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The general condition of patients requiring the alveolar bone crest reconstruction

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Abstract

Objectives: To present the survey questionnaire used for the medical assessment of patients requiring alveolar ridge reconstruction as well as the study of concomitant pathologies and their influence on the healing process.
Material and methods: The study involved 173 patients aged between 18 and 69 years. All patients have been assessed according to the survey questionnaire developed to determine the patient's general condition, life anamnesis, and medical history.
Results: Out of the total of 173 patients, 72 (41.6%) had no concomitant pathologies, 8 patients (4.6%) had concomitant pathologies that did not interfere with the operation, 40 (23.1%) had pathologies that might affect the outcome of alveolar ridge reconstruction but still were admitted to surgery, and 53 patients (30.6%) had pathologies that could affect the outcome of the reconstruction procedure and were not admitted to bone grafting.
Conclusions: Assessment of patients with alveolar ridge defects during preparation and planning of preimplantation bone reconstruction identified a number of concomitant pathologies, more or less noticed by the patient, which may remain unclear due to superficial study of the patient's condition that is able to influence the surgical treatment outcome. These issues can be both intraoperative and postoperative and lead to failure of surgical treatment and further reoperation.
Key words: alveolar ridge reconstruction, systemic conditions.

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Introduction

In our days, implant treatment of toothless is the most elected method. Chele et al. propose the immediate post extraction implant placement [1], however, in cases of alveolar ridge deficiency additional bone growth is needed. In 2016, Knofler W. et al. showed that bone growth procedures associated with dental implants are required in 58.2% of cases [2]. Postoperative healing after bone grafting is directly influenced by the general condition of the body. Thus, in addition to the thorough study of the affected area, the assessment of the patient's general condition and concomitant diseases are equally important for the rehabilitation of edentulous patients with severe mandibular atrophy.

A multitude of alveolar grafting methods are proposed in preimplantation. In literature, there are studies on guided bone regeneration, which is the most widely used method of alveolar grafting showing high efficacy [3].

Guided bone regeneration (GBR) is an extremely delicate procedure that relies on body's ability of self-healing. Therefore, patients with poor healing potential cannot undergo GBR procedures. Systemic conditions that may impede the patient to undergo surgery include a number of general medical conditions such as: uncontrolled diabetes mellitus, tumors, recent radiation of the head and neck region, acquired immunodeficiency syndrome (AIDS) or other conditions that cause immunosuppression, decompensated systemic conditions, cardio-vascular diseases, etc. [4]. Cardiovascular diseases are systemic conditions that highly affect tissue regeneration as they disrupt the nutrition and oxygenation of tissues through vascular damage. These types of diseases are extensively evaluated while preparing patients for preimplantation. Cardiovascular diseases are among the most common systemic conditions. Patients with cardiovascular diseases may develop medical conditions such as: congestive heart failure, angina pectoris, myocardial infarction, cardiac arrhythmia, heart valve prosthesis, pacemaker, hypertension, anticoagulant addiction, and post-extraction dental hemorrhage (PDH) [5].

Patients may also suffer from general diseases and conditions such as: infectious endocarditis, diabetes mellitus, osteoporosis, hormonal medication, radiotherapy, gastroesophageal reflux disease (GERD), systemic lupus erythematosus, HIV infection, smoking status, and stress. All these diseases may have a different impact on alveolar ridge reconstruction. Often, because of the focus on local diseases doctors neglect the assessment of body's general condition. A general pathology may go unnoticed if the patient does not communicate about it. All causes mentioned above, as well as superficial examination of the patient can generate poor

results and failure of clinical outcomes. Thus, it is imperative to detect concomitant pathologies and study their impact on alveolar ridge reconstruction.

This study is to assess the general medical condition of patients requiring alveolar ridge reconstruction. To study the concomitant pathologies and their influence on the healing process after bone grafting.

Material and methods

The study took place between 2016 and 2020. There were assessed 173 patients aged between 18 and 69 years and the mean age constituted 46.7±0.3 years (84 men and 89 women).

All patients have been assessed according to a survey questionnaire that was developed to determine the patient's general condition, life anamnesis, and medical history. The first part contains information about the patient's personal data. The second part is filled in by the doctor and contains information about oral hygiene, smoking status, smile line and aesthetic expectations of the patient. The third part of the survey questionnaire contains a set of questions to which the patient answers by ticking the options, if necessary; additionally it states information about the disease.

List of patient's questions:

- Do you suffer/ have you suffered from any acute or chronic diseases?
- Do you suffer/ have you suffered from: disorders of the immune system; allergies or drug/nonmedicinal intolerances; hypertension; vascular diseases; heart disease; respiratory diseases; gastrointestinal diseases; hepatobiliary diseases; kidney and/or urinary diseases; neurological diseases; mental illness; eye diseases; hematological diseases; endocrine diseases; diseases of the skeleton; diseases of the skin and mucous membranes; tumors; obstructive sleep apnea?
- Are you following any treatment (medicinal, homeopathic, phytotherapy)?
- Have you been on any treatment with: antibiotic in the last month, anticoagulants, or bisphosphonates?
- Are you having difficulty breathing?
- Do you have / have you had any vicious habits?
- Have you undergone any surgery in your lifetime?
- Have you had dental treatment before?
- Have accidents/incidents or complications occurred in previous dental treatments?
- Have you ever donated blood?
- Are you pregnant?

In the study all patients have had severe alveolar ridge atrophy requiring reconstruction and further implant-prosthetic rehabilitation. By using the survey questionnaire, the presence or absence of general pathologies was evaluated and some of the patients were accepted for bone grafting. Other patients were not engaged in bone reconstruction surgery because of concomitant pathologies occurrence associated with absolute contraindications. The selected patients were assessed according to evaluating postoperative healing parameters at 7 days, 21 days, and 6 months (implantation stage). The influence of general pathology on healing process was also taken into account. The healing parameters were: wound dehiscence, mucosal erosion, and graft exposure. These parameters have been analyzed after clinical and paraclinical aspects by using pictures. The data obtained was entered into a Microsoft Excel table and analyzed statistically using IBM SPSS Statistics 22.

Results and discussion

Out of the total 173 patients, 72 (41.6%) had no concomitant pathologies, 8 patients (4.6%) had concomitant pathologies that did not interfere with the operation, 40 (23.1%) had pathologies that could affect the outcome of alveolar ridge reconstruction but still were admitted to intervention, and 53 patients (30.6%) had pathologies that could affect the outcome of the reconstruction and were not admitted to bone grafting. 53 (100%) patients who were not admitted to bone reconstruction had the following general pathologies and vices (tab.1.): osteoporosis treated with intravenous bisphosphonates (3-5.7%), cardiopathies or angiopathies treated with oral anticoagulants (7-13.2%), compensated or decompensated diabetes mellitus (14-26.4%), long-term treatment of pemphigus with corticosteroids that decreases osteogenesis and creates immunosuppression (1-1.9%), long-term treatment of osteoarthritis with corticosteroids that decreases osteogenesis and creates immunosuppression (2-3.8%), radiotherapy performed no less than 12 months after the last cure (5-9.3%), chemotherapy performed no less than 6 months after the last cure (3-5.7%), rheumatoid arthritis treated with cytostatic (7-13.2%), hemophilia (2-3.8%), non-compliant heavy smokers (more than 10 cigarettes/day) (8-15.1%), after use of intravenous phosphate drugs (current consumption in suspension) (1-1.9%).

Table 1. Patients with general pathologies and unaccepted vices for bone reconstruction

General pathologies and vices	Patient No	Percentage
Osteoporosis treated with intravenous bisphosphonates	3	5.7%
Cardiopathies or angiopathies treated with oral anticoagulants	7	13.2%
Compensated or decompensated diabetes mellitus	14	26.4%
Long-term treatment of pemphigus with corticosteroids	1	1.9%
Long-term treatment of osteoarthritis with corticosteroids	2	3.8%
Radiotherapy /no less than 12 months after the last cure	5	9.3%
Chemotherapy /no less than 6 months after the last cure	3	5.7%
Rheumatoid arthritis treated with cytostatic	7	13.2%
Hemophilia	2	3.8%
Non-compliant heavy smokers	8	15.1%
After use of intravenous phosphate drugs	1	1.9%
Total	53 patients	100%

40 patients (100%) had pathologies and vices that could affect the outcome of alveolar ridge reconstruction but still were admitted to intervention (tab. 2). These pathologies are: hyperparathyroidism (osteoporosis) (1-2.5%), hypothyroidism (osteoporosis) (4-10%), Crohn's disease (osteoporosis caused by malabsorption of D2 and calcium in the intestine) (2-5%), gastroesophageal reflux disease (5-12.5%), compensated diabetes (18-45%), and light smokers (up to 10 cig/day) (10-25%).

Table 2. Patients with general pathologies and vices admitted to bone reconstruction

General pathologies and vices	Patient No	Percentage	Local complications	
			Wound dehiscence	Erosion of the mucosa with graft exposure
Hyperparathyroidism	1	2.5%	0 – 0%	1 – 2.5%
Hypothyroidism	4	10%	1 – 2.5%	0 – 0%
Crohn's disease	2	5%	0 – 0%	0 – 0%
Gastrointestinal reflux disease	5	12.5%	2 – 5%	1 – 2.5%
Compensated diabetes	18	45%	6 – 15%	1 – 2.5%
Light smokers	10	25%	3 – 7.5%	1 – 2.5%
Total	40	100%	12 – 30%	4 – 10%

Other 8 (100%) patients had the following concomitant pathologies that did not interfere with alveolar ridge reconstruction (tab. 3): drug allergy (3-37.5%), hepatitis B infection (2-25%), chronic bronchitis (2-25%), and renal lithiasis (1-12.5%).

Table 3. Patients with concomitant pathologies that do not interfere with bone reconstruction surgery

General pathologies	Patient No	Percentage	Local complications	
			Wound dehiscence	Erosion of the mucosa with graft exposure
Drug allergy	3 – 37.5%	37.5%	0	0
Hepatitis B	2 – 25%	25%	0	0
Chronic bronchitis	2 – 25%	25%	0	0
Renal lithiasis	1 – 12.5%	12.5%	0	0
Total	**8 patients**	**100%**	**0%**	**0%**

The majority of patients (72) admitted to surgery did not have concomitant pathologies or vices (tab. 4).

Table 4. Patients without concomitant pathologies and complications admitted to bone reconstruction

General pathologies	Patient No	Percentage	Local complications	
			Wound dehiscence	Erosion of the mucosa with graft exposure
No pathologies	72	100%	1 – 1.4%	5 – 7%

The presence of complications was studied in patients who underwent alveolar ridge reconstruction. Concomitant pathology which is influencing the outcome of alveolar ridge reconstruction can lead to high rate of exacerbations. Thus, out of 72 patients (100%), 1 patient (1.4%) had wound dehiscence and 5 patients (7%) had mucosal erosion with graft exposure. All these patients, who experienced complications were completely healthy without concomitant pathologies. Patients with general pathologies that did not influence bone reconstruction (8 patients) had no postoperative complications. 40 (100%) patients who had pathologies that could affect the outcome of alveolar ridge reconstruction showed wound dehiscence in 12 cases (30%) and erosion of the mucosa with graft exposure in 4 cases (10%).

The positive outcome of bone reconstruction surgery is closely related to bone structure characteristics. Bone tissue is a dynamic highly organized structure that can be remodeled according to mechanical stress and hormonal activity. The resorbed bone is replaced by the forming cells and the bone neoformation, which lasts approximately 3 months [6]. Another component of the positive outcome of bone reconstruction procedures is related to body condition when various intra- and postoperative complications may occur but they are not directly related to bone healing. These conditions and their management are described below [7].

Some cardiovascular pathologies are treated with anticoagulant medication. These can lead to immediate and delayed complications with harmful consequences or alveolar ridge reconstruction failure. Zanoaga O. et al. showed that dental extractions can be carried out without cancelling the administration of antithrombotic drugs [8]. Two classes of new oral anticoagulants are currently available for this purpose: thrombin inhibitors (dabigatran) and factor Xa inhibitors (rivaroxaban, apixaban, edoxaban). Unlike vitamin K inhibitors (acenocoumarol, warfarin), which block the formation of several active vitamin K-dependent factors (factors II, VII, IX and X), new oral anticoagulants block the activity of a single factor in the blood clotting cascade [8]. These new oral anticoagulants are: Dabigatran etexilate (brand name Pradaxa), Rivaroxaban (brand name Xarelto), Apixaban (brand name Eliquis), and Edoxaban (brand name Lixiana).

Cardiac pathology and increased risk of endocarditis should be considered in the oral surgical patient. Patients with valvular prostheses, history of infectious endocarditis, as well as those with cyanogenic congenital heart disease may develop infectious endocarditis, which remains a severe form of valvular dysfunction associated with poor prognosis and high mortality. In 2018, Zanoaga O. showed that dentoalveolar surgery requires prophylaxis of the infective endocarditis [9].

Glucose metabolism disease influences the tissue healing. Uncontrolled diabetes was associated with greater variability and increased rate of infectious complications in alveolar ridge reconstructions; insulin-mediated metabolic control can reverse these adverse effects [10].

The high rate of complications, such as resorption, non-

integration and delayed healing of bone graft, especially in the upper jaw, can occur in patients with osteoporosis. Generally, osteoporosis is not a contraindication for bone augmentation and placement of dental implants. Although, an increase of risk factors and complications can be expected in patients with osteoporosis [11]. A number of therapeutic approaches have been proposed to accelerate bone healing and prevent complications in bone grafting. These treatments include bisphosphonates, hormone replacement therapy (HRT), calcitonin, diet high in vitamins and calcium supplements [12]. The cornerstone of osteoporosis prevention and treatment is the provision of adequate intake of calcium, vitamin D and weight-bearing exercises. It is known that mechanical demand produces an increase of the cellular metabolism and collagen synthesis. There are studies showing that physical exercises are beneficial for preventing bone loss in postmenopausal women. Smoking is a risk factor for osteoporosis and is also associated with high rate of implant failure [13]. A combination of osteoporosis and tobacco intake leads to a high complication rate, thus, quitting smoking is imperative for a positive outcome of bone reconstruction in patients with osteoporosis. Other risk factors for osteoporosis are the use of corticosteroids and increased consumption of alcohol and caffeine. Patients with osteoporosis should be encouraged to reduce alcohol and caffeine intake before dental implant surgery or bone grafting.

Currently, it is unknown if the use of systemic bisphosphonates for the treatment of osteoporosis influences directly or indirectly the capacity of guided bone regeneration (GBR) techniques [14]. Bisphosphonates are the synthetic analogues of inorganic pyrophosphate. The most common oral drugs used in the treatment of osteoporosis are: alendronate, risedronate and ibandronate. They have been shown to reduce osteoclast activity and therefore bone resorption [15]. Recently, bisphosphonates have been associated with jaw osteonecrosis. Most cases of necrosis are, however, associated with intravenous administration of high doses of pamidronate and zoledronate, which are commonly used for bone metastases treatment in multiple myeloma and breast cancer. Treatment with oral bisphosphonates may be considered as risk factor for osteonecrosis [16].

In 2008, Radzichevici M. showed that the excess of phosphorus accumulates in tissues. Phosphorus binds with calcium and is retained in the bone in large quantities sclerosing and destroying bone vascular and nerve endings. Thus, the oral cavity appears to be "the gate of infection" that communicates with the jaw bones through the periodontium [17]. In this way the mechanism of overinfection of jaw bones can be explained. The high risk of failure or occurrence of postreconstruction osteonecrosis in patients who administer or have administered narcotic phosphorus substances emphasizes the importance of a full preoperative assessment.

Long-term administration of corticosteroids within systemic pathologies has negative impact on the body, i.e. on marginal periodontium and alveolar ridge reconstruction. Corticosteroid therapy has an adverse effect on the bone system and can induce osteoporosis [18]. Regarding the alveolar ridge reconstruction in long-term corticosteroid therapy it is reasonable to assess the risk induced by corticosteroid-induced osteoporosis [19].

After radiotherapy osteoblasts and osteoclasts decrease quantitatively and the terminal differentiation of osteoblasts is accelerated. Data published showed that mesenchymal stem cells in the bone marrow are quantitatively reduced [20]. Vascular sclerosis and fibrosis are characteristic features of radiation injury. Spontaneous bone healing is highly compromised and reduced in irradiated areas and the physiology of bone regeneration is modified as well [21]. One of the most important life-threatening adverse effect is osteoradionecrosis. Ionizing radiation limits the vascularization, increases the incidence of fibrous union, and leads to high morbidity rate. Bone grafts cannot be used when vascular system is in poor condition [22]. Therefore, alveolar ridge reconstruction should be considered from 12 months after the last course of radiotherapy.

Gastric pathologies have a great impact on the oral cavity state, as well they affect the rehabilitation after oral surgery. Gastroesophageal reflux disease GERD constitutes the risk factor for chronic marginal periodontitis; therefore, it can influence the outcome of alveolar ridge reconstruction. The most reasonable explanation is the reduction of salivary gland functioning. Mixed saliva covers all vital internal anatomical surfaces with secretions rich in mucin that provide a diffuse protective barrier against mechanical, thermal, chemical and microbial damage. Saliva also acts as an endogenous antacid agent that acts against symptomatic gastroesophageal reflux disease. Therefore, the decrease of salivary secretion leads to insufficient acid neutralization [23]. Hyposalivation in patients with GERD has been demonstrated in several studies. It was found an association between reduced salivary flow and periodontal disease among the elderly [24]. Therefore, we can conclude that hyposalivation in GERD may have an influence on the development of chronic periodontitis by allowing the proliferation of intraoral bacteria, thus increasing the risk of infection of grafts and materials used in alveolar ridge reconstructions. Therefore, dental surgeons should manage GERD in patients requiring alveolar ridge reconstruction.

In 2016, Adachi et al. showed that the degree of endoscopic atrophy of the gastric mucosa in patients with marginal periodontitis was significantly higher compared to those without periodontitis [25]. Long-term *H. pylori* infection causes not only atrophy of the gastric mucosa, but also marginal periodontitis. Therefore, it is reasonable to treat *H. pylori* before alveolar ridge reconstruction. This measure will help to control periodontopathic bacteria and prevent complications after reconstruction.

HIV-positive patients may be candidates for alveolar bone reconstruction. These immunocompromised patients may be incapable for sustained, controlled and effective immune response to exogenous trauma that constitutes a high risk for developing further postoperative complications. Thus, HIV-positive patients have a high postoperative infection rate after rehabilitation of maxillofacial trauma (11.8%

vs 4.4% HIV-negative) [26]. The hypothesis of a higher risk for HIV-infected patients after oral surgery has been presented [27]. No relationships between complications and virologic or immunological laboratory parameters were found.

A special category of patients requiring alveolar ridge reconstruction are smokers. Although, smokers may not have general pathologies that could influence the outcome of alveolar ridge reconstruction there is a risk associated with smoking consequences on tissues and structures of the oral cavity. Smoking has been associated with increased accumulation of bacterial plaque; high incidence of gingivitis and periodontitis; high rate of tooth loss and increased resorption of the alveolar bone; and poor mucogingival healing after surgery due to frequent occurrence of refractory periodontitis. Several studies have shown that smoking was a risk factor for marginal bone loss or implant failure [28]. Some authors suggest that better results can be achieved in smokers if an aggressive antimicrobial regimen is followed [29], however, the results obtained after keeping this regimen are not as favorable as those obtained in non-smokers.

Particular attention should be paid to patients aged 60 years old or over (geriatrics) while performing alveolar ridge reconstruction. Being a geriatric patient is not a contraindication for implant treatment and alveolar ridge reconstruction. Healthy elderly patients without systemic conditions can have dental implants and there is no evidence that geriatric changes of bone metabolism affect directly the osseointegration. According to Hyo-Jung Lee et al. implant therapy in geriatric patients should not be considered a risk factor [30]. It is imperative to assess the general state of the geriatric patient that is a candidate for oral reconstructive surgery and take a therapeutic decision according to obtained results.

The study allowed us to identify some steps (fig. 1) for the guidance of specialists that have to elect patients with general diseases for alveolar ridge reconstruction [29].

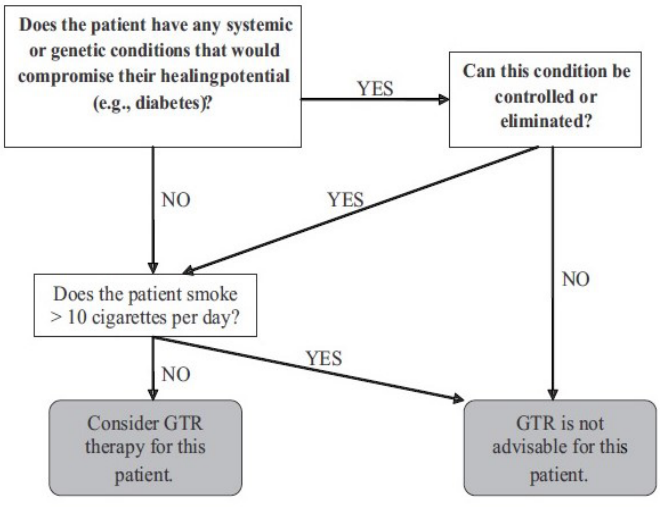

Fig. 1. Decision tree for determining whether the patient is a candidate for GBR, based on their systemic conditions [29]

The fact that 10% of all patients presented concomitant pathologies that can influence the alveolar ridge reconstruction highlights the importance of anamnesis and a thorough preoperative preparation in order to maximize the positive outcome of alveolar ridge reconstruction.

Conclusions

The study has shown the existence of: high rate of postoperative complications after alveolar ridge reconstruction in patients with concomitant pathologies, which are able to influence the healing process; low complication rate or its absence when concomitant pathologies are lacking; pathologies that cannot influence the healing process. Assessment of patients with alveolar ridge defects during preparation and planning of preimplantation bone reconstruction identified a number of concomitant pathologies, more or less noticed by the patient, which may remain unclear due to superficial study of the patient's condition that is able to influence the surgical treatment outcome. These issues can be both intraoperative and postoperative and lead to failure of surgical treatment and further reoperation.

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Author's contribution
AG conceptualized the idea, conducted literature review, wrote the manuscript, revised and finalized the text.

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The trial was the author's initiative. The author is independent and takes responsibility for the integrity of the data and accuracy of the data analysis.

Ethics approval and consent to participate
The research project was approved by the Research Ethics Committee of *Nicolae Testemitanu* State University of Medicine and Pharmacy (Protocol No 8, 31.05. 2021).

Conflict of Interests
No competing interests were disclosed.