(RESEARCH ARTICLE)

Functional and Esthetic Outcomes after Mandibular Reconstruction in Patients with Squamous Cell Carcinoma

Sally S Awad [1, *], Amir M Zaid [2] and Amira AMM Attia [1]

[1] Oral & Maxillofacial Surgery Department, Faculty of Dentistry, Mansoura University, Egypt.
[2] Surgical Oncology Department, Faculty of Medicine, and Oncology center, Mansoura University, Egypt.

Abstract

Background: The mandible has a vital role in the functions of mastication, deglutition, speech, as well as the harmony of lower face appearance. Loss of mandibular bone due to ablative surgery can negatively affect the oral function and facial appearance.

Aim: It was to evaluate the impact of defect size, site (HCL classification) where (H) for hemimandibular lateral defect with condylar involvement, (C) central defect, (L) lateral defects without the condyle, and impact of different reconstructive methods on functional and esthetic outcomes in patients with mandibular Squamous cell carcinoma.

Methods: Sixty-four patients with a mean age of (50 ± 14.2) years were treated by segmental resection and immediate reconstruction. Chi-Square test or Fisher's exact, and Mann-Whitney U test were used to evaluate functional and esthetic outcomes.

Results: The defects' site had no significant difference with oral competence, speech, deglutition, and facial appearance, except with oral feeding and mastication (P=0.005). There was no statistical significance in functional and esthetic outcomes between the reconstructive methods.

Conclusion: Among the studied predictor factors, only the defect site affects oral feeding and mastication with more proportion of good to excellent results in lateral mandibular defect 'L' type vs. poor to fair in other types.

Keywords: Reconstructive surgery; Mandibulectomy; Outcomes; OSCC; HCL classification

1. Introduction

Oral squamous cell carcinoma (OSCC) represents the sixth most common cancer in the world [1], and the predominant malignancy in developing countries. In Egypt, the incidence rate of oral cancer (OC) ranges from 1.4 to 2 per 100.000 persons [2]. Above 90% of all cancers of the oral cavity is oral squamous cell carcinoma [3].

Surgical resection with adequate free margins and postoperative adjuvant therapy as indicated is the treatment of choice in OC. Inadequate ablation of tumor consequences in increased local recurrence and decreased long-term prognosis. [4] Oral defects following tumor resection often cause dysfunctions in oral function such as mastication and swallowing, along with speech, and may disturb facial appearance; so, reconstruction has a crucial role in OC surgery [5, 6].

* Corresponding author: Sally S Awad; Email:sallyshamaa@yahoo.com
Associate professor, Oral & Maxillofacial Surgery Department, Faculty of Dentistry, Mansoura University, Egypt.

Regardless of the reconstructive method used either free flaps, prosthesis, or implantable materials, an accurate evaluation of oral tissue defects is essential [7].

Segmental mandibular defects can be broadly classified according to their site and size. Many classification systems have been used to classify this defect [8]. Pavlov et al. in 1974 introduced the first classification [9]. In 1989, [Jewer et al. [10] presented the HCL classification systems; "H" for lateral defects of any length with condylar involvement, "C" for central defects including both canines, "L" for lateral defects without condylar involvement, In this classification, eight permutations of the 3 letters are used to describe the mandibular defects (H, C, L, LC, HC, LCL, HCL, HH) [8, 10, 11]. Later then, diverse classifications have been proposed either as a modification of Jewer et al. classification or new systems. Nevertheless, Jewer et al. classification is still the most widely used [12].

Segmental mandibular substance loss is frequently encountered in maxillofacial surgery. The reconstruction of these defects remains a challenge for the reconstructive surgeon, regarding both function and esthetic. Therefore, this study aimed to evaluate the impact of defect size, site (HCL classification), and different reconstructive methods on functional and esthetic outcomes in OSCC patients.

2. Patients & Methods

One hundred patients with oral lesions attending Oral & Maxillofacial Surgery Department clinics and Surgical Oncology Unit, Oncology Center, Mansoura University underwent detailed history, thorough clinical examination, a biopsy of the lesions, and computed tomography to consider tumor spread and the presence of cervical nodes. Sixty –four patients who were diagnosed with OSCC were included in our study considering inclusion and exclusion criteria. All patients were staged according to the International Union Against Cancer (UICC) 2002 guidelines.

Inclusion criteria were; Patients with biopsy-confirmed OSCC, and fit for surgery, patients gave informed consent, no induction or adjuvant therapy received at any time of the study. Exclusion criteria were; patients who had tumors other than squamous cell carcinoma, patients with substantial loss of soft tissues, and patients who cannot complete follow-up period.

All patients were classified according to HCL classification proposed by (Jewer et al.) [10] to assess the characteristics of the defect. They underwent mandibular resection and immediate reconstruction by either (free flaps, pedicled flaps, or prosthesis). All patients signed informed consent. The study followed the principles laid down in the Declaration of Helsinki on medical research protocols and ethics and was approved by the institutional review board (No. A11010222)

2.1. Follow-up and outcomes

Patients were assessed and followed- up after 3 months, assessment of functional outcomes included: oral competency restoration, mouth opening and closure, mastication, and speech. Functional outcomes were sorted on a 4-point score in which 4 = excellent, 3 = good, 2 = fair, 1 = poor.

In oral competency evaluation: excellent=normal; good= rarely drolling; fair =occasional drolling and poor= severe drolling. In mouth opening and closure: excellent =normal movement; good = normal with difficulty in movement; fair=incomplete movement and poor= extremely restricted movement. In speech: normal=excellent; good= intelligible, fair =intelligible with effort; poor= not intelligible. In mastication: excellent = normal diet tolerance, good = semisolid, fair= soft diet, and poor = fluids only. In deglutition: excellent =normal, good =slightly sensible or mild dysphagia to solid, fair =with difficult swallowing or dysphagia, and poor =painful or with regurgitation.

In overall functional outcome, excellent score ranges from 17- 20, good (13 16), fair (9 – 12) and poor is less than 8.

In esthetic outcome, the assessment included facial appearance, by the same 4- point scale used in functional outcome. In facial appearance: excellent = nearly equal to normality; good = a little changed; fair = obviously changed from normality and not very distorted and poor= much distorted.

2.2. Statistical analysis

Data weres analyzed using IBM-SPSS software (IBM Corp. Released 2019. IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY: IBM Corp.). Qualitative data were expressed as N (%). Chi-Square test or Fisher's exact test was used according to the sample size of cells. Phi was used to assess the strength of association between two nominal variables. To compare quantitative data for two groups, Mann-Whitney U test was used (after being tested for normality by Shapiro-Wilk's test). For any of the used tests, results were considered as statistically significant if (p value ≤ 0.050).

3. Results

In the current study, 64 patients (33 males, 31 females) met the inclusion criteria and were enrolled. The age range was (25-75 years) with a mean age of 50±14.2 years. The most frequent tumor site was the body of the mandible represented (37.5 %) in 24 patients. The body with other sites represented (51.5%); 3 cases involved body, ramus, and condyles, 18 cases involved body, and ramus, and 12 cases involved body and central. (Table 1)

Pattern diagrams of the HCL classification of mandibular defects and the distribution among the 64 patients are shown in (Fig. 1) [10, 13].
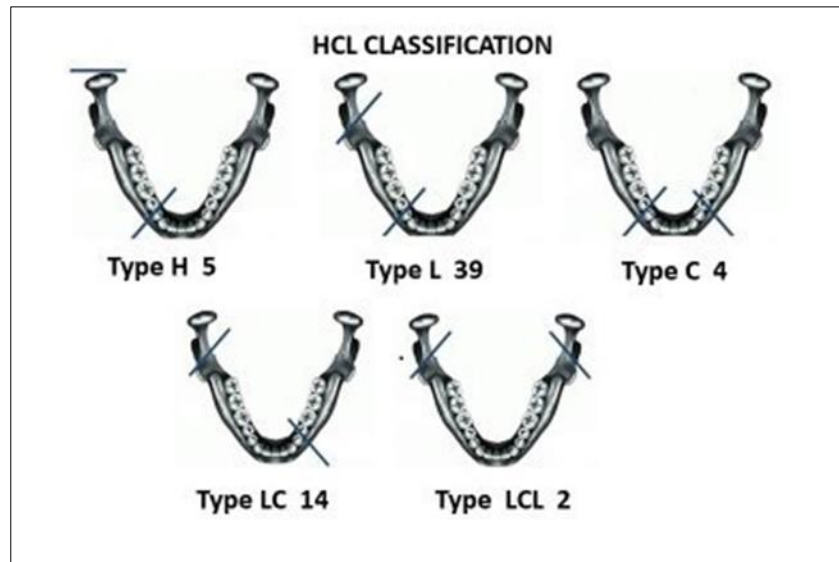
Figure 1 Classification of mandibular bone defects by HCL classification and number of cases in each type

Table 1 Characteristics of tumor primary site and size in the studied cases

Characteristic	Descriptive statistics
Site	
Body	24 (37.5%)
Ramus	4 (6.25%)
Central	3 (4.7%)
Body and other sites	33 (51.5%)
Defect size (cm)	
Mean ± SD	7.9 ± 2.2
Minimum – Maximum	4.6 – 12.9

Notes: Data are N (%) unless otherwise stated.

Table (2) showed the functional and esthetic outcomes according to (HCL classification). The site of mandibular defects had no significant difference in oral competence, speech, deglutition, and facial appearance, while there was significant difference with oral feeding and mastication (P=0.005), low significance in mouth opening (P =0.07). There was a statistically significant association between type 'L' and mastication with more proportion of good to excellent results in 'L' type vs. poor to fair in other types. The association was of moderate strength (Phi = 0.366).

Table 2 The functional & esthetic outcomes in relation to HCL classification (defect site)

HCL classification		H	L	C	LC	LCL	p. value
Outcomes							
Oral competence	Excellent	2 (40%)	23(59.0%)	2(50%)	3(21.4%)	0	0.159
	Good	2(40%)	13(33.3%)	1(25%)	9(64.3%)	2(100%)	
	Fair	0	2(5.1%)	1(25%)	2(14.3%)	0	
	Poor	1(20.0%)	1(2.6%)	0	0	0	
Speech	Excellent	0	20(51.3%)	2(50%)	6(42.9%)	1(50%)	0.402
	Good	3(60%)	15(38.5%)	2(50%)	8(57.1%)	1(50%)	
	Fair	2(40%)	3(7.7%)	0	0	0	
	Poor	0	1(2.6%)	0	0	0	
Mouth opening and closure	Excellent	0	15(38.5%)	2(50%)	1(7.1%)	0	0.072
	Good	3(60%)	17(43.6%)	1(25%)	7(50.0%)	0	
	Fair	2(40%)	7(17.9%)	1(25%)	6(42.9%)	2(100%)	
	Poor	0	0	0	0	0	
Mastication	Excellent	0	3(7.7%)	0	1(7.1%)	0	0.005
	Good	3(60%)	24(61.5%)	3(75%)	1(7.1%)	0	
	Fair	2(40%)	10(25.6%)	1(25%)	11(78.6%)	2(100%)	
	Poor	0	2(5.1%)	0	1(7.1%)	0	
Deglutition	Excellent	2(40%)	21(53.8%)	3(75%)	3(21.4%)	0	0.596
	Good	3(60%)	14(35.9%)	1(25%)	8(57.1%)	2(100%)	
	Fair	0	2(5.1%)	0	2(14.3%)	0	
	Poor	0	2(5.1%)	0	1(7.1%)	0	
Facial appearance	Excellent	0	11(28.2%)	0	4 (28.6%)	0	0.295
	Good	2(40%)	19(48.7%)	1 (25%)	7(50.0%)	1(50.0%)	
	Fair	3(60%)	5(12.8%)	1 (25%)	3(21.4%)	1(50.0%)	
	Poor	0	4(10.3%)	2 (50%)	0	0	
Total		5	39	4	14	2	

The defect size Mean ± SD was (7.9 ± 2.2) with no statistically significant difference in defect size between excellent/good and Fair/poor scores of all outcome measures. Table (3).

Reconstruction was done mainly by three methods: Free flaps were done in 17 patients, by free fibular flap in (12 patients) or by iliac crest free flap in (5 patients). Pedicled flaps were done in 12 patients by a sternomastoid-clavicular flap (9 patients); or pectoralis major with 5th rib flap (3 patients), and prosthetic reconstruction in 35 patients by acrylic plate (5 patients); titanium mesh (24 patients); and titanium plates (6 patients).

Table (4) summarized overall functional and esthetic outcomes in relation to the reconstruction methods, where overall functional outcome was excellent in 31patients; Good in 28 patients; and fair in 5 patients. There was no statistical significance in functional outcomes between the reconstructive methods. (P >0.05).

The facial appearance was excellent in 19 patients, good in 29 patients, fair in 13 patients, and poor in 3 patients. There was no statistical significance in facial appearance between the reconstructive methods (P=0.93).

Table 3 Defect size in (cm) in relation to functional & esthetic outcome measures

Outcome	Defect size
	Median (IQR)
Esthetic	
poor / fair (1 and 2)	7 (6.5 – 9.1)
good / excellent (3 and 4)	7.4 (6.3 – 9.9)
P value	0.648
Competence	
poor / fair (1 and 2)	7.4 (6.6 – 9.4)
good / excellent (3 and 4)	7.3 (6.3 – 9.9)
P value	0.809
Speech	
poor / fair (1 and 2)	7.4 (6.2 – 10.5)
good / excellent (3 and 4)	7.3 (6.5 – 9.7)
P value	0.900
Opening	
poor / fair (1 and 2)	7.7 (7 – 10)
good / excellent (3 and 4)	7.3 (6.3 – 9.6)
P value	0.562
Mastication	
poor / fair (1 and 2)	8 (7 – 10)
good / excellent (3 and 4)	7.3 (5.7 – 8.5)
P value	0.188
poor / fair (1 and 2)	7 (6.5 – 10.3)
good / excellent (3 and 4)	7.5 (6.5 – 9.7)
P value	0.900

IQR = Interquartile range, reported as 25th percentile – 75th percentile).
Tests of significance is Mann-Whitney U-test

Table 4 Summarizes the functional &esthetic outcomes in relation to reconstructive methods

Reconstructive methods		Total	Free flaps	Pedicled	Prosthetic	p. value
Outcomes						
Oral competence	Excellent	30(46.9%)	8(47.1%)	6(50.0%)	16(45.7%)	0.925
	Good	27(42.2%)	8(47.1%)	5(41.7%)	14(40.0%)	
	Fair	5(7.8%)	1(5.9%)	1(8.3%)	3(8.6%)	
	Poor	2 (3.1%)	0	0	2(5.7%)	
Speech	Excellent	29(45.3%)	9(52.9%)	4(33.3%)	16(45.7%)	0.606
	Good	29(45.3%)	7(41.2%)	8(66.7%)	14(40.0%)	
	Fair	5(7.8%)	1(5.9%)	0	4 (11.4%)	
	Poor	1(1.6%)	0	0	1(2.9%)	
Mouth opening and closure	Excellent	18(28.1%)	5(29.4%)	0	13(37.1%)	0.127
	Good	28(43.8%)	6(35.3%)	7(58.3%)	15(42.9%)	
	Fair	18(28.1%)	6(35.3%)	5(41.7%)	7(20.0%)	
	Poor	0	0	0	0	
Mastication	Excellent	4(6.3%)	1(5.9%)	2(16.7%)	1(2.9%)	0.430
	Good	28(43.8%)	6(35.3%)	7(58.3%)	15(42.9%)	
	Fair	27(42.2%)	8(47.1%)	3(25.0%)	16(45.7%)	
	Poor	5(7.8%)	2(11.8%)	0	3(8.6%)	
Deglutition	Excellent	29(45.3%)	6(35.3%)	6(50.0%)	17(48.6%)	0.940
	Good	28(43.8%)	9(52.9%)	5(41.7%)	14(40.0%)	
	Fair	4(6.3%)	1(5.9%)	1(8.3%)	2(5.7%)	
	Poor	3(4.7%)	1(5.9%)	0	2(5.7%)	
Facial appearance	Excellent	17(26.6%)	6(35.3%)	3(25.0%)	17(26.6%)	0.930
	Good	29(45.3%)	6(35.3%)	5(41.7%)	29(45.3%)	
	Fair	13(20.3%)	4(23.5%)	3(25.0%)	13(20.3%)	
	Poor	5(7.8%)	1(5.9%)	1(8.3%)	5(7.8%)	

4. Discussion

Functions and esthetic in the head and neck play vital role in social and emotional communication, and thus any dysfunction can negatively affect social interface as well as physical functioning. When comparing patients of oral and maxillofacial tumors with less evident tumors in other body areas, these patients experience more damage to their, self-esteem, and self-confidence [14].

Large tissue defects in the head and neck are a challenge for reconstructive surgery. Irrespective of the cause of the resection either neoplasm, infection, osteoradionecrosis, or trauma, the objectives and principles are the same; these are to restore adequate function and esthetics and consequently enhance the quality of life [15].

Patients in our study were classified according to HCL classification proposed by (Jewer et al.) [8], to assess the characteristics of the defects and their impact on function and esthetics. The most prevalent defects were lateral (60.9%) and lateral with central (21.8%), this finding was supported by (Okojie, et al.) [16], who reported that defects

were L in (44.7%), LC in (25.5%). Also supported by (Mochizuki et al.) study [17], and dissimilar to studies by (Kakarla et al. and Cordeiro et al.) [18, 19], where lateral and anterior defects were the two main types of these classifications.

For function outcomes (oral competence, speech, and deglutition), there was no statistical significance with any of the types of HCL classification (H, L, C, LC, and LCL). But there was strong significance with mastication (P=0.005) and low significance with mouth opening and closure (P=0.072)

The results showed significant association between lateral mandibular defects type 'L' and mastication with more proportion of good to excellent results vs. poor to fair in other types, comparable to studies[18,19] in which, lateral resections are better accepted than resections involving the anterior symphyseal region.

In esthetic outcome, we evaluated the facial appearance of the patients, the results showed no significant difference with HCL classification. It was excellent to good in 45 patients (70.3%), fair in 13 patients (20.3%) and poor in 6 patients (9.3%). The poor esthetic outcome observed in patients with central defects (50%) and with lateral defects (10.3%).

In the present study, the size of the defect was measured in cm with mean ± SD (7.9 ± 2.2) ranging from (4.6 – 12.9), with no statistically significant difference in defect size between functional and esthetic outcomes. The possible reason for the lack of significant differences is hat, the detects size were close in length in most of the patients.

The choice of the reconstruction method after mandibular segmental resection remains a clinical dilemma, which is complicated by the enormous suitable reconstructive options [20, 21].

Different methods were used for mandibular reconstruction mainly by Free flaps in 26.5% of the patients by (fibular flap, iliac crest flap), Pedicled flaps in 19% by (sternomastoid-clavicular flap, pectoralis major with 5th rib flap), and prosthetic reconstruction in 54.6% by (titanium mesh, acrylic plate, and titanium plates).

We expected that results of using different reconstructive methods would be strongly associated with differences in functional and esthetic outcomes. However, the association was not statistically significant. This is probably due to the number of treated cases by free and pedicled flaps are much less than those treated by plates are. This result was in contrast to many studies [22-27], that give advantages to free flaps over other methods of reconstruction in the functional and esthetic outcomes.

5. Conclusion

Oral feeding and mastication after segmental mandibulectomy differed according to the defect site, where lateral mandibular defects 'L' type showed more proportion of good to excellent results vs. poor to fair in other types.

Compliance with ethical standards

Disclosure of conflict of interest

The authors have no competing interests to declare relevant to this article's content.

Statement of ethical approval

The institutional research ethics committee approved the study.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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