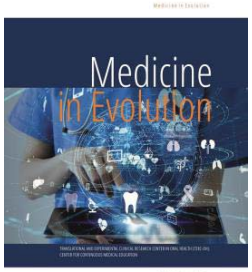
Success rates of dental implant restorations and alveolar bone reconstruction: a clinical-statistical study



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Abstract

The aim of the study was to determine the clinical and statistical success rates for implant-prosthetic rehabilitation and alveolar bone crest reconstruction in edentulous patients, evaluating the overall state of patients, identify potential risk factors during implant-prosthetic therapy, track the evolution of the patients' subsequent prognosis over time, and assess the ultimate results of implant-prosthetic treatment. The research approach was a retrospective and prospective longitudinal study, which was conducted over a period of seven years (2016-2023).

Keywords: dental implant, bone graft, prosthetic rehabilitation

INTRODUCTION

A dental implant is a crucial component in modern dentistry for replacing missing teeth, offering high success rates and improved patient outcomes. Enhancing dental implants with novel designs and materials has been the subject of research. To fix issues like peri-implant inflammation, research has suggested dental implants with separate parts made of different materials, like ceramic with zirconium dioxide added and surface treatments to make them more superhydrophilic [1]. In addition, the adoption of the augmentation procedure enhanced implantological success rates. These techniques are dependent on the specific clinical situation, such as the level of bone loss, implant site, and the patient's overall condition. Successful augmentation is crucial to the long-term stability and function of dental implants, requiring proper planning, the use of modern materials and techniques, and competent execution by the clinician [2]. Overall, dental implants have significantly transformed the field of dentistry, providing effective solutions for patients requiring tooth replacement [3]. Implants can be accepted and fused into the bone if the general condition is correctly evaluated, the peri-implant conditions are improved, the right surgical treatment is used and the right biomaterials are used. It is necessary to make a correct assessment of the general status of patients with different systemic diseases under therapeutic control. To keep post-implant complications from happening, it's important to treat diseases of the teeth and gums and get a good idea of how patients with different systemic diseases are doing overall [4]. This is because reconstructing prosthetics on implants involves a lot of invasive procedures and interventions [5]. The specialists perform dental extractions, surgical treatments to establish a suitable bone receptor bed, implant insertion and manoeuvres while the patient is under anaesthesia. The patient must be in good general condition to be able to undergo all these procedures. Therapeutic success, as well as the execution of pre-implantation and implantation procedures, depend on individual anatomical parameters, the preoperative clinical situation, grafting materials, and implant types used in relation to the initial preoperative local and loco-regional conditions [6-8].

Aim and objectives

The aim of the study was to find out what the clinical and statistical success rates for implant-prosthetic reabilitation and reconstructing missing alveolar bone crests in edentouluos patients. The specific study's objectives were to evaluate the general condition of partially (unimaxillary, bimaxillary, mixed) or fully (maxillary, mandibular, both arches) edentulous patients, identify potential risk factors during implant-prosthetic treatment, track the evolution of the patients' subsequent prognosis over time and assess the final results of implant-prosthetic treatment, while considering the number of implants and the topography of the edentulousness.

MATERIAL AND METHODS

The study included 104 patients, 56 male and 48 female, aged 30-67 years, with an average age of 51.6 years, who had 298 implants inserted. The research method used is a retrospective and prospective longitudinal study, which was conducted over a period of seven years (2016–2023) with periodic evaluations at one year, two years, three years, five years, and even more than five years. Patients were selected from the cases of the dental and oral implantology practices “Dr. Spânu Dental & Implant Clinic” in Oradea and “Dentalnet Oradea”. Patients needed prosthetic treatment of maxillary and mandibular partial edentulousness, or even bilateral maxillary edentulousness. Anamnesis, clinical, and

paraclinical examinations (orthopantomography, CBCT) were performed. Two study groups were defined from the total of 104 patients, applying inclusion and exclusion criteria. Group I comprises 55 patients with implant rehabilitation and Group II comprises 49 patients with both implant and natural teeth rehabilitation, in order to evaluate the success rate over time.

RESULTS

Out of the total 104 patients taken in the study, a total of 48 patients were female, representing a percentage of 45.65%, and a total of 56 patients were male, representing a percentage of 54.35% (Table 1). The patients were aged between 30-67 years. A total of 298 implants were inserted in these patients.

The demographic assessment showed that, taking into account the environment of origin, out of the total of 104 patients, 74 of them come from urban areas, which represents the majority percentage, with a value of 73.91%, and 30 of the patients come from rural areas, representing a percentage of 26.09% (Table 1).

Table 1. Demographic data

Patient sex	Patient number	%
M	56	54,35%
F	48	45,65%
Place of origin		
Urban	74	73,91%
Rural	30	26,09%

Among the associated pathologies, the most common was high blood pressure (hypertension), present in 62 of the patients, representing a percentage of 65.21%, followed by smoking which is present in 36 of the patients representing a percentage of 39.13%. Ischemic heart disease is found in 18 patients, representing a percentage of 17.39%. Diabetes mellitus was encountered in 20 of the patients, representing a percentage of 18.47%, followed by osteoporosis, 8 patients, representing a percentage of 8.69%. Alcohol consumption is encountered in 6 of the patients, representing a percentage of 5.43%. The least common pathology in the studied group is gastric/duodenal ulcer, present in 3 of the patients representing a percentage of 2.17% (Table 2).

Table 2. Distribution of cases by associated pathology

Associated pathology	Patient number	%
High blood pressure	62	65,21%
Ischemic heart disease	18	17,39%
Diabetes mellitus	20	18,47%
Gastric/duodenal ulcer	3	2,17%
Osteoporosis	9	8,69%
Smoking	38	39,13%
Alcohol consumption	6	5,43%

In the group of patients, an inflammatory periodontal pathological lesion was the most common cause of edentulousness (85 out of 104 patients, or 85.86%). Poor oral hygiene was the second most common cause, affecting 17 patients, or 15.21%. The least common cause of edentulousness in the studied group is oro-gingival mucosal disease, which is present in 12 of the patients, representing a percentage of 9.78% (Table 3, Figure 1).

Table 3. Percentage distribution of cases by cause of edentulousnes

Cause of edentulousness	Patient number	%
Inflammatory periodontal pathological lesions	85	85,86%
Oro-gingival mucosal lesions	12	9,78%
Poor oral hygiene	17	15,21%

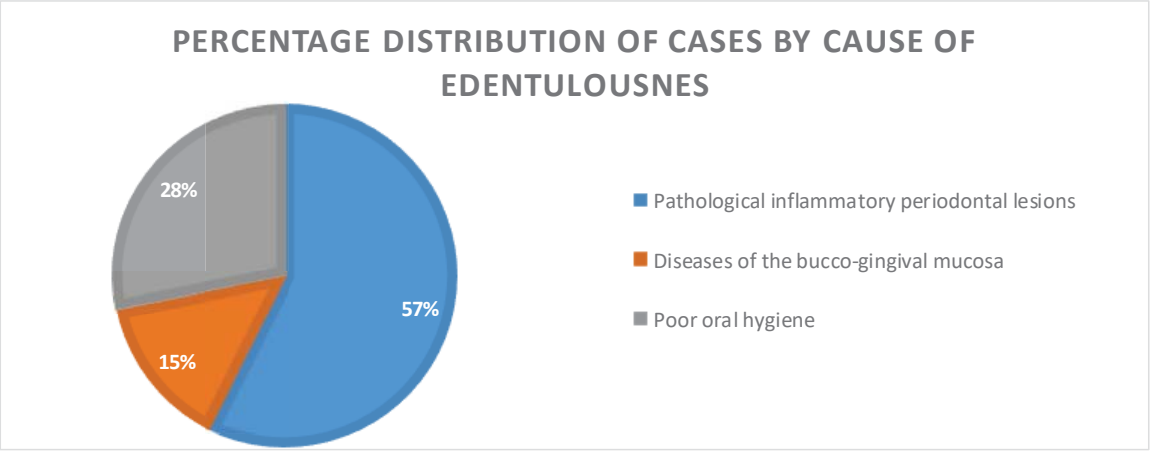

Figure 1. Percentage distribution of cases by cause of edentulousnes

In terms of edentulous topography, statistically we have the following result: in the maxilla, 31 patients have edentations, representing a percentage of 33.69%. Edentations in the maxilla can be partially unilateral in 19 of the patients, representing a percentage of 20.65%, or partially bilateral in 12 of the patients, representing a percentage of 13.04%. In the mandible, 34 of the patients have edentulousness, representing 36.95%. Edentulousness is partially unilateral in 21 patients, representing 22.82%, or partially bilateral in 13 patients, representing 14.13%. Mixed edentulousness, which includes both partial mandibular and partial maxillary defects, is present in 27 patients, accounting for a percentage of 29.34%. It is unilateral, occurring in 16 of the patients and accounting for 17.39%, or bilateral, occurring in 11 of the patients and accounting for 11.95% (Figure 2).

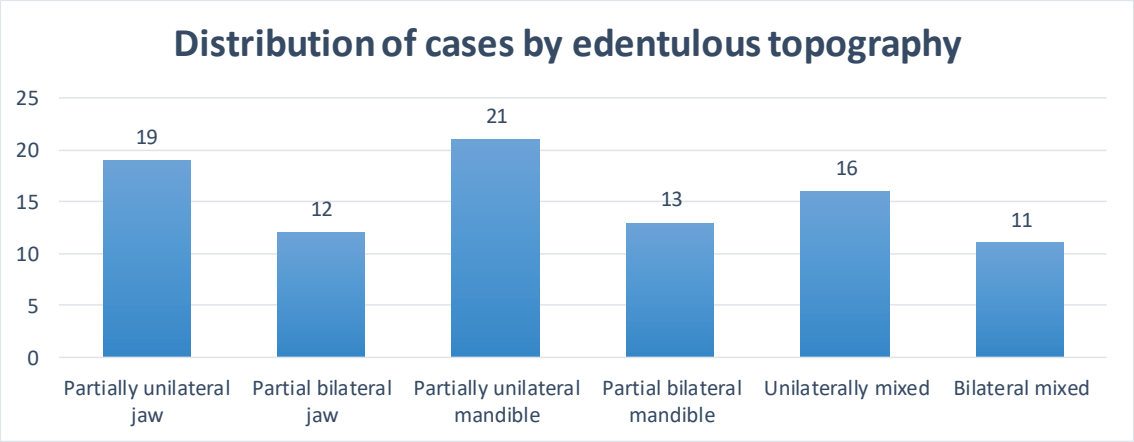

Figure 2. Distribution of cases by edentulous topography

In the 55-64 age group were inserted 34.06% or 99 implants, while in the 45-54 age group 97 implants or 32.31%. Patients aged 35–44 years accounted for 17.03% of the total, with

56 implants inserted. The lowest number of implants inserted is in patients over 65 years of age: 46 implants, representing a percentage of 16.59%, because the number of patients in this age group who went to the implantologist for oral rehabilitation on implants was much lower compared to the other age groups (Table 4, Figure 3).

Table 4. Distribution of inserted dental implants by age group in relation to total number of implants

Age group	Implant number	%
35-44 years	56	17,03%
45-54 years	97	32,31%
55-64 years	99	34,06%
>=65 years	46	16,59%

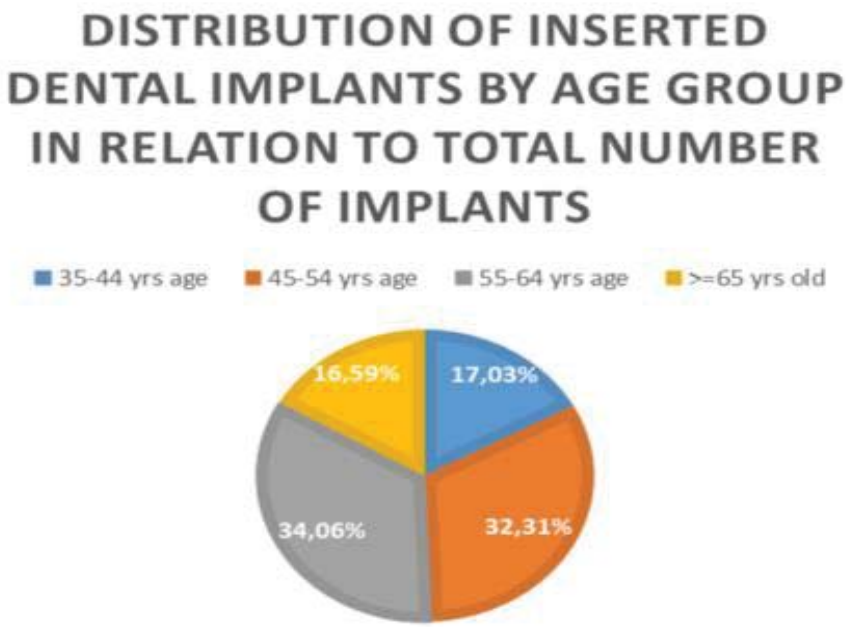

Figure 3. Distribution of inserted dental implants by age group in relation to total number of implants

The majority of patients had moderately diminished bone supply (63 of the patients represented 51.08%), followed by slightly diminished bone supply (27 of the patients representing 31.52%), and severely diminished bone supply (14 patients representing 17.39%) (Table 5, Figure 4).

Table 5. Distribution of cases according to bone supply

bone supply	Patient number	%
Slightly diminished	27	31,52%
Moderate diminished	63	51,09%
Severely diminished	14	17,39%

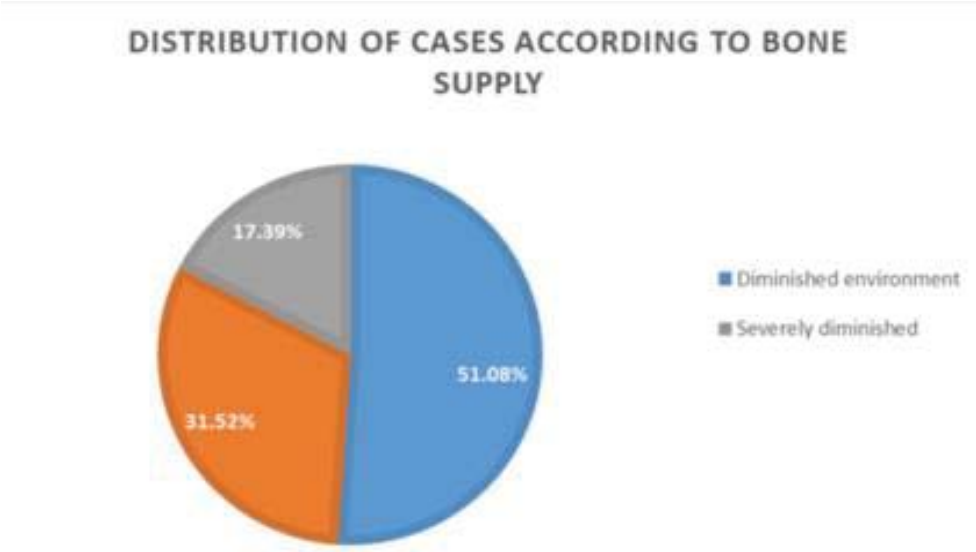

Figure 4. Distribution of cases according to bone supply

Out of the total number of 104 patients, 27 did not need bone augmentation to have their implants inserted. For a total of 29 female patients, it was performed alveolar ridge reconstruction in 14 cases using the Sinus-Lift technique (maxillary) and in 15 cases using bone augmentation (mandibular). Out of 38 male patients, 19 underwent the sinus-lift technique, and 24 underwent the bone augmentation technique. It was performed both techniques on a total of seven male patients, who required both maxillary and mandibular bone augmentation. Of the total number of patients who needed bone augmentation, 65 patients, 34 female patients, represent 45%, and 36 male patients represent 55%. Only 29.35% of patients require bone augmentation. The percentage increases to 70.65% when bone augmentation is required (Table 6).

Table 6. Distribution of cases according to the need to improve bone supply or not, by patient gender and total number of patients, expressed as a percentage

Gender	No. of cases with increased bone volume	%	No. of cases without increased bone volume	%
M	38	39,13%	14	15,21%
F	34	31,52%	13	14,14%
Total	65	70,65%	27	29,35%

Ossteointegration is particularly important in order to achieve long-lasting dental implants and to have strong bones that can withstand the prosthetic load. From the above table, we can see that in a very high percentage of cases, bone integration was achieved at 6 months, representing 69.57%, and in a much smaller number of cases, cases with extensive medical manoeuvres of reconstruction of the alveolar, maxillary, and mandibular crests, on extensive territories, bimaxillary, with complex implant-prosthetic work, and patients with various associated diseases, integration was achieved at 9 months, representing a percentage of 30.43%, at which time prosthetic loading could be achieved (Table 7).

Table 7. Case distribution by bone integration

Bone integration	Patient number	%
6 months	72	69,57%
9 months	32	30,43%

Table 8 illustrates the implant-prosthetic treatment plan, revealing that out of 104 cases, 55 underwent oral rehabilitation on implants, with 51.1% of these cases focusing solely on implant-prosthetic rehabilitation. In 49 cases, it was decided to perform implant-prosthetic rehabilitation, including both implants and abutment teeth. These have a 48.9% percentage representation (Figure 5).

Table 8. Distribution of cases by type of implant-prosthetic rehabilitation performed

Prosthetic rehabilitation type	implant-prosthetic rehabilitation	prosthetic rehabilitation implant – natural teeth abutment
Number of cases	55	49
%	51,1%	48,9%

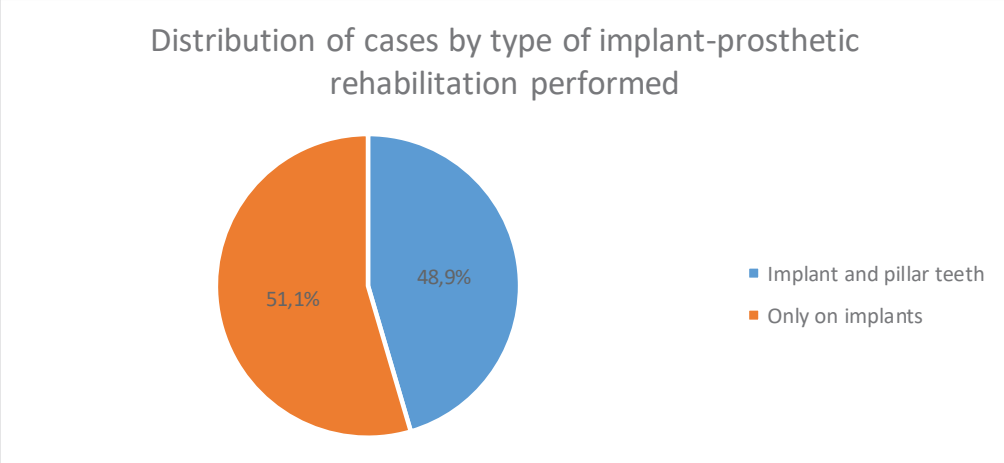

Figure 5. Distribution of cases by type of implant-prosthetic rehabilitation performed

DISCUSSIONS

Bone volume augmentation is a crucial aspect of implant dentistry to ensure successful implant placement and prosthetic outcomes. Various techniques such as Guided Bone Regeneration, sinus floor elevation, ridge splitting, autogenous block bone grafting are commonly used to address bone defects and achieve adequate bone volume for implant placement [9-12]. Advances in surgical techniques, biomaterials, and growth factors have significantly improved the predictability and success of bone augmentation procedures in recent years [13]. Overall, bone volume augmentation plays a vital role in achieving ideal prosthetic results in implant dentistry, emphasizing the importance of selecting the most suitable technique based on individual patient needs and anatomical considerations.

In this study a total of 298 implants were inserted in patients aged between 30-67 years. According to the technique of bone volume reconstruction, of the total number of 104 patients, 29% did not need bone volume augmentation. In a total of 29 female patients, alveolar ridge reconstruction was performed in 14 cases by the sinus-lift technique (maxillary) and in 15 cases by the bone augmentation technique (mandibular). In a total of 36 male patients, the sinus-lift technique was performed in 19 of them, and the bone augmentation technique was performed in 24 patients. In a total of 7 male patients, both techniques were performed, as both maxillary and mandibular bone augmentation were required. Practitioners, as part of the treatment plan, should opt for those techniques that have low peri-implant and bone graft complication rates that are beneficial to the patient [14]. In order

to be able to choose the right type of surgery to restore lost bone volume, which often has undergone only vertical resorption or both vertical and horizontal resorption, it is necessary to perform a three-dimensional analysis of the edentulous ridges using 3D CBCT images [14]. In situations where we have deficient prosthetic fields for implant insertion, surgery is required to augment the recipient bone field [15,16]. Vertical augmentation with bone grafts, with or without resorbable membranes and growth factors, as well as horizontal expansion of atrophic alveolar ridges, are the most commonly used surgical interventions in oral implantology [17]. For example, in the posterior maxillary area, in some patients, bone height is limited even when teeth are present. In conditions where teeth are lost in the posterior area, pneumatization of the maxilla results in the need for sinus elevation (122). Increasing the bone supply required for implant insertion is done by bone augmentation techniques using bone growth factors and resorbable membranes [18-21].

Out of the total of 104 patients who received implant prosthetic treatment, the number one cause of edentulism was inflammatory periodontal pathological lesions, which was found in 85 patients. The second cause of edentulousness, poor oral hygiene, was found in 17 patients. Oro-gingival mucosal diseases were found in 12 patients. All these causes can also lead to early loss of implants. In the study of Basson et all from a total of 585 individuals with implant failure the location of implants, and smoking history were significant correlates of early implant failure [22].

Today, oral implantology has evolved with outstanding medical results, both functionally and aesthetically. Patients prefer implant prosthetic rehabilitation to oral rehabilitation with mobile prosthetics. However, the decision for implant-prosthetic rehabilitation and the establishment of a treatment plan require a careful assessment of the patient's general condition, a careful evaluation of the prosthetic field, the bone supply, and the local and loco-regional status [23]. The patient assessment stage holds significant importance as it defines the clinical problem and establishes an optimal treatment plan, leading to implant-prosthetic rehabilitation that yields satisfactory results, both aesthetically and functionally, and increases the long-term success rate [24].

CONCLUSIONS

As part of the pre-implantation preparation and in order to establish a treatment plan, each patient must undergo a complete evaluation of the general condition, an evaluation of the prosthetic field, an analysis of the local and loco-regional status, an evaluation of the bone supply through imaging examinations, and a thorough clinical examination to assess the alveolar morphology. In most cases, the resorbability of the bone prevents the implant from being inserted and the implant from being rehabilitated. Pre-implant preparation includes taking care of the oral and perioral tissues. Establishing the criteria and contraindications of poor alveolar ridge reconstructions, as they significantly influence the results produced, the thickness reconstruction of alveolar ridges yields better results than the height reconstruction. The type of implant depends on the clinical status of the patient, the age of the patient, the bone supply and the dental periodontal status. Successful treatment requires that the surgical procedure is performed under aseptic conditions and that the patient is under antibiotic protection. If implants are to be inserted after bone reconstruction, this should be done after 4-6 months. The success of the surgical procedure also depends on correct wound coverage with muco-periosteal flaps, without suturing in tension, without wound dehiscence.

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