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Subjective and objective appearance of head and neck cancer patients following microsurgical reconstruction and associated quality of life—A cross-sectional study

Katinka Kansy*, Jürgen Hoffmann, Obada Alhalabi, Nicole Mistele, Kolja Freier, Christian Mertens, Christian Freudlsperger, Michael Engel

Department of Oral and Maxillofacial Surgery, Heidelberg University Hospital, Heidelberg, Germany

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ABSTRACT

Purpose: Depending on the site and size of head and neck cancer, the disease affects patients' appearance and subsequently their quality of life. The aim of this study was to correlate subjective and objective evaluation of facial appearance and associated quality of life following ablative tumor surgery and microsurgical reconstruction.

Material and methods: A total of 99 patients with combined ablative and reconstructive microsurgical procedure for head and neck malignancy and seven patients with non-malignant disease were examined by three-dimensional (3D) (photogrammetry at least 6 months post-surgery and were evaluated by two-dimensional (2D) and 3D means for symmetry and facial proportions. Measurements were correlated with subjective reporting from the University of Washington Quality of Life Questionnaire and observer ratings.

Results: Of the 106 patients, three patients scored themselves as significantly disfigured (2.8%), 19 were bothered by their appearance (17.9%), 27 (25.5%) reported no change, and 57 (53.8%) reported minor changes in their appearance. On 2D evaluation, 10 patients (9.4%) showed severely abnormal facial proportions. On 3D analysis, 17 patients showed major asymmetry. There was a high correlation (0.67) between patient and observer subjective rating ($p < 0.05$). While 2D evaluation alone showed no significant correlation with subjective rating, 3D evaluation showed a moderate correlation (0.37; $p < 0.05$). The best results were achieved by combining 2D and 3D measurements (0.5; $p < 0.05$). Young female patients were most critical about their appearance.

Conclusion: Following combined ablative and microsurgical reconstructive procedures, patients have a realistic perception of their appearance compared with observer ratings and a combination of 2D and 3D objective evaluation.

1. Introduction

Oral maxillofacial ablative and reconstructive surgery almost always requires extraoral surgical approaches and therefore inevitably has a permanent impact on patients' appearance due to scars. In addition, the amount and location of ablated and reconstructed soft and hard tissue may lead to further and more severe changes in appearance. The aim of modern reconstructive oral maxillofacial surgery is to leave patients with only minimal appearance changes and to reconstruct as close to perfect as possible. However, there are no standardized evaluation tools to objectively analyze how well this goal is achieved. While there is a possibility of evaluating bony structures from preoperative and postoperative computed tomography (CT) scans or by mirroring, objective evaluation of soft tissue components is not state of the art. Furthermore, there may be a difference between surgeons' and patients' perception, subjective evaluation and objective evaluation of appearance.

In this cross-sectional study, our aim was to objectively evaluate patients' appearance two- and three-dimensionally and to correlate these findings with subjective self-perception and associated quality of life and subjective observer ratings.

* Corresponding author. Department of Oral and Maxillofacial Surgery, University Hospital Heidelberg, Im Neuenheimer Feld 400, 69120, Heidelberg, Germany.
E-mail address: katinka.kansy@med.uni-heidelberg.de (K. Kansy).

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2. Materials and methods

2.1. Study population

The study was based on a cross-sectional design approved by the local Ethics Committee (S-585/2015) and carried out according to the Declaration of Helsinki. Included were all patients treated at our institution between January 1, 2009, and April 30, 2016, with combined ablative and microsurgical reconstructive surgery, a minimal follow-up time of 6 months post-surgery and written consent to trial participation. All patients included completed the University of Washington Quality of Life Questionnaire (UWQOL) version 4, German translation, and received standardized three-dimensional (3D) photogrammetric scans.

A total of 106 patients (65 male, 41 female) with a mean age of 61 years (range, 21 to 81) and a mean follow-up time of 2.5 years (range, 6 months to 7 years, ± 1.6 years) were included in the analysis. Diagnoses were squamous cell carcinoma (n = 85), recurrent squamous cell carcinoma (n = 4), mucoepidermoid carcinoma (n = 3), osteosarcoma (n = 1), not otherwise specified sarcoma (n = 1), recurrent adenoid cystic carcinoma (n = 1), salivary gland ductal carcinoma (n = 1), malignant melanoma (n = 1), sebaceous gland carcinoma (n = 1), recurrent adenocarcinoma (n = 1) and chondroblastoma (n = 1), osteomyelitis (n = 3), ameloblastoma (n = 2), and Goldenhar syndrome (n = 1), with a total of 99 patients with malignant and seven patients with non-malignant disease. An overview of patient characteristics is given in Table 1. Details on ablative and reconstructive surgery are given in Table 2.

2.2. Data acquisition

All photogrammetric scans were performed using a Canfield VECTRA-360 nine-pod system (Canfield Scientific, Parsippany, NJ, USA). 3D data were generated using a standardized recording protocol (Fig. 1). Using nine synchronized camera systems, noninvasive 360° data acquisition based on the stereophotogrammetric method could be guaranteed. Only one scan with a recording time of 1.5 ms was required.

The 3D photogrammetric data were analyzed using Cranioform Analytics 4.0® software (Cranioform®, Alpnach, Switzerland). For evaluation of symmetry, 3D scans were mirrored and fused with the aid of the following anatomic landmarks: medial and lateral canthus, dorsal tragus point, subnasal point. The software created a 3D coordinate system with the y-axis through the midpoint (M) between the tragus markers (Tr) and the subnasal marker (SN) (Camper's plane). The x-axis was applied as a perpendicular plane through the midpoint. The z-axis was an additional perpendicular plane to the x and y-axis through the vertex of the head. With the aid of the software, the aligned surfaces of the two sides of the face were compared on a voxel-based analysis and distances were visualized with a color-based scheme (Figs. 2–5). Prior to data analysis, two steps were performed: 1) Facial scans were screened for artifacts (movement, hair, beard, eyebrows and clothing), and scans were segmented to exclude these artifacts. 2) As the program calculated maximal and minimal (negative values) of distances between the two surfaces, all images were screened for the most appropriate measurement (minimum/maximum/both). The obtained values were then further analyzed and categorized. Measurements were transformed into a semiquantitative score with deviations of <5 mm = 0 points, 5–10 mm = 1 point, 10–15 mm = 2 points, and >15 mm = 3 points.

For analysis of facial proportions, a frontal and profile view of the 3D scan was transformed into a two-dimensional (2D) image and analyzed for harmonic ("divine") proportions (Ricketts, 1982) and the profile analysis described by Schwarz (Schwarz, 1958). Deviations from the ideal proportion were calculated. Absolute measurements were again transformed into a scoring system. A detailed overview of the 2D and 3D scoring system is given in Table 3.

Patient ratings were acquired from the UWQOL completed at the same time as the photogrammetric scan was performed.

Table 1
Clinico-demographic factors, esthetic score, subjective rating and UWQOL appearance of the cohort.

		Patients	Esthetic score[a]		Observer rating[a]	UWQOL appearance	
		n	2D	3D		% <75	Mean score
Time since surgery (mo)	<36	73	82	71	70	16/73 (21.9%)	71
	36+	33	73	65	74	6/33 (18.2%)	77
Age at survey (yr)	<60	46	79	75	70	10/46 (21.7%)	74
	60+	60	80	64	72	12/60 (20%)	77
Gender	Male	65	79	70	75	8/65 (12.3%)	79
	female	41	79	67	66	14/41 (34.1%)	71
Diagnosis	malignant	99	80	68	73	19/99 (19%)	77
	Non-malignant	7	68	79	54	3/7 (43%)	61
Surgery[b]	previous surgeries	40	74	70	64	10/40 (25%)	70
	subsequent surgeries	20	77	67	68	8/22 (36.4%)	66
	No further surgeries	59	83	70	76	8/59 (13.6%)	81
Radiotherapy	Yes	27	78	70	63	9/27 (33.3%)	69
	No	79	79	69	73	10/79 (12.7%)	79
Chemotherapy	Yes	12	73	65	60	3/12 (25%)	71
	No	94	80	70	73	16/94 (17%)	77
Clinical T stage	Tis/T1/T2	73	81	70	75	15/73 (20.5%)	77
	T3/T4	26	73	69	58	4/26 (15.4%)	76
Clinical N stage	0	81	80	70	73	11/81 (13.6%)	78
	1	11	83	73	65	4/11 (36.4%)	73
	2+	7	68	57	57	4/7 (57.2%)	61
Composite clinical groups	B. T1 T2 oral cancer free flap no RT	57	81	70	76	8/57 (14.0%)	80
	C. T1 T2 oral cancer free flap + RT	16	82	61	68	6/16 (37.5%)	67
	D. T3 T4 oral cancer free flap no RT	16	71	63	58	2/16 (12.5%)	78
	E. T3 T4 oral cancer free flap + RT	10	75	78	58	3/10 (30.0%)	73

RT = radiation therapy.
[a] For better comparability, point scores were transformed into a 0–100 point scale similar to the UWQOL scoring system.
[b] Total is > 106 because some patients had previous and subsequent surgeries.

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