

THE IMPORTANCE OF PERIODONTAL TISSUES AND THE INTERRELATIONSHIP AMONG THEIR COMPONENTS

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Abstract. Periodontal tissues constitute a complex and dynamic system responsible for anchoring and supporting teeth within the jaw. These tissues—gingiva, periodontal ligament (PDL), cementum, and alveolar bone—function not independently, but as an integrated unit. This article provides an in-depth examination of each component, focusing on their anatomical structure, individual functions, and most importantly, the biological and mechanical interdependence among them. Special emphasis is placed on the types and functions of the periodontal ligament and how the health of each component influences the integrity of the entire periodontal complex.

Keywords: periodontal tissue, periodontal ligament, PDL, cementum, alveolar bone.

PERIODONT TO'QIMASINING AHAMIYATI VA UNING QISMLARI ORASIDAGI O'ZARO ALOQA

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Annotatsiya. Parodontal to‘qimalar jag‘ ichida tishlarni mustahkamlash va qo‘llab-quvvatlashga mas’ul bo‘lgan murakkab va dinamik tizimni tashkil etadi. Bu to‘qimalar – milk, parodontal boylam (PDL), sement va alveolyar suyak – o‘z funksiyalarini alohida emas, balki o‘zaro uzviy bog‘liqlikda bajaradi. Ushbu maqola bu komponentlarning har birini batafsil o‘rganib, ularning aniq tuzilishi, vazifalari va ayniqsa ular orasidagi biologik va mexanik aloqalarni tahlil qiladi. Xususan, parodontal boylamning turlari va ularning funksiyasi, hamda parodontal to‘qimalarning o‘zaro bog‘liqligi, birining sog‘ligi boshqasining barqarorligiga qanday ta’sir qilishini chuqur ilmiy yondashuv bilan ko‘rib chiqiladi.

Kalit so‘zlar: milk, parodontal boylam, PDB, sement, alveolyar suyak.

Introduction. The periodontium is a vital and intricate system in human oral anatomy, consisting of four major components: the gingiva, periodontal ligament, cementum, and alveolar bone. Together, they ensure the structural stability of teeth, absorb and distribute masticatory forces, and protect deeper structures from mechanical and microbial insult. Unlike static anatomical structures, periodontal tissues are living and responsive, undergoing continuous remodeling and adaptation to functional stimuli.

The health of each individual component is essential, but more importantly, the system relies on the interconnected functionality among all tissues. Pathology in one part often triggers a cascade of destructive changes in the others. For instance, gingival inflammation may lead to PDL degradation and bone resorption, illustrating the critical importance of harmonious function [1].

Gingiva: The First Line of Defense.

Gingiva, the soft tissue component of the periodontium, serves as a barrier against mechanical trauma and microbial invasion. It comprises keratinized stratified

squamous epithelium and underlying connective tissue rich in fibroblasts, immune cells, and vascular elements.

The junctional epithelium - a key structure at the base of the sulcus - adheres to the enamel or cementum and acts as a biological seal, preventing microbial penetration into deeper tissues. It is highly permeable to immune cells and plays a pivotal role in early immune responses during the onset of periodontal inflammation.

Gingival connective tissue also contains:

- Fibroblasts, responsible for collagen and ground substance production,
- Immune cells, including macrophages, lymphocytes, and dendritic cells,
- Blood vessels and nerves, supporting nutrition and sensory function.

If the integrity of the gingiva is compromised, pathogens can infiltrate the underlying PDL and bone, initiating periodontitis. Thus, gingiva acts not only as a mechanical shield but also as a crucial immunological frontier [2].

Periodontal Ligament (PDL): Structure and Fiber Types (Continued)

The periodontal ligament is a dynamic tissue with rapid turnover, crucial for maintaining homeostasis within the periodontium. In addition to collagen fiber groups, it contains a high concentration of water (about 70% of its weight), contributing to its viscoelastic properties that help cushion forces during mastication.

Cell Types in the PDL:

- Fibroblasts: The predominant cell type, involved in synthesis and degradation of collagen.
- Cementoblasts and osteoblasts: Located near the cementum and alveolar bone, respectively, contributing to remodeling.
- Undifferentiated mesenchymal cells: Serve as a reservoir for regeneration during injury.
- Epithelial cell rests of Malassez: Remnants of the Hertwig's epithelial root sheath; may be involved in periodontal cyst formation.

The PDL space varies in width from 0.15 mm to 0.38 mm and narrows with age. Despite this, it retains the capacity to adapt to changing functional loads, such as orthodontic movement [3, 4].

Cementum: The Anchoring Layer.

Cementum is a mineralized connective tissue covering the tooth root. It serves as the attachment surface for PDL fibers and plays a critical role in tooth stability.

Types of Cementum:

- Acellular cementum: Located primarily at the cervical third of the root; responsible for tooth attachment.
- Cellular cementum: Found in the apical third; contains cementocytes and contributes to adaptation and repair.

Cementum is avascular and receives nutrition from the PDL. It shares structural similarities with bone but lacks remodeling capability. The integrity of cementum is crucial for the proper insertion of Sharpey's fibers from the PDL

Functions of Cementum:

- Anchors the tooth to the alveolus via PDL fibers.
- Seals dentinal tubules and protects underlying dentin.
- Compensates for tooth wear by continuous deposition at the apex.

Alveolar Bone: Structural Framework.

The alveolar process is a part of the maxilla and mandible that supports the teeth. It consists of:

- Cortical plate: Dense outer bone layer.
- Cancellous (trabecular) bone: Spongy inner layer.
- Bundle bone (cribriform plate): Lines the tooth socket and contains Sharpey's fibers.

Bone remodeling in response to functional forces and inflammation is a hallmark of periodontal health. Osteoblasts, osteoclasts, and osteocytes coordinate this remodeling under hormonal and mechanical regulation.

Alveolar bone is intimately linked to the PDL and cementum. Loss of stimulation from PDL (e.g., in tooth loss) results in rapid bone resorption, demonstrating their interdependence.

Interrelationship among Periodontal Components.

The components of the periodontium operate as a single functional unit. Structural and signaling crosstalk ensures adaptation to mechanical forces and microbial challenges.

Key Interrelationships:

- Gingiva protects the underlying PDL and bone from pathogens.
- PDL connects cementum to alveolar bone and responds to mechanical stimuli.
- Cementum and alveolar bone provide anchor points for PDL fibers.
- All components participate in immunological defense through cytokine signaling.

Periodontal breakdown often begins with plaque-induced gingival inflammation (gingivitis), which can progress to periodontitis if left untreated. The inflammatory process spreads apically, destroying collagen fibers of the PDL and resorbing alveolar bone. Hence, maintenance of one tissue depends on the health and function of the others [5, 6].

Clinical Implications.

Understanding the anatomy and interactions of periodontal tissues is essential for diagnosing and treating periodontal diseases. Interventions must target the entire periodontium to ensure regenerative success.

Modern therapies - including guided tissue regeneration, bone grafting, and the use of growth factors - seek to restore the structural and functional integrity of all components. Long-term success hinges on the preservation of the dynamic balance among gingiva, PDL, cementum, and alveolar bone.

Conclusion. Periodontal tissues are interdependent both anatomically and functionally. Their health is sustained through constant biological communication, mechanical adaptation, and immune surveillance. A failure in any single component threatens the integrity of the whole, underscoring the necessity for a holistic approach to periodontal care.

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