinal questions. Its purpose is to assess the effect of swallowing impairment on quality of life in patients with head and neck cancer. The questions address the patient's status of the preceding week. The MDADI consists of four different domains of swallowing-related quality of life: Global, Emotional, Functional and Physical. Each question can be answered on an ordinal scale ranging from 1 (strongly disagree) to 5 (strongly agree). For each domain, the patients' mean scores were calculated and normalized to a scale ranging from 20 (very low functioning) to 100 (high functioning). According to Bauer et al. [15], the MDADI scores were graded into three groups: below 55 (swallowing impairment "definitely noticeable"), between 55 and 70 ("more noticeable than not"), and above 70 ("more unnoticeable than not").

The FIGS consists of three questions with a focus on the ability to chew, swallow, and speak during the preceding week. It is a self-administered questionnaire with an ordinal scale ranging from 1 (inability to speak, chew, or swallow) to 5 (no disability). Following Goldie et al. [14], each individual score was summed up into a total score with a possible range between 3 (complete disability) and 15 (no disability).

The clinical examinations consisted of the 11-item postoperative function deficit examination ("11-Item") and a standardized articulation test. The 11-Item is a simple and rapid clinical examination of eleven functional tests to identify the main postoperative function deficits after primary surgery for oral and oropharyngeal cancer. The assessed functions are: lip competence, tongue mobility, oral health, dental status, mouth opening, speech, drooling, diet consistency, appearance, sensation, and shoulder function. The assessment of all 11 items together yields a final score ranging from 0 (complete functional deficiency) to 29 (no functional deficits).

The articulation test is a speech task in German consisting of a phonetically balanced word list ("Artikulationstest" [16]) and a phonetically balanced text ("Der Teppichklopfer" [17]). These two tasks allow to measure the subject's articulation of all possible phonemes of the German language. Additionally, each subject was invited to speak freely about a topic of their choice for at least 3 min to evaluate their spontaneous speech abilities. Each articulation test was rated using the speech intelligibility NTID-scale suggested by Samar and Metz [18], and the three scores summed up to a total articulation score with a range between 3 (incomprehensible) and 15 (comprehensible).

All assessments were performed after a median follow-up of 60 months after treatment (range 13–159 months).

Statistical analysis

Descriptive statistics and histograms are used to describe patient characteristics and the distribution of outcomes. Associations between outcomes and potential risk factors [age, tumor site, T-category, pN-category, completion neck dissection (CND), adjuvant radiotherapy (aRT)] were analyzed using Mann Whitney U tests to compare score distributions for patients with and without each individual risk factor. The relation between outcomes and follow-up time were analyzed using spearman rank correlations.

All analyses were performed in the R programming language (version 3.2.3; R Core Team 2013). A two-sided p-value of 0.05 or less was considered statistically significant. P-values were not adjusted for multiple testing as our study is of explorative nature.

Results

A total of 63 patients was treated in curative intent by transoral resection of the primary tumor and SNB. The defect was left to secondary intention healing in 60 cases (95%) whereas in 3 cases (5%) the defect was covered with a split-thickness skin graft. No primary wound closure or flap reconstructions were performed.

In 17/63 patients (27%) the SNB revealed occult nodal disease. In all these cases, a CND was performed. An additional 10/63 patients (16%) underwent a CND irrespectively of the status of their sentinel lymph node (SLN) as part of the SNB validation trial published earlier [4].

Among all patients 7 (11%) were treated with aRT. Six (10%) were irradiated at the neck site due to either extracapsular spread of the lymph node metastases or involvement of more than two lymph nodes and 1 (2%) at the primary site due to perineural invasion and high grade tumor. In Table 1 the clinical characteristics of the study cohort are outlined.

The vast majority of patients in the study cohort achieved maximum scores in all tests, reflecting excellent function and quality of life. The results of the two validated subjective questionnaires and the two objective clinical examinations are summarized in Fig. 1.

The mean MDADI Global QOL score (standard deviation, SD), Emotional domain score, Functional domain score and Physical domain score for the entire patient cohort were 94.29 (11.03), 94.92 (9.06), 97.08 (5.76), and 93.17 (12.98), respectively.

In MDADI Global, 1 patient (2%) scored below 55 (i.e. 40), while all other patients scored above 70 (i.e. 80 or 100). In MDADI Emotional, 1 patient (2%) scored below 55 (i.e. 53) and 1 patient (2%) scored 70. In MDADI Physical, 1 patient (2%) scored below 55 (i.e. 27.5) and 3

Table 1
Clinical characteristics of the study cohort.

Characteristic	n (%)	
Sex		
	Male	42 (67%)
	Female	21 (33%)
Age (median = 61 years)		
	< 60 years	31 (49%)
	≥ 60 years	32 (51%)
Primary tumor site		
	Floor of mouth	15 (24%)
	Mobile tongue	48 (76%)
T-category		
	T1	47 (75%)
	T2	16 (25%)
pN-category		
	N0	46 (73%)
	N+	17 (27%)
	N0 i+	5 (8%)
	N1	8 (13%)
	N2a	0 (0%)
	N2b	4 (6%)
Completion neck dissection		
	No	36 (57%)
	Yes	27 (43%)
Adjuvant radiotherapy		
	No	56 (89%)
	Yes	7 (11%)

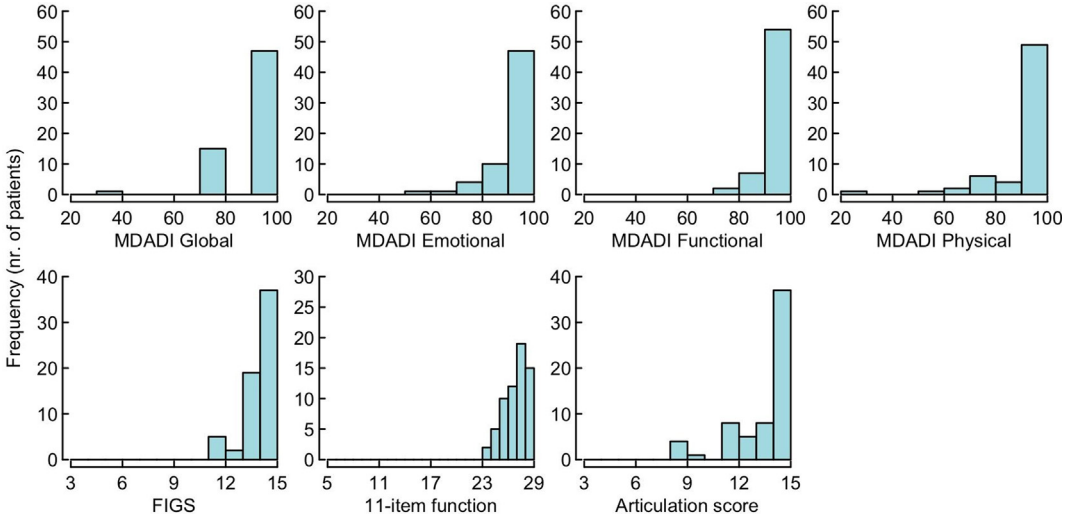

Fig. 1. Frequency distribution of quality of life and functional assessment scores.

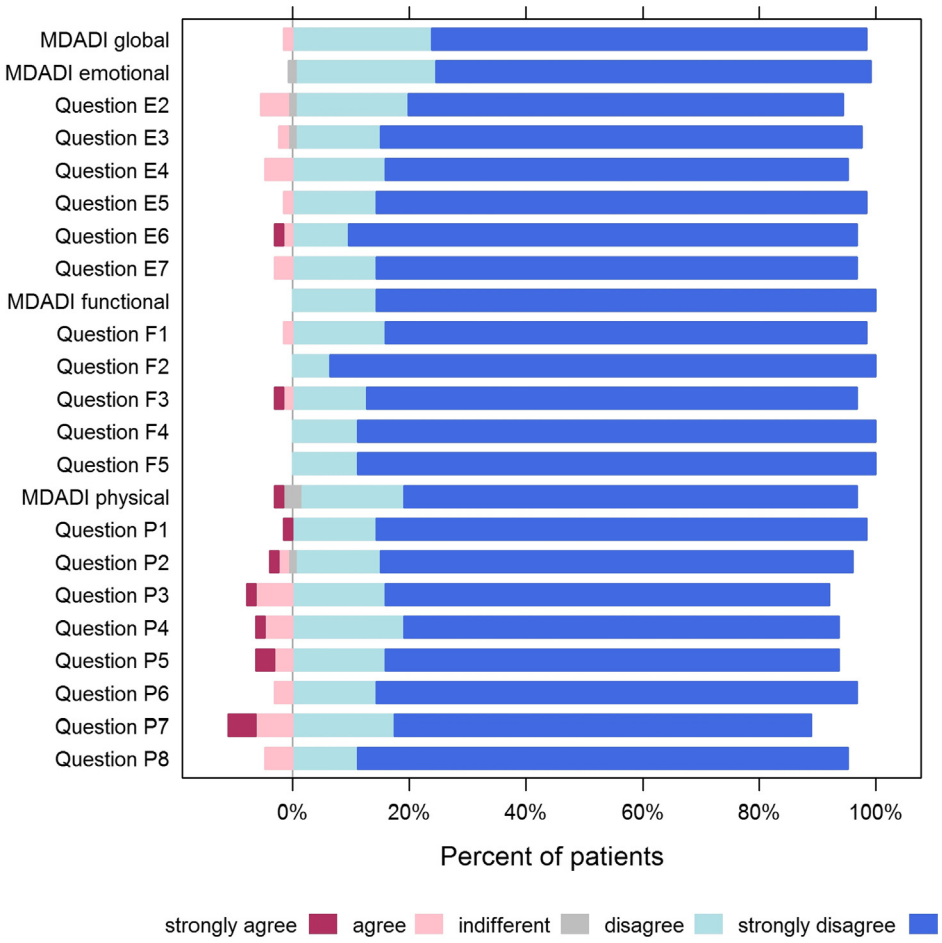

Fig. 2. Distribution of MDADI questionnaire scores.

patients (5%) scored between 55 and 70 (i.e. 60, 65 and 70, respectively). Finally, in MDADI Functional, no patients scored below 70. Overall, our study cohort achieved very high QOL rates in all domains. The percentage of scores for the four different domains of swallowing-related QOL are depicted in Fig. 2.

For all but one question in the MDADI questionnaire > 90% of patients reported no impairment. The only question where the distribution was slightly lower was related to food intake ("It takes me longer to eat because of my swallowing problem"; 71.4% strongly disagree, 17.5% disagree, 0% indifferent, 6.3% agree, 4.8% strongly agree).

The answers to MDADI Physical in the patient group scoring > 80 in MDADI Global were compared to the answers of the patient group scoring ≤ 80 in MDADI Global. As depicted in Fig. 3, patients scoring ≤ 80 in MDADI Global had lower scores in MDADI Physical which is indicating consistent results in the different items of the

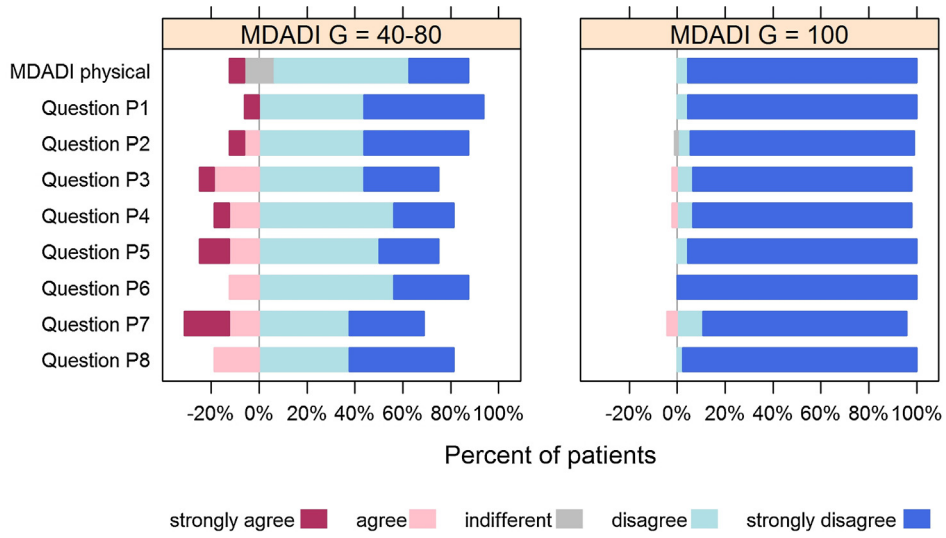

Fig. 3. Comparison of MDADI Global and MDADI Physical questionnaire scores.

questionnaire.

In the FIGS, all patients of the cohort showed very high scores with a mean score of 14.4 (SD 0.89). The different sub scores were 4.63 (0.49) for speech, 4.9 (0.35) for chewing, and 4.86 (0.50) for swallowing.

Similarly, the scores in the 11-Item test were very high. The overall mean was 27.37 (SD 1.38). The lowest, however still high scores were achieved in the functional sub items concerning the tongue mobility (tongue protrusion [83% of maximum score], lateral mobility [86%], and sensation [75%]).

The overall articulation test score was also excellent, with a mean of 13.87 (SD 1.75). The scores in the sub items "wordlist" 4.68 (0.62), "text reading" 4.65 (0.60), and "speak freely" 4.54 (0.64) were almost identical.

As outlined in Table 2, none of the parameters like size (T1 versus T2 category), site of the tumor (floor of mouth versus tongue), pN-stage (N0 versus N +), age (< 60 versus > 60), CND (yes versus no) and aRT (yes versus no) had significant impact on the test outcomes. The only exceptions were detected in the articulation test, where patients above 60 years achieved lower scores compared to the younger age group and in the MDADI global and physical score, where patients undergoing CND or aRT achieved lower scores.

The median follow-up time was 60 months (range 13–159 months). The follow-up time showed no significant correlation with any of the outcome parameters (Table 3).

Discussion

The goal of cancer treatment is not only to cure the patient but also to minimize long term impairment of QOL. While improvements in treatment effectiveness have led to increasing survival rates of 90% in

Table 2
Mann-Whitney U tests for different clinical characteristics.

	Age (years)					**T-category**				
	< 60 (n = 31)		> 60 (n = 32)		p-value	T1 (n = 47)		T2 (n = 16)		p-value
MDADI global	100	(40–100)	100	(80–100)	0.33	100	(40–100)	100	(80–100)	0.58
…emotional	100	(80–100)	100	(53–100)	0.88	100	(80–100)	98	(53–100)	0.30
…functional	100	(84–100)	100	(76–100)	0.30	100	(84–100)	100	(76–100)	0.41
…physical	100	(28–100)	100	(60–100)	0.38	100	(28–100)	100	(60–100)	0.81
FIGS	15	(12–15)	14	(12–15)	0.12	15	(12–15)	15	(12–15)	0.78
11-item	28	(24–29)	27	(24–29)	0.20	28	(24–29)	28	(24–29)	0.67
Articulation	15	(9–15)	14	(9–15)	**0.03**	15	(9–15)	14	(9–15)	0.39
	Primary tumor site					**pN-category**				
	Floor (n = 15)		Tongue (n = 48)		p-value	N0 (n = 46)		N+ (n = 17)		p-value
MDADI global	100	(40–100)	100	(80–100)	0.36	100	(40–100)	100	(80–100)	0.10
…emotional	97	(70–100)	100	(53–100)	0.25	100	(53–100)	100	(73–100)	0.58
…functional	100	(84–100)	100	(76–100)	0.40	100	(80–100)	100	(76–100)	0.57
…physical	100	(28–100)	100	(60–100)	0.37	100	(28–100)	98	(65–100)	0.32
FIGS	15	(12–15)	15	(12–15)	0.84	15	(12–15)	15	(14–15)	0.96
11-item	28	(24–29)	28	(24–29)	0.52	28	(24–29)	27	(25–29)	0.18
Articulation	15	(9–15)	15	(9–15)	0.45	15	(9–15)	15	(9–15)	0.52
	Completion neck dissection					**Adjuvant radiotherapy**				
	no (n = 36)		yes (n = 27)		p-value	no (n = 56)		yes (n = 7)		p-value
MDADI global	100	(40–100)	100	(80–100)	**0.00**	100	(40–100)	80	(80–100)	**0.05**
…emotional	100	(80–100)	100	(53–100)	0.34	100	(53–100)	97	(83–100)	0.16
…functional	100	(84–100)	100	(76–100)	0.20	100	(76–100)	100	(84–100)	0.36
…physical	100	(28–100)	98	(60–100)	**0.03**	100	(28–100)	92	(70–100)	**0.02**
FIGS	15	(12–15)	15	(12–15)	0.42	15	(12–15)	15	(13–15)	0.94
11-item	28	(24–29)	28	(24–29)	0.40	28	(24–29)	27	(26–28)	0.44
Articulation	15	(9–15)	14	(9–15)	0.10	15	(9–15)	15	(12–15)	0.93

Table 3
Spearman rank correlations for follow-up time in months.

Outcome	Correlation coefficient and p-value
MDADI global	$r = -0.09$, $p = 0.50$
… emotional	$r = -0.18$, $p = 0.16$
… functional	$r = -0.07$, $p = 0.60$
… physical	$r = -0.12$, $p = 0.37$
FIGS	$r = -0.06$, $p = 0.63$
11-item	$r = 0.23$, $p = 0.07$
Articulation	$r = -0.12$, $p = 0.37$

early stage disease [5], > 60% of survivors suffer from long-term side effects [19].

At the neck site, SNB has been implemented as the standard procedure in more and more centers throughout the world [20]. While maintaining high regional control rates, SNB has been associated with significantly lower morbidity than END with regard to surgical complications, shoulder function, and QOL [6,7].

At the primary site, depending on the site and size of the primary tumor, surgical resection may lead to permanent speech and swallowing deficits [8–11]. While flap reconstruction harbors a greater risk for perioperative complications and might restrict oral function due to lack of sensitivity and possible restrictions of tongue mobility by their bulkiness [11], secondary healing might inhibit tongue mobility due to the risk of scarred fixations.

At our institutions, all OSCCs staged cT1/2 cN0 are approached transorally by local resection and synchronous SNB. The defect is left to secondary healing. The aim of this study was to assess functional outcome and QOL in long-term survivors of a consecutive patient cohort managed by this approach.

Overall, the study cohort achieved excellent scores in both subjective questionnaires and objective clinical examinations in almost all domains. Only in the physical subscale of the MDADI questionnaire lower scores were achieved, reflecting a slightly higher effort to swallow, longer time to eat, limitations in food intake, and maintaining weight in the entire patient group compared to the normal population. Furthermore, the 11-Item postoperative functional examination revealed marginally compromised tongue mobility and tongue sensation.

In subgroup analysis, none of the parameters assessed (T1 vs. T2 tumors; floor of mouth vs oral tongue; age < 60 years vs. age > 60 years; pN0 vs. pN +) had a significant influence on functional outcomes and subjective QOL with the exception of a negative impact of age on articulation and adjuvant treatment in form of CND and aRT on parts of the MDADI questionnaire.

The lower swallowing scores of patients receiving adjuvant treatment confirm the results of previous studies [2,8,10,11,21]. Patients undergoing CND indicated lower MDADI global scores, suggesting that the swallowing ability limited the patients' day-to-day activities. This finding is in line with the ones of Schiefke et al. [6]. They compared patients after SNB with patients after END for disease-specific QOL using the European Organization of Research and Treatment of Cancer Quality of Life Questionnaire-Core 30 (EORTC QLQ-C30) and Head and Neck 35 module (EORTC QLQ-HN35) and found that END patients showed significantly more swallowing problems. With regard to the higher invasiveness of these treatments (END and CND) and the consequently higher probability of defects on the suprahyoid muscles, these findings seem to be plausible.

Similarly, the use of aRT is a major determinant of QOL in cancer survivors [8,10,11,21]. Reduced saliva production subsequent to aRT can augment already compromised preparatory and oral phases in these patients [22–25]. Some studies suggested that the adverse effect of aRT might be explained by advanced tumor stages and not by the therapeutic side effects. However, since in our study only early tumor stages were included, the adjuvant treatment rather than the tumor size is responsible for the impaired functional outcome as confirmed by Thomas et al. [26], including a similar patient cohort with comparable results. In a study by Boyapati et al. including patients with early oral cancer, none of the patients who underwent aRT achieved highest scores in the assessment of speech and swallow function [27].

With regard to reconstructive techniques, it is widely believed that they play a crucial role in the maintenance of a satisfactory function and QOL [28]. Free flaps have become an accepted modality for the reconstruction of T3/T4 defects [29], while early (T1/T2) defects are often reconstructed using loco-regional flaps [30,31], primary closure, or left to secondary healing as in our institution. In a study by Dwivedi et al. reconstruction was an important factor affecting swallowing function [32]. The reported mean scores of the Sydney Swallow Questionnaire (SSQ) were significantly higher for patients who underwent reconstruction than for those in whom the defect was closed primarily or left to heal by secondary intention. However, there is no consensus on the need for reconstruction in relation to the size of defect as well as the ideal reconstructive method in accordance to the site of resection. A long-term follow-up study of 63 patients with partial glossectomy showed good speech and swallowing function without flap reconstruction [33]. A prospective multicenter study reported on superior functional outcome following primary closure compared to free flap reconstruction for tongue cancer [34]. However, another study reported that consonant intelligibility was better in the flap reconstruction group than in the primary closure group [35]. In the study by Ji et al., tongue motility, articulation, and speech intelligibility were better in the secondary intention group for partial glossectomy patients whereas in hemiglossectomy cases functional outcome was significantly better after free flap reconstruction. This implies, that in patients who undergo resection of half or more of the tongue, restoration of tongue volume by free flap reconstruction is beneficial while secondary intention might be appropriate after partial glossectomy [36].

The strengths of our study are that the functional outcome has been assessed by a variety of validated tests in a homogeneous cohort of patients. These excellent results can be used as comparative standard setting for other cohorts. The weakness of our study is the lack of direct comparison for example with patients with free flap reconstruction. Nevertheless, this study adds new information that has not been published before and supports the efforts for minimizing treatment in patients with early oral cancer.

Conclusion

Transoral resection without flap reconstruction of the primary tumor and management of the neck by SNB and completion neck in case of positive SNB showed excellent results with regard to speech and swallowing function and associated QOL. Therefore, we suggest this minimally invasive approach as treatment of choice for early stage OSCCs.

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