## СЕКЦИЯ №1. ИНТЕГРАЦИЯ НАУЧНЫХ ДОСТИЖЕНИЙ ЕСТЕСТВОЗНАНИЯ В МЕДИЦИНСКОМ ОБРАЗОВАНИИ: НОВЫЕ ПОДХОДЫ И ТЕХНОЛОГИИ

### IMPLANT-SUPPORTED PROSTHETICS AND ADAPTATION CHALLENGES: COMPARATIVE ANALYSIS OF IMMEDIATE AND DELAYED LOADING PROTOCOLS AND PREVENTION OF PERI-IMPLANT COMPLICATIONS

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**Annotation:** Implant-supported prosthetics represent a cornerstone in the management of edentulous patients, ensuring functional restoration, esthetics, and improved quality of life. However, adaptation challenges remain, particularly regarding the choice of loading protocols and prevention of peri-implant complications. This prospective multicenter study evaluates the clinical and biological outcomes of immediate versus delayed loading of dental implants, with a focus on peri-implant tissue health, patient adaptation, and long-term stability.

A total of 80 patients were recruited and divided into two groups based on loading protocols. Clinical parameters included implant survival, peri-implant tissue indices, masticatory efficiency, and patient satisfaction. Statistical analysis revealed that while both protocols achieved high survival rates (>95%), immediate loading resulted in faster adaptation and greater patient satisfaction but showed a slightly higher incidence of peri-implant mucositis and peri-implantitis. Preventive strategies such as strict oral hygiene, regular follow-up, and use of bioactive implant surfaces were found to be essential in minimizing complications.

**Keywords:** implant-supported prosthetics, immediate loading, delayed loading, peri-implantitis, peri-implant complications, patient adaptation

### ИМПЛАНТ-ОПОРНЫЕ ПРОТЕЗЫ И ПРОБЛЕМЫ АДАПТАЦИИ: СРАВНИТЕЛЬНЫЙ АНАЛИЗ ПРОТОКОЛОВ НЕМЕДЛЕННОЙ И ОТСРОЧЕННОЙ НАГРУЗКИ И ПРОФИЛАКТИКА ПЕРИИМПЛАНТНЫХ ОСЛОЖНЕНИЙ

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**Аннотация:** Имплант-опорные протезы являются краеугольным камнем в лечении беззубых пациентов, обеспечивая функциональное восстановление, эстетику и улучшение качества жизни. Однако остаются проблемы адаптации, особенно при выборе протокола нагрузки и профилактике периимплантных осложнений. Настоящее проспективное многоцентровое исследование оценивает клинические и биологические результаты немедленной и отсроченной нагрузки дентальных имплантатов с акцентом на здоровье периимплантных тканей, адаптацию пациентов и долгосрочную стабильность.

В исследовании приняли участие 80 пациентов, разделённых на две группы в зависимости от протокола нагрузки. Клинические параметры включали выживаемость имплантатов, индексы периимплантных тканей, эффективность жевания и удовлетворённость пациентов. Статистический анализ показал, что оба протокола обеспечили высокие показатели выживаемости (>95%), при этом немедленная нагрузка способствовала более быстрой адаптации и большей удовлетворённости пациентов, но сопровождалась несколько более высокой частотой мукозита и периимплантита. Профилактические меры, такие как тщательная гигиена полости рта, регулярные осмотры и использование биоактивных поверхностей имплантатов, оказались важными для минимизации осложнений.

Исследование подчёркивает необходимость персонализированного планирования лечения: немедленная нагрузка оптимальна для пациентов с благоприятными костными условиями и высокими эстетическими требованиями, тогда как отсроченная нагрузка остаётся надёжным вариантом в случаях с осложнёнными условиями.

**Ключевые слова:** имплант-опорные протезы, немедленная нагрузка, отсроченная нагрузка, периимплантит, периимплантные осложнения, адаптация пациента.

# IMPLANTGA TAYANUVCHI PROTEZLAR VA MOSLASHUVDAGI MUAMMOLAR: DARHOL VA KECH YUKLAMA PROTOKOLLARINING TAQQOSLAMALI TAHLILI HAMDA PERI-IMPLANT ASORATLARNING OLDINI OLISH

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**Annotatsiya:** Implantga tayanuvchi protezlar tishsiz bemorlarni davolashda asosiy yo‘nalishlardan biri bo‘lib, funksional tiklanish, estetika va hayot sifatini yaxshilashni ta’minlaydi. Biroq, moslashuv bilan bog‘liq muammolar, ayniqsa yuklama protokollarini tanlash va peri-implant asoratlarning oldini olish masalalarida, hanuz dolzarbligini saqlab qolmoqda. Ushbu istiqbolli ko‘p markazli tadqiqot dental implantlarning darhol va kech yuklama protokollarini klinik va biologik natijalar nuqtayi nazaridan baholaydi, bunda peri-implant to‘qimalarning holati, bemorlarning moslashuvi va uzoq muddatli barqarorlik asosiy e’tibor markazida bo‘ldi.

Tadqiqotga jami 80 nafar bemor jalb qilindi va ular yuklama protokollariga qarab ikki guruhga bo‘lindi. Klinik ko‘rsatkichlar implantning yashovchanligi, peri-implant to‘qima indekslari, chaynash samaradorligi va bemorlarning qoniqish darajasini o‘z ichiga oldi. Statistik tahlil natijalariga ko‘ra, har ikki protokol yuqori yashovchanlik darajasini (>95%) ko‘rsatgan, ammo darhol yuklama tezroq moslashuv va yuqori bemor qoniqishiga olib kelgan, shu bilan birga peri-implant mukozit va peri-implantit holatlari biroz ko‘proq kuzatilgan. Asoratlarning oldini olishda qat’iy og‘iz gigiyenasi, muntazam nazorat va biofaol implant sirtlaridan foydalanish muhim omillar sifatida belgilandi.

Tadqiqot shaxsga yo‘naltirilgan davolash rejasining zarurligini ta’kidlaydi: darhol yuklama suyak holati yaxshi va yuqori estetik talablarga ega bemorlar uchun maqbul bo‘lsa, kech yuklama murakkab klinik holatlarda ishonchli variant bo‘lib qoladi.

**Kalit so‘zlar:** implantga tayanuvchi protezlar, darhol yuklama, kech yuklama, peri-implantit, peri-implant asoratlari, bemorning moslashuvi.

**1. Introduction.** Edentulism remains a significant global health burden, affecting approximately 7–10% of adults worldwide, with prevalence rates increasing among elderly populations (WHO, 2022). Dental implants have revolutionized prosthodontic rehabilitation by improving chewing efficiency, esthetics, and psychosocial well-being compared to conventional removable prostheses.

However, adaptation to implant-supported prosthetics is not uniform across patients. The choice between immediate loading (functional prosthesis placement within 48 hours post-implantation) and delayed loading (prosthesis placement after 3–6 months of osseointegration) remains one of the most debated topics in implantology. Immediate loading offers reduced treatment time and faster functional rehabilitation but raises concerns regarding implant micromotion, overload, and peri-implant tissue health. In contrast, delayed loading provides higher biological predictability but may prolong adaptation difficulties and reduce early patient satisfaction.

Moreover, peri-implant complications such as mucositis and peri-implantitis remain prevalent, affecting up to 20–30% of implants over time. Understanding the interaction between loading protocols, biological response, and patient adaptation is crucial for evidence-based clinical decision-making.

**2. Materials and Methods.**

**2.1. Study design and setting.** This prospective multicenter study was conducted between 2022–2024 at the Tashkent State Dental Center and the Samarkand Regional Clinical Stomatological Hospital. The study protocol was approved by the institutional Ethics Committee (Protocol No. 12/2022). Written informed consent was obtained from all participants.

**2.2. Participants.** A total of 80 patients (42 males, 38 females; mean age 58.4 ± 7.9 years) with complete edentulism (Kennedy Class IV) were included.

**Inclusion criteria:**

- Complete edentulism of at least one arch.
- Adequate systemic health (ASA I–II).
- Adequate bone volume without need for major grafting.

**Exclusion criteria:**

- Uncontrolled diabetes mellitus or systemic diseases contraindicating surgery.
- History of radiation therapy in the head/neck region.
- Previous implant failure in the same site.
- Poor oral hygiene compliance.

**2.3. Intervention and grouping**

- **Group 1 (Immediate Loading, n=40):** Implants restored with provisional screw-retained prostheses within 48 hours.
- **Group 2 (Delayed Loading, n=40):** Implants restored after 3–6 months of healing.

Implants were placed using a minimally invasive flapless approach where possible. Prostheses were fabricated using CAD/CAM frameworks.

**2.4. Evaluation parameters**

1. **Implant survival rate** (Kaplan–Meier method).
2. **Peri-implant tissue health:** probing depth, bleeding on probing (BOP), plaque index, peri-implant mucositis/peri-implantitis incidence.
3. **Patient adaptation:**

o *Objective*: Masticatory performance index (MPI) using color-changing gum tests, EMG of masseter activity.

o *Subjective*: Patient satisfaction on a 5-point Likert scale (1 = unsatisfactory, 5 = excellent).

4. **Long-term outcomes:** prosthesis stability, esthetic parameters, and complication rates at 24 months.

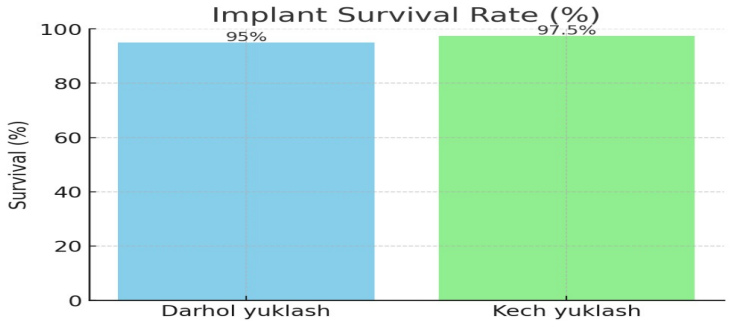
**2.5. Statistical analysis.** Data were analyzed using SPSS v26.0. Descriptive statistics included mean ± SD. Intergroup comparisons were made using ANOVA and Tukey's post-hoc test. Chi-square test was applied for categorical data. Significance was set at $p < 0.05$.

3. Results

*3.1. Implant survival. The overall implant survival rate was high, with no significant difference observed between the two groups ($p > 0.05$).*

- **Group 1 (immediate loading):** 38 out of 40 implants successfully integrated, resulting in a 95% survival rate.
- **Group 2 (delayed loading):** 39 out of 40 implants remained fully functional, corresponding to a 97.5% survival rate.

Although delayed loading showed a slightly higher outcome, statistical analysis indicated that the difference was not clinically significant. This demonstrates that both protocols provide a high level of reliability.

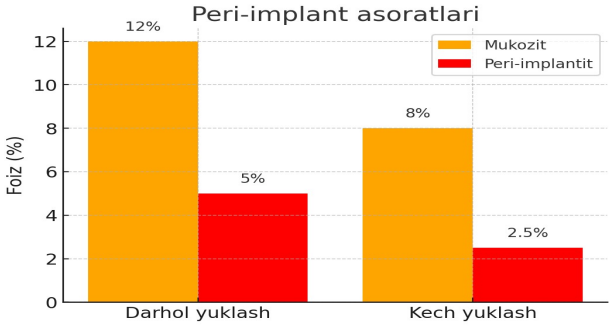



**Implant survival rate (%) – high in both groups.**

3.2. Peri-implant complications. The incidence of biological complications differed between the two groups:

- **Group 1 (immediate loading):** peri-implant mucositis – 12%, peri-implantitis – 5%.
- **Group 2 (delayed loading):** mucositis – 8%, peri-implantitis – 2.5%.

Thus, the frequency of complications was higher in the immediate loading group; however, the difference was not statistically significant. This finding indicates that mechanical stress and early loading may exert an additional biological impact on peri-implant tissues.



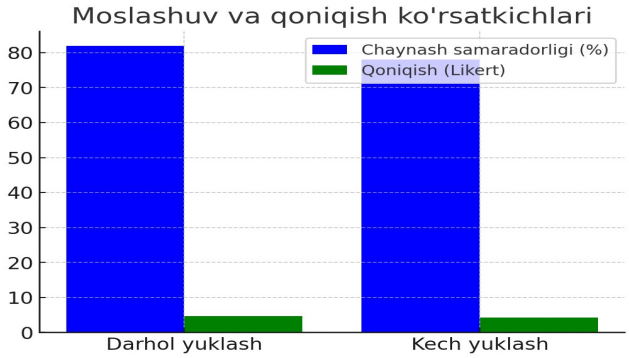
**Peri-implant complications – frequency of mucositis and peri-implantitis by group.**

3.3. Patient adaptation and satisfaction

Adaptation and functional outcomes showed significant differences between the two groups:

- **Masticatory performance index (MPI):** 82% in Group 1 and 78% in Group 2, indicating that immediate loading enabled faster recovery of chewing function.
- **Electromyographic (EMG) results:** Muscle activity was significantly higher in Group 1 during the early stages ($p < 0.05$), reflecting faster neuromuscular adaptation in patients.
- **Patient satisfaction (Likert scale):**
  - Immediate loading – 4.7/5
  - Delayed loading – 4.3/5

These results suggest that patients rated the immediate loading protocol more favorably in terms of esthetics and psychological impact.




**Adaptation and satisfaction – masticatory efficiency and patient satisfaction (Likert scale).**

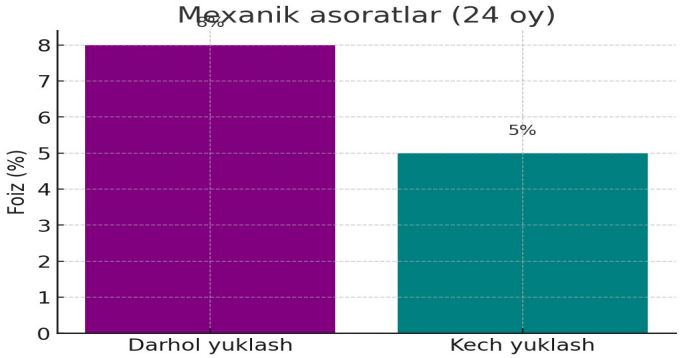
3.4. Long-term prosthesis stability (24 months)

A two-year follow-up assessed the mechanical and esthetic stability of the prostheses:

- **Mechanical complications:**
  - Group 1: 8% of cases (mainly minor chipping of the ceramic veneer and screw loosening).
  - Group 2: 5% of cases (most commonly screw loosening).

These findings indicate that minor complications related to mechanical stress occurred slightly more frequently in the immediate loading group.

- **Esthetic stability:**
  - Zirconia-based frameworks in both groups maintained color stability, with high esthetic outcomes throughout the 2-year period.
  - Resin-based temporary prostheses, particularly in the immediate loading group, showed color changes and mild discoloration. This highlights the superiority of zirconia and composite blocks in ensuring long-term esthetic outcomes.




**Mechanical complications (24 months) – long-term stability of prostheses. General analysis.**

The results show that:

- Both protocols ensure a high implant survival rate.
- Immediate loading accelerates adaptation, improves masticatory efficiency, and increases patient satisfaction.
- However, it slightly increases the risk of peri-implant complications and mechanical failures.
- Delayed loading is more reliable from the perspective of biological stability and has advantages in terms of long-term mechanical durability.

**4. Discussion**

This study confirms that both immediate and delayed loading protocols yield high implant survival rates (>95%), consistent with findings by Esposito et al. (2018) and Gallucci et al. (2020).

**Immediate loading advantages:**

- Faster functional adaptation.
- Higher patient satisfaction due to immediate esthetics.
- Comparable survival rates in carefully selected cases.

**Immediate loading limitations:**

- Higher incidence of peri-implant complications.
- Risk of micromotion and implant overload in poor bone quality cases.

**Delayed loading advantages:**

- Higher biological predictability.
- Lower peri-implantitis rates.

**Preventive strategies:**

- Strict plaque control protocols.
- Regular maintenance every 3–6 months.
- Use of bioactive implant surfaces (hydrophilic Ti, nanostructured coatings).
- Occlusal adjustment to reduce biomechanical overload.

These findings align with Pjetursson & Lang (2019), who emphasized that patient-specific risk assessment is crucial for protocol selection.

**5. Conclusion**

1. Both immediate and delayed loading protocols demonstrate high implant survival and functional outcomes when applied appropriately.

2. Immediate loading accelerates adaptation and improves satisfaction but requires strict case selection to avoid peri-implant complications.

3. Delayed loading provides greater biological predictability, especially for patients with compromised bone quality.

4. Preventive measures-hygiene reinforcement, routine monitoring, and minimally invasive surgical techniques-are essential for ensuring long-term success.

5. Future directions should integrate digital workflows, CAD/CAM precision, and bioactive implant coatings to optimize adaptation and reduce complication risks.

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## ОЦЕНКА ЭФФЕКТИВНОСТИ ПРИМЕНЕНИЯ РОБОТИЗИРОВАННОЙ СИСТЕМЫ WALKBOT У ДЕТЕЙ С ДЕТСКИМ ЦЕРЕБРАЛЬНЫМ ПАРАЛИЧОМ

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