ence: An introduction to materials in medicine. 2nd ed. San Diego: Elsevier Academic Press. P. 304.
*Naldini A., Pucci A., Bernini C., Carraro F.*2003. Regulation of angiogenesis by Th1- and Th2-type cytokines. Curr. Pharm. Des. V. 9. P. 511. https://doi.org/10.2174/1381612033391423
Nepola J.V. 1996. External fixation. In: Rockwood and green's fractures in adults. 4th ed. Philadelphia: Lippincott–Raven. P. 229.
Pucci N.A., Bernini C., Carraro F. 2003. Regulation of angiogenesis by Th1- and Th2-type cytokines. Curr. Pharm. Des. V. 9. P. 511. https://doi.org/10.2174/1381612033391423
Schell H., Duda G.N., Peters A., Tsitsilonis S., Johnson K.A., Schmidt-Bleek K. 2017.The haematoma and its role in bone healing. J. Exp. Orthop. 4: 5. https://doi.org/10.1186/s40634-017-0079-3
Tite T., Popa A.C., Balescu L.M., Bogdan I.M., Pasuk I., Ferreira J.M.F., Stan G.E. 2018. Cationic substitutions in hydroxyapatite: Current status of the derived biofunctional effects and their *in vitro* interrogation methods. Materials. V. 11. P. 2081. https://doi.org/10.3390/ma11112081
Van den Broek L.J., Kroeze K.L., Waaijman T., Breetveld M., Sampat-Sardjoepersad S.C., Niessen F.B., Middelkoop E., Scheper R.J., Gibbs S. 2014. Differential response of human adipose tissue-derived mesenchymal stem cells, dermal fibroblasts, and keratinocytes to burn wound exudates: potential role of skin-specific chemokine CCL27. Tiss. Eng. (A). V. 20. P. 197. https://doi.org/10.1089/ten.TEA.2013.0123
Wang X., Lennartz M. R., Loegering D.J., Stenken J. A. 2008. Multiplexed cytokine detection of interstitial fluid collected from polymeric hollow tube implants – A feasibility study. Cytokine. V. 43. P. 15. https://doi.org/10.1016/j.cyto.2008.04.009
Yuan H., van Blitterswijk C.A., de Groot K., de Bruijn J.D. 2006. Cross-species comparison of ectopic bone formation in biphasic calcium phosphate (BCP) and hydroxyapatite (HA) scaffolds. Tiss. Eng. V. 12. P. 1607. https://doi.org/10.1089/ten.2006.12.1607
Yuan Y., Chen X., Zhang L., Wu J., Guo J., Zou D., Chen B., Sun Z., Shen C., Zou J. 2016. The roles of exercise in bone remodeling and in prevention and treatment of osteoporosis. Prog. Biophys. Mol. Biol. V. 122. P. 122. https://doi.org/10.1016/j.pbiomolbio.2015.11.005
Yuan Y., Li H., Liao Y., Feng C. 2019. $CD8^+$ T cells are involved in early inflammation before macrophages in a rat adipose tissue engineering chamber model. J. Tiss. Eng. Regen. Med. V. 13. P. 1499. https://doi.org/10.1002/term.2836
Zheng Z.W., Chen Y.H., Wu D.Y., Wang J.B., Lv M.M., Wang X.S., Sun J., Zhang Z.Y. 2018. Development of an accurate and proactive immunomodulatory strategy to improve bone substitute material-mediated osteogenesis and angiogenesis. Theranostics. V. 8. P. 5482. https://doi.org/10.7150/thno.28315

Morphofunctional Reaction of T Lymphocytes on *in vitro* Contact with Calcium Phosphate Coating in the Presence of T-cell Activation Kit

L. S. Litvinova[a, *], E. S. Melashchenko[a], O. G. Khaziakhmatova[a], K. A. Yurova[a], Yu. P. Sharkeev[b, c], E. G. Komarova[c], M. B. Sedelnikova[c], N. M. Todosenko[a], and I. A. Khlusov[a, d, e]

[a] *Center for Immunology and Cell Biotechnology, Immanuel Kant Baltic Federal University, Kaliningrad, 236041 Russia*
[b] *Research School of High-Energy Physics, National Research Tomsk Polytechnic University, Tomsk 634050 Russia*
[c] *Institute of Strength Physics and Materials Science of the Siberian Branch of the Russian Academy of Sciences, Tomsk, 634055 Russia*
[d] *Morphology and General Pathology Department, Siberian State Medical University, Tomsk, 634050 Russia*
[e] *Research School of Chemistry and Applied Biomedical Sciences, National Research Tomsk Polytechnic University, Tomsk 634050 Russia*
**e-mail: larisalitvinova@yandex.ru*

Morphofunctional activity of T lymphocytes *in vitro* contacted with calcium phosphate (CP) coating in the presence of particles with antibodies to CD2, CD3 and CD28 antigens has been studied. VT1-0 titanium plates ($10 \times 10 \times 1$ mm^3) with a bilateral micro-arc rough (index $R_a = 2–5$ μm) CP coating were used as a model samples to imitate the bone mineral matrix. MACSiBead™ magnetic particles of T-Cell Activation/Expansion Kit human with monoclonal antibodies to CD2, CD3 and CD28 antigens (T-cell activator, TCA) employed to simulate antigen-presenting cell (APC) signaling. Human blood mononuclear cells (hBMNCs; 98.8% of $CD45CD3^+$ cells) were cultivated in the presence of the CP-coated samples and/or TCA (2×10^6 particles per 1.5 ml of nutrient medium with a mixture of cells in a ratio of 2 : 1) for 2 and 14 days. CP coating and TCA synergistically triggered *in vitro* adaptation of hBMNC culture *via* the mechanisms of hyperactivation and subsequent death of T lymphocytes. An immunoselection was conditioned by the accumulation of $CD45RA^+/RO^+$ naive T lymphocytes and memory T cells and the simultaneous depletion of the pool of $CD4^+$ and $CD8^+$ T cells. Changing of T cell subsets was accompanied by enhanced cell secretion in 2 days versus its deprivation in 14 days of investigation. CP coating supported, as compared with cell culture on plastics the secretory capacity of lymphocytes Th1 (IL-12, TNFα, IFNγ) and Th2 (IL-4, IL-6, IL-10, IL-13). At the same time, a prolonged TCA signal after 48 hours of activation led to depletion of morphofunctional activity of T cells. A hypothesis that the effects found *in vitro* could be important in switching of signaling between T lymphocytes, APC, and CP materials at the cell/foreign body interface is discussed. A change in the phases of inflammation/regeneration, the development of immune tolerance, successful osseointegration of implants or impaired bone tissue remodeling may be an outcomes of such cellular-molecular crosstalk.

Keywords: human blood mononuclear leukocytes, short-term and prolonged cultures, viability, immunophenotype, cytokines, anti-CD2CD3CD28 beads, micro-arc calcium phosphate coating