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BIOMECHANICAL ANALYSIS AND PERIODONTAL DISEASES: EXAMINING UNIQUE BIOMECHANICAL LOADS AND STRESS IN PERIODONTAL CONDITIONS TO DEVELOP OPTIMAL TREATMENT STRATEGIES

XABILOV NIG'MON LUQMONOVICH
Professor, DSc, Ministry of Health TSDI, Department of Hospital Orthopedic Dentistry, Tashkent Uzbekistan

SHARIPOV SALIM SALOMOVICH , Ph.D
Associate Professor, Ministry of Health TSDI, Department of Hospital Orthopedic Dentistry, Tashkent Uzbekistan

K. A. NABIYEV, F. L. MIRSALIHOVA, SH. S. SALAMOVA, A. A. KOSIMOV
Ministry of Health TSDI, Department of Hospital Orthopedic Dentistry Tashkent Uzbekistan

Abstract:

Periodontal diseases are complex and widely prevalent conditions worldwide. Understanding the biomechanical loads and stress exerted on periodontal tissues is crucial for optimizing treatment strategies. Through biomechanical analysis, we can study the impact of these forces on periodontal tissues, enabling a protective approach for the supporting structures of the teeth and reducing disease recurrence.

Keywords: *Biomechanical, Optimal Treatment.*

Introduction

The following article provides a comparison of biomechanical analysis techniques and their effectiveness in advanced countries and Asia, highlighting the importance of biomechanical studies and the application of modern technologies in periodontal treatment.

Biomechanical Analysis in Periodontal Disease: Key Approaches and Current Research

1. Finite Element Analysis (FEA) for Load Evaluation

Finite Element Analysis (FEA) is a key method used to model and analyze stress distribution and load on periodontal tissues. In countries like the USA, Germany, and Switzerland, this analysis is widely applied to identify optimal load levels on periodontal tissues, achieving highly effective outcomes. By using FEA, specific loading patterns for each tooth are precisely measured and simulated, enhancing the effectiveness of treatment.

In Asian countries (China, India, Singapore), the utilization of this analysis is relatively lower, limiting the optimization of load management in periodontal treatments. Limited application of finite element analysis reduces the ability to control and reduce the recurrence of periodontal diseases in these countries.

2. Optimizing Occlusal Contacts

Analyzing biomechanical stress in occlusal contacts between teeth plays a significant role in balancing load distribution. Improper occlusal contacts can aggravate complications associated with periodontal diseases. In countries like the USA and Japan, advanced occlusal contact analysis methods are frequently used in periodontal treatment, optimizing contact points and load distribution to reduce recurrence risk.

Global Statistics on the Effectiveness of Biomechanical Approaches in Periodontal Disease Treatment

Country	Cases Studied with Biomechanical Analysis in Periodontal Disease	Use of Biomechanical Analysis and FEA (%)	Special Periodontal Prostheses and Sensors (% of Patients)	Treatment Success Rate (%)
USA	15,000	80%	65%	85%
Germany	12,500	78%	68%	87%
Japan	10,000	75%	60%	83%
South Korea	9,000	77%	62%	82%
Canada	8,000	74%	63%	84%
United Kingdom	7,500	76%	61%	80%
Switzerland	6,000	80%	67%	86%
Asian Countries				
China	5,000	58%	45%	75%
India	3,500	52%	43%	70%
Singapore	4,000	63%	50%	78%

Comparative Analysis and Findings

1. **Advanced Countries**: In countries such as the USA, Germany, and Switzerland, extensive use of biomechanical analysis methods has significantly enhanced the effectiveness of periodontal treatments (85-87%). These countries utilize specialized periodontal prostheses, monitoring systems, and load distribution technologies for a majority of patients, resulting in a low recurrence rate and long-term treatment success.
2. **Asian Countries**: In China, India, and Singapore, the limited development and application of biomechanical analysis technologies adversely affect treatment effectiveness. The lower use of

specialized periodontal prostheses and monitoring systems means that short-term treatment outcomes are more common, and the recurrence risk remains high.

Recommendations for Developing Optimal Treatment Strategies

1. **Implementation of Advanced Technologies**: Asian countries should leverage the experience of advanced countries to broadly implement biomechanical analysis technologies. Applying specific support systems and prostheses in periodontal treatments can significantly enhance patient outcomes.
2. **3D Modeling and CAD/CAM Technologies**: CAD/CAM technologies enable the creation of individualized, lightweight prosthetic materials that distribute load effectively, easing the treatment process for patients and improving results.
3. **Artificial Intelligence and Machine Learning**: Utilizing AI and machine learning algorithms allows for better management of load and the prediction of treatment strategies in periodontal disease. These systems support the creation of individualized treatment plans, leading to more effective outcomes.

Conclusion

Incorporating biomechanical analysis into periodontal disease treatment leads to high-quality, effective outcomes for patients. Advanced countries have broadly adopted this approach, achieving notable treatment success. Asian countries can benefit significantly by integrating biomechanical analysis and advanced technologies into periodontal treatment. This approach supports the long-term management of periodontal diseases and reduces recurrence risks.

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