Clinical and Biomechanical Evaluation of Dental Implants for Long-Term Functional Stability

Autor:

Assistant, Department of Orthopaedic Dentistry, Yusupova Sitora Sanjarovna

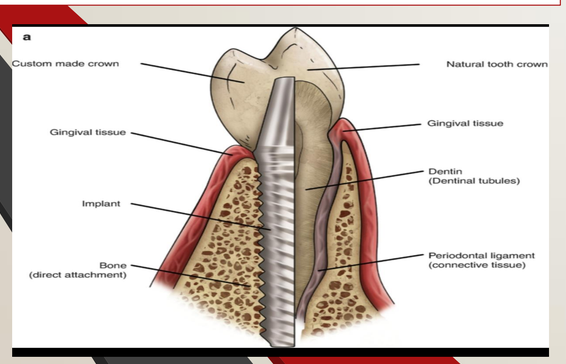
Samarkand State Medical University

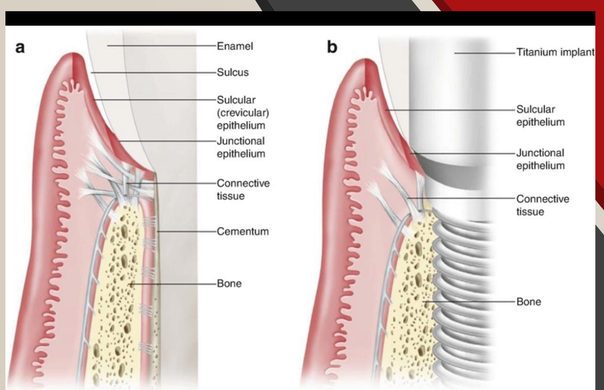
Absract

Dental implantology is one of the most rapidly developing fields in modern prosthodontics. With the growing demand for aesthetic and functional rehabilitation, dental implants have become the standard treatment for partial and complete edentulism. However, implant success depends not only on osseointegration but also on biomechanical load distribution, prosthetic design, and patient-related factors such as bone density and oral hygiene.

Inrtoduction

To evaluate the clinical and biomechanical factors affecting the long-term stability and success rate of dental implants and to identify optimal protocols for improving implant survival and patient satisfaction.





Materials and Methods

The study included 40 patients aged 25–60 years who received dental implants in the posterior mandible and maxilla. Implants with titanium screw-type geometry and roughened surfaces were used.

Clinical parameters such as primary stability, marginal bone level, and peri-implant soft tissue health were recorded at 3, 6, and 12 months postoperatively.

Radiographic evaluation was performed using periapical and panoramic X-rays.

Biomechanical load analysis was conducted through finite element simulation (FEA) to assess stress distribution under different occlusal loading conditions.

Statistical analysis was performed using ANOVA with significance set at $p < 0.05$.

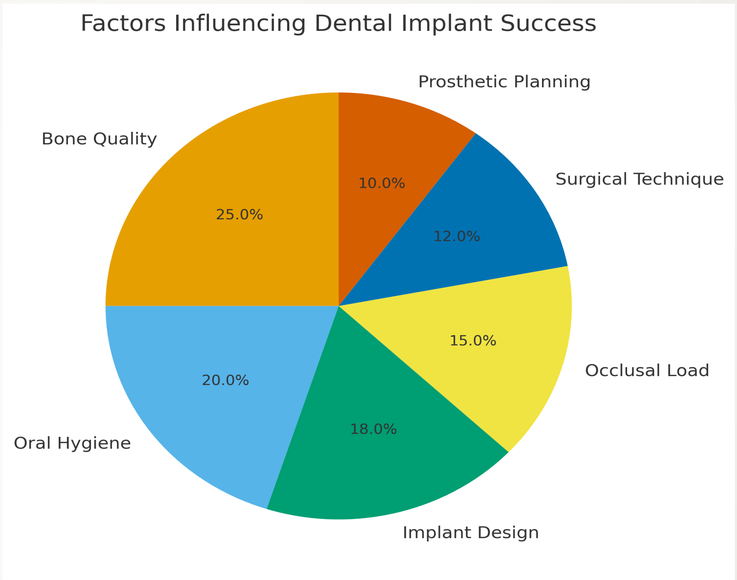
Results of the research

Most implants demonstrated excellent osseointegration within 3 months. Marginal bone loss did not exceed 1.2 mm during the first year in 92.5% of cases.

The finite element model showed that excessive occlusal loading and improper angulation significantly increased stress on the crestal bone and implant neck.

Implants placed with guided digital planning demonstrated better load distribution and lower bone resorption rates.

No implant fractures or significant prosthetic failures were observed during the study period.



Conclusion

The study confirms that both clinical and biomechanical parameters play a decisive role in the long-term success of dental implants. Proper treatment planning, accurate implant placement, and optimal occlusal adjustment reduce mechanical complications and bone loss.

Integration of digital implantology, 3D surgical guides, and FEA-based biomechanical analysis enhances treatment precision and ensures predictable functional and aesthetic outcomes.

Contacts

<Yusupova Sitora>
Email: burxonova.zara@bk.ru
<Samarkand State Medical University>
Phone number +998998135671

Reference:

1. Albrektsson T., Zarb G., Worthington P., Eriksson A.R. The long-term efficacy of currently used dental implants: A review and proposed criteria of success. Int J Oral Maxillofac Implants. 1986;1(1):11–25.

2. Misch C.E. Contemporary Implant Dentistry. 4th ed. St. Louis: Mosby; 2020.

3. Buser D., Sennerby L., De Bruyn H. Clinical long-term stability of osseointegrated implants in partially edentulous patients. Clin Oral Implants Res. 2017;28(5):531–537.

4. Brunski J.B. Biomaterials and biomechanics in dental implant design. Int J Oral Maxillofac Implants. 1999;14(1):29–45.