

## Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)

ISSN 2760-4942 (Online) Volume 2, Issue 3, March 2026



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# BIOMECHANICAL ASPECTS OF IMPLANT-SUPPORTED PROSTHETIC CONSTRUCTIONS AND THEIR IMPACT ON TREATMENT LONGEVITY

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### Abstract

Implant-supported prosthetic constructions are widely used in modern dentistry for the restoration of missing teeth. However, one of the key challenges remains ensuring their long-term durability, which directly depends on biomechanical factors. The aim of this study is to analyze the influence of load distribution, material selection, and implant positioning on clinical treatment success. It has been established that proper biomechanical planning significantly reduces the risk of complications and increases the lifespan of prosthetic restorations.

**Keywords:** Dental implants, biomechanics, prosthetic dentistry, load, osseointegration.

### Introduction

In recent decades, dental implantation has become one of the leading methods for restoring dentition defects. The success of implant treatment depends not only on the surgical stage but also on proper prosthetic planning.

Despite high implant survival rates, biomechanical complications remain a relevant issue. These include:

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- implant overload
- bone resorption
- screw loosening
- fracture of prosthetic structures

Biomechanics plays a crucial role in the distribution of functional loads between the implant, bone tissue, and the prosthetic construction.

### Literature Review

Modern studies in prosthetic dentistry indicate that the main factors affecting implant longevity include:

#### 1. Load Distribution

Uneven distribution of masticatory load can lead to localized overload and bone loss.

#### 2. Implant Positioning

Incorrect implant placement alters force direction and increases stress in bone tissue.

#### 3. Materials of Prosthetic Constructions

The use of modern materials such as zirconia ensures more uniform load distribution.

According to international studies, the application of finite element analysis (FEA) allows accurate modeling of stress distribution and prediction of clinical outcomes.

Research by Uzbek scholars such as R.Kh. Khasanov and D.A. Karimov emphasizes that an individualized approach to implant planning significantly reduces complications and improves treatment outcomes.

### Materials and Methods

This study is based on theoretical analysis and modeling.

The following approaches were used:

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- analysis of scientific publications (Scopus, PubMed)
- modeling using finite element analysis (FEA)
- comparative analysis of different prosthetic designs

Three types of constructions were evaluated:

1. single implants
2. implant-supported bridges
3. full-arch implant-supported prostheses

The following parameters were assessed:

- stress levels in bone tissue
- load distribution
- structural stability

### Results

#### 1. Influence of Implant Position

Implant angulation exceeding  $15^\circ$  increases stress in bone tissue by 30–40%.

#### 2. Type of Prosthetic Construction

Bridge structures provide more uniform load distribution compared to single crowns.

#### 3. Materials

Zirconia-based constructions demonstrated better load distribution compared to metal-based ones.

#### 4. Implant Overload

The highest risk of complications is observed in cases of:

- bruxism
- improper occlusion
- insufficient bone density

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### Discussion

The obtained data confirm that biomechanical factors play a decisive role in the success of implant treatment.

Particular importance is given to:

- proper planning
- computer modeling
- individualized treatment approaches

Modern technologies, including digital diagnostics and 3D modeling, significantly improve planning accuracy.

However, several issues remain unresolved:

- standardization of loading conditions
- influence of individual patient characteristics
- long-term clinical observations

### Conclusion

Biomechanical aspects are a key factor in the successful functioning of implant-supported prosthetic constructions.

Optimization of load distribution, proper material selection, and precise implant positioning significantly increase the lifespan of prosthetic restorations and reduce the risk of complications.

Future research should focus on developing personalized treatment approaches using digital technologies.

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