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THE INFLUENCE OF THYROTOXICOSIS ON THE MICROELEMENT COMPOSITION OF JAW BONES AND THE CHOICE OF ORTHOPEDIC DESIGN

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Abstract. Thyrotoxicosis is a systemic endocrine disorder that significantly impacts bone tissue, including the jawbone. Microelement imbalances, decreased mineralization, and accelerated bone resorption complicate orthopedic treatment planning. This study aims to rationalize the choice of dental implant-supported orthopedic structures in patients with thyrotoxicosis. The study demonstrates the effectiveness of an orthopedically oriented, individualized approach based on a comprehensive assessment of bone quality and the use of digital technologies for planning the implant and orthopedic stages of treatment.

Keywords: thyrotoxicosis, dental implantation, bone microelement composition, orthopedic dentistry, CAD/CAM, osseointegration.

Introduction

Thyrotoxicosis is accompanied by systemic metabolic disturbances leading to accelerated bone remodeling, with resorption processes prevailing over bone formation. A decrease in the density and quality of jaw bone tissue affects their functional stability and ability to withstand masticatory loads. These changes are of fundamental importance in orthopedic dentistry, as traditional prosthetic methods (removable and bridge structures) with reduced bone strength can overload the supporting teeth, worsen alveolar atrophy, and reduce the service life of orthopedic structures. Modern concepts of orthopedic rehabilitation for patients with endocrine pathology are based on the use of dental implants, taking into account bone tissue condition, hormonal levels, and functional characteristics of occlusion. The use of digital planning technologies and CAD/CAM systems allows for increased accuracy in the orthopedic stage and a better long-term prognosis.

Materials and Methods

The study included patients diagnosed with moderate thyrotoxicosis and partial or complete tooth loss associated with decreased jaw bone mineral density.

The examination included:

clinical examination and collection of a general and dental history;

cone beam computed tomography (CBCT) analysis to assess bone volume and density;

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analysis of bone microelement composition (calcium, phosphorus, magnesium) as an indicator of bone metabolic activity;

morphological examination of bone tissue.

Functional diagnostics of occlusion was also performed, followed by orthopedic load planning.

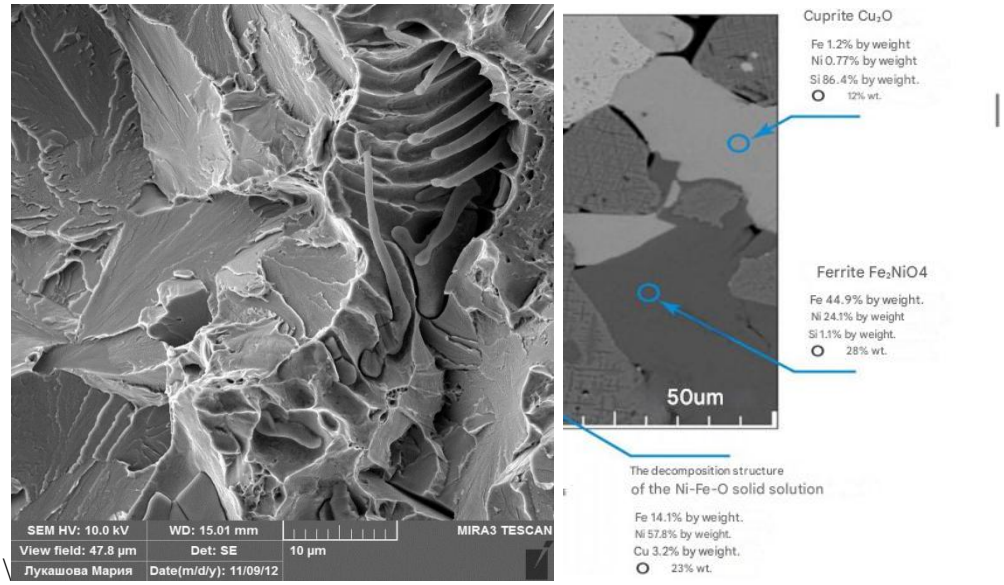
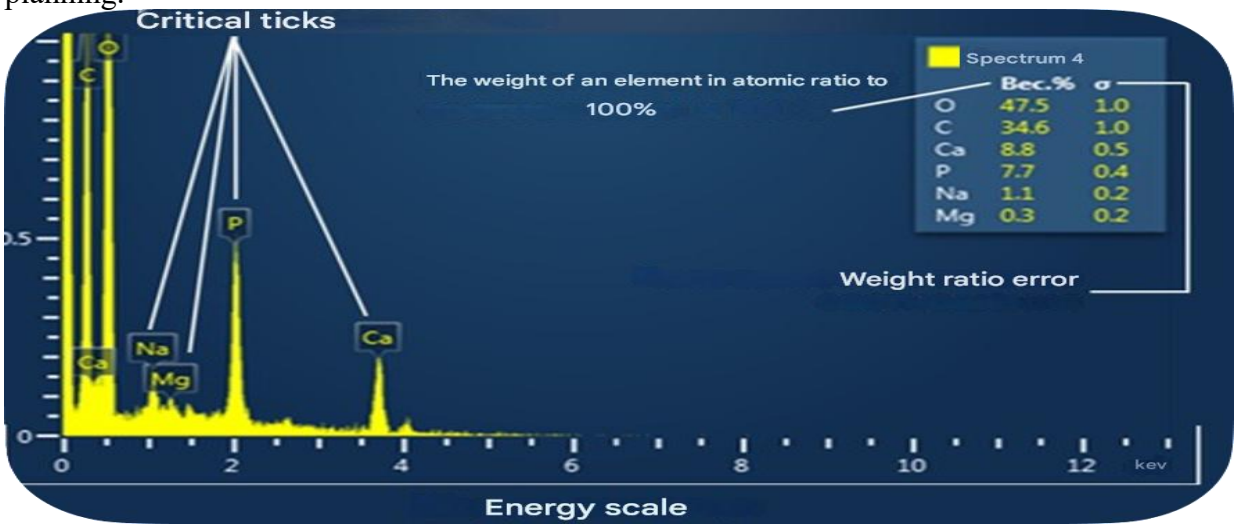


Figure 1. Morphological state of bone tissue before treatment.

The presented microscopic specimen of jaw bone tissue before treatment reveals pronounced signs of impaired bone remodeling characteristic of thyrotoxicosis. Loosening of compact bone tissue with areas of its replacement by mature fibrous connective tissue, as well as foci of bone resorption, are noted. These changes indicate reduced mechanical strength of the bone and its limited ability to withstand functional loads, making orthopedic and implant treatment impossible without prior endocrine correction and individualized planning.



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Element	Type lines	Conditional concentration	Attitude k	Weight.%	Sigma Bec.%	Name standard	Predus reference
C	K series	0.05	0.00049	34.60	0.97	C Vit	Yes
O	K series	0.19	0.00063	47.50	0.95	SiO2	Yes
Na	K series	0.01	0.00002	1.10	0.20	Albite	Yes
Mg	K series	0.00	0.00001	0.29	0.15	MgO	Yes
P	K series	0.04	0.00021	7.67	0.37	GaP	Yes
Ca	K series	0.03	0.00024	8.84	0.48	Wollastonite	Yes
Sum:				100.00			

Figure 2. Energy dispersive spectrum of the microelement composition of bone tissue before treatment.

Energy-dispersive X-ray analysis of bone tissue before treatment revealed decreased calcium and magnesium levels with a relative phosphorus imbalance. The data obtained reflect insufficient bone mineralization and a predominance of bone resorption over bone formation. This state of the bone substrate explains the increased risk of overloading of orthopedic structures and the poor predictability of implant osseointegration in the absence of a comprehensive treatment approach. Dental implants with a modified bioactive surface, optimized for placement in conditions of reduced bone mineral density, were used to restore the dentition. Treatment planning was performed using digital CAD/CAM technologies.

The protocol included:

implant placement with stabilized hormonal levels;

digital modeling of the orthopedic superstructure;

development of rational occlusal contacts taking into account implant-guided occlusion;

final fixation of the orthopedic structures. Selecting an Orthopedic Structure

Implant-based orthopedic treatment has been chosen as the preferred method for rehabilitating patients with thyrotoxicosis because it:

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minimizes the involvement of intact teeth in prosthetic restorations;

ensures uniform distribution of masticatory loads on bone tissue;

reduces the risk of overloading supporting elements due to impaired bone mineralization;

increases the stability, functionality, and durability of orthopedic structures;

improves the aesthetic outcome and quality of life of patients.

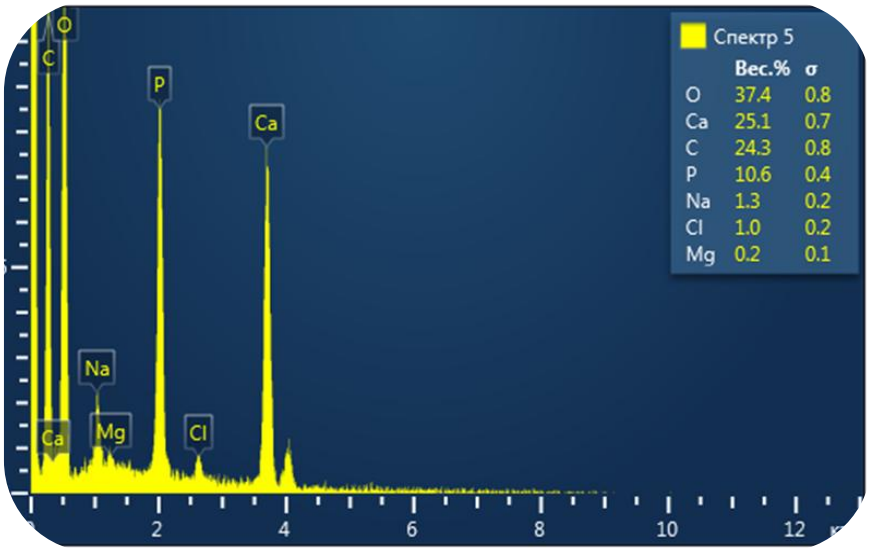
Characteristics of orthopedic and implant treatment for thyrotoxicosis:

surgical and orthopedic stages are performed exclusively when compensating for the endocrine disorder;

preference is given to implants with a bioactive and microporous surface, which promotes accelerated osseointegration;

Digital CAD/CAM planning allows for precise calculation of the superstructure shape and control of occlusal loads;

the principle of implant-guided occlusion is maintained, eliminating lateral overloads and premature contacts.



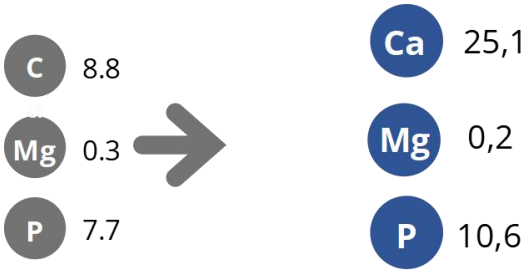


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Figure 3. Changes in the microelement composition of bone tissue after orthopedic and implant treatment.

Following compensation for thyrotoxicosis and successful implant and orthopedic treatment, positive changes in the microelement composition of bone tissue were observed. Energy dispersive analysis revealed an increase in calcium and stabilization of phosphorus and magnesium levels, indicating restoration of mineralization processes. These changes are a consequence of the properly selected orthopedic device, which ensured physiological distribution of masticatory load and created the conditions for the formation of more mature and functionally complete bone tissue.

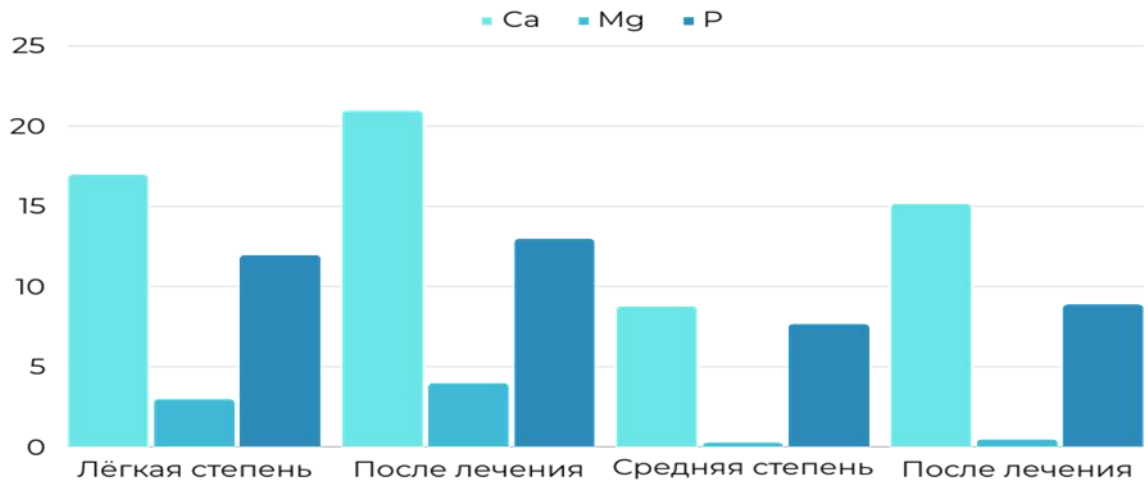

Figure 4. Comparative diagram of the microelement composition of bone tissue before and after treatment.

A comparative analysis of bone microelement composition before and after treatment clearly demonstrates the effectiveness of the chosen orthopedic approach. After implantation and fixation of the orthopedic structure, an increase in calcium content and a normalization of the calcium-phosphorus ratio are observed, indicating improved bone quality. The obtained data confirm that individualized orthopedic planning and implant-guided occlusion play a key role in stabilizing bone metabolism in patients with thyrotoxicosis.

Conclusion

Thyrotoxicosis has a significant impact on the structure, microelement composition, and functional properties of jaw bone tissue, requiring a personalized and well-founded approach to orthopedic dental treatment. Dental implantation, with a stabilized hormonal background, is an effective and prognostically sound method of orthopedic rehabilitation for patients with thyrotoxicosis, allowing for the restoration of chewing function, aesthetics, and the preservation of bone volume. The use of digital CAD/CAM technologies and implants with modified surfaces ensures high precision of orthopedic structures, optimal osseointegration, and long-

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term treatment. Individualized planning of the orthopedic stage and control of functional load distribution are key factors in the successful rehabilitation of this category of patients.

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