



Quality of life in patients after reconstruction with the supraclavicular artery island flap (SCAIF) versus the radial free forearm flap (RFFF)

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Abstract

Purpose Gold-standard for defect reconstruction in the head and neck region is the radial free forearm flap (RFFF). The supraclavicular artery island flap (SCAIF) gained popularity due to its versatility. Our objective was to compare functional advantages between both modalities.

Methods A retrospective analysis of 24 consecutive cases with advanced-stage squamous cell cancer of the oral cavity and oropharynx after cancer defect reconstruction with two modalities (12 SCAIF; 12 RFFF) was conducted. Patients completed the European Organization for Research and Treatment of Cancer (EORTC) questionnaires, Quality of Life Questionnaire-Core 30-questions (QLQ-C30) and Quality of Life Questionnaire-Core 30 Head and Neck 35-questions (QLQ-H&N35).

Results Mean follow-up was 22.2 ± 9.5 months. Comparison of quality of life (QOL) showed significant differences only in speech and problems with the senses in favor of the SCAIF.

Conclusion Patients report satisfactory QOL results after oncologic surgery and reconstruction with preliminary no significant differences in most aspects comparing the two modalities. Therefore, the SCAIF appears as a viable alternative to the gold standard, the RFFF.

Keywords Quality of life · Supraclavicular island flap · SCAIF · Radial free forearm flap · HNSCC

Introduction

Quality of life (QOL) variables have become increasingly important and are being used as end points in cancer therapy, supplementing traditional end points, such as patients overall survival [1]. According to the World Health Organization, health-related quality of life is the QOL relative to one's health or disease status. Its dimensions often include physical, social, psychological, and spiritual factors. It measures

the prevalence and incidence of non-fatal health outcomes, as well as health care needs and can guide us on the effectiveness of health care systems in an internationally comparable manner [2]. This is particularly important in head and neck squamous cell cancer which affects structures that are critical for basic speech and swallowing function. Thus, treatment may lead to deformities that adversely impact psychosocial functioning [3]. The principal goal of reconstruction in oncologic surgery is to restore the functions of speech, mastication and swallowing which are vital in sustaining an adequate QOL [4].

To restore the above functions in advanced (Union for International Cancer Control, UICC) stage HNSCC, different flaps and techniques have evolved in the last 30 years. While in the past, regional-pedicled flaps, such as the pectoralis major myocutaneous flap (PMCF) were used, microvascular free flaps, such as the radial forearm (RFFF) or the anterolateral thigh free flap (ALTF) represent the current gold-standard in the reconstructive head and neck cancer surgery [5]. In the last 5 years, the pedicled supraclavicular artery island flap (SCAIF) has been used increasingly in

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complex cancer defect reconstruction in the head and neck region [6].

One of the largest studies evaluating the long-term QOL after oncologic surgery and microvascular reconstruction in patients with oral or oropharyngeal malignancies, reported swallowing problems, difficulties in eating in public, restriction of mouth opening, dental problems and salivary dysfunction as the major complaint of these patients [4].

Canis et al. have previously published their results regarding the QOL of patients after resection of pT3 lateral tongue carcinoma treated either with a microvascular reconstruction or with primary closure [7]. Results of this study show that reconstruction can reduce problems with swallowing, speech, and social eating.

Several studies have identified the advantages offered by this flap [8, 9] as patients have reported fewer problems with swallowing, speech, and social eating. Several studies have described impaired but acceptable QOL in patients with HNSCC who underwent defect reconstruction via free flaps such as the RFFF or ALTF or pedicled flaps such as PMCF [10–13].

Until now, there has been no published data regarding the QOL of patients after defect reconstruction with SCAIF. To quantify the effect of our therapy and to objectively evaluate the importance of SCAIF in oncologic reconstructive surgery, we aimed to measure QOL and to compare these results with patients who underwent RFFF reconstruction.

Methods

Patients and methods

The present study is based on a retrospective analysis of 92 consecutive patients who received a SCAIF or RFFF for defect reconstruction at the Ear Nose and Throat Department of the University Medical Center Goettingen, Germany (tertiary referral center), from February 2011 until December 2016. The study was approved by the institutional review board and ethics committee of the university (no. 22/08/15).

We included all patients with advanced UICC stage oropharyngeal and oral cavity squamous cell cancer who either underwent SCAIF ($n = 12$) or RFFF ($n = 12$) procedure for defect reconstruction after transoral laser microsurgery and bilateral neck dissection with a curative intent. In all patients, there was no history of prior surgery, cancer disease or radiation in the head and neck region. We excluded patients with non-HNSCC, cN3 metastasis, distant metastasis and follow-up less than 4.0 months. All patients finished postoperative radiation therapy 12 weeks after surgery. Follow-up was defined as the time point of questionnaire assessment.

We recorded demographic data, past medical history with smoking and alcohol consumption, indication for surgery and postoperative complications, which were divided into major and minor complications (major complication—required surgical intervention, minor complications—managed conservatively). Postoperative complications were further divided into donor site and recipient complications. The HNSCC tumor stage was categorized using the Union for International Cancer Control (UICC) TNM seventh edition classification [14]. The patients were identified through the hospital's cancer database and data was collected from electronic and paper charts. At the post-surgical routine oncologic consultation at our hospital, informed consent was obtained from all individual participants included in this study and additional informed consent was obtained from all individual participants for whom identifying information is included in this manuscript.

Assessment of quality of life

The QOL data was collected using the European Organization for Research and Treatment of Cancer (EORTC) QLQ-C30 core questionnaire [15–17]. Both questionnaires have been re-evaluated, validated, translated and cross-culturally adapted for German-speaking patients [16].

The QLQ-C30 questionnaire is an oncologic specific questionnaire evaluating general condition, functional and symptom scores with a total of 30 questions. It consists of six multi-item function scales measuring physical, role, social, emotional and cognitive functions, and overall QOL. Separate symptom scales are included to assess pain, fatigue, and emesis, and five single items are included to measure bowel function, breathing, appetite, and sleeping disturbances. A final item evaluates the economic consequences of the disease. The H&N35 questionnaire is disease specific, and consists of seven multiple-item scales and six symptom items with a total of 35 questions. It assesses pain, swallowing, senses (taste and smell), speech, social eating, social contact, sexuality, teeth problems, trismus, dry mouth, sticky saliva, cough and feeling ill.

A high score in the functional scales and overall QOL scale represents a high level of functioning, and a high score in the symptoms scales or single items represents a high level of symptoms or problems. All scores were linearly transformed with scales ranging from 0 to 100 according to the EORTC scoring manual recommendations; missing data was processed according to specific instructions for each questionnaire.

Statistical analysis

The data was statistically analyzed with the program R version 3.3.3 (R Foundation for Statistical Computing,

Vienna, Austria). Prior to comparison of the SCAIF and the RFFF group, the Kolmogorov–Smirnov goodness-for-fitness test assessed no normal distribution. Levene’s test was performed to investigate for equality of variances. Regarding comparing analysis, the chi-square test and the Wilcoxon–Mann–Whitney *U* test was applied. Differences were considered significant at *p* values less than 0.05.

All figures were created with Microsoft Excel version 16.16.5 for IOS.

Results

A total of 92 patients required a reconstruction with SCAIF or RFFF between February 2011 and December 2016. After applying the inclusion and exclusion criteria mentioned above and excluding patients who refused participation in the study or who did not completed/returned the questionnaire (Supplemental Figure), 24 consecutive patients were recruited for the study. 12 underwent reconstructive surgery with SCAIF and 12 with RFFF. Males accounted for 66.7% in the SCAIF cohort and 83.3% for RFFF patients. Mean follow-up was 22.2 ± 9.5 months. Five (41.7%) of the SCAIF patients had a UICC-tumor stage III and seven (58.7%) a UICC-tumor stage IV disease. For RFFF, eight (66.7%) had a UICC-tumor stage III and four (33.3%) had UICC-tumor stage IV disease. The mean age in the SCAIF group was 67.9 years and 59.6 years for the RFFF group. The majority of the patients (SCAIF 83.3%, RFFF 91.7%) underwent postoperative radiotherapy. In the SCAIF-group, two patients refused the postoperative therapy, regarding the RFFF-cohort one patient refused the treatment.

In the SCAIF cohort, we recorded four minor complications (33.3%) and 1 (8.3%) major complication of the donor site and four minor complications (33.3%) and no major complications of the recipient site. The equivalent values for RFFF were five (41.7%) minor complications and one (8.3%) major complication for the donor site and one (8.3%) minor complication and 3 (25.0%) major complications for the recipient site.

A postoperative barium swallow, performed 10–15 days postoperatively, identified aspiration in three patients, respectively (25.0% each group), a fistula in one SCAIF patient (8.3%) and a fistula along with aspiration in another SCAIF patient (8.3%). Patient demographics and postoperative data are summarized in Table 1.

Analysis of the questionnaires revealed the following: the global health status as measured by the QLQ-C30 was 50.7 for SCAIF and 52.1 respectively for RFFF showing no statistically significant difference between the two groups. Role functioning was the score which was mostly affected postoperatively in both groups, with cognitive functioning being the least affected. In terms of the symptom scales,

insomnia (SCAIF 50.0; RFFF 44.4), fatigue (SCAIF 49.1; RFFF 47.2) and dyspnea (SCAIF 44.4; RFFF 47.2) were the three symptoms mostly affected postoperatively. Even though the scores recorded by SCAIF patients were marginally better than the RFFF patients, there was no statistically significant difference in the symptom or functional scales between the two groups. The comparison between the two modalities/groups is displayed in Table 2 and Fig. 1

In terms of the QLQ-H&N35 questionnaire, patients undergoing reconstruction with RFFF experienced senses significantly less intense than SCAIF patients (SCAIF 12.5; RFFF 44.4; *p* value 0.02) and reported more trouble with speech (SCAIF 35.2; RFFF 44.4; *p* value 0.018) compared to the SCAIF group. Comparing the remaining scores between both groups, no significant difference was observed. The most severe symptoms experienced by SCAIF patients were less sexuality (65.2), need for painkillers (60.0), sticky saliva (57.6), problems with nutritional supplements (50.0) and feeding tubes (50.0). In the RFFF, the most severe symptoms experienced were dry mouth (63.9), sticky saliva (60.6) and trouble with social eating (55.3). The comparison between the two modalities/groups is displayed in Table 2 and Fig. 2.

Discussion

Treatments associated with advanced head and neck malignancy have a significant impact on the QOL and daily functioning of cancer patients. These patients frequently experience speech, eating and respiration impairments often in combination with facial disfigurement. Along with survival as a key measure of success in the treatment of patients with head and neck cancer, health-related QOL has been increasingly recognized to be of paramount relevance in the assessment of treatment outcomes [1]. In the last 20 years, there has been considerable effort in incorporating QOL measures in the management of these patients, as these scores are multidimensional, sensitive to changes over the course of treatment and reflect the patient’s perspective.

The present study did not show any significant differences between both groups concerning tumor stage, application of a gastrostomy tube, rate of tracheostomy, complications of donor and recipient region, smoking and alcohol consumption. Furthermore, exclusively advanced staged squamous cell cancer of the oropharynx and oral cavity with a follow up of at least four months were included to obtain a homogeneous cohort. The analysis of the QOL questionnaires did not show significant differences, besides senses and trouble with speech with significant better results in the SCAIF cohort. This underlines the eligibility of the SCAIF for oral and oropharyngeal cancer reconstruction as we have demonstrated previously [8, 9]. To date, the present

Table 1 Demographics and complications; no significant difference between sex ($p=0.637$), UICC-tumor stage ($p=0.413$) or complication rate ($p=0.408$, $p=0.910$) between the SCAIF and RFFF group

	SCAIF		RFFF		Total	
	Mean	SD	Mean	SD	Mean	SD
Follow-up	22.2	9.5	22.3	16.3	22.3	13.1
Age	67.9	7.8	59.6	8.6	63.7	9.0
Sex	<i>n</i> (%)		<i>n</i> (%)		<i>p</i> value	
Male	8 (66.7)		10 (83.3)		0.637	
Female	4 (33.3)		2 (16.7)			
UICC-tumor stage					0.413	
III	5 (41.7)		8 (66.7)			
IV	7 (58.3)		4 (33.3)			
Esophagram						
None	5 (41.7)		7 (58.3)			
Aspiration	3 (25.0)		3 (25.0)			
Fistula	1 (8.3)		0 (0.0)			
Aspiration and fistula	1 (8.3)		0 (0.0)			
Not applied	2 (16.7)		2 (16.7)			
PEG	6 (50.0)		3 (25.0)			
Tracheostomy	7 (58.3)		10 (83.3)			
Complications recipient site					0.408	
None	8 (66.7)		8 (66.7)			
Minor	4 (33.3)		1 (8.3)			
Major	0 (0.0)		3 (25.0)			
Complications donor site					0.910	
None	7 (58.3)		6 (50.0)			
Minor	4 (33.3)		5 (41.7)			
Major	1 (8.3)		1 (8.3)			
Phoniatric follow-up	3 (25.0)		0 (0.0)			
Adjuvant therapy						
None	1 (8.3)		1 (8.3)			
RCT	8 (66.7)		10 (83.3)			
Recurrence/palliative	2 (16.7)		0 (0.0)			
Rejected	1 (8.3)		0 (0.0)			
Death	0 (0.0)		1 (8.3)			
Past medical history						
None	3 (25.0)		2 (16.7)			
Cardiovascular risk	0 (0.0)		4 (33.3)			
Two	5 (41.7)		4 (33.3)			
Three	2 (16.7)		0 (0.0)			
More than three	1 (8.3)		1 (8.3)			
Other cancer disease	1 (8.3)		1 (8.3)			
Smoking	7 (58.3)		8 (66.7)			
Alcohol	3 (25.0)		6 (50.0)			

analysis is the first to compare the QOL in SCAIF-patients to RFFF-patients.

In terms of the type of reconstruction however, authors have reported better functional results when using free flaps with either RFFF [11, 18] or ALTF compared to pedicled flaps such as the PMCF [19]. Li et al. were the first to compare two microvascular flaps for the treatment of tongue and oral cavity malignancies directly, showing that the ALTF

performs better and offers superior QOL compared to RFFF [20]. These results are in line with other studies [21]. However recently, Yuan et al. showed no relevant differences in the QOL or surgical results when comparing the two flap types for all domains at 12 months [22].

When compared to patients with other cancer entities, e. g. Colorectal, lung cancer or melanoma, the HNSCC patients after SCAIF/RFFF reconstruction in the present

Table 2 All values of the questionnaires, EORTC QLQ-C30 and EORTC QLQ-H&N35; no significant difference between the SCAIF and the RFFF group, besides "senses problems" ($p=0.020$) and "speech problems" ($p=0.018$) in favor of the SCAIF

	SCAIF		RFFF		<i>p</i> value
	Mean	SD	Mean	SD	
EORTC QLQ-C30					
Global Health Status	50.7	25.7	52.1	26.4	0.929
Functional scales					
Physical functioning	60.0	33.2	60.6	28.8	1.000
Role functioning	46.7	37.5	37.5	31.9	0.590
Emotional functioning	68.1	30.0	59.0	20.0	0.379
Cognitive functioning	76.4	21.9	73.6	28.8	0.976
Social functioning	56.9	39.2	45.8	31.1	0.396
Symptom scales					
Fatigue	49.1	32.0	47.2	29.3	0.639
Nausea and vomiting	13.8	29.2	4.2	7.5	0.538
Pain	31.9	38.6	44.4	43.4	0.483
Dyspnea	44.4	38.5	47.2	26.4	0.690
Insomnia	50.0	43.8	44.4	35.8	0.788
Appetite loss	36.7	36.7	33.3	37.6	0.835
Constipation	11.1	29.6	12.1	27.0	0.963
Diarrhea	8.3	15.1	5.6	13.0	0.651
Financial difficulties	27.7	39.8	41.6	40.5	0.325
EORTC QLQ-H&N35					
Symptom scales					
Pain	16.6	21.3	20.4	18.2	0.494
Swallowing	45.8	35.6	38.4	22.9	0.728
Senses Problems	12.5	19.0	44.4	35.8	0.020*
Speech Problems	35.2	14.9	44.4	26.4	0.018*
Trouble with Social Eating	47.0	35.8	55.3	33.8	0.509
Trouble with Social Contact	23.9	26.4	23.9	24.5	0.725
Less sexuality	65.2	41.8	47.0	38.6	0.250
Teeth	30.5	43.7	40.7	49.4	0.780
Opening mouth	47.2	46.6	41.7	40.5	0.880
Dry mouth	51.5	43.1	63.9	33.2	0.502
Sticky saliva	57.6	33.6	60.6	25.9	0.804
Coughing	44.4	35.8	44.4	34.3	0.927
Feeling Ill	27.8	34.3	38.9	52.2	0.411
Pain killers	60.0	70.0	45.5	48.3	0.720
Nutritional supplements	50.0	70.7	30.0	46.7	0.588
Feeding tube	50.0	52.7	27.3	48.3	0.316
Weight loss	20.0	42.2	30.0	48.7	0.651
Weight gain	27.3	46.7	45.5	52.2	0.408

*Indicate significant differences, p value < 0.05

study reported worse global health status scores. A study by Quinter et al. in 2017 analyzed a total of 3476 cancer patients of various cancer sites (melanoma, colorectal,

lung, etc.) in the age group between 50 and 70 years and compared their questionnaire results with those of a general population. The results were overall better than those of the SCAIF or RFFF patients of the present study [23]. We attribute, however, the differences in scores to the advanced cancer stage of our cohort as we have only included patients with UICC-tumor stage III or IV disease.

Rettig et al. analyzed health-related QOL results of 1653 individuals diagnosed with HNSCC in the United States treated with different modalities [24]. They showed that QOL decreases slowly preceding diagnosis and reaches a nadir at 13 months post-diagnosis. This is followed by an increase in HRQOL from 13 months until approximately 5 years after the diagnosis with a final decline after the 5-year period. Bian et al. observed, that cancer at different sites influences QOL differently, especially in patients with tongue malignancies [25–27]. Canis et al. have previously shown that the QOL of patients after resection of pT3 lateral tongue carcinoma is significantly higher when reconstructing the surgical defect with a microvascular flap compared to primary closure [7].

Previous studies have shown good long-term postoperative QOL results for patients undergoing surgery for malignancies of the oropharynx and oral cavity in comparison to other treatment modalities. Moreover, defect reconstruction increases QOL in terms of swallowing, speech and social eating [4, 7].

In general, a comparison to other studies bears challenges due to the usage of various questionnaires in different studies and different tumor sites. When assessing the QOL in HNSCC patients, other questionnaires than the EORTC QLQ-C30 and EORTC H&N35 questionnaires that were used in the present study, were applied as well: The University of Washington Quality of Life Scale (UW-QOL v4), the Oral Health Impact Profile Questionnaire (OHIP-14), the Medical Outcomes Study Short Form 36 (SF-36) and the Functional Assessment of Cancer Therapy-Head and Neck (FACT-H&NV4). The limitations of the present study lie in the nature of a retrospective analysis and the small sample size of 24 patients. This could probably influence the results.

However, to date there has been no direct comparison of QOL of patients undergoing reconstruction with SCAIF compared to microvascular free flaps. We have retrospectively analyzed all cases with advanced UICC stage oropharyngeal and oral cavity squamous cell carcinomas reconstructed either using the SCAIF or RFFF in our hospital within a 5-year time period. The present study has identified no significant differences in the QLQ-C30 scores and minor differences in the QLQ-H&N35 scores between the two surgical modalities. This underlines the

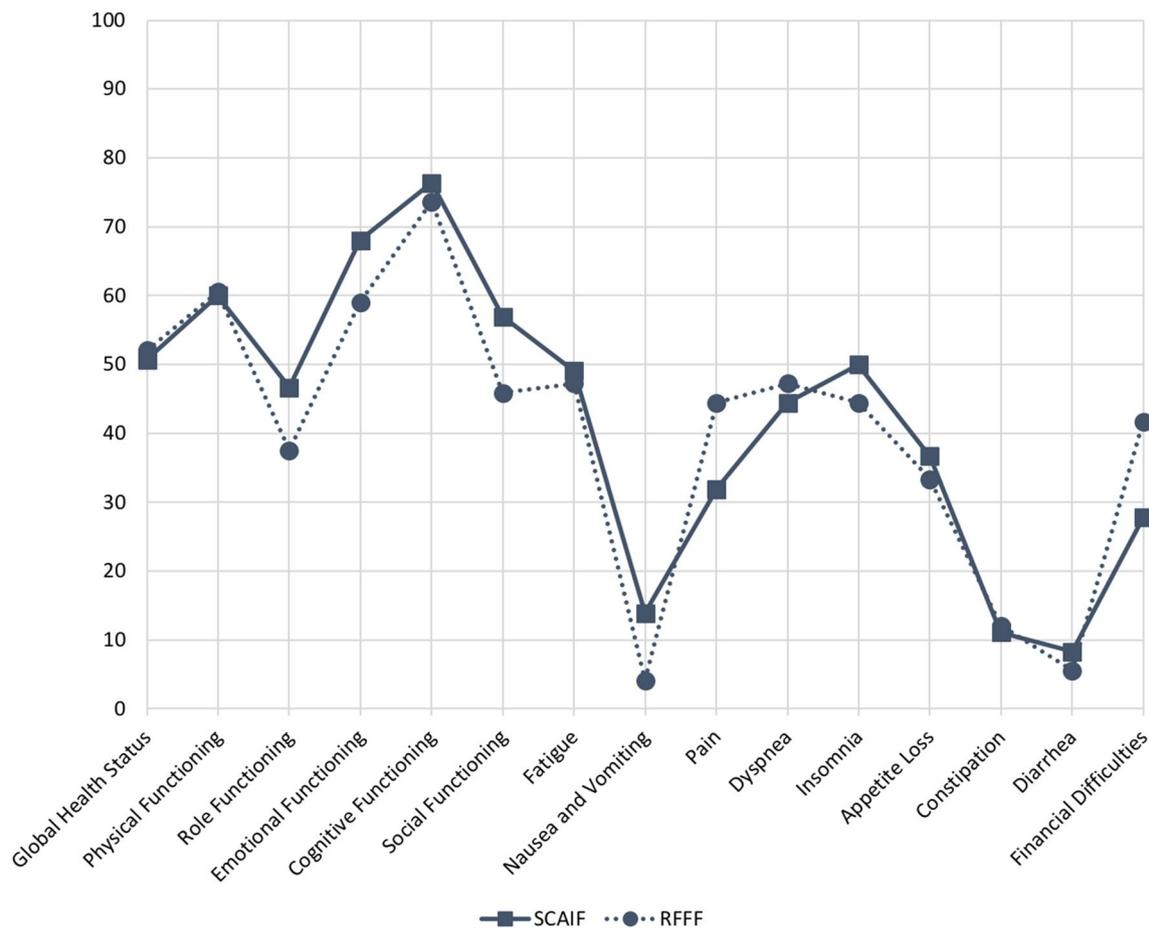


Fig. 1 Mean values of the EORTC QLQ-C30 questionnaire of the SCAIF and the RFFF group. No significant differences between both groups

eligibility of the SCAIF which is a malleable, versatile and well vascularized flap with several advantages over more traditional regional and free flaps [6, 28–31, 8].

Conclusion

Microvascular reconstruction with the RFFF is, among the ALTF, still one gold standard in oncologic surgery of the head and neck. Nevertheless, when comparing QOL results

of RFFF to SCAIF-patients for the treatment of advanced UICC stage oropharyngeal and oral cavity squamous cell cancer, the results of the study have shown significant differences only in speech and problems with the senses in favor of the SCAIF-reconstruction. The presented study underlines the SCAIF as a reliable alternative in oral and oropharyngeal reconstruction after cancer surgery.

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Author contributions JLS designed the experiments, collected and analyzed data, and wrote the paper; YL collected data and wrote parts of the paper; BGW performed experiments, and provided critical revision; MC performed the surgeries and provided critical revision. CW performed the surgeries, designed the experiments, and wrote parts of the paper. All authors discussed the results and implications and commented on the manuscript at all stages.

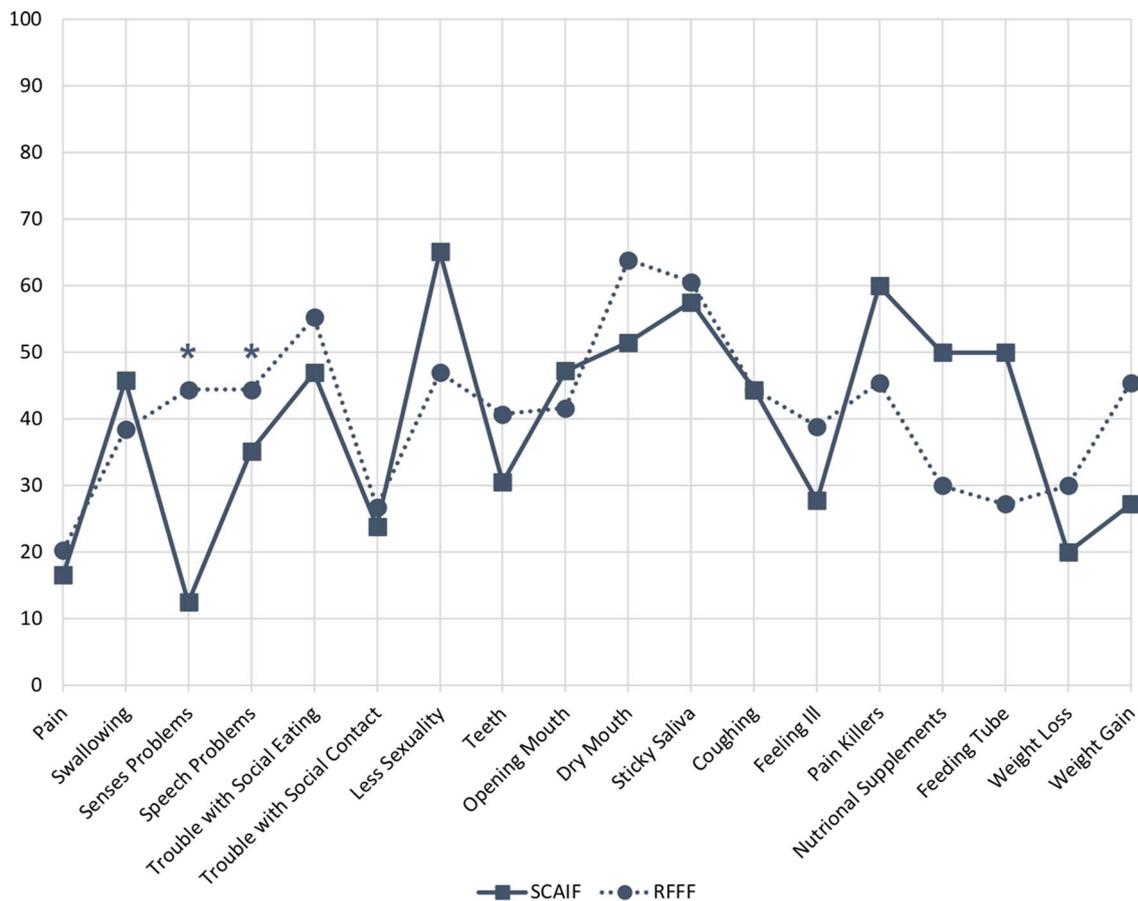


Fig. 2 Mean values of the EORTC QLQ-H&N35 questionnaire of the SCAIF and the RFFF group; two parameters with significant difference ["senses problems" ($p=0.02$) and "speech problems" ($p=0.018$)] between the SCAIF and RFFF group are marked with an asterisk

Compliance with ethical standards

Conflict of interest The authors have no financial interest to declare in relation to the content of this article. No funding was received for this article.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee (Institutional Review Board and Ethics Committee of the University Medical Center Goettingen, Germany; reference number 22/08/15) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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