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Effectiveness of dental implants placed into microvascular free flaps

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Conflicts of interest

None to declare

INTRODUCTION

The reconstruction of hard and soft tissue defects, mainly after ablative oncologic surgery in the maxillofacial region, is a challenging and strongly evolving topic in the field of medicine (Takushima, et al., 2005; Bak, et al., 2010; Gerressen, et al., 2013). In modern medicine, the reconstruction of large defects in the maxillofacial region with free autologous tissue transplants and microvascular anastomosis is described as the gold standard with established protocols (Wong et al., 2010; Thiele, et al., 2014; Kessler, et al., 2013). Currently there is still a growing interest for use of microvascular free flaps for head and neck reconstruction: a PubMed search in September 2019 for "free flap maxillofacial" yielded as many as 1774 medical articles, with a range of different options for maxillofacial reconstructive surgery.

The aim of this retrospective study was to evaluate the survival rates of oral implants in a group of patients who underwent maxillofacial reconstructive surgery with microvascular free flaps.

MATERIALS AND METHODS

The study population included patients that were treated between 15/01/2008 and 15/09/2019 at the Department of Oral Science and Maxillofacial surgery, University of Milan. A signed informed consent form was obtained from all subjects for the medical and surgical procedure and for the use of data in the research. The protocol was approved by the Ethics Committee of Milano Area B (Act 478/2017).

The inclusion criterion was patients who needed oral reconstruction and rehabilitation with dental implants after ablative surgery. No exclusion criterion was set. A standardized follow-up protocol, including clinical and radiographic examinations was planned as 1 month, 3, 6, 12 months and then every 6 months for following years.

All the patients underwent resections in the head and neck region and received simultaneous microvascular reconstructions with distant free flaps. Implant survival was taken as primary outcome of the study. The complications following implant, reconstructive surgeries and prosthesis delivery were assessed as secondary outcomes.

Descriptive statistics was done using mean values and standard deviation (SD) for quantitative variables normally distributed. Normality of distributions was assessed using the d'Agostino and Pearson omnibus test. The effect of the different variables (gender, patients' condition, flap type, site, radiotherapy, chemotherapy, type of prosthesis, smoking habits) on implant survival was evaluated by using the Fisher's exact test, given the low incidence of failures in each group. The implant was the unit of analysis. P=0.05 was considered as the significance threshold. Statistical

analysis was performed using GraphPad Prism 5.03 (GraphPad Software, Inc., La Jolla, CA, USA).

RESULTS

The study population consisted of 23 patients (11 male/12 female). Mean age at surgery was 57.04 (SD 17.95) years. A total of 87 implants were inserted. The average post-reconstructive surgery follow-up period was 55.3 (SD 24.2) months, range 20-140 months. The average post-implant surgery follow-up period was 21.4 (SD 9.4) months, range 6-39 months. The average interval between reconstructive surgery and implant placement was 28.0 (SD 17.3) months, range 5-66 months.

Detailed data concerning type of pathology in head and neck region, type of microvascular flap utilized, characteristics of surgery, treatment modality are listed in Table 1. Post reconstructive surgery complications were seen in 10 patients and are listed on Table 2 with treatment modalities. Two patients developed radionecrosis and they received additional FFF reconstructive surgeries (1 FFF, 1 forearm FF).

Implant survival rates for comparing different characteristics are listed on table 3. The overall implant survival rate was 97.7%. Eight Toronto bridges, five fixed bridges, and one removable prosthesis were delivered. Five prosthetic rehabilitations are still at temporary phase and 4 patients have received no prosthesis yet.

DISCUSSION

The outcome of the maxillofacial reconstruction after ablative surgery protocol can vary from patient to patient due to the biology of the disease and general health status of the patient (Kademani, et al., 2016, Urken, et al., 1991). Restoration of oral functions does not only require the reconstruction of the maxillofacial defect, but also facial and dental rehabilitation of the patient with implants and prosthesis in terms of function and esthetics (Chiapasco, et al., 2006; Wijbenga, et al., 2016; Chen, et al., 2019, Bodard, et al., 2015).

In most cases, the use of dental implants to retain prostheses, as part of rehabilitation for head and neck cancer patients, is a common treatment approach (Pellegrino, et al., 2018; Laverty, et al., 2004; Schoen, et al., 2004). However, this can be challenging, because the bone into which the implants are placed is grafted and has often underwent irradiation (Barber, et al., 2011, Harrison, et al., 2003).

Several factors might influence implant survival such as; the experience of the surgeon, bone

quality, and technical aspects such as implant length, diameter and primary stability, bone topography and applied radiation dose, general health, diminished oral hygiene, smoking and alcohol abuse and each play pivotal roles (Pompa, et al., 2015). The location of implant placement (maxilla versus mandible) was evaluated by various authors in literature (Pompa, et al., 2015, Schoen, et al. 2004). In this study, no relation was found between implant survival and the location of placement (maxilla versus mandible).

Radiotherapy might be an important factor in implant failure (Pompa, et al., 2015, Sammartino, et al., 2011). Some authors recommend implant insertion before radiation therapy because of the initial osseointegration takes place before irradiation and there is a reduced risk of late complications (Colella, et al., 2007, Pompa, et al., 2015; Laverty, et al., 2018). According to the results of this study, the implant survival was not influenced by radiotherapy.

In our study, delayed loading protocol for prosthetic phase was applied with a period of at least 6 months in order to provide effective dental rehabilitation for implant osseointegration, and stability. Most of patients had Toronto bridges as final prosthesis and no specific superstructure was found to be particularly favorable in terms of implant survival.

CONCLUSION:

Oral rehabilitation with implant-supported prostheses after maxillofacial reconstruction with microvascularized free flaps can be accepted as a safe procedure with successful aesthetic and functional outcomes.

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Table 1: Graft type and tumor location

Patient N	Indication for Maxillofacial surgery	Tumor location and resection site	Graft type
1	Chronica Sclerosing Osteomyelitis	Right mandible corpus and condyle	FFF Double barrel- Right side
2	Fusocellular Phleomorfic Neoplasia	Right madible	FFF Double barrel- left side
3	MEC	Right mandible	FFF Double barrel- left side
4	SCC	Left madible from 33 till the angle	FFF right plus osteodistraction
5	Keratocystic odontogenic tumor	Mandibula right (from 44 till mandibular branch)	FFF Double barrel
6	SCC	Right mandible from tigone till mental foramen	ALT Free flap
7	SCC	Half-base of the tongue and oral floor (right) removal	ALT free flap

8	Gorlin-Golz syndrome (mutiple keratocystis)	Left mandible and right mandibular branch	FFF right
9	SCC	Half tongue left	Forearm free flap
10	Mandibular pseudoartrhosis after SCC removal	Left mandible	FFF left
11	SCC	Oral pelvis and tongue right	Forearm free flap
12	SCC	Mandibular trigone, soft palate, anterior tonsillar pillar	ALT free flap
13	SCC	Mandibular trigone left	FFF left
14	SCC	Mandible right body	FFF left
15	Odontogenic Mixoma	Mandible right	FFF Double barrel left
16	SCC	Mandible left from 41 till 35	FFF left
17	SCC	Mandible left and oral pelvis+ tongue left	FFF left
18	Ossifying fibroma	Mandible left from 33 till36	FFF right
19	SCC	Mandibular trigone, cheek, bone baguette	Forearm free flap
20	SCC	Mandibula left and cheek mucosa	Forearm free flap
21	SCC	Pelvis and tongue left	Forearm free flap
22	SCC	Upper maxilla crest (premaxilla area from 11 to 21	Medial femoral condyle free flap
23	SCC	Maxilla, right cheek mucosa and upper right vestibule	ALT free flap

MEC= Mucoepidermoid Carcinoma, SCC= Squamous Cell Carcinoma, FFF= Free fibular flap, ALT= Antero-lateral thigh.

Table 2: Post reconstructive surgery complications

	Condition	Flap type	Complication
1	SCC	FFF	Painful neuropathy of the lower face 3rd
2	Chronic Sclerosing Osteomyelitis	FFF	oral bleeding for wound dehiscence at the inferior right fornix. Treated under general anesthesia with superficial temporary artery clip
3	SCC	FFF	Cutaneous fistula during osteodistraction; Treatment: Fistulectomia and distractor remove
4	SCC	FFF	Mandibular right condyle dislocation and cutaneous fistula; Treatment: surgical revision and necrotic condyle removal
5	SCC	ALT	SCC relapse in oral pelvis; Treatment: surgical removal
6	Keratocystic odontogenic tumor	ALT	cutaneous fistula; Treatment: surgical revision
7	SCC	Free forearm flap	cutaneous fistula; Treatment: pectoralis flap reconstruction
8	SCC	Free forearm flap	tumor relapse and mandibular pseudoarthrosis and osteoradionecrosis. FFF reconstruction
9	SCC	Free forearm flap	intraoral small dehiscence of sutures; spinal nerve suffering with paresthesia of hand's first finger; Treatment: controls, solved by the time
10	Gorlin-Golz syndrome (mutiple keratocystis)	FFF	keratocystis relapse at maxilla and mandible; Treatment: keratocystis removal followed by Lefort 1 maxillectomy after major reconstructive surgery due to malocclusion

MEC= Mucoepidermoid Carcinoma, SCC= Squamous Cell Carcinoma, FFF= Free fibular flap, ALT= Antero-lateral thigh.

Table 3: Implant success rates for comparison of different characteristics

Patient	Characteristics	Failed implants/Total no of Implants	Survival %	P-value
Gender	Male	0 /36	100	0.34
	Female	2/51	96.1	
Condition assessed by histological analysis	Chronica Sclerosing Osteomyelitis	0/ 3	100	0.59*
	SCC	2/67	97	
	Fusocellular Phleomorfic Neoplasia	0/ 3	100	
	MEC	0/ 4	100	
	Keratocystic odontogenic tumor	0/ 2	100	
	Odontogenic Mixoma	0/ 3	100	
	Ossifying fibroma	0/ 2	100	
	Gorlin Gortz	0/ 3	100	
Site	Mandible	1/70	98.6	0.32
	Maxilla	1/17	94.1	
Flap type	FFF (Free fibular flap)	1/38	97.4	0.02
	FFF(Double barrel)	0 /12	100	
	Antero-lateral thigh (ALT) Free flap	0 /16	100	
	Forearm free flap	0 /19	100	
	Medial femoral condyle free flap	1/2	50	
Radiotherapy	No rx therapy radiotherapy	2/54 0/33	96.3 100	0.38
Chemotherapy	No chemotherapy chemotherapy	2/ 76 0/11	97.4 100	0.76

Type of prosthesis	Temporary	1/13	92.3	0.06
	Toronto	0/45	100	
	Removable	0/4	100	
	Bridge	1/14	92.6	
	No prosthesis	0/11	100	
Smoker	yes smoke no smoke	1/2 - 1/85	50 98.8	0.02**

*SCC was compared to all other conditions taken together; **not relevant, given the disparity in sample size