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PREVALENCE OF PERI-IMPLANT DISEASE AROUND SUBCRESTAL PLACED IMPLANTS

SUBKRESTAL OLARAK YERLEŞTİRİLEN İMPLANTLARIN PERİ-İMPLANT HASTALIK PREVALANSI

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ABSTRACT

Objective: To investigate the long-term peri-implant health of subcrestal placed implants and identify the local factors influencing it.

Material and Methods: A total of 103 patients participated in this cross-sectional study. Subcrestal placed implants (n=322) were followed up. Patients were assessed for peri-implant health status at routine visits and the results were recorded. Binary logistic regression analysis was used to investigate factors influencing the peri-implant health status.

Results: The peri-implant health of 103 patients was analysed. The mean function time was 14.05±5.95 years. In total, 47.5% of the patients were found to be healthy. 31% had peri-implant mucositis and 21.5% had peri-implantitis. When all variables were analysed, it was found that peri-implant mucositis and peri-implantitis were significantly associated with the following outcomes: additional instruments adjunct regular brushing [Odds ratio (OR):11.23]; and type of prosthesis retention [Odds ratio (OR):4.032].

Conclusion: Peri-implant mucositis and peri-implantitis occur in approximately half of subcrestal placed implants, and the use of oral hygiene instruments in addition to regular brushing and screw-retained prostheses plays an important role in implant survival.

Keywords: Peri-implant mucositis, Peri-implantitis, Prevalence

ÖZ

Amaç: Subkrestal olarak yerleştirilen implantların uzun dönemli peri-implant sağlık durumlarını incelemek ve bu duruma etki eden lokal faktörleri belirlemektir.

Gereç ve Yöntemler: Çalışmaya 103 hasta katılmıştır. Subkrestal olarak yerleştirilen 322 implant takip edilmiştir. Hastalara rutin kontrollerinde peri-implant sağlık durumu taraması yapılmış ve sonuçlar kaydedilmiştir. İkili (binary) lojistik regresyon analizi ile peri-implant sağlık durumuna etki eden lokal faktörler araştırılmıştır.

Bulgular: Ortalama fonksiyon süresi 14,05±5,95 yıl olan hastaların %47,5'i sağlıklı tespit edilirken; %31'inde peri-mukozitis ve %21,5'sında peri-implantitis gözlenmiştir. Değişkenler incelendiğinde peri-implant mukozitis ve peri-implantitisin, diş fırçalamaya ek oral hijyen enstrümanlarının kullanımı [Odds oranı (OR): 11,23]; ve Protez retansiyon tipi [Odds oranı (OR): 4,032] ile anlamlı şekilde ilişkili olduğu görülmüştür.

Sonuç: Peri-implant mukozitis ve peri-implantitis, subkrestal olarak yerleştirilen implantların yaklaşık yarısında görülür ve diş fırçalamaya ek bakım enstrümanlarının kullanımı ve vidalı protezler implantın sağkalımında önemli bir yere sahiptir.

Anahtar Kelimeler: Peri-implant mukozitis, Peri-implantitis, Prevelans

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INTRODUCTION

The number of dental implants placed has increased dramatically with the increase in human life expectancy. Naturally, this increase has led to many mechanical and biological complications. Mechanical complications (screw loosening, porcelain chipping, abutment fracture) (1) are generally problems that can be managed without additional surgeries, whereas biological complications (peri-implant mucositis & peri-implantitis) (2) are very common after implant treatment (3). They often require revision of either the prosthesis or the implant. Peri-implantitis is preceded by peri-implant mucositis and is caused by bacterial plaque accumulation (4). Exposing irregularities and roughness in the implant topography to the oral environment rapidly leads to plaque accumulation, which, together with the colonisation of pathogenic oral bacteria (5), may lead to bone destruction and even implant loss. With the accumulation of a bacterial biofilm for 3 weeks, the response of the host is disturbed and an inflammatory response develops (6). However, this condition is usually reversible with the removal of the bacterial plaque (7). Peri-implant mucositis is a reversible condition limited to soft tissue inflammation (8). If the condition is left untreated and progresses, it will develop into peri-implantitis, which is pathological (4). Due to the differences between peri-implant and periodontal tissues, peri-implantitis is similar to periodontitis, but progresses more rapidly (9) and shows inflammatory bone destruction (8), but often does not follow a linear trend. The resulting gingival pocket and intraosseous defects, combined with the complex surface topography of the implant, cause anaerobic bacteria to accumulate in the reservoir areas, further exacerbating the disease (5). In contrast to peri-implant mucositis, peri-implantitis is characterized by increased bleeding on probing and increased pocket depth (≥ 6 mm), with additional signs of inflammation such as swelling, pain on palpation and/or spontaneous pain and pus (4) and radiographic sign as marginal bone loss ≥ 3 mm in the coronal part of the implant (8). Although it has been proven that peri-implantitis is due to a bacterial aetiology, it is still a matter of controversy as to which facilitating conditions cause it. The frequency of bacterial accumulation is determined by many patient- and implant-related factors, including; history of periodontitis (10), oral hygiene, implant malpositions, type of restoration, smoking, improper fit of the prosthesis margin (11), cement residues, implant surface characteristics, and systemic diseases (12). The prevalence of peri-implant disease varies between studies and populations. However, it is estimated to occur in approximately one in five implants and half of the patients (3). A variety of surgical and non-surgical treatment modalities have been developed for peri-implantitis, but there is no consensus on the most appropriate protocol. Therefore, the early diagnosis and timely treatment of peri-implant disease by identifying its causative factors is critical to prolonging implant survival and improving overall patient satisfaction and quality of life (4).

The aim of this study was to investigate the peri-implant health status of subcrestal placed implants and to determine the influencing local factors.

MATERIAL AND METHODS

Estimation of the required sample size

In order to determine the sample size, the study carried out by Romandini et al. in 2021 was taken as a reference (13). The prevalence of peri-implantitis and peri-implant mucositis was 56.6% and 31.7%, respectively. With an alpha level of 0.05 and a power (1-ß) of 0.80, the required sample size was 98 and the critical z was 1.64 (G Power version 3.1, Düsseldorf, Germany). To compensate for possible drop-outs, an additional 10 patients were added to the final sample size.

Allocation of the patients

This study was approved by the Ethics Committee of Istanbul University Faculty of Dentistry (Date: 21.11.2023, IRB No: 2023/42) and conducted in accordance with the Declaration of Helsinki as revised in 2011. The study included patients who came to the Department of Oral Implantology Faculty of Dentistry between November 2023 and September 2024 for routine check-ups or with any complaints, who had implant/implants placed in the department and who volunteered to participate in the study. Eligible patients for the study were enrolled after a detailed clinical and radiological evaluation. The study design was explained, and consent forms were signed.

Inclusion and exclusion criteria

The following inclusion criteria were defined for patient selection;

Patients who are willing to participate in the study and who have at least one existing implant and rehabilitated with implant-supported fixed prosthesis (at least 1 year of use) / over 18 years of age / implants with platform switching / who attend routine check-ups.

The exclusion criteria were as follows;

Uncontrolled systemic diseases that may affect the success of implant treatment (HbA1c>7, osteoporosis)/Patients taking medications that may delay bone turnover or wound healing (bisphosphonates, steroids)/ Smokers (>10 cigarettes per day)/ Patients requiring implant removal who have lost more than half of their bone support/Patients with implant-supported removable dentures.

Study variables

The following variables were analysed;

oral hygiene habits of patients (toothbrush, dental floss, interdental brush, water jet), type of prosthesis retention (screw retained-cemented), implant diameter (narrow-standard-wide), prosthesis cleanability (yes-no), history of periodontitis (yes-no), bridge or crown, number of implants, and prosthesis function time (years).

Study Design and Case Definition

The archive records of 103 patients and the measurements taken during the radiological examination were recorded. Gentle probing was performed to examine the peri-implant tissue he-

alth during clinical examinations (4). Probing depth, bleeding on probing, and pus and crestal bone changes were compared with previous examination findings obtained from patient records. Panoramic and periapical radiographs were taken to accurately detect changes in the marginal bone levels and peri-implant health. Peri-implant mucositis and peri-implantitis status were defined according to the study by Berglundh et al in 2018 (8).

Peri-implant mucositis: According to previous examinations; presence of increased bleeding on probing (with or without the presence of pus) without radiographic evidence of bone loss. The pocket depth may be increased.

Peri-implantitis: According to previous examinations; radiographic bone loss with bleeding on probing (with or without the presence of pus) and increased pocket depth.

Statistical Analysis

The normality of the distribution of the data was assessed using Kolmogorov–Smirnov. The chi-square test and Mann Whitney-U t-test were used to assess the similarity of the baseline variables between the groups. The effect of the variables was measured by binary logistic regression analysis. All variables were included in the regression model and a significant model was created by the backwards elimination method with Wald statistics. The fit and efficiency of the built model were assessed using the Hosmer-Lemeshow test and Nagelkerke R^2 test, respectively. Odds ratios (OR) and parameter estimates (β) were calculated for all the variables in the model that was built. $P<0.05$ was considered as statistically significant. All statistical analyses were performed using SPSS® (version 29.0.20.0) for Mac (IBM Corporation, Armonk, NY, USA, 2024) and were written according to the statistical guidelines of Altman et al. (14) The Strengthening Reporting of Observational Studies in Epidemiology Checklist (STROBE) was employed for the preparation of this manuscript.

RESULTS

In this study, 165 patients were screened between November 2023 and September 2024. 22 patients were heavy smokers (>10 cigarettes per day) and excluded. 12 patients with uncontrolled systemic disease, 12 patients requiring implant removal and 9 patients with implant-supported removable dentures were also excluded from the study. A total of 110 patients were evaluated clinically and radiographically. Clinical parameters were assessed around the implants with a periodontal probe (PCP-UNC 15, Hu-Friedy®, Chicago, USA). PD (Probing depth), BOP (Bleeding on probing), and pus and crestal bone changes were recorded, and patients were classified as healthy or peri-implant mucositis/peri-implantitis according to the peri-implant health criteria of Berglundh et al. (8), (Figure 1-5). 7 patients were excluded because their records were not accessible in the archive. Finally, 103 patients (48 females, 55 males) with 322 implants with platform switching were analysed. The majority of the implants (67%) had an internal conical connection. The remaining implants had an internal hexagonal connection.

Figure 1: Clinical and radiological views of a healthy person after 5 years of function

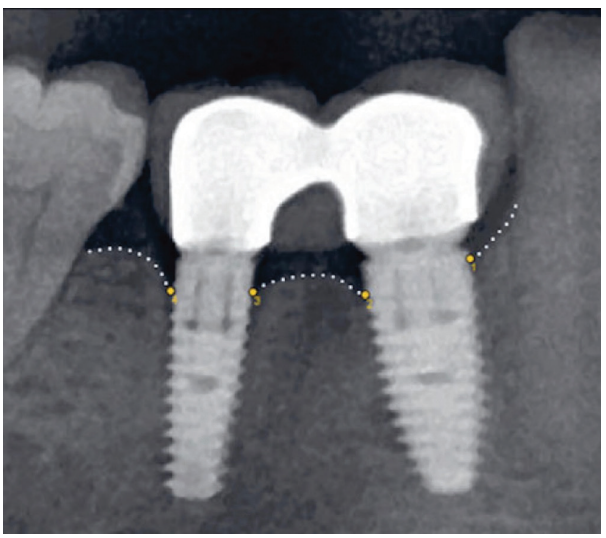

Figure 2: Panoramic radiographs were taken to monitor the progression of marginal bone loss

All implants exhibited a tapered apex, microgrooves in the neck area, and a rough collar with variable degrees of platform shifting. The distribution of implants according to the commercial manufacturers is listed in Table 1. The mean age of the study population was 53.64±11.16 years. Implants were considered healthy in 49 patients, whereas 54 patients had evidence of peri-implant mucositis or peri-implantitis in at least one implant. Peri-implant mucositis and peri-implantitis were found in 31% and 21.5% of patients, respectively (Table 2). The mean

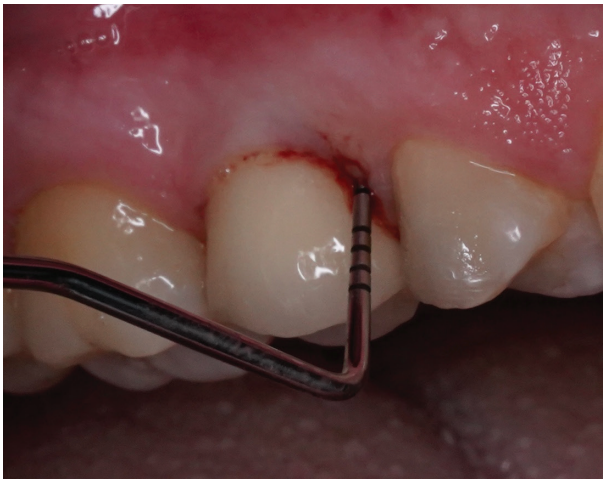

Figure 3: Peri-implant mucositis diagnosed by bleeding on probing after 2 years of function

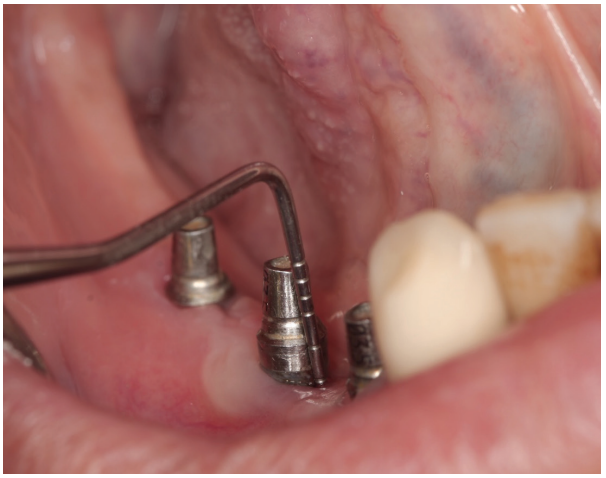

Figure 4: Clinical view and probing of an implant in region #45-46 after removal of the prosthesis

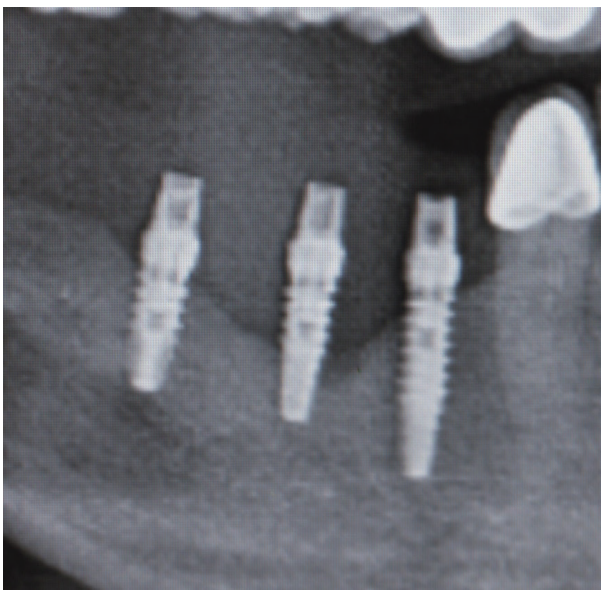

Figure 5: Radiographic examination indicated peri-implantitis

Table 1: Commercial manufacturers of implants

	N	Abutment connection	Degree of the conical connection
Biomet 3i	56	Internal hexagon	
Straumann BL	43	Internal conical	15°
Nobel (Parallel)	38	Internal conical	<12°
Mis (C1)	61	Internal conical	12°
Nucleoss (T6)	50	Internal hexagon	
Camlog (Conelog)	74	Internal conical	7.5°
Total	322		

Biomet 3i; Florida,USA; Straumann® (Straumann BL), Basel, Switzerland; Nobel®, Götheburg,Sweden; Mis (C1), Shlomi,Israel; Nucleoss®, İzmir, Turkey; Camlog (Conelog),Stuttgart,Germany

Table 2: Distribution of healthy and patients

	n (%)
Healthy	49 (47.5%)
Peri-implant mucositis	32 (31%)
Peri-implantitis	22 (21.5%)

n=number of patients

Table 3: Distribution of the patient cohort according to the variables

Physician-related factors	Healthy (n=49)	Diseased (n=54)	p
The type of Retention			0.39
Cement-retained	9 (19%)	6 (11%)	
Screw-retained	39 (81%)	48 (89%)	
İmplant Diameter			0.40
Narrow	20 (43%)	19 (36%)	
Standard	23 (49%)	32 (60%)	
Wide	4 (8%)	2 (4%)	
Prosthesis Cleanability			0.20
Yes	34 (71%)	45 (83%)	
No	14 (29%)	9 (17%)	
Patient-related factors			
History of Periodontitis			0.89
Yes	18 (38%)	22 (41%)	
No	30 (62%)	32 (59 %)	
Need for Implants for			0.23
Crown	7 (19%)	14 (33%)	
Bridge	30 (81%)	28 (67%)	
Additional Instruments Adjoining Regular Brushing			**<0.001****
Yes	41 (85%)	25 (46%)	
No	7 (15%)	29 (54%)	
Number of Implants[z] *(Mean)*	3.48±1.53	3.13±1.85	0.154
Function Time[z] *(Mean)*	13.46± 6.25	14.57± 5.67	0.340

***p<0.05, **p<0.01 χ2: Chi-square test (Categoric data), z: Mann-Whitney U t-test**
n = Number of patients

duration of function of the evaluated implants was 14.05±5.95 years (range 1- 24 years). The mean number of implants was 3.29±1.71. The distribution of the patient cohort according to the variables is listed in Table 3. Almost all of the participants brush their teeth at least once a day, while 35% used dental floss, 17% used an interdental brush, and 29% used a water jet as an adjunct. 64% of patients use additional instruments in addition to regular brushing (Table 4).

Table 4: Frequency of Using Oral Hygiene Instruments

Patient	Toothbrush	Dental floss	İnterdental brush	Water-jet	Additional instruments adjunct regular brushing
N (%)	102 (%99)	36 (%35)	17 (%17)	30 (%29)	**66 (%64)**

n = Number of patients

Table 5: Predictors in the Regression Model for Disease (Peri-implant mucositis&Peri-implantitis)

Variable	Explanation	β (Estimate)	Standard error	Wald	p	Odds Ratio
Function Time	Continuous	0.071	0.041	2.955	0.086	1.073
Additional Instruments Adjoining Regular Brushing	None	2.416	0.583	17.152	**<0.001****	11.23
The type of Prosthesis Retention	Cement-retained	1.395	0.699	3.979	**<0.046***	4.032

Peri-implant mucositis-peri-implantitis; 0=Healthy, 1=Disease
Hosmer and Lemeshow test p = 0.58
*p<0.05 **p<0.01; Nagelkerke's R^2= 0.316

A total of 8 variables were included in the regression analysis, but only 3 variables were used to form a meaningful model (p=0.58; Hosmer and Lemeshow test). In the model, the use of additional instruments adjunct regular brushing (OR:11.23 p<.001) and the type of prosthesis retention (OR:4.032 p=.046) were statistically significant for the odds of peri-implant mucositis and peri-implantitis. 31% of the variance in the dependent variables could be explained by the model (Table 5).

DISCUSSION

This cross-sectional study analysed 322 implants in 103 patients. A comprehensive set of variables including peri-implant mucositis and peri-implantitis was evaluated to define long-term peri-implant health. The prevalence of peri-implant disease at the patient level was found in %52 in this study, which was followed up for 14.05±5.95 years. Derks et al. found similar results (%45) in their study, which was followed up for 9 years (15). Ferreira et al. found a higher rate (73.5 %) of peri-implant disease in non-smoking patients (16). Obreja et al. found an increased rate of peri-implant disease (81.5%) in smokers and non-smokers who were followed up for 9 years (10). However, there is no clear evidence of a negative effect of heavy smoking on peri-implant disease in recent studies (17). Thus, smoking was not assessed in the study and heavy smokers (more than 10 cigarettes per day) were not excluded.

It can be hypothesised that the prevalence of peri-implantitis increases with longer function time. However, no statistically significant difference was found in the study regarding implant function time, which corresponds to the literature as well (18). Differing diagnostic criteria, rather than function time, cause

the prevalence of peri-implant mucositis and peri-implantitis to vary between studies (19). In many studies, the inflammation cut-off and the probing depth threshold are different (13). For example, Krebs et al. diagnosed peri-implantitis in 29.6% of patients with PD ≥ 4 mm with BOP, while this rate decreased to 15% when the bone loss threshold was used as ≥1.5 mm (20). Moreover; probing depth, which is the main parameter defining disease (2), cannot be measured objectively, mainly due to the threads of the implant. In addition, retrospective studies usually do not include data on initial bone loss (radiographic status several weeks after abutment placement), which is a limiting factor in defining peri-implantitis (19). There is a consensus on the need for long-term and regular clinical and radiographic evaluation of peri-implant tissues. Therefore, the threshold in this study was based on the initial peri-implant health status to track disease progression (8). This definition is supported by several recent studies (10).

Although there appears to be no debate in the literature about the negative impact of poor periodontal health on implant success, it is known that supportive care and maintenance therapy can improve the success rate of dental implants even in patients with a history of periodontal disease (21) unless there is a history of aggressive periodontitis (22). The main objective of supportive care and maintenance therapy in dental implantology is to maintain a healthy peri-implant mucosa and thus prevent the development of peri-implantitis. In cases where plaque-induced peri-implant mucositis has occurred, a well-designed therapy adjunct to oral hygiene motivation can help to restore the mucosa to a healthy state and prevent the development of peri-implantitis (23) In our department, patients are instructed on how to maintain good oral hygiene after each implant-supported rehabilitation, and follow-up appointments are scheduled at 6-month intervals and, if necessary, maintenance therapy will be given. Considering that 64% of the patients in this study used oral hygiene instruments in addition to regular brushing, the impact of oral hygiene motivation adjunct to maintenance therapy is undeniable. Many studies have linked poor oral hygiene to peri-implantitis (24). The results in the present study are also consistent with the literature, considering that the non-use of oral hygiene instruments adjunct regular brushing increased the odds of peri-implantitis (OR: 11.23). Similarly, Romandini et al. found the non-use of interdental flossing as an indicator of poor oral hygiene and peri-implantitis (13). Furthermore, Monje et al. found that the interval frequency of maintenance therapy was significant for both peri-implant mucositis and peri-implantitis (25).

All of the implants in the study were placed one to 3 mm subcrestal. The subcrestal placement of an implant is essential for long-term success. In a study conducted by Agrali and colleagues, it was observed that only 20% of implants (placed subcrestally) demonstrated marginal bone loss exceeding 2 mm (26). However, it causes more pronounced bone remodelling (27) and this may play a facilitating role in the development of peri-implant inflammation. For implants with crown margins ≤ 1.5 mm from the crestal bone, studies have shown higher odds ratios for peri-implantitis (15). Because subcrestal placement may reduce the accessibility of the prosthesis for cleaning and oral hygiene, some studies have defined subcrestal placement as a modifying factor of plaque control and peri-implantitis (28). Particularly with cement-retained prostheses, inadequate cleaning of the cement residue from the deep pocket epithelium, due to subcrestal placement, can lead to increased inflammation and peri-implant disease (29). The present results also show that the type of prosthesis retention (cement retained) is a strong predictor of peri-implantitis (OR:4.03). These findings are supported by many studies in the literature (30). On the contrary, Bayer et al. concluded that screw-retained prostheses may make little or no difference in the risk of peri-implantitis, but the evidence was considered low in this systematic review (31).

The main limitations of this study were the lack of randomization, as the study was conducted in a single university clinic. In addition, the presence of more than one brand of implant affects the generalizability. Another issue that needs to be considered is that the use of oral hygiene instruments affects plaque control, which was not investigated in the study. Although the aetiologies are the same, it is important to analyse peri-implant mucositis and peri-implantitis separately to identify the causative factors.

CONCLUSION

Within the limits of the study, peri-implant mucositis and peri-implantitis occurred in approximately half of subcrestal placed implants, and the use of oral hygiene instruments, in addition to regular brushing and screw-retained prostheses, played an important role in implant survival.

Ethics Committee Approval: This study was approved by İstanbul University Faculty of Dentistry (Date: 21.11.2023, IRB No: 2023/42).

Peer Review: Externally peer-reviewed.

Author Contributions: Conception/Design of Study- A.S., V.A.; Data Acquisition- A.S., V.A.; Data Analysis/Interpretation- A.S., V.A.; Drafting Manuscript- A.S., V.A.; Critical Revision of Manuscript- A.S., V.A.; Final Approval and Accountability- A.S., V.A.; Material and Technical Support- A.S., V.A.; Supervision- A.S., V.A.

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