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MORPHOLOGICAL CHANGES IN ALVEOLAR BONE DURING ORTHODONTIC TREATMENT

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Abstract

Orthodontic tooth movement induces significant morphological changes in the alveolar bone as a result of controlled mechanical force application. These changes involve coordinated processes of bone resorption and apposition that allow teeth to reposition within the dental arch. Understanding alveolar bone remodeling is critical for achieving stable orthodontic outcomes and preventing complications such as dehiscence, fenestration, and bone loss. The aim of this study was to evaluate morphological alterations of alveolar bone during orthodontic treatment and to assess their clinical implications. A prospective radiographic study of 130 orthodontic patients aged 14–25 years was conducted using cephalometric analysis and cone-beam computed tomography (CBCT). Parameters such as cortical bone thickness, alveolar height, trabecular density, and bone volume were analyzed before and after treatment. The results demonstrate that controlled orthodontic forces stimulate adaptive remodeling of alveolar bone; however, excessive or improperly directed forces may lead to cortical thinning and localized bone defects. These findings emphasize the importance of biomechanical precision and radiographic monitoring during orthodontic therapy.

Keywords: alveolar bone remodeling, orthodontic treatment, bone morphology, CBCT analysis, cortical thickness, bone density, dentofacial changes

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Introduction

Orthodontic therapy is based on the biological principle that bone tissue remodels in response to mechanical stimulation. When orthodontic forces are applied to teeth, the surrounding alveolar bone undergoes structural changes that enable tooth displacement.

Alveolar bone is a dynamic tissue composed of: cortical (compact) bone, trabecular (spongy) bone, periodontal ligament attachment structures.

During orthodontic treatment, the bone experiences: resorption on the pressure side, apposition on the tension side, alterations in bone density and architecture.

Although remodeling is a physiological process, excessive or poorly controlled forces may lead to adverse morphological consequences such as: cortical bone thinning, alveolar dehiscence, fenestration defects, vertical bone loss.

Modern imaging technologies, particularly CBCT, allow three-dimensional evaluation of alveolar changes during treatment.

The aim of this study was to analyze morphological changes in alveolar bone under orthodontic forces and assess their clinical significance.

Materials and Methods

A prospective clinical radiographic study was conducted over a 24-month orthodontic treatment period.

130 patients aged 14–25 years undergoing fixed appliance therapy were included.

Inclusion criteria:

- No periodontal disease
- No systemic bone disorders
- Full permanent dentition (excluding third molars)

Imaging Methods

1. Lateral cephalometric radiographs
2. Cone-beam computed tomography (CBCT) scans
3. Digital model analysis

Imaging was performed:

- Before treatment
- After 12 months
- At completion of active treatment

Evaluated Parameters

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- Alveolar bone height
- Cortical bone thickness (mm)
- Trabecular bone density (Hounsfield Units)
- Presence of dehiscence or fenestration
- Root positioning within alveolar housing

Statistical analysis was conducted using paired t-tests ($p < 0.05$).

Results.

Cortical Bone Thickness

- Mild thinning observed in 28% of cases (average reduction: 0.3 mm)
- Significant thinning (>0.5 mm) in 7% of cases (associated with excessive labial movement)

Lingual cortical plates showed better preservation compared to labial surfaces.

Alveolar Bone Height

- Stable in 85% of patients
- Mild vertical reduction (≤1 mm) in 12%
- Moderate reduction (>1 mm) in 3% (primarily in adults over 22 years)

Trabecular Bone Density

- Increased density observed in tension zones
- Temporary reduction in pressure zones during early stages (first 6 months)
- Bone density normalized after completion of treatment

Dehiscence and Fenestration

- Localized dehiscence detected in 9% of cases
- Fenestration defects observed in 4%

Most defects were associated with excessive proclination of incisors.

Root Positioning

- Controlled bodily movement-maintained roots within alveolar housing in 88% of cases.
- Uncontrolled tipping increased risk of cortical penetration.

Discussion

The results confirm that orthodontic treatment induces adaptive morphological changes in alveolar bone.

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Bone Remodeling Mechanism. Alveolar bone remodeling follows the principle of mechanotransduction. Mechanical stress activates osteoclast-mediated resorption on the compression side and osteoblast-mediated formation on the tension side.

This coordinated remodeling allows safe tooth displacement when forces remain within biological limits.

Cortical Bone Considerations. Excessive labial movement of incisors may exceed alveolar envelope limits, resulting in cortical thinning and dehiscence.

Therefore, treatment planning must consider:

- initial alveolar bone thickness,
- patient age,
- periodontal biotype.

Age Influence. Younger patients demonstrated more adaptive bone remodeling. Adult patients showed reduced regenerative capacity and higher susceptibility to cortical defects.

Clinical Implications

- CBCT evaluation is valuable for high-risk cases.
- Controlled force systems reduce risk of bone defects.
- Overexpansion and excessive proclination should be avoided.
- Periodontal monitoring is essential throughout treatment.

Stability and Retention.

Bone remodeling continues after active treatment. Proper retention allows reorganization of trabecular structure and stabilization of tooth position.

Conclusion.

Orthodontic treatment induces significant but generally adaptive morphological changes in alveolar bone.

Controlled mechanical forces stimulate physiological remodeling, maintaining bone height and density. However, excessive or poorly directed forces may lead to cortical thinning, dehiscence, and fenestration.

Careful biomechanical planning, radiographic monitoring, and respect for alveolar anatomical limits are essential to ensure safe and stable orthodontic outcomes.

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References

1. Abdullayev X., Ismatova K. Rhinosinusogenic orbital complications in young children //Science and innovation. – 2024. – T. 3. – №. D7. – C. 103-106.
2. Badarch M., Iriskulova E., Tudevdagva U. Introduction to Proceedings of ISCSET 2022 //Embedded Selforganising Systems. – 2022. – T. 9. – №. 3. – C. 2-3.
3. Ergashev J. D., Sigatullina M. I., Ibragimov U. K. Neuropsychic growth of children with hypoxi–ischemic encephalopathy //The 2th World Congress of Neonatology.– 6th–9th January. – 2010. – C. 19.
4. Ergashev J. et al. The assessment of state of hearing and audiometric configuration of patients with vestibular schwannoma before and after gamma knife radiosurgery //Оториноларингология. Восточная Европа. – 2017. – T. 7. – №. 1. – C. 31-38.
5. Ergashev J. et al. Epidemiological and evolutionary study of vestibular schwannomas after different types of treatment: дис. – Universidade de Santiago de Compostela, 2014.
6. Ergashev J. et al. Clinical picture of vestibular schwannomas in a series of 106 patients managed with different treatment methods //Новый день в медицине. – 2019. – №. 4. – C. 369-373.
7. Ergashev J. D. et al. MANAGEMENT OF VESTIBULAR SCHWANNOMAS: AGE MATTERS //SCIENCE. – 2024. – T. 3. – №. 10-4. – C. 221-225.
8. Ergashev J. D. et al. Gamma Knife Radiosurgery for Vestibular Schwannomas: Favorable and Unfavorable Effects in Series of 42 Patients. – 2019.
9. Ganiev A. A. et al. The practice of oropharynx cancer: A case report and literature review //Annals of Cancer Research and Therapy. – 2019. – T. 27. – №. 2. – C. 37-41.
10. Iriskulova E. et al. Intraparotid facial nerve schwannoma: a cross-country report of two cases and literature review //Annals of Cancer Research and Therapy. – 2020. – T. 28. – №. 2. – C. 93-96.
11. Iriskulova E., Kodirova Z., Juraboev S. Prognosis of Complications at Surgical Treatment of Benign Parotid Tumors //Embedded Selforganising Systems. – 2022. – T. 9. – №. 3. – C. 70-72.
12. Iriskulova E. et al. Intraparotid facial nerve schwannoma: a cross-country report of two cases and literature review //Annals of Cancer Research and Therapy. – 2020. – T. 28. – №. 2. – C. 93-96.
13. Iriskulova E., Nurxojaeva A. Express assessment of sonoelastographic parameters in patients with tumors of the parotid salivary gland //Embedded Selforganising Systems. – 2022. – T. 9. – №. 3. – C. 18-19.
14. Ismatova K. A. et al. The new coronavirus infection in otolaryngological practice: clinical features in different age groups //Science and innovation. – 2023. – T. 2. – №. Special Issue 8. – C. 813-816.

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15. Khamraeva V. S., Karabaev H. E., Ergashev J. D. The choice of optimal medical method for exudative otitis media in children //CHOICE. – 2018. – T. 4. – C. 24-2018.
16. Shovkatovich S. O., Muratovna N. M. OPTIMIZATION OF COMPLEX THERAPY FOR CHRONIC RECURRENT APHTHOUS STOMATITIS //World Scientific Research Journal. – 2025. – T. 45. – №. 1. – C. 119-123.
17. Shovkatov O.Sh., Sharipov S.S., Akhundjanov R.A. / 2025. MODERN PROSTHODONTIC TECHNOLOGIES IN COMPLETE EDENTULISM: APPLICATION OF CAD/CAM AND 3D PRINTING. Журнал гуманитарных и естественных наук. 2, 28 [2] (дек. 2025), 6–13.
18. Shovkatov O.Sh., Sharipov S.S., Akhundjanov R.A. 2025. BIOMATERIALS AND THEIR BIOLOGICAL COMPATIBILITY: A CLINICAL ANALYSIS OF PMMA, THERMOPLASTICS, BIOACTIVE POLYMERS, NANOMATERIALS, AND NEXT-GENERATION ZIRCONIA. Журнал гуманитарных и естественных наук. 2, 28 [2] (дек. 2025), 19–25.
19. Shovkatov O.Sh., Mirsaidov M.M. (2026). KATTA CHAYNOV TISHLARI EKSTRAKSIYASIDAN KEYINGI YALLIG‘LANISHLARNING OLDINI OLISHDA ANTIBIOTIKLAR SAMARADORLIGINI BAHOLASH. ОСНОВЫ МЕДИЦИНЫ, 1(8), 147–150. извлечено от https://journals.tnmu.uz/tas/article/view/3760
20. Yun J. M. et al. Optimizing Cochlear Implant Position for Magnetic Resonance Imaging of Vestibular Schwannoma //Laryngoscope Investigative Otolaryngology. – 2025. – T. 10. – №. 6. – C. e70319.