



Biomechanical Principles and Prosthetic Complications of All-on-Four Implant Prostheses

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Date of Submission: 15-02-2026

Date of Acceptance: 28-02-2026

Abstract

The All-on-Four implant concept provides fixed full-arch rehabilitation with predictable functional and esthetic outcomes. This review analyzes biomechanical principles, prosthetic design considerations, and common mechanical complications associated with All-on-Four restorations. Literature shows that proper implant angulation, load distribution, and prosthetic material selection are essential for long-term success. Frequent complications include screw loosening, acrylic fracture, veneer chipping, and prosthetic wear. Advances in digital planning, guided surgery, and stronger restorative materials have reduced complication rates. Regular maintenance and occlusal control are critical to prevent mechanical failure. Understanding biomechanical factors and prosthetic management improves longevity and clinical outcomes of All-on-Four implant-supported prostheses.



I. Introduction

All-on-Four implant rehabilitation allows complete arch restoration using four implants strategically placed to maximize bone support and minimize cantilever forces. This technique has become widely accepted due to reduced surgical time and immediate functional loading.

Despite high success rates, mechanical and prosthetic complications may occur if biomechanical principles are not properly followed.

Background

The success of All-on-Four prostheses depends on proper implant positioning, angulation, and prosthetic design. Tilted posterior implants reduce cantilever length and improve load distribution. Cross-arch stabilization enhances prosthetic strength and stability.

Mechanical complications may arise from occlusal overload, parafunctional habits, or inadequate prosthetic design.



II. Materials and Methods

A narrative review of the literature was conducted using PubMed and scientific databases from 2000 to 2025. Keywords included: "All-on-Four biomechanics," "implant prosthetic complications," and "full-arch implant prosthesis."

Clinical studies, retrospective analyses, and reviews evaluating prosthetic complications and biomechanical performance were included.

III. Discussion

The All-on-Four concept relies on biomechanical stability achieved through implant angulation and cross-arch splinting. Proper occlusal design reduces overload and improves prosthesis longevity.

Common prosthetic complications include:

- Screw loosening
- Acrylic base fracture



- Veneer chipping
- Prosthetic wear



Digital planning and CAD/CAM frameworks improve passive fit and reduce stress on implants. Night guards are recommended for bruxism patients. Regular maintenance visits allow early detection of complications.



IV. Conclusion

All-on-Four implant prostheses provide reliable full-arch rehabilitation when biomechanical principles and prosthetic design are properly implemented. Preventive maintenance and careful occlusal management are essential to minimize complications and ensure long-term success.



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