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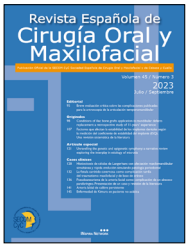

Original

Conditions of iliac bone grafts application in mandibular defects replacement: a retrospective study of 11-years' experience

Bekir Osmanov[1], *Alla Shepelja*[2], *Yurii Chepurnyi*[1], *Andrii Kopchak*[1] *and Johanna Snäll*[3]

[1]*Department of Maxillofacial Surgery and Innovative Dentistry. Bogomolets National Medical University. Kyiv, Ukraine.* [2]*Department of Dental Surgery, Implantology and Periodontology. Dnipro State Medical University. Dnipro, Ukraine.* [3]*Department of Oral and Maxillofacial Diseases. University of Helsinki and Helsinki University Hospital. Helsinki, Finland*

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Mandibular reconstruction, mandibular continuity defect, iliac crest graft, free bone transferring.

ABSTRACT

Background: This study aimed to clarify the occurrence and causes of postoperative complications in patients with continuous mandibular defects, reconstructed with free iliac bone grafts.

Patients and methods: Patients with mandibular continuity defect with bone tissue loss, resulting in a 2 cm gap or more underwent reconstruction with non-vascularized iliac crest bone graft. The outcome variable was graft failure which was defined as its loss due to the postoperative infection, graft exposure, full resorption or non-unition of the graft. The predictors were timing of reconstruction, length of the bone defect, preoperative presence of mucosa defect and/or dehiscence and fixation method. All explanatory and predictor variables were analyzed with univariate binomial logistic regression.

Results: The study included the results of 50 mandibular reconstructions with non-vascularized iliac crest bone graft which were observed retrospectively. The follow-up of included patients ranged from 6 months to 11 years. 34 patients (68 %) had successful surgery results. In 16 patients (32 %) the bone grafts were lost. All of them due to the infection development, suppuration and/or graft exposure during the first 6-months of the observation period. In univariate analysis, the main failure predictor variables were smoking (OR 5.8, CI 1.48-22.7, p = 0.002), timing of reconstruction (OR 7.94, CI 1.88-33.5, p = 0.004) and mucosa defect or dehiscence (OR 8.49, CI 2.21-32.6, p = 0.002). The multivariate analysis also revealed symphyseal involvement of defect (OR 5.63, CI 1.14-27.8, p = 0.034) as the significant failure predictor in a case of immediate reconstruction. The length of defect and fixators type remained statistically non-significant for mandibular reconstruction with NVICG ($p < 0.05$).

Conclusion: The incidence of graft failure in patients with continuous mandibular defects reconstructed with non-vascularized iliac crest graft is determined by the risk factors, asso-

*Correspondence:
E-mail: bkrsmnv@gmail.com (Bekir Osmanov).
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ciated with timing of reconstruction, smoking and presence of the mucosal defect and/or dehiscence. No significant influence on the surgical outcomes was demonstrated for the large defects (more than 6 cm in comparison to less than 6 cm). Immediate reconstructions with iliac crest graft could not be recommended also in a case of symphyseal localization of a defect due to the significant increase in graft failure rates. In these categories of patient's other treatment modalities should be considered.

Condiciones de aplicación del injerto ilíaco óseo en la sustitución de defectos mandibulares: un estudio retrospectivo de 11 años de experiencia

Palabras clave:

Reconstrucción mandibular, defecto de continuidad mandibular, injerto de cresta ilíaca, transferencia ósea libre.

RESUMEN

Antecedentes: Este estudio tenía como objetivo aclarar la aparición y las causas de complicaciones postoperatorias en pacientes con defectos mandibulares continuos, reconstruidos con injertos óseos ilíacos libres.

Pacientes y métodos: Los pacientes con defecto de continuidad mandibular con pérdida de tejido óseo, que dio lugar a una brecha de 2 cm o más, se sometieron a reconstrucción con injerto óseo de cresta ilíaca no vascularizado. La variable de resultado fue el fracaso del injerto, que se definió como su pérdida por infección postoperatoria, exposición del injerto, reabsorción completa o no unión del injerto. Los factores predictivos fueron el momento de la reconstrucción, la longitud del defecto óseo, la presencia preoperatoria de defecto mucoso y/o dehiscencia y el método de fijación. Todas las variables explicativas y predictoras se analizaron mediante regresión logística binomial univariante.

Resultados: El estudio incluyó los resultados de 50 reconstrucciones mandibulares con injerto óseo de cresta ilíaca no vascularizado que se observaron retrospectivamente. El seguimiento de los pacientes incluidos osciló entre 6 meses y 11 años. 34 pacientes (68 %) tuvieron resultados quirúrgicos satisfactorios. En 16 pacientes (32 %) se perdieron los injertos óseos. Todos ellos debido al desarrollo de infección, supuración y/o exposición del injerto durante los primeros 6 meses del periodo de observación. En el análisis univariante, las principales variables predictoras de fracaso fueron el tabaquismo (OR 5,8; IC: 1,48-22,7; p = 0,002), el momento de la reconstrucción (OR 7,94; IC: 1,88-33,5; p = 0,004) y el defecto o dehiscencia de la mucosa (OR 8,49; IC: 2,21-32,6; p = 0,002). El análisis multivariante también reveló la afectación sinfisaria del defecto (OR 5,63; IC: 1,14-27,8; p = 0,034) como factor predictivo significativo de fracaso en un caso de reconstrucción inmediata. La longitud del defecto y el tipo de fijadores siguieron siendo estadísticamente no significativos para la reconstrucción mandibular con NVICG (p < 0,05).

Conclusiones: La incidencia de fracaso del injerto en pacientes con defectos mandibulares continuos reconstruidos con injerto de cresta ilíaca no vascularizado viene determinada por los factores de riesgo, asociados al momento de la reconstrucción, el tabaquismo y la presencia del defecto mucoso y/o la dehiscencia. No se demostró ninguna influencia significativa en los resultados quirúrgicos en el caso de los defectos grandes (más de 6 cm en comparación con menos de 6 cm). Las reconstrucciones inmediatas con injerto de cresta ilíaca no podían recomendarse tampoco en caso de localización sinfisaria de un defecto debido al aumento significativo de las tasas de fracaso del injerto. En estas categorías de pacientes deberían considerarse otras modalidades de tratamiento.

INTRODUCTION

Mandibular continuity defects, associated with considerable esthetic disfigurement and loss of the masticatory function, significantly affect life quality and socialization of patients. The etiology of such defects is usually associated with benign and malignant tumors, osteonecrosis and high velocity trauma including gun-shot and blast injuries[1-3]. The main goals of the mandibular reconstruction are restoring the bone integrity, contour and 3-dimentional position as well as functional rehabilitation, providing the patient with adequate mastication and articulation[4].

Numerous treatment modalities were proposed for replacement of mandibular defects over the last decades. They included bone grafts, standard and patient specific implants/endoprostheses, distraction devices etc. Whereas, restoring of the mandibular integrity is still a major challenge even for experienced surgeons due to its complex form and biomechanical functions[3]. The free iliac crest bone graft is still considered by many authors as a simple and effective method for oro-facial

reconstructions, widely used in maxillofacial surgery and dental implantology. It is associated with limited donor site morbidity, possibility to perform the shape of the bone graft in accordance with the individual jaw anatomy and favorable biomechanical characteristics of the graft. However, the cortico-spongious iliac bone grafts also demonstrate the unpredictable resorption in postoperative period, consisting up to 60 %[5].

There are challenges in free iliac bone reconstructions in mandibular continuity defects, however. The infections have been reported to occur in 15-35 %, while total graft failure is observed in 11-48 %[6-8]. The main risk factors of the graft failure are not well-studied yet and remain a controversial issue. Some studies demonstrated that the timing of surgery associated with the state of the recipient zone is a strong predictor of the immediate and long-term success of free iliac graft transfer. The study of Lawson et al.[9] demonstrated the higher risk of graft failure in immediate reconstructions, but other authors did not confirm this finding[10]. The possible explanation may be the combined influence of multiple risk factors in individual cases that require the further research to establish the exact indications for free iliac bone grafts for mandibular reconstruction and the limitations of the method in various clinical conditions.

The aim of the present study was to clarify the occurrence and causes of postoperative complications in patients with continuous mandibular defects, reconstructed with free iliac bone grafts. The specific aim was to evaluate influence of timing of reconstruction on clinical outcome. We hypothesized that timing of reconstruction is a significant predictor for graft failure.

MATERIALS AND METHODS

Data of patients with continuous mandibular defects, treated at the Department of Maxillofacial Surgery in Kyiv Regional hospital (Kyiv, Ukraine) from 2012 to 2023 years was evaluated retrospectively. All patients, who underwent mandibular reconstruction with free bone graft, were identified from the electronic medical records based on the surgical procedure code and the information on study variables was retrieved from the system.

Patients with mandibular continuity defect with bone tissue loss, resulting in a 2 cm gap or more and who underwent reconstruction with non-vascularized iliac crest bone graft, were included. Exclusion criteria were age under 18 years, decompensated or sub-compensated concomitant somatic pathologies such as diabetes mellitus, thyroid diseases, cardio-vascular pathology or systemic osteoporosis, mental illnesses, human immunodeficiency virus (HIV), active radiation or chemotherapy, non-compliance with medical recommendations and lack of interaction with a physician, incomplete clinical and tomographic documentation of the case, and the follow-up period less than 6 months. Patients requiring microvascular free flap reconstruction were also excluded.

Study variables

The outcome variable was graft failure, which was defined as its loss due to the postoperative complications, full (more than 90 %) resorption or non-union of the graft.

The primary predictor was timing of reconstruction, categorized as immediate (performed simultaneously with mandibular resection or primary wound treatment) or delayed mandibular reconstruction (more than 2 months after the appearance of the bone defect). Secondary predictor variables were length of the bone defect (grouped as 2-6 cm or more than 6 cm), preoperative presence of mucosa defect and/or dehiscence (in all cases existing clinical conditions allowed the primary closure of mucosa, so dimensions of the mucosal defects were not categorized). Another secondary predictor was the fixation method, grouped in patient specific titanium implants (PSI) manufactured with direct laser sintering method (DLSM) and conventional titanium plate fixation (prebend reconstructive plates or miniplates). Depending on a bone graft length and defect's site, at least 8 screws were placed – 3 or more were set to both sides of the mandible around the defect and at least 2 into the bone graft.

Explanatory variables were age, gender, cause of the defect, smoking, alcohol and or drug abuse, symphyseal involvement and type of the defect according to Brown et al.[11]. Thus, defects were classified in types I (lateral defects not including ipsilateral canine or condyle), Ic (lateral defects including condyle), II (hemimandibular defects including ipsilateral but not contralateral canine or condyle), IIc (hemimandibular defects including condyle), III (anterior defects including both canines), IV (extensive defects including canines and angles) and IVc (extensive defects including canines, angles and condyles). In addition, occurrence of postoperative infections was also reported. The infection was defined to occur if a patient received additional antimicrobial medication for postoperative clinical infection signs (such as pus and/or cellulitis).

Surgical procedure and follow-up

All surgeries were performed under general anesthesia via conventional extraoral approaches. Most of the surgeries were performed after appropriate computer simulation with the use of prefabricated surgical guides and/or stereolithographic models. The surgical technique included reconstruction of an existing mandibular defect with a cortico-cancellous bone autograft from the iliac crest in combination with conventional prebend reconstructive plates, miniplates or PSIs. For coverage of the bone graft in cases of existing soft tissue (skin) defects, local and regional flaps were used. All patients received antibiotic prophylaxis, which endured 5 to 7 days postoperatively. The antibiotics that were used: penicillin, cephalosporine or lincosamide groups. The postoperative computed tomography (CT) imaging was obtained within 3 days and 6 months after surgery.

Statistical analyses

Data were initially described through absolute and percentage frequencies (qualitative variables). As a background investigation, the explanatory variables were analyzed pairwise with Student's t-test, Pearson's Chi-square test or Fisher's exact test between the study groups regarding the main outcome variable. All explanatory and predictor variables were

analyzed with univariate binomial logistic regression. The statistically significant ones were selected in a multivariate model and explored for independent association with the main outcome variable. If strong correlation was found between two variables, we included only one to the multivariate analysis. All the calculations were performed in R-software version 4.2.2, with a significance level of $p < 0.05$.

The sample size calculation was based on the results of the alternative similar studies, where the mean failure rate of mandibular reconstructions with NVICG is 22 % (ranges from 30.8 to 11.5 %)[6,12,13]. Thus, if the failure incidence was considered as 22 % and the anticipated rate of the study was defined as 0 % (with no failure expectation) with the 0.01 I/II error rate at the power level of 95 %, at least 34 patients have to be engaged for adequate study power.

Ethical considerations

The study was performed in accordance with the ethical standards of the 1964 Helsinki declaration and its later amendments. The research protocol was reviewed and approved by bioethics committee of the Bohomolets National Medical University (protocol N.° 163).

RESULTS

Among 81 patients with continuous mandibular defects, who received medical care during the indicated period, a total of 50 patients fulfilled the above-mentioned criteria. The follow-up of included patients ranged from 6 months to 11 years.

The age of the patients ranged from 18 to 60 years (mean 38.5 ± 12 years). Females and males were presented in the equal parts (50 % in each group). The benign tumors (52 %) were the main cause of the defects, followed by mine-blast injuries (26 %) malignancies (10 %) and MRONJ/ORNJ (12 %). The 22 patients (44 %) underwent immediate reconstruction and in 28 cases (56 %) delayed reconstructions were performed (Table I).

The type of the defects was classified according to Brown et al.[11] and presented in the Table II with more other patient- and reconstruction-related variables. Defects spread to the frontal area of the mandibular body (between the lower canines) in 20 cases, to the distal areas (premolars, molars and the mandibular angle) in 27 cases and to the ramus in 3 patients.

The length of the defects varied from 2 to 12 cm (mean value 7.2 ± 3.59 cm). Twenty-six patients (52 %) had the defects with the length from 2 to 6 cm, in 24 patients (48 %) the defect length was more than 6 cm. The intact mucosa was present in 34 patients (68 %). All other cases were associated with defects and dehiscence caused by chronic inflammatory processes and exposure of the necrotized bone and/or perforations of mucosa caused by teeth extractions and resections of alveolar process during the surgery. In all cases of existing clinical conditions allowed the primary closure of mucosa. Defects were sutured with non-resorbable monofilament material.

For the fixation of iliac crest graft to the remaining mandibular fragments traditional prebend reconstruction plates were used in 16 cases (32 %), miniplates - in 5 patients (11 %), and in 29 cases (57 %) patient specific implants were applied.

In all, 34 patients (68 %) had successful surgery results. In 16 patients (32 %) the bone grafts were lost. All graft losses associated with postoperative infection ($p < 0.001$). Infections of six patients were treated without graft loss. All complications developed during the first 6-months of the observation period. Delayed reconstructions were remarkably associated with graft success ($p = 0.001$). In addition, smoking ($p = 0.01$) and preoperative mucosa defect or dehiscence ($p = 0.02$) were significantly associated with graft loss.

The statistical univariate logistic analysis indicated that timing of surgery, mucosal state and smoking were the strongest predictors for complications development (Table III). Multivariate logistic regression also revealed that the combination of the symphyseal involvement and immediate reconstruction enhanced the risk of the graft failure ($p < 0.05$) (Table IV), but the defect length did not increase the occurrence of graft failures.

DISCUSSION

In the present study we analyzed the frequency and causes of postoperative complications in patients with continuous mandibular defects, reconstructed with free iliac bone grafts and with special attention to the timing influence of the reconstruction on clinical outcome. Our initial hypothesis was confirmed. Furthermore, the timing of reconstructions associated with the graft success rates. The delayed reconstruction led to the graft success in 92 % of patients, whereas the corresponding rate was 48 % in the immediate reconstructions. Moreover, additional strong predictors for a graft failure were smoking and presence of the primary preoperative mucosal defects or dehiscence. Interestingly, success rates were not associated with defect size. Thus, even over 6 cm defects can be reconstructed without increased graft failure risk.

The previous studies focusing on iliac crest graft transplantations in continuous defects and complications reported the success rates from 69.2 to 88.5 %[6,12,13]. The most common complications associated with the graft failure were infection and exposure of the graft and/or fixation hardware. The success rate in our study was slightly lower (68 %), which was explained by the cause of the reconstruction and the infection occurrence. In the present study, postoperative infections were present in all graft failure cases. The high number of complications were associated with significant number of cases with mucosal defects and dehiscence, which were accompanied by excessive bacterial contamination (often with antibiotic resistant stems) especially in cases where defects resulted from mine-blast injuries and osteonecrosis were associated with bisphosphonates or irradiation of the malignant tumors. Such cases proved to be unfavorable and were associated with failure rate more than half of the patients, while in tumor resection cases the general success rate was 77.4 %. Gurrerier at al.[13] presented similar findings in mandibular reconstructions with iliac crest graft in population of war-wounded Iraqi civilians. Therefore, in cases of high-velocity war trauma and resections for osteonecrosis iliac crest graft could not be considered as the first choice for primary reconstruction. According to the literal data, the microvascular fibular flaps might be preferable in such cases[13] to secure sufficient soft tissue coverage and cover any empty space.

Table I. Associations between patient- and reconstruction-related variables and time of reconstruction.

	Immediate reconstruction		Delayed reconstruction		p-value
	n		**n**		
All	**25**		**25**		
Age (years)					0.929*
Mean	38.3		38.6		
SD	11.9		12.2		
	n	**%**	**n**	**%**	
Sex					
Male	9	36	16	64	0.047**
Female	16	64	9	36	
Smoking					
Yes	9	37.5	5	63	0.207**
No	16	44.4	20	55.6	
Heavy alcohol and/or drug use					
Yes	0	0	5	100	0.051***
No	25	44.5	20	45.5	
Etiology of defect					0.227**
Malingnant tumour	0	0	5	100	
Bening tumour	17	65.4	9	34.6	
Osteonecrosis (MRONJ/ORNJ)	1	16.7	5	83.3	
Mine-Blast injury	6	46.1	7	53.9	
Fixation method					0.233**
mlPSI	12	41.4	17	58.6	
Prebend reconstruction plate	9	56.2	7	43.8	
Miniplates and screws	4	80	1	20	
Length of defect					0.571**
2-6 cm	12	46.1	14	53.9	
More than 6 cm	13	54.2	11	45.8	
Type of the defect (Brown clas.)					0.564**
I, Ic	16	53.3	14	46.7	
I	6	54.5	5	45.5	
Ic	10	52.6	9	47.4	
II, IIc, III, IVc	9	45	11	55	
II	4	44.4	5	55.6	
IIc	2	33.3	4	66.7	
III	2	66.7	1	33.3	
IV	-		-		
IVc	1	50	1	50	
Symphyseal involvement					0.564**
Yes	9	45	11	55	
No	16	53.3	12	46.7	
Preoperative mucosa defect or dehiscence					**<0.001*****
Yes	14	87.5	2	12.5	
No	11	32.3	23	67.7	
Postop infection					**0.004****
Yes	16	72.7	6	27.3	
No	9	32.1	19	67.9	

**Independent sample t-test. **Pearson's Chi-square test. ***Fisher's exact test*

Table II. Associations between patient- and reconstruction-related variables and graft failure.

	Patiens with graft success		Patiens with graft failure		p-value
	n		**n**		
All	**34**		**16**		
Age (years)					0.571*
Mean	39.1		39.6		
SD	11.3		11.9		
	n	**%**	**n**	**%**	
Sex					0.225**
Male	15	60	10	40	
Female	19	76	6	24	
Smoking					**0.024*****
Yes	4	36.4	7	63.6	
No	30	76.9	9	23.1	
Heavy alcohol and/or drug use					
Yes	3	60	2	40	0.649***
No	31	68.6	14	31.4	
Etiology of defect					0.337**
Malingnant tumour	4	80	1	20	
Bening tumour	20	76.9	6	23.1	
Osteonecrosis (MRONJ/ORNJ)	3	50	3	50	
Mine-Blast injury	7	53.8	6	46.2	
Length of defect					0.679**
2-6 cm	17	65.4	9	34.6	
More than 6 cm	17	70.8	7	29.2	
Fixation method					0.448**
mlPSI	21	72.4	8	27.6	
Prebend reconstruction plate	9	56.2	7	43.8	
Miniplates	4	80	1	20	
Type of the defect (Brown clas.)					0.107**
I, Ic	23	76.6	7	23.4	
I	8	72.7	3	27.3	
Ic	15	78.9	4	21.1	
II, IIc, III, IVc	11	55	9	45	
II	5	55.5	4	44.5	
IIc	4	66.7	2	33.3	
III	1	33.3	2	66.7	
IV	-		-		
IVc	1	50	1	50	
Symphyseal involvement					0.107**
Yes	11	55	9	45	
No	23	76.6	7	23.4	
Preoperative mucosa defect or dehiscence					**0.011***
Yes	7	43.7	9	56.3	
No	27	79.4	7	20.6	
Postop infection					**0.002*****
Yes	7	31.8	15	68.2	
No	0	0	28	100	
Timing of reconstruction					
Immediate reconstruction	12	48	13	52	**0.001*****
Delayed reconstrion	23	92	2	8	

**Independent sample t-test. **Pearson's Chi-square test. ***Fisher's exact test*

Table III. Univariate logistic regression model predicting graft failure.

Variable	OR	95 % CI	P-value
Age (years)	1	0.95-1.06	0.795
Gender, male	2.1	0.62-7.1	0.229
Smoking	5.8	1.48-22.7	**0.002**
Heavy alcohol and/or drug use	0.69	0.06-7.2	0.755
Etiology of defect			
Malingnant tumour	0.29	0.02-3.37	0.324
Bening tumour	0.35	0.08 -1.45	0.148
Osteonecrosis (MRONJ/ORNJ)	1.17	0.17- 8.1	0.876
Mine-Blast injury		Referent	
Fixation method			
Miniplates		Referent	
PSI	1.52	0.15-15.8	0.724
Reconstructive plates	3.11	0.281-34.4	0.355
Length of defect, more than 6 cm	0.78	0.23-2.57	0.68
Type of the defect (Brown clas.), II, IIc, III, IVc	0.37	0.8-11.7	0.09
Timing of reconstruction, primary	7.94	1.88-33.5	**0.004**
Symphyseal involvement	2.69	0.79-9.12	0.113
Preoperative mucosa defect or dehiscence	8.49	2.21-32.6	**0.002**

OR = odds ratio. CI = confidence interval.

Table IV. Multivariate logistic regression model predicting graft failure.

Variable	OR	95 % CI	P-value
Timing of reconstruction, primary	13.9	2.5-77.0	**0.002**
Length of defect, more than 6 cm	0.427	0.09-1.9	0.264
Symphyseal involvement	5.63	1.14-27.8	**0.034**

OR = odds ratio. CI = confidence interval.

Iliac crest bone grafts applied for mandibular defects replacement is a well-known method that is widely used in clinical practice due to the relative simplicity of the graft harvest and the possibility to achieve a satisfactory anatomic and functional result. Iliac crest graft demonstrated the high osteoinductive potential and biomechanical advantages[5]. Their curvature is closer to the normal mandibular shape compared to fibula, rib or scapula, and they can be easily preformed in accordance with the defect's geometry. In cases where transplantation of vascularized flaps is contraindicated or associated with significant risk due to existing clinical conditions or technical limitations, the non-vascularized iliac crest grafts are considered as the method of choice. According to Akinbami et al.[4] and Moura et al.[14] reviews that the non-vascularized iliac crest grafts were used for reconstruction of the mandibular defects in 76-88 %. In the series of 784 and 926 patients correspondingly iliac crest grafting was the most commonly used method for mandibular reconstruction among non-vascularized bone grafts and the most successful method after the microvascular fibular flaps.

The location of the defect should be considered, however. The topographic anatomy of the mental area, muscles, mucosa, mobility of the symphysis region due to a permanent tongue motion and contraction of the soft tissues attached to the lower jaw might be responsible for negative consequences of reconstruction in such cases[15]. Due to the fact that Van Gemert et al.[7] recommended the usage of free non vascularized Iliac crest graft as the method of choice in lateral defects of the mandible, while in symphyseal area free fibular flaps should be considered. Besides, Guerrier et al.[13] and Handschel et al.[10] also reported on the tendency of a higher failure rate in a case of symphyseal involvement but did not demonstrate a statistical significance for this factor, neither did we in the present study. According to our findings, however, the graft failure risk is higher in dentate area mandible reconstructions and symphysis region especially, compared to the lateral parts of the mandible. In anterior reconstructions, careful patient selection and delayed surgery can be recommended to minimize the risk of graft failure.

In general, delayed reconstructions in our study were associated with significantly higher success rates ($p < 0.05$). Similar results were demonstrated by Lawson et al.[9]. Authors compared immediate and delayed mandibular reconstructions after tumor resection. The success rate for immediate surgery was

48 % *vs.* 92 % in cases with delayed repair. Authors explained this finding by postoperative infection from salivary contamination. Our findings confirm the previous findings and first-stage reconstruction cannot be recommended except for tumor surgery.

The mucosal defects and perforations were less common in delayed reconstruction cases (8 % *vs.* 56 %, $p < 0.001$). Thus, the compromised mucosal coverage of the graft and higher probability of mucosal damage in immediate reconstruction was an important cause of the infection associated graft failures. On the contrary, the success rate in cases of defects caused by benign tumor subperiosteal resections with preserved oral mucosa was 100 %, in either immediate or delayed reconstructions. Timing of intervention, which had a significant impact on success rate, probably was to a great extent associated with mucosa condition and prospective communication between oral cavity and bone graft. Gadre et al.[15] recommend in cases of mucous defects to form a double layer soft tissue coverage above a bone graft using temporalis, nasolabial, sternomastoid, platysma muscles or buccal fat pad beneath a mucosal layer to avoid bacterial contamination. Osborn et al.[6], on the contrary, consider a mucosa perforation during resection as a direct indication for delayed reconstruction after tissue healing or the usage of vascularized grafts.

It should be noticed that there are some articles that did not find any significant impact of the intraoperative perforation of mucosa and skin during mandibular reconstruction and infection or graft failure risks[16]. Additionally, it may be correlated with a low quantity of patients with mucosa inconsistency (11 cases) and absence of osteonecrosis and mine-blast trauma etiology defects in the study, which are widely presented in our work.

Maurer et al.[17] reported that the level of mechanical stability of the "plate-bone" system is an important predictor of the postoperative complications after mandibular reconstruction with Iliac crest graft. Osborn et al.[6] and Pogrel et al.[12] demonstrated the significant impact of the defect length on the complications risk. These findings are based on the fundamental biological and biomechanical patterns of the graft remodeling process. Some authors consider that the length of the defect and perimandibular soft tissue state are important predictors of the integral success rate. They advocated the use of microvascular fibular flap in cases of large mandibular defects combined with the soft tissue deficiency as more predictable. Nevertheless, we did not find a significant impact of defect's length factor on the integral treatment results in our study. Also, despite the lower graft failure rates associated with the usage of PSI (27.6 % *vs.* 38.1 % in a case of conventional titanium plate use), influence of fixators type was not statistically significant.

Smoking was the only systemic factor in our study, which significantly impacts the outcome of the free iliac bone grafting in mandibular reconstruction. The mechanism is explained by the influence of the heated fume, with toxic by-products, such as nicotine, carbon monoxide, and hydrogen cyanide. It may affect wound healing due to the arteriolar vasoconstriction and decreased blood flow[18,19].

This study has some limitations due to the comparably low number of patients that could be enrolled and its retrospective design. Patients were not randomly assigned to a type of reconstruction. Treatment procedures applied in cases of complication development or secondary reconstructions after the bone graft failure were not analyzed in this study. Prosthetic rehabilitation methods were not evaluated either. The comparative analyses of other types of bone grafts for reconstruction of continuous mandible defects in unfavorable conditions also require the further research.

In conclusion, our study emphasizes the role of preoperative planning, patent selection and optimal timing and reducing infection risk in the mandibular defect reconstructions with free iliac bone graft. Procedures in smokers and in cases with mucosal defect or dehiscence should be approached with caution, as well as reconstructions of defects for high-velocity primary injuries and osteonecrosis. Moreover, delayed reconstruction or other treatment possibilities may be preferable for such patients.

CONCLUSION

The incidence of graft failure in patients with continuous mandibular defects reconstructed with non-vascularized iliac crest graft is determined by the risk factors, associated with timing of reconstruction, smoking and presence of the mucosal defect and/or dehiscence. No significant influence on the surgical outcomes was demonstrated for the large defects (more than 6 cm in comparison to less than 6 cm). Immediate reconstructions with iliac crest graft could not be recommended also in a case of symphyseal localization of a defect due to the significant increase in graft failure rates. In these categories of patient's other treatment modalities should be considered.

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CONFLICT OF INTEREST

None.

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