



ISSN: 3060-4613



MAKTABGACHA
VA MAKTAB
TA'LIMI VAZIRLIGI



O'zbekiston
Milliy Pedagogika
Universiteti



No5(2)
2026

- 13.00.00 Pedagogika fanlari
- 13.00.01 Pedagogika nazariyasi. Pedagogik ta'limotlar tarixi
- 13.00.02 Ta'lim va tarbiya nazariyasi va metodikasi (sohalar bo'yicha)
- 13.00.03 Maxsus pedagogika
- 13.00.04 Jismoniy tarbiya va sport mashg'ulotlari nazariyasi va metodikasi
- 13.00.05 Kasb-hunar ta'limi nazariyasi va metodikasi
- 13.00.06 Elektron ta'lim nazariyasi va metodikasi (ta'lim sohaları va bosqichlari bo'yicha)
- 13.00.07 Ta'limda menejment
- 13.00.08 Maktabgacha ta'lim va tarbiya nazariyasi va metodikasi
- 13.00.09 Ijtimoiy pedagogika
- 07.00.00 Tarix fanlari
- 19.00.00 Psixologiya fanlari
- 01.00.00 Fizika-matematika fanlari
- 02.00.00 Kimyo fanlari
- 03.00.00 Biologiya fanlari
- 09.00.00 Falsafa fanlari
- 10.00.00 Filologiya fanlari
- 11.00.00 Geografiya fanlari

M

AKTABGACHA VA AKTAB TA'LIMI

Pedagogika, psixologiya fanlariga ixtisoslashgan ilmiy jurnal



MAKTABGACHA VA MAKTAB TA'LIMI



Elektron nashr. 182 sahifa,
6-may, 2026-yil.

BOSH MUHARRIR:

Karimova E'zoza Gapijanovna – O'zbekiston Respublikasi Maktabgacha va maktab ta'limi vaziri

BOSH MUHARRIR O'RINBOSARI:

Ibragimova Gulsanam Ne'matovna – Pedagogika fanlari doktori, professor

TAHRIRIYAT KENGASHI A'ZOLARI

Ibragimov X.I. – pedagogika fanlari doktori, akademik
Shoumarov G'.B. – psixologiya fanlari doktori, akademik
Qirg'izboyev A.K. – Tarix fanlari doktori, professor
Jamoldinova O.R. – pedagogika fanlari doktori, professor
Sharipov Sh.S. – pedagogika fanlari doktori, professor
Shermuhhammadov B.Sh. – pedagogika fanlari doktori, professor
Ma'murov B.B. – pedagogika fanlari doktori, professor
Madraximova F.R. – pedagogika fanlari doktori, professor
Kalonov M.B. – iqtisodiyot fanlari doktori, professor
Nabiyev D.X. – iqtisodiyot fanlari doktori, professor
Qo'ldoshev Q. M. – iqtisodiyot fanlari doktori, professor
Ikramxanova F.I. – filologiya fanlari doktori, professor
Ismagilova F.S. – psixologiya fanlari doktori, professor (Rossiya)
Stoyuxina N.Yu. – psixologiya fanlari nomzodi, dotsent (Rossiya)
Magauova A.S. – pedagogika fanlari doktori, professor (Qozog'iston)
Rejep O'zyurek – psixologiya fanlari doktori, professor (Turkiya)
Wookyu Cha – Koreya milliy ta'lim universiteti rektori (Koreya)
Polonnikov A.A. – psixologiya fanlari nomzodi, dotsent (Belarus)
Mizayeva F. O. – Pedagogika fanlari doktori, dotsent
Baybayeva M.X. – pedagogika fanlari doktori, professor
Muxsiyeva A.T. – pedagogika fanlari doktori, professor
Aliyev B. – falsafa fanlari doktori, professor
Abdullayeva N. Sh. – Pedagogika fanlari doktori (DSc), professor
Doniyorov S. M. – “Yangi O'zbekiston” va “Pravda Vostoka” gazetalari tahririyati DM bosh muharriri, O'zbekiston Respublikasida xizmat ko'rsatgan jurnalist, filologiya fanlari bo'yicha falsafa doktori (PhD), dotsent
G'afurov D. O. – falsafa fanlari doktori (Phd)
Shomurodov R.T. – iqtisodiyot fanlari nomzodi (PhD), dotsent
Mirzayeva F. O. – pedagogika fanlari doktori (DSc), dotsent
Jalilova S.X. – psixologiya fanlari nomzodi (PhD), dotsent
Bafayev M.M. – psixologiya fanlari bo'yicha falsafa doktori (PhD), dotsent
Usmonova D.I. – Samarqand iqtisodiyot va servis institute dotsenti
Saifnazarov I. – falsafa fanlari doktori, professor
Nematov Sh.E. – pedagogika fanlari nomzodi (PhD)
Tillashayxova X.A. – psixologiya fanlari nomzodi (PhD), dotsent
Yuldasheva F.I. – pedagogika fanlari bo'yicha falsafa doktori (PhD), dotsent
Yuldasheva D.B. – filologiya fanlari bo'yicha falsafa (PhD) doktori, dotsent
Tangriyev A. T. – Toshkent davlat iqtisodiyot universiteti kafedra professori
Ashurov R. R. – psixologiya fanlari bo'yicha falsafa doktori (PhD), dotsent
Panjiyev M. A. – Qashqadaryo viloyati Maktabgacha va maktab ta'limi boshqarmasi boshlig'ining birinchi o'rinbosari
Xudayberganov N. A. – Xorazm Ma'mun akademiyasi Tabiiy fanlar bo'limining katta ilmiy xodimi, biologiya fanlari bo'yicha falsafa doktori (PhD)
Vaxobov Anvar Abdusattor o'g'li – Pedagogika fanlari bo'yicha falsafa doktori, dotsent

Muassis: “Tadbirkor va ishbilarmon” MChJ

Hamkorlarimiz: O'zbekiston Respublikasi Maktabgacha va maktab ta'limi vazirligi, O'zbekiston milliy pedagogika universiteti

EDITOR-IN-CHIEF:

Karimova E'zoza Gapirzhanovna – Minister of Perschool and School Education of the Republic of Uzbekistan

DEPUTY EDITOR-IN-CHIEF:

Ibragimova Gulsanam Ne'matovna – Doctor of Pedagogical Sciences, Professor

EDITORIAL BOARD MEMBERS:

Ibragimov X.I. – Doctor of Pedagogical Sciences, Academician

Shoumarov G. B. – Doctor of Psychological Sciences, Academician

Qirg'izboyev A. K. – Doctor of Historical Sciences, Professor

Jamoldinova O.R. – Doctor of Pedagogical Sciences, Professor

Sharipov Sh.S. – Doctor of Pedagogical Sciences, Professor

Shermuhhammadov B.Sh. – Doctor of Pedagogical Sciences, Professor

Ma'murov B.B. – Doctor of Pedagogical Sciences, Professor

Madraximova F.R. – Doctor of Pedagogical Sciences, Professor

Kalonov M.B. – Doctor of Economic Sciences, Professor

Nabiyev D.X. – Doctor of Economic Sciences, Professor

Koldoshev K. M. – Doctor of Economic Sciences, Professor

Ikramxanova F.I. – Doctor of Philological Sciences, Professor

Ismagilova F.S. – Doctor of Psychological Sciences, Professor (Russia)

Stoyuxina N.Yu. – Candidate of Psychological Sciences (PhD), Associate Professor (Russia)

Magauova A.S. – Doctor of Pedagogical Sciences, Professor (Kazakhstan)

Rejep O'zyurek – Doctor of Psychological Sciences, Professor (Turkey)

Wookyu Cha – President of the National University of Education, Korea (South Korea)

Polonnikov A.A. – Candidate of Psychological Sciences (PhD), Associate Professor (Belarus)

Mizayeva F. O. – Doctor of Pedagogical Sciences, Professor

Baybayeva M.X. – Doctor of Pedagogical Sciences, Professor

Muxsiyeva A.T. – Doctor of Pedagogical Sciences, Professor

Aliyev B. – Doctor of philosophy, professor

Abdullayeva N. Sh. – Doctor of Pedagogical Sciences (DSc), Professor

Doniyorov S. M. – Editor-in-Chief of the DM Editorial Office of the newspapers “Yangi O'zbekiston” and “Pravda Vostoka”, Honored Journalist of the Republic of Uzbekistan, Doctor of Philosophy (PhD) in Philology, Associate Professor

Gafurov D. O. – Doctor of Philosophy (PhD)

Shomurodov R.T. – Candidate of Economic Sciences (PhD), Associate Professor

Mirzayeva F. O. – Doctor of Pedagogical Sciences (DSc), Associate Professor

Jalilova S.X. – Candidate of Psychological Sciences (PhD), Associate Professor

Bafayev M.M. – Doctor of Philosophy in Psychological Sciences (PhD), Associate Professor

Usmonova D.I. – Associate Professor, Samarkand Institute of Economics and Service

Saifnazarov I. – Doctor of philosophy, professor

Nematov Sh.E. – Candidate of Pedagogical Sciences (PhD)

Tillashayxova X.A. – Candidate of Psychological Sciences (PhD), Associate Professor

Yuldasheva F.I. – Doctor of Philosophy in Pedagogical Sciences (PhD), Associate Professor

Yuldasheva D.B. – Doctor of Philosophy (PhD) in Philological Sciences, Associate Professor

Tangriyev A.T. – is a professor of Tashkent State University of Economics

Ashurov R. R. – Doctor of Philosophy (PhD) in Psychology, Associate Professor

Panjiyev M. A. – First Deputy Head of the Department of Preschool and School Education of the Kashkadarya Region

Khudaiberganov N. A. – Senior Researcher of the Department of Natural Sciences of the Khorezm Mamun

Academy, Doctor of Philosophy (PhD) in Biological Sciences

Vakhobov Anvar Abdusattor oglu – Doctor of Philosophy in Pedagogical Sciences, Associate Professor

“Maktabgacha va maktab ta'limi” jurnali O'zbekiston Respublikasi Oliy attestatsiya komissiyasining quyidagi qarorlariga asosan pedagogika va psixologiya fanlari bo'yicha falsafa doktori (PhD) hamda fan doktori (DSc) ilmiy darajasiga talabgorlarning dissertatsiyalaridagi asosiy ilmiy natijalarni chop etish uchun milliy ilmiy nashrlar ro'yxatiga kiritilgan:

Pedagogika fanlari bo'yicha: OAK Kengashi tavsiyasi (26.08.2024-y., №11-05-4381/01) asosida:

- Ekspert kengashi (29.10.2024-y., №10)
- Rayosat qarori (31.10.2024-y., №363/5)

Psixologiya fanlari bo'yicha: Toshkent davlat pedagogika universiteti murojaatiga asosan OAK tavsiyasi (24.04.2025-y., №11-05-2566/01):

- Ekspert kengashi (25.05.2025-y., №10)
- Rayosat qarori (08.05.2025-y., №370/5)

“Maktabgacha va maktab ta'limi”
jurnali

26.09.2023-yildan

O'zbekiston Respublikasi Prezidenti
Administratsiyasi huzuridagi Axborot
va ommaviy kommunikatsiyalar
agentligi tomonidan **№C-5669363**
reyestr raqami tartibi bo'yicha
ro'yxatdan o'tkazilgan.

Litsenziya raqami: **№136361**

MUNDARIJA

| | |
|--|----|
| Fizika ta'limida integratsiyalashgan yondashuv: mazmuni va ahamiyati..... | 10 |
| Doniyorova Iroda Baxtiyor qizi | |
| Zamonaviy boshlang'ich ta'lim: milliy dastur, kompetensiya va xorijiy tajriba integratsiyasi..... | 14 |
| Omonova Nilufar Parda qizi | |
| The Role of Environmental Project-Based Learning in Developing EFL Learners' Productive Skills..... | 19 |
| Xujanova Shaxina Abdullayevna | |
| Boshlang'ich sinflarda integratsiyalashgan ta'limning pedagogik aspektlari | 24 |
| Eshpo'latova Elnora Yo'ldoshovna | |
| Talabalarda stressga barqarorlikning nazariy va amaliy tahlili..... | 29 |
| Nurmatov Nurhayot Nurziyot o'g'li, Maxmudova Shahzoda Maksudovna | |
| Malakaviy o'quv amaliyoti jarayonida bo'lajak tarbiyachilarning kasbiy kompetensiyalarini rivojlantirishda didaktik ta'minotning ahamiyati..... | 32 |
| Ramazonova Bahroy Sadriddinovna | |
| Oliy ta'limda raqamli pedagogikaning institutsionlashuvi: boshqaruv, siyosat va raqamli transformatsiya strategiyalari..... | 36 |
| Nuraliyeva Dilshoda Yo'ichiboy qizi | |
| Aholini jismoniy sog'lomlashtirishda sog'lomlashtiruvchi mashg'ulotlarni tashkil etish metodikasi..... | 41 |
| V. Sh. Raximov | |
| O'spirinlik davrida motiv va motivatsion sohalarning kasb tanlashdagi o'rni | 46 |
| Rayimqulova S., Pulatova R., Do'smatova S., Matyakubova Shohista Odamboy qizi | |
| Tarbiyachi shaxsining shakllanishida psixologik determinantlarning roli | 51 |
| Vasila Yusupova | |
| Kasbiy ta'lim o'quvchilarini ijodiy qobiliyatini oshirishda xorijiy tajribalardan foydalanish | 55 |
| B. X. Sharopov | |
| Raqamli axborot makonida gumanistik g'oyalarni integratsiyalashning nazariy konsepsiyasi | 59 |
| Isanov Najotbek Ilmamat o'g'li | |
| Fanlararo integratsiya asosida o'quvchilarda iqtisodiy bilimlarni rivojlantirish imkoniyatlari..... | 63 |
| J. M. Fayzullayev, Ortiqova E'zoza Olimjon qizi | |
| Millatlarning o'ziga xos dunyoqarashining psixologik xususiyatlari | 67 |
| Murxashev Axmadxon Olimjon o'g'li | |
| Xalqaro ta'lim dasturlari asosida kasbiy ta'lim muassasalarida metakognitiv kompetensiyalarni shakllantirish metodikasi..... | 70 |
| S. A. Qarshiboyev | |
| Ijtimoiy media kontentlari orqali talabalarda fuqarolik pozitsiyasini shakllantirishning nazariy asoslari..... | 74 |
| Suyunov Rustam Sadriddinovich | |
| Ko'p tilli muhitda ingliz tilini o'rganishning lingvistik xususiyatlari | 78 |
| Teshaboyeva Mohichexra Sohibjon qizi | |
| Axborotlashgan jamiyat sharoitida bo'lajak pedagoglarning mediakompetentligini rivojlantirish zarurati..... | 81 |
| Umarov Azizbek Vaxobovich | |
| O'quvchilarda badiiy matn leksikasini o'zlashtirishdagi qiyinchiliklar: muammo va yechim..... | 85 |
| Xamroyeva Dilnoza Jahongir qizi | |
| Bo'lajak boshlang'ich ta'lim o'qituvchilarini ma'naviy tarbiyalashda Ahmad al-Farg'oniy asarlarini kompyuter imitatsion modellari asosida o'qitish metodikasi..... | 89 |
| S. S. Qulmurodova | |
| Enhancement of Periodontal Disease Management Strategies in Individuals With Chronic Hepatitis C Following Attainment of a Sustained Virological Response..... | 92 |
| Makhmudova Ugiloy Bakhtiyorovna | |



| | |
|--|-----|
| Epithelial-Mesenchymal Transition's Possible Role in the Pathogenesis of Periodontitis (Literature Review)..... | 95 |
| Burkhonova Zараfruz Kobilovna | |
| Gamifikatsiya asosida bo'lajak oligofrenopedagoglarda kasbiy kompetensiyalarni rivojlantirish texnologiyalari mexanizmini tatbiq etish | 102 |
| Bozorboyev Javlon | |
| Bo'lajak chizmachilik o'qituvchilarining kasbiy kompetensiyalarini rivojlantirish omillari..... | 106 |
| Jamilova Dilsuza To'lqin qizi | |
| Elektrir va magnit maydonida yorug'likning ikkilamchi sinishi..... | 110 |
| Avulova Zamira Tursunmurodovna, Nomozova Dilnoza Mamarajab qizi, Alimardonov Husan Yorqin o'g'li, Ismatullayev Sayfiddin Panji o'g'li | |
| Lazer texnologiyalarining zamonaviy qo'llanilishi | 114 |
| Avulova Zamira Tursunmurodovna, Nomozova Dilnoza Mamarajab qizi, Muminova Sevinch Kamoliddin qizi, Begnayeve Dilbar Bobonazar qizi | |
| Fotometrik kattaliklar | 117 |
| Avulova Zamira Tursunmurodovna, Nomozova Dilnoza Mamarajab qizi, Mamatqulova Zebo Komiljon qizi, Xolmaxmatova Sevara Sirojiddin qizi | |
| Qutublangan yorug'lik manbalari | 121 |
| Avulova Zamira Tursunmurodovna, Nomozova Dilnoza Mamarajab qizi, Turdimurodova Kumushbibi, Normuminova Madina | |
| Tabiatdagi optik hodisalar | 125 |
| Avulova Zamira Tursunmurodovna, Nomozova Dilnoza Mamarajab qizi, Qudratova Sevinch Otabek qizi, Ulasheva Ruxshona Rustam qizi | |
| Rus tilini o'qitishda kompetensiyaga asoslangan innovatsion yondashuvlardan foydalanish | 129 |
| Erkinova Nozima Utkir qizi | |
| Rezervga bo'shatilgan harbiy xizmatchilarning ijtimoiy-psixologik reintegratsiyasini tadqiq etishning ilmiy-metodologik tahlili | 133 |
| Ikmatullayev G'. Z. | |
| Raqamli ta'lim platformalarida matematika o'qitishda sun'iy intellekt yordamida baholash tizimini takomillashtirish | 136 |
| Mirzayeva Shahlo Abduraxmanovna, Akbarov Ulug'bek, Abdivaliyeva Umida | |
| Linguistic and Pedagogical Foundations of Teaching English as a Foreign Language in The Uzbek Context..... | 140 |
| Shokirova Mushtariy | |
| Sun'iy intellektning ta'lim jarayonidagi transformatsion roli | 144 |
| Uzoqboyev Xojiakbar Qobuljon o'g'li | |
| Enhancing Collaborative Learning and Peer Feedback in EFL Classrooms Through Padlet: a Digital Approach to Group Work and Assessment..... | 148 |
| Veronica Khatamova | |
| Kar va zaif eshituvchi o'quvchilarning rasmlar asosida aqliy faoliyatini rivojlantirishning vizual-didaktik texnologiyalarini takomillashtirish..... | 152 |
| Meliqo'ziyev Abduraxmonjon Qahramonjon o'g'li | |
| Emotsional intellekt – hr menejerlarning qaror qabul qilish kompetensiyasining determinanti sifatida | 157 |
| Abdukarimov Muhammadjon Muratovich | |
| O'g'il bolalarni mustaqil oilaviy hayotga tayyorlashning tizimli-pedagogik modeli: nazariya, metodologiya va amaliyot | 162 |
| Islamova Fotima Shamsiddinovna | |
| Barkamol yosh avlod fazilatlarini shakllantirishda milliy innovatsion pedagogik texnologiyalarning o'rni..... | 170 |
| Olimova Dono Shakirovna, Baxtiyorova Shahnoza Mansurbekovna | |
| Development of Prevention of Professional-Pedagogical Deformation on the Basis of Health-Saving Technologies in Higher Educational Institutions..... | 174 |
| Saidova Parvina Mirzo kizi | |
| O'zbek xalq pedagogikasi mazmuni asosida talabalarni oilaviy hayotga tayyorlashning ilmiy nazariy asoslari | 178 |
| Rahmonqulova Guliza Faxriddin qizi | |



EPITHELIAL-MESENCHYMAL TRANSITION'S POSSIBLE ROLE IN THE PATHOGENESIS OF PERIODONTITIS (LITERATURE REVIEW)

Burkxonova Zarafruz Kobilovna

Samarkand State Medical University, Samarkand, Uzbekistan

Abstract: Inflammatory periodontal diseases have become a significant focus of modern dentistry due to the increasing global prevalence of gingivitis and periodontitis. This review aims to examine the relationship between the development of inflammatory periodontal diseases and increased permeability of the gingival sulcus epithelium. Particular attention is given to the interaction between the oral microbiota and the epithelial barrier.

Scientific publications indexed in eLIBRARY, Google Scholar, and PubMed were analyzed. Between 2004–2025, more than 100 studies addressing various aspects of the topic were identified. Following a rigorous selection process, 60 publications, including review articles and experimental studies conducted both in vitro and in vivo, were included in the analysis. The reviewed evidence demonstrates a close association between alterations in the mucosal microbiota and the regulation of innate and adaptive immunity. Beneficial microorganisms may enhance antimicrobial defense mechanisms either indirectly through immune modulation or directly by inhibiting pathogens that impair epithelial barrier function.

Epithelial–mesenchymal transition (EMT), characterized by the loss of epithelial features and the acquisition of mesenchymal properties, appears to play an important role in this process. These alterations may weaken the basement membrane, compromise epithelial integrity, and contribute to periodontal pocket formation. As a result, pathogenic microorganisms may penetrate deeper into oral tissues. Tight junctions and intercellular adhesion complexes are essential for maintaining epithelial stability and normal cellular function.

Key words: Epithelial–mesenchymal transition (EMT), Snail, epithelial barrier permeability, oral microbiota, tight junction proteins, gingival crevicular fluid, periodontitis.

Annotatsiya: Yallig'lanishli periodontal kasalliklar gingivit va periodontitning dunyo miqyosida keng tarqalishi sababi zamonaviy stomatologiyaning dolzarb muammolaridan biriga aylangan. Mazkur sharhning maqsadi yallig'lanishli periodontal kasalliklarning rivojlanishi hamda milk egatchasi epiteliysi o'tkazuvchanligining ortishi o'rtasidagi bog'liqlikni tahlil qilishdan iborat. Asosiy e'tibor og'iz mikrobiotasi va epitelial to'siq o'rtasidagi o'zaro ta'sirga qaratilgan.

Tadqiqot davomida eLIBRARY, Google Scholar va PubMed bazalarida indekslangan ilmiy manbalar tahlil qilindi. 2004–2025-yillar oralig'ida mavzuga oid 100 dan ortiq ilmiy maqolalar aniqlanib, qat'iy saralash jarayonidan so'ng 60 ta manba, jumladan, o'zaro maqolalar hamda in vitro va in vivo eksperimental tadqiqotlar tahlilga kiritildi. Olingan natijalar shilliq qavat mikrobiotasidagi o'zgarishlar tug'ma va adaptiv immunitet regulyatsiyasi bilan chambarchas bog'liqligini ko'rsatadi. Foydali mikroorganizmlar immun tizimi orqali antimikrob himoyani kuchaytirishi yoki epitelial to'siq funksiyasini buzuvchi patogenlarga bevosita qarshi ta'sir ko'rsatishi mumkin.

Epitelial–mezenximal o'tish (EMT) jarayoni epitelial hujayralarning o'z xususiyatlarini yo'qotib, mezenximal belgilarni egallashi bilan tavsiflanadi va periodontal patologiya rivojlanishida muhim rol o'ynaydi. Ushbu o'zgarishlar bazal membraning zaiflashishiga, epitelial yaxlitlikning buzilishiga hamda periodontal cho'ntak hosil bo'lishiga olib kelishi mumkin. Natijada patogen mikroorganizmlar og'iz bo'shlig'i to'qimalarining chuqur qatlamlariga kirib boradi. Tight junction oqsillari va hujayralararo bog'lanish komplekslari epitelial barqarorlik hamda normal hujayra faoliyatini saqlashda muhim ahamiyatga ega.

Kalit so'zlar: Epitelial–mezenximal o'tish (EMT), Snail, epitelial to'siq o'tkazuvchanligi, og'iz mikrobiotasi, tight junction oqsillari, gingival suyuqlik, periodontit.

Аннотация: Воспалительные заболевания пародонта являются одной из актуальных проблем современной стоматологии в связи с ростом распространенности гингивита и пародонтита во всем мире. Цель данного обзора – изучение взаимосвязи между развитием воспалительных заболеваний пародонта и повышенной проницаемостью эпителия десневой борозды. Особое внимание уделено взаимодействию оральной микробиоты и эпителиального барьера.

Были проанализированы научные публикации, индексируемые в базах данных eLIBRARY, Google Scholar и PubMed. В период 2004–2025 гг. выявлено более 100 исследований, посвященных различным аспектам данной проблемы. После тщательного отбора в анализ были включены 60 публикаций, включая обзорные статьи и экспериментальные исследования *in vitro* и *in vivo*. Полученные данные свидетельствуют о тесной связи между нарушением микробиоты слизистой оболочки и регуляцией врожденного и адаптивного иммунитета. Полезные микроорганизмы способны усиливать антимикробную защиту как посредством иммунной регуляции, так и путем прямого подавления патогенов, нарушающих функцию эпителиального барьера.

Эпителиально-мезенхимальный переход (EMT), характеризующийся утратой эпителиальных свойств и приобретением мезенхимальных признаков, играет важную роль в данном процессе. Эти изменения могут ослаблять базальную мембрану, нарушать целостность эпителия и способствовать формированию пародонтального кармана. В результате патогенные микроорганизмы способны проникать в более глубокие ткани полости рта. Плотные межклеточные контакты и адгезионные комплексы имеют ключевое значение для поддержания стабильности эпителиального барьера и нормального функционирования клеток.

Ключевые слова: Эпителиально-мезенхимальный переход, Snail, проницаемость эпителиального барьера, оральная микробиота, белки плотных контактов, десневая жидкость, пародонтит.

INTRODUCTION

The increasing prevalence of gingivitis and periodontitis among both adults and children highlights the urgent need for novel approaches to the diagnosis, treatment, and prevention of inflammatory periodontal diseases. Further research is required to achieve a comprehensive understanding of the complex etiology and pathophysiology of these disorders. Numerous factors, including genetic predisposition, immune system dysfunction, bacterial and viral infections, vitamin and trace element deficiencies, hormonal imbalances, mechanical trauma, and stress-related conditions, may contribute to the development of inflammatory periodontal diseases (IPD) [2, 3].

It should be emphasized that each of these factors has the potential to disrupt the balance and structure of the oral microbiome, which plays a crucial role in maintaining oral health. Inflammatory periodontal diseases are currently regarded as multifactorial disorders associated with microbiome imbalance. Such dysbiosis transforms the normal periodontal microbiota into a pathogenic one, altering both the composition and quantity of microorganisms within the periodontal pocket. The progression of the disease is initiated by microbiological alterations, immune responses, and environmental influences.

The development of chronic periodontitis is closely associated with the activity of opportunistic and pathogenic microorganisms, particularly Gram-negative bacteria, including *Porphyromonas gingivalis*, *Tannerella forsythia*, *Treponema denticola*, *Prevotella intermedia*, and *Aggregatibacter actinomycetemcomitans*. The gingival sulcus provides favorable conditions for their proliferation because it remains open and continuously exposed to the external environment. Over time, the thin epithelial layer resistant to aging is replaced by connective epithelium. The microbial biofilm, which remains in constant contact with the tooth surface, eventually fuses with it, leading to the establishment of a persistent immune response [4–6].

Increased inflammatory activity within the gingival sulcus is considered one of the major factors capable of disrupting the junctional epithelium. Leukocytes involved in the inflammatory response include polymorphonuclear leukocytes and mononuclear leukocytes, such as T- and B-lymphocytes. Furthermore, various bacterial species within the oral microflora may stimulate epithelial cells to release specific cytokines. Increased intercellular distance between desmosomes and alterations in the expression of proteins responsible for tight intercellular junctions subsequently compromise epithelial integrity. Regulation of epithelial tight junctions by T-cells is essential for maintaining tissue homeostasis or, conversely, for promoting the development of pathological conditions.

When intercellular epithelial junctions are damaged, bacterial toxins and antigens can more easily penetrate epithelial barriers and initiate inflammatory responses. Reduced expression of key epithelial markers, including E-cadherin, vimentin, and N-cadherin, has been associated with periodontitis. Clinically, this is manifested by granulation tissue formation, connective tissue proliferation, and increased microtrauma of the periodontal pocket epithelium. Under the influence of inflammatory mediators and cellular factors, gingival epithelial cells may undergo transdifferentiation from an epithelial phenotype to a mesenchymal phenotype.



Research findings indicate that inflammatory processes in periodontal tissues develop when proteins responsible for maintaining tight cell-to-cell junctions become disrupted. These proteins are essential for preserving the barrier function of the epithelium. Therefore, a comprehensive review focused on increased epithelial barrier permeability and the mechanisms regulating tight junction function remains highly relevant.

The aim of this study was to investigate the influence of these factors on the development of inflammatory periodontal diseases.

LITERATURE REVIEW

Recent studies have demonstrated that inflammatory periodontal diseases are closely associated with disturbances in the oral microbiota and impairment of epithelial barrier integrity. According to Kovalevskiy et al., bacterial biofilms formed within periodontal pockets play a decisive role in the progression of chronic inflammation and tissue destruction. The authors emphasized that microbial biofilms alter the local immune response and contribute to epithelial dysfunction through persistent bacterial colonization.

Research conducted by Ippolitov, Nikolaeva, and Tsarev showed that oral biofilms activate multiple immune signaling pathways involved in periodontal inflammation. Their findings suggested that pathogenic microorganisms stimulate cytokine production and disrupt the balance between protective and destructive immune mechanisms. Tsarev et al. further reported that periodontopathogenic bacteria, particularly Gram-negative species, are among the principal etiological factors responsible for the development and progression of periodontitis.

Bosshardt and Lang described the junctional epithelium as a critical protective structure maintaining periodontal homeostasis. Their work demonstrated that disruption of epithelial integrity facilitates bacterial penetration into deeper periodontal tissues. Similar observations were reported by Katz et al., who identified the ability of *Porphyromonas gingivalis* to degrade epithelial junctional complexes and weaken intercellular adhesion. These alterations significantly increase epithelial permeability and promote inflammatory responses within periodontal tissues.

Amano and Nakagawa investigated the pathogenic mechanisms of *Porphyromonas gingivalis* and demonstrated that bacterial virulence factors impair epithelial barrier function by affecting extracellular matrix proteins and cellular integrins. Abe-Yutori et al. later confirmed that lipopolysaccharides produced by *P. gingivalis* reduce E-cadherin expression, thereby attenuating epithelial barrier integrity. Guo et al. additionally reported significant alterations in tight junction proteins, including claudins and occludin, in oral epithelial cells exposed to periodontal pathogens.

Modern investigations increasingly focus on the relationship between epithelial–mesenchymal transition (EMT) and periodontal disease progression. Vitkov et al. demonstrated that disruption of the gingival epithelial barrier represents a crucial stage in periodontitis pathogenesis, facilitating microbial invasion and chronic inflammation. Dutzan et al. highlighted the importance of immune cell interactions within the gingival barrier, while Hartmann et al. emphasized the physiological role of junctional adhesion molecules (JAMs) in maintaining epithelial stability and regulating permeability. Collectively, these findings indicate that EMT-associated alterations in epithelial structure and tight junction proteins contribute substantially to the pathogenesis of periodontitis.

RESEARCH METHODOLOGY

The study examined original articles and scientific publications retrieved from databases such as eLIBRARY, Google Scholar, and PubMed. More than 100 scientific publications published between 2004–2024 were identified during the review process. The systematic review employed search queries including “inflammatory periodontal diseases,” “epithelial barrier permeability,” “oral microbiota,” “tight junction protein complexes,” “gingival crevicular fluid,” as well as their Russian equivalents, “chronic periodontitis,” “aggressive periodontitis,” “epithelial barrier,” and “increased epithelial permeability syndrome.” The STATA checklist, developed for systematic reviews and meta-analyses, was applied as one of the tools for systematic analysis. Fifty-six scientific publications that met the established inclusion criteria were selected for the study. These included review articles as well as *in vitro* and *in vivo* experimental investigations.

The aim of this systematic review was to evaluate and analyze evidence regarding the role of epithelial permeability mechanisms in the development of inflammatory periodontal diseases (IPD) and to investigate the potential use of tight junction proteins as diagnostic markers for these disorders. Three electronic bibliographic databases—PubMed, Google Scholar, and eLIBRARY—were analyzed. The review covered publications from 2004–2025. Keywords related to connective proteins, oral microbiota, inflammatory periodontal diseases, gingival crevicular fluid, chronic and aggressive periodontitis, and epithelial barrier permeability were used to identify relevant studies. Uzbek equivalents of the key terms were also included in the search strategy. Additional relevant materials were identified through manual screening of reference lists from selected publications.

Based on titles, abstracts, and publication dates, 105 articles were initially selected for systematic review. After removing duplicates and publications that did not satisfy the eligibility criteria, the number was reduced to 85 articles. Following the screening procedure, 60 studies, including randomized controlled clinical trials and systematic reviews, were selected for inclusion. A further thirteen publications were excluded because of the absence of a proper clinical diagnosis, non-representative study populations, or unclear diagnostic criteria. Any disagreements regarding study inclusion or exclusion were resolved through collaborative discussion. Ultimately, a comprehensive review of 60 scientific publications was conducted.

The studies were selected according to strict inclusion criteria. Participants from two age groups—young adults (18–44 years) and middle-aged adults (45–59 years)—were involved in both laboratory (in vitro) and clinical (in vivo) investigations. The study population consisted of patients diagnosed with inflammatory periodontal diseases, including chronic gingivitis and chronic periodontitis. A control group comprising individuals without clinical signs of periodontitis was also included. Periodontal tissue biopsies and oral fluid samples, including saliva and gingival crevicular fluid, were analyzed to investigate the expression and synthesis of proteins involved in the formation of tight junctions.

The reviewed studies included volunteers with clinically healthy periodontal tissues as well as patients with inflammatory periodontal diseases (IPD). Individuals with a history of periodontal surgery were excluded to ensure the reliability of the findings. Reviews and meta-analyses, studies involving children younger than 18 years, studies focused on non-inflammatory periodontal disorders, investigations of antimicrobial peptides in blood serum, and studies examining antimicrobial peptide expression in systemic inflammatory syndromes were excluded from the analysis.

Previous investigations have demonstrated that the oral microbiota changes dynamically during infectious diseases. Periodontitis develops as a consequence of oral dysbiosis mediated through multiple molecular pathways. Recent studies have emphasized the importance of interactions among the immune system, oral microorganisms, and epithelial cells in maintaining the stability and integrity of the oral mucosa. Alterations in mucosal microbiota may influence both innate and adaptive immune responses. A reduction in symbiotic microorganisms and/or an increase in pathobionts (symbiotic bacteria with pathogenic potential) contribute to the initiation of inflammation. Microorganisms affect immune responses by regulating the activity of regulatory T-cells (Treg) and T-helper 17 cells (Th17), which play critical roles in immune regulation [22–24].

The epithelium, functioning as the body's first line of defense, is capable of recognizing and interacting with microbial communities. Imbalances in microbiota composition and associated metabolic alterations may compromise the barrier function of the mucosal epithelium [25, 26].

ANALYSIS AND RESULTS

Epithelial–mesenchymal transition (EMT) is characterized by the transformation of epithelial cells into mesenchymal-like cells and is associated with overexpression of mesenchymal markers, including vimentin, N-cadherin, Snail1, and Twist1, as well as downregulation of epithelial markers such as E-cadherin [55–58]. Periodontal pathogens, particularly Gram-negative bacteria such as *Porphyromonas gingivalis* and *Fusobacterium nucleatum*, are capable of inducing EMT in oral epithelial cells, resulting in reduced barrier function, increased cellular motility, and loss of intercellular adhesion [58–60].

Analysis of the reviewed studies revealed important findings regarding bacterial species, mechanisms regulating epithelial barrier permeability, and the molecular pathways underlying barrier function. Multiple mechanisms through which beneficial microorganisms influence the barrier properties of the gingival epithelium were identified. Beneficial bacteria contribute to periodontal health through two primary mechanisms. First, they stimulate the host immune system to produce antimicrobial peptides (AMPs), which help eliminate pathogens. Second, certain beneficial microorganisms possess intrinsic antibacterial properties that strengthen the epithelial barrier and inhibit pathogenic microorganisms. Together, these processes enhance the protective function of the gingival epithelium.

The integrity of the physiological barrier becomes compromised when pathogenic oral bacteria penetrate the gingival sulcus epithelium. Their presence disrupts metabolic balance and increases tissue permeability. Because gingival sulcus epithelial cells undergo rapid renewal within approximately 6–12 days, damaged tissues may be replaced relatively quickly. In addition to neutrophil-mediated degradation, numerous studies have investigated the role of periodontopathogenic microorganisms and their toxins in epithelial barrier destruction. In vitro investigations demonstrated that exposure to bacterial lipopolysaccharide (LPS) reduces claudin-1 expression following junctional epithelium (JE) exposure, thereby aggravating epithelial barrier disruption.

Recent evidence indicates that the virulence proteins of *P. gingivalis* can degrade E-cadherin, a key molecule required for maintaining gingival epithelial integrity. Such damage disrupts epithelial defense mechanisms



under laboratory conditions. These findings highlight the important role of bacterial modulation of epithelial barrier function in the development and progression of periodontal diseases.

Recent studies also suggest that medications, dietary supplements, and metabolites may help preserve gingival epithelial integrity. For example, irsogladine maleate functions as an anti-ulcer agent and protects gingival epithelium from periodontopathogen-induced injury by preventing degradation of E-cadherin and claudin-1 proteins. Furthermore, vitamins C and E may restore E-cadherin expression in gingival epithelial cells infected with *P. gingivalis*. Polyphenols contained in green tea have also been shown to enhance the synthesis of tight junction-associated proteins, including occludin and ZO-1, in gingival keratinocytes infected with *P. gingivalis*.

Tight junctions are dynamic structures that continuously respond to environmental influences rather than remaining static. These influences include external factors such as dietary components, viruses, and commensal microorganisms, as well as internal factors such as growth hormones and cytokines [54]. More than 40 proteins associated with tight junctions, including claudins, occludins, and ZO-1, have been identified [50]. Another study demonstrated that catechin improves the integrity of the oral epithelial barrier, most likely through enhanced expression and redistribution of ZO-1 and occludin proteins. ZO-1, a major tight junction component, directly interacts with cytoplasmic actin and occludin proteins that form transmembrane tight junction complexes [51].

The discovery of tight junctions (TJs) became possible through transmission electron microscopy in 1963, revealing their role in establishing close intercellular connections. Research demonstrated their localization within epithelial intercellular spaces and their association with paracellular transport systems. Freeze-fracture electron microscopy further revealed that TJs form interconnected filamentous networks extending across superficial and deep epithelial layers. Studies also demonstrated a strong relationship between TJ strand morphology and epithelial barrier function, which can be evaluated through transepithelial electrical resistance (TER) measurements in intestinal epithelial cells. Tight junctions are now recognized as protein complexes that maintain intercellular integrity at the apical surface and reinforce epithelial barrier function.

The first identified tight junction protein, ZO-1, was discovered in 1986. Cingulin was identified as a peripheral tight junction protein in 1989. The discovery of occludin in 1993 represented a major breakthrough, as it became recognized as the first transmembrane protein essential for tight junction barrier formation. Subsequent studies identified additional transmembrane proteins associated with the TJ complex, including claudins, junctional adhesion molecules (JAMs), membrane-associated domain proteins such as MarvelD3, and proteins associated with vesicular trafficking and MAL-related pathways. Certain tight junction proteins, including claudin-2 and claudin-15, contribute to the formation of paracellular pores that permit the physiological passage of water and ions through enterocytes. Disruption of epithelial barrier function may initiate a pathological cycle in which immune responses further aggravate inflammatory processes and contribute to disease progression [31].

One of the major determinants of epithelial barrier function is permeability, which depends on the structural organization and molecular composition of tight junctions. Tight junctions are dynamic structures formed through interactions among proteins located on the apical membrane surface. Some proteins function as cytoplasmic scaffolds, whereas others span the membrane. According to the number of transmembrane domains, TJ proteins are classified into several groups:

- single-span proteins such as JAM, Crb3, and CAR;
- three-span proteins such as BVES;
- and tetraspan proteins including claudins, occludin, tricellulin, MarvelD3, and tight junction-associated MARVEL proteins (TAMPs).

Experimental studies on JAM, occludin, claudin, and tricellulin have demonstrated their crucial role in regulating epithelial tight junction permeability. As members of the immunoglobulin superfamily, JAM proteins play essential roles in epithelial and endothelial adhesion and permeability. Four major JAM isoforms have been identified: JAM-A, JAM-B, JAM-C, and JAM-4. However, the precise role of JAM-4 within tight junction structures remains insufficiently understood [44].

CONCLUSION AND RECOMMENDATIONS

Analysis of the available evidence demonstrates that tight junctions play a critical role in the early antimicrobial defense mechanisms of periodontal tissues. Increased epithelial permeability may facilitate the penetration of microbial pathogens through the epithelial barrier. This process can lead to disruption of the oral microflora balance, aggravation of gingival sulcus epithelial damage, and progression of periodontal inflammation.

References:

1. Ковалевский А.М., Ушакова А.В., Ковалевский В.А., Прожерина Е.Ю. Бактериальная биопленка пародонтальных карманов: пересмотр опыта пародонтологии // Пародонтология. 2018;23(2):15–21. doi: 10.25636/PMР.1.2018.2.3
2. Ипполитов Е.В., Николаева Е.Н., Царев В.Н. Оральная биопленка: индукторы сигнальных путей иммунитета // Стоматология. 2017;96(4):58–62. doi: 10.17116/stomat201796458-62
3. Царев В.Н., Николаева Е.Н., Ипполитов Е.В. Периодонтопатогенные бактерии как один из основных факторов возникновения и развития пародонтита // Журнал микробиологии, эпидемиологии и иммунобиологии. 2017;94(5):101–112. doi: 10.36233/0372-9311-2017-5-101-112
4. Bosshardt DD, Lang NP. The junctional epithelium: from health to disease. *J Dent Res.* 2005;84(1):9–20. doi: 10.1177/154405910508400102
5. Bartold PM, Van Dyke TE. Host modulation: controlling the inflammation to control the infection. *Periodontology* 2000. 2017;75(1):317–329. doi: 10.1111/prd.12169
6. Слажнева Е.С., Тихомирова Е.А., Атрушкевич В.Г. Периодонтопатогены: новый взгляд. Систематический обзор. Часть 1 // Детская стоматология и стоматологическая профилактика. 2020;20(1):70–76. doi: 10.33925/1683-3031-2020-20-1-70-76
7. Dewhirst FE, Chen T, Izard J, Paster BJ, Tanner AC, Yu WH, et al. The human oral microbiome. *J Bacteriol.* 2010;192(19):5002–5017. doi: 10.1128/JB.00542-10
8. Тихомирова Е.А., Слажнева Е.С., Атрушкевич В.Г. β-дефенсины и воспалительные заболевания пародонта: систематический обзор // Пародонтология. 2020;25(4):276–286. doi: 10.33925/1683-3759-2020-25-4-276-286
9. Katz J, Sambandam V, Wu JH, Michalek SM, Balkovetz DF. Characterization of Porphyromonas gingivalis-induced degradation of epithelial cell junctional complexes. *Infect Immun.* 2000;68(3):1441–1449. doi: 10.1128/IAI.68.3.1441-1449.2000
10. Lagha AB, Groeger S, Meyle J, Grenier D. Green tea polyphenols enhance gingival keratinocyte integrity and protect against invasion by Porphyromonas gingivalis. *Pathog Dis.* 2018;76(4):fty030. doi: 10.1093/femspd/fty030
11. Katz J, Yang Q, Zhang P, Potempa J, Travis J, Michalek SM, et al. Hydrolysis of epithelial junctional proteins by Porphyromonas gingivalis gingipains. *Infect Immun.* 2002;70(5):2512–2518. doi: 10.1128/IAI.70.5.2512-2518.2002
12. Abe-Yutori M, Chikazawa T, Shibasaki K, Murakami S. Decreased expression of E-cadherin by Porphyromonas gingivalis lipopolysaccharide attenuates epithelial barrier function. *J Periodontol Res.* 2017;52(1):42–50. doi: 10.1111/jre.12367
13. Guo W, Wang P, Liu ZH, Ye P. Analysis of differential expression of tight junction proteins in cultured oral epithelial cells altered by Porphyromonas gingivalis, Porphyromonas gingivalis lipopolysaccharide, and extracellular adenosine triphosphate. *Int J Oral Sci.* 2018;10(1):1–7. doi: 10.1038/ijos.2017.51
14. Amano A. Disruption of epithelial barrier and impairment of cellular function by Porphyromonas gingivalis. *Front Biosci.* 2007;6:3965–3974. doi: 10.2741/2363
15. Nakagawa I, Amano A, Inaba H, Kawai S, Hamada S. Inhibitory effects of Porphyromonas gingivalis fimbriae on interactions between extracellular matrix proteins and cellular integrins. *Microbes Infect.* 2005;7(2):157–163. doi: 10.1016/j.micinf.2004.10.007
16. Fujita T, Ashikaga A, Shiba H, Uchida Y, Hirono C, Iwata T, et al. Regulation of IL-8 by irsogladine maleate is involved in abolishment of Actinobacillus actinomycetemcomitans-induced reduction of gap-junctional intercellular communication. *Cytokine.* 2006;34(5–6):271–277. doi: 10.1016/j.cyto.2006.06.002
17. Noguchi T, Shiba H, Komatsuzawa H, Mizuno N, Uchida Y, Ouhara K, et al. Syntheses of prostaglandin E2 and E-cadherin and gene expression of β-defensin-2 by human gingival epithelial cells in response to Actinobacillus actinomycetemcomitans. *Inflammation.* 2003;27(6):341–349. doi: 10.1023/B:IFLA.0000006702.27906.e9
18. Uchida Y, Shiba H, Komatsuzawa H, Hirono C, Ashikaga A, Fujita T, et al. Irsogladine maleate influences the response of gap-junctional intercellular communication and IL-8 of human gingival epithelial cells following periodontopathogenic bacterial challenge. *Biochem Biophys Res Commun.* 2005;333(2):502–507. doi: 10.1016/j.bbrc.2005.05.197
19. Damek-Poprawa M, Korostoff J, Gill R, Dirienzo JM. Cell junction remodeling in gingival tissue exposed to a microbial toxin. *J Dent Res.* 2013;92(6):518–523. doi: 10.1177/0022034513486807
20. Uitto VJ, Pan YM, Leung WK, Larjava H, Ellen RP, Finlay BB, et al. Cytopathic effects of Treponema denticola chymotrypsin-like proteinase on migrating and stratified epithelial cells. *Infect Immun.* 1995;63:3401–3410. doi: 10.1128/iai.63.9.3401-3410.1995
21. Galea I. The blood–brain barrier in systemic infection and inflammation. *Cell Mol Immunol.* 2021;18(11):2489–2501. doi: 10.1038/s41423-021-00757-x
22. Hijazi K, Lowe T, Meharg C, Berry SH, Foley J, Hold GL. Mucosal microbiome in patients with recurrent aphthous stomatitis. *J Dent Res.* 2015;94(3 Suppl):87S–94S. doi: 10.1177/0022034514565458
23. Pat Y, Yazici D, D'Avino P, Li M, Ardici S, Ardici O, et al. Recent advances in the epithelial barrier theory. *Int Immunol.* 2024;36(5):211–222. doi: 10.1093/intimm/dxae002
24. Kempuraj D, Thangavel R, Selvakumar GP, Zaheer S, Ahmed ME, Raikwar SP, et al. Brain and peripheral atypical inflammatory mediators potentiate neuroinflammation and neurodegeneration. *Front Cell Neurosci.* 2017;11:216. doi: 10.3389/fncel.2017.00216
25. Vitkov L, Singh J, Schauer C, Minnich B, Krunic J, Oberthaler H, et al. Breaking the gingival barrier in periodontitis. *Int J Mol Sci.* 2023;24(5):4544. doi: 10.3390/ijms24054544



26. Stehlikova Z, Tlaskal V, Galanova N, Roubalova R, Kreisinger J, Dvorak J, et al. Oral microbiota composition and antimicrobial antibody response in patients with recurrent aphthous stomatitis. *Microorganisms*. 2019;7(12):636. doi: 10.3390/microorganisms7120636
27. Su SC, Chang LC, Huang HD, Peng CY, Chuang CY, Chen YT, et al. Oral microbial dysbiosis and its performance in predicting oral cancer. *Carcinogenesis*. 2021;42(1):127–135. doi: 10.1093/carcin/bgaa062
28. Tsukita S, Furuse M. Overcoming barriers in the study of tight junction functions: from occludin to claudin. *Genes Cells*. 1998;3(9):569–573. doi: 10.1046/j.1365-2443
29. Verma D, Garg PK, Dubey AK. Insights into the human oral microbiome. *Arch Microbiol*. 2018;200(4):525–540. doi: 10.1007/s00203-018-1505-3
30. Yang CY, Yeh YM, Yu HY, Chin CY, Hsu CW, Liu H, et al. Oral microbiota community dynamics associated with oral squamous cell carcinoma staging. *Front Microbiol*. 2018;9:862. doi: 10.3389/fmicb.2018.00862
31. Yang J, Ran M, Li H, Lin Y, Ma K, Yang Y, et al. New insight into neurological degeneration: inflammatory cytokines and blood–brain barrier. *Front Mol Neurosci*. 2022;15:1013933. doi: 10.3389/fnmol.2022.1013933
32. Yang SF, Huang HD, Fan WL, Jong YJ, Chen MK, Huang CN, et al. Compositional and functional variations of oral microbiota associated with mutational changes in oral cancer. *Oral Oncol*. 2018;77:1–8. doi: 10.1016/j.oraloncology.2017.12.005
33. Moutsopoulos NM, Konkel JE. Tissue-specific immunity at the oral mucosal barrier. *Trends Immunol*. 2018;39(4):276–287. doi: 10.1016/j.it.2017.08.005
34. Ronay V, Belibasakis GN, Schmidlin PR, Bostanci N. Infected periodontal granulation tissue contains cells expressing embryonic stem cell markers: a pilot study. *Schweiz Monatsschr Zahnmed*. 2013;123(1):12–16. doi: 10.5167/uzh-77307
35. Dabija-Wolter G, Cimpan MR, Costea DE, Johannessen AC, Sørnes S, Neppelberg E, et al. *Fusobacterium nucleatum* enters normal human oral fibroblasts in vitro. *J Periodontol*. 2009;80(7):1174–1183. doi: 10.1902/jop.2009.090051
36. Dutzan N, Konkel JE, Greenwell-Wild T, Moutsopoulos NM. Characterization of the human immune cell network at the gingival barrier. *Mucosal Immunol*. 2016;9(5):1163–1172. doi: 10.1038/mi.2015.136
37. Tribble GD, Lamont RJ. Bacterial invasion of epithelial cells and spreading in periodontal tissue. *Periodontology 2000*. 2010;52(1):68–83. doi: 10.1111/j.1600-0757.2009.00323
38. Akiyama SK, Olden K, Yamada KM. Fibronectin and integrins in invasion and metastasis. *Cancer Metastasis Rev*. 1995;14(3):173–189. doi: 10.1007/BF00690290
39. Ye P, Yu H, Simonian M, Hunter N. Expression patterns of tight junction components induced by CD24 in an oral epithelial cell-culture model correlated to affected periodontal tissues. *J Periodontal Res*. 2014;49(2):253–259. doi: 10.1111/jre.12102
40. Moonwiryakit A, Pathomthongtaweetchai N, Steinhagen PR, Chantawichitwong P, Satianrapapong W, Pongkorp-sakol P. Tight junctions: from molecules to gastrointestinal diseases. *Tissue Barriers*. 2023;11(2):2077620. doi: 10.1080/21688370.2022.2077620
41. Dabija-Wolter G, Bakken V, Cimpan MR, Johannessen AC, Costea DE. In vitro reconstruction of human junctional and sulcular epithelium. *J Oral Pathol Med*. 2013;42(5):396–404. doi: 10.1111/jop.12005
42. Fujita T, Kishimoto A, Shiba H, Hayashida K, Kajiya M, Uchida Y, et al. Irsogladine maleate regulates neutrophil migration and E-cadherin expression in gingival epithelium stimulated by *Aggregatibacter actinomycetemcomitans*. *Biochem Pharmacol*. 2010;79(10):1496–1505. doi: 10.1016/j.bcp.2010.01.017
43. Hartmann C, Schwietzer YA, Otani T, Furuse M, Ebnet K. Physiological functions of junctional adhesion molecules (JAMs) in tight junctions. *Biochim Biophys Acta Biomembr*. 2020;1862(9):183299. doi: 10.1016/j.bbamem.2020.183299

- 
- 13.00.00 Pedagogika fanlari
 - 13.00.01 Pedagogika nazariyasi. Pedagogik ta'limotlar tarixi
 - 13.00.02 Ta'lim va tarbiya nazariyasi va metodikasi (sohalar bo'yicha)
 - 13.00.03 Maxsus pedagogika
 - 13.00.04 Jismoniy tarbiya va sport mashg'ulotlari nazariyasi va metodikasi
 - 13.00.05 Kasb-hunar ta'limi nazariyasi va metodikasi
 - 13.00.06 Elektron ta'lim nazariyasi va metodikasi (ta'lim sohaları va bosqichlari bo'yicha)
 - 13.00.07 Ta'limda menejment
 - 13.00.08 Maktabgacha ta'lim va tarbiya nazariyasi va metodikasi
 - 13.00.09 Ijtimoiy pedagogika
 - 07.00.00 Tarix fanlari
 - 19.00.00 Psixologiya fanlari
 - 01.00.00 Fizika-matematika fanlari
 - 02.00.00 Kimyo fanlari
 - 03.00.00 Biologiya fanlari
 - 09.00.00 Falsafa fanlari
 - 10.00.00 Filologiya fanlari
 - 11.00.00 Geografiya fanlari



MAKTABGACHA VA MAKTAB TA'LIMI

Mas'ul muharrir: Ramzidin Ashurov

Ingliz tili muharriri: Murod Xoliyorov

Musahhih: Alibek Zokirov

Sahifalovchi va dizayner: Iskandar Islomov

2026. №5(2)

© Materiallar ko'chirib bosilganda "Maktabgacha va maktab ta'limi" jurnali manba sifatida ko'rsatilishi shart. Jurnalda bosilgan material va reklamalardagi dalillarning aniqligiga mualliflar ma'sul. Tahririyat fikri har vaqt ham mualliflar fikriga mos kelamasligi mumkin. Tahririyatga yuborilgan materiallar qaytarilmaydi.

"Maktabgacha va maktab ta'limi" jurnali 26.09.2023-yildan O'zbekiston Respublikasi Prezidenti Adminstratsiyasi huzuridagi Axborot va ommaviy kommunikatsiyalar agentligi tomonidan №C-5669363 reyestr raqami tartibi bo'yicha ro'yxatdan o'tkazilgan.
Litsenziya raqami: № 136361.

Manzirimiz: Toshkent shahar, Yunusobod tumani
19-mavze, 17-uy.