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Article

Structure of Complications and Risk Factors in Various Methods of Orthopedic Rehabilitation for Edentulism

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Abstract: A comprehensive assessment of the long-term outcomes and safety of orthopedic rehabilitation methods requires a detailed analysis of the resulting complications and a systematization of the factors predisposing their development. Identifying correlations between the applied treatment technology, the patient's premorbid background, and the frequency of adverse events makes it possible to develop risk prediction algorithms and optimize clinical protocols. The article presents the results of a systematic analysis of intra- and postoperative complications recorded during prospective observation. All cases of complications were recorded on standardized individual observation charts from the time of surgery until the completion of a 12-month monitoring period. Complications were classified according to their clinical form, localization, time of onset, and severity using the modified Clavien-Dindo scale.

Keywords: secondary edentulism; partial edentulism; complete edentulism; clinical and anamnestic characteristics; radiological diagnostics; dental implantation; subperiosteal implants; alveolar process deficiency; orthopedic dentistry.

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1. Introduction

Secondary edentulism remains one of the most common pathologies of the dentoalveolar system and is accompanied by significant functional, aesthetic, and psycho-emotional impairments. Modern orthopedic dentistry has a wide range of rehabilitation methods for patients with partial and complete tooth loss, from traditional removable prostheses to various types of dental implantation. The choice of treatment strategy is largely determined by the patient's clinical status, the volume and quality of bone tissue, the location of the defect, as well as anamnestic and demographic characteristics[1,2].

Despite the active implementation of implant technologies, including custom subperiosteal frameworks, there remains a need in clinical practice for a systematic description of the patient population with secondary edentulism, the structure of dental arch defects, and the features of the diagnostic and therapeutic approaches used.

Study Objective. To evaluate the frequency, structure, and severity of intra- and postoperative complications associated with various orthopedic rehabilitation methods, and to identify independent risk factors for their development based on a prospective 12-month follow-up, in order to substantiate a personalized choice of treatment method and optimize clinical protocols[3,4,5].

2. Materials and Methods

As part of this study, a comprehensive examination was conducted on 147 patients aged 20 to 65 years with complete and partial secondary edentulism of various localizations, who had no significant somatic pathology. The cohort included 80 men and 67 women.

The clinical portion of the study was conducted at the "EURO-DENTAL" private dental clinic in Urgench, Khorezm Region.

All clinical and instrumental data were subjected to statistical processing for quantitative analysis and to validate the reliability of the results obtained.

Results. During a prospective 12-month follow-up of 167 patients who underwent orthopedic rehabilitation using various methods, the overall incidence of at least one complication was found to be 30.6%. Most adverse events were recorded in the early postoperative period (61.7%), whereas the proportion of late complications reached 38.3%. Intraoperative complications were rare (0.1%) and predominantly mild in nature.

3. Results and Discussion

During the prospective 12-month observation of 167 patients who underwent orthopedic rehabilitation using various methods, it was established that the total frequency of at least one complication was 30.6%. Most adverse events were recorded in the early postoperative period (61.7%), while the share of late complications reached 38.3%. Intraoperative complications occurred rarely (0.1%) and were predominantly mild in nature.

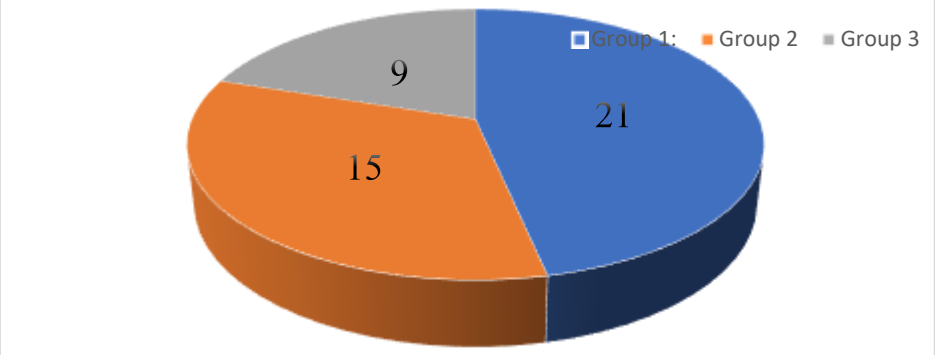

Figure 1. Total frequency of complications

The overall frequency of at least one complication was 30.6% (45 out of 167 patients). The distribution by groups and types of complications is detailed in Table 1.

Table 1

Type and degree of complication	**Group 1 (n=47) Abs. (%)**	**Group 2 (n=48) Abs. (%)**	**Group 3 (n=52) Abs. (%)**
Total complications	29	24	13
Intraoperative (I-III stage)	0 (0)	4 (8.3)	3 (5.8)
Mucosal perforation (I)	–	2 (4.2)	1 (1.9)
Seam failure (I)	–	2 (4.2)	2 (3.8)
Early postoperative	12 (25.5)	9 (18.8)	6 (11.5)
Local inflammatory reaction (I-II)	5 (10.6)	4 (8.3)	3 (5.8)
Alveolitis / impaired healing (II)	–	3 (6.3)	2 (3.8)
Fussination of hematoma (II)	–	2 (4.2)	1 (1.9)

Prolapse under the base of the prosthesis (II)	7 (14.9)	–	–
Late (functional)	17 (36.2)	11 (22.9)	4 (7.7)
Recurrent mucositis (II)	3 (6.4)	5 (10.4)	2 (3.8)
Periimplantitis (III-IV)	–	5 (10.4)	2 (3.8)*
IV implant rejection	–	2 (4.2)	0 (0)
Bone tissue resorption >1.5 mm (II-IV)	8 (17.0)	–	–
Necessity of prosthesis replacement (III)	6 (12.8)	–	–
Number of patients with ≥1 complication	21 (44.7%)	15 (31.3%)	9 (17.3%)
Total complication rate per 100 patients	61.7	50.0	25.0

Note: - the difference between Group 2 and Group 3 is statistically significant ($p < 0.05$).

The analysis results presented in the table indicate pronounced differences in the frequency and severity of complications between the three main clinical groups.

The overall complication rate in Group 1 (patients with traditional removable dentures) was 61.7 cases per 100 patients, which is significantly higher than in Group 2 (50.0) and especially in Group 3 (25.0)[6,7,8,9].

Late functional complications, including recurrent mucositis, peri-implantitis, and the need for prosthetic correction, were most frequently encountered, especially in groups 1 and 2.

In Group 3, where custom-made subperiostal titanium implants were used, the overall frequency of complications was 2.5 times lower than in Group 1 and was accompanied by the absence of severe Grade IV complications (e.g., implant rejection)[10,11].

Intraoperative complications were noted only in the 2nd and 3rd groups and did not require additional surgical intervention. Their frequency did not exceed 8.3%, primarily due to mucosal perforations and grade I suture failure.

Figure 2. Gematoma suppuration

Early postoperative complications in Group 1 included ulcers under the base of the prosthesis (14.9%) and local inflammatory reactions (10.6%), which were associated with the lack of even distribution of chewing load and the presence of mobility in the prostheses.

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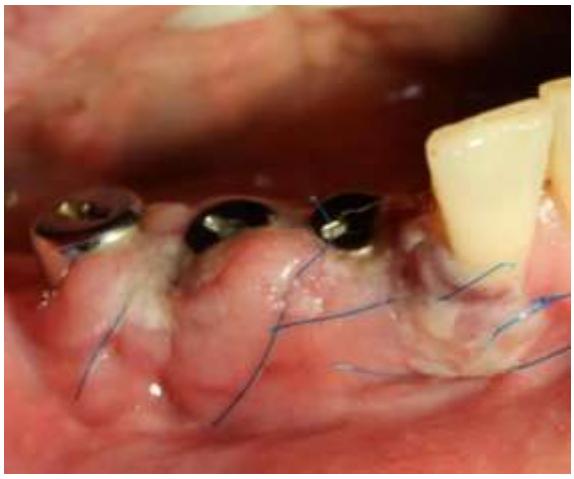

Figure 3. Local inflammatory reaction

Furthermore, a multifactorial analysis of complications established that the use of individualized subperiostal implants is an independent factor in reducing the risk of complications (OR = 0.34; 95% CI: 0.16–0.71; p = 0.004)[12].

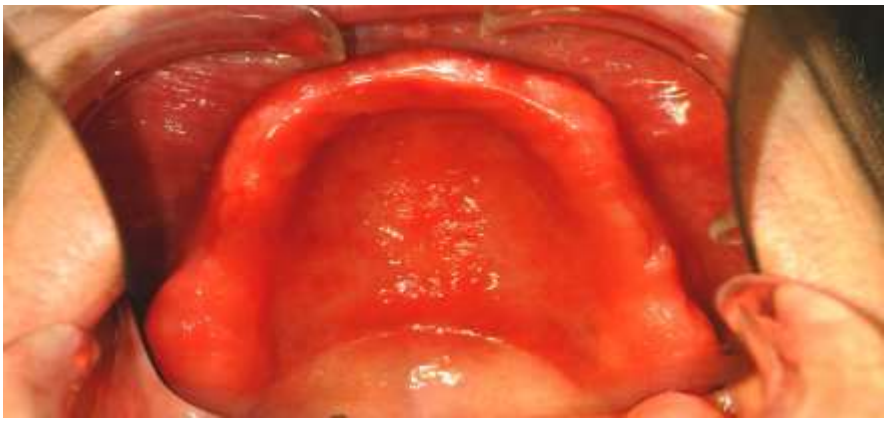

Fig. 4. Prolapse under the base of a prosthesis[13]

Data analysis demonstrates a clear gradation of risk depending on the treatment method. Group 1 (removable prostheses) leads in the number of late functional complications (36.2%), primarily related to bone atrophy and mucosal trauma. Group 2 (intraosseous implants) is characterized by specific risks associated with the surgical stage and inflammatory processes (periimlantitis – 10.4%, rejection – 4.2%). Group 3 (subperiostal implants) shows the best results: the total number of patients with complications here was 2.6 times lower than in Group 1 (17.3% versus 44.7%, p<0.01), and the total complication rate per 100 patients was minimal (25.0).

Figure 5. Recurrent mucositis[14]

To quantitatively assess the contribution of various variables to the risk of developing NIA, a multi-factor logistic regression analysis was conducted. The model included factors significant at the p<0.1 level based on the results of the single-factor analysis. The results are presented in Table 2.

Table 2

Multifactorial analysis of risk factors for complications

Risk factor	Category	**β-coefficient**	**Standard error**	**Adjusted odds ratio**	**95% CI for aOR**	**p-value**
Treatment method	Group 1 (Ref. Group 3)	1.92	0.41	6.82	3.05 – 15.25	<0.001
	Group 2 (Ref. Group 3)	1.15	0.38	3.16	1.50 – 6.65	<0.01
Smoking	>10 sigs/day	1.88	0.45	6.55	2.72 – 15.78	<0.001
Type 2 Diabetes Mellitus	HbA1c > 7.5%	1.72	0.50	5.58	2.10 – 14.85	<0.01
Original MPK	<450 HU	1.41	0.39	4.10	1.91 – 8.80	<0.001
Periodontological history	Heavy*	0.97	0.36	2.64	1.30 – 5.35	<0.05
Age	>70 years	0.51	0.33	1.67	0.87 – 3.19	0.122
Floor	Male	0.32	0.31	1.38	0.75 – 2.54	0.301

Note: - severe periodontitis in the anamnesis (stage III-IV according to the 2017 classification). Ref. – reference (basic) category for comparison.

The analysis identified four independent and statistically significant predictors of complications:

1. Treatment method. Patients treated with traditional removable dentures (Group 1) had a 6.82-fold higher risk of complications compared to patients receiving individual subperiostal implants (Group 3) (aOR = 6.82; 95% CI: 3.05-15.25; p < 0.001). For patients in Group 2 (intraosseous implants after bone grafting), the risk of complications was also significantly higher than in Group 3—3.16 times (p < 0.01). The data indicate a statistically

significant reduction in the risk of complications when using individualized subperiostal structures[15,16].

2. Active smoking of more than 10 cigarettes per day is associated with a 6.55-fold increase in the likelihood of complications ($p < 0.001$), making it one of the strongest risk predictors. Smoking disrupts osteointegration processes, worsens microcirculation in the intervention area, and reduces immune response.

3. Somatic and radiological predictors. Type 2 diabetes mellitus (HbA1c > 7.5%) increased the risk of complications by nearly 5.6 times (aOR = 5.58; 95% CI: 2.10–14.85; $p < 0.01$), which is explained by the disruption of regenerative processes and susceptibility to infection. Patients with an initial bone mineral density (BMD) of less than 450 HU according to CLCT data showed a 4-fold increase in risk ($p < 0.001$), confirming the critical importance of assessing bone tissue quality when choosing a treatment method.

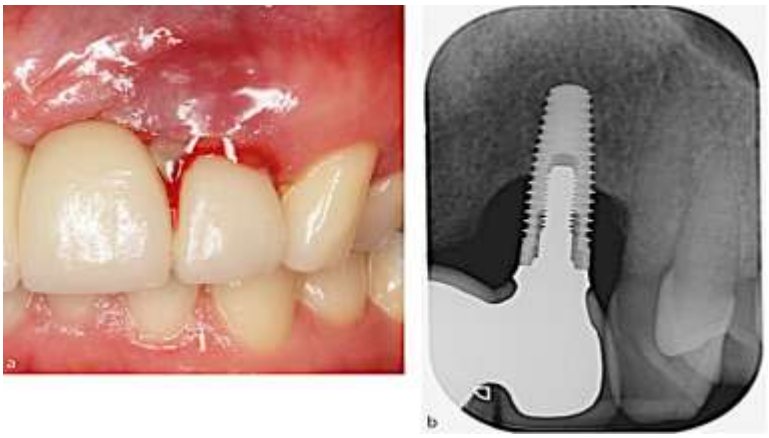

Figure 6. Resorption of bone tissue

4. Periodontal history and other variables. A complicated periodontal history (multiple tooth loss, severe forms of periodontitis) proved to be a statistically significant predictor of complications (aOR = 2.64; $p < 0.05$). Age >70 years and male gender did not reach the level of statistical significance ($p > 0.05$), but in combination with other factors, they may increase individual risk[17].

For clarity, a stratified analysis of implant rejection frequency and pronounced bone resorption (>2 mm) was conducted in patients with a severe medical history (n=41). The results confirmed the stability of Group 3 results (Table 3).

Table 3

Frequency of severe complications (Grade IV) in high-risk patients (n=41)

Complication / Group	**Group 2 (n=19)**	**Group 3 (n=22)**	**p-value**
Implant rejection	4 (21.1%)	0 (0%)	<0.05
Severe bone resorption (>2 mm)	–	1 (4.5%)	–
Re-operation Necessity	5 (26.3%)	1 (4.5%)	<0.05

Note: - Patients with ≥2 risk factors (smoking, diabetes mellitus, low BMI) were included in the analysis. - In Group 2, all implants were installed with simultaneous augmentation, so isolated resorption was not evaluated.

In this high-risk subgroup, the advantage of CAD/CAM technology became even more pronounced: in Group 2, every fifth implant was lost, and every fourth patient required re-intervention. In Group 3, no cases of rejection were recorded, and the frequency of repeat operations was minimal (4.5%).

4. Conclusion

The conducted systemic analysis convincingly demonstrates that the frequency, structure, and severity of orthopedic rehabilitation complications depend directly on both the chosen treatment method and the patient's individual somatic and dental status. During the 12-month observation, a clear risk gradation was identified: traditional removable prostheses were characterized by the highest prevalence of late functional complications, while intraosseous implants following bone grafting were accompanied by specific surgical and inflammatory risks, including periimplantitis and rejection.

The most favorable clinical results were demonstrated in the group of individualized subperiostal implants, where the overall frequency of complications was minimal, there were no severe IV-degree complications, and the risk of adverse outcomes decreased more than three times compared to alternative methods. Multifactorial analysis confirmed that the use of CAD/CAM-prepared subperiostal structures is an independent protective factor, even in high-risk patients.

The key predictors for the development of complications remain active smoking, decompensated type 2 diabetes mellitus, low bone mineral density, and a complicated periodontal history, while age and gender did not demonstrate independent statistically significant influence. The obtained data emphasize the need for a personalized choice of orthopedic rehabilitation method with a mandatory assessment of risk factors and confirm the clinical feasibility of using individualized subperiostal implants as an effective and safe alternative in complex and compromised clinical situations.

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