# Progress in Fascial Network Research

János Pálhalmi[1], Lin Yuan[2], József Bódis[3, CA]

[1]East-West BioMedicine Research-Development and Healthcare Ltd., Hungary.

[2]Southern Medical University, Guangzhou, China.

[3]University of Sciences, Pécs, Hungary.

**Summary**

The fascia framework is supposed to be an information transmission channel and is composed of variety of cells, fibres and extracellular matrix components. This system is responsible for the support and regeneration of the functional, differentiated cells of the body and for regulating the internal environment. The theory of fasciology sheds light on the mechanisms of the stimulative therapies, like acupuncture and Chinese massage, which deliver mechanical stimulation of the subcutaneous fascia and connective tissues to cause responses of specific functional cells and hence result in observable therapeutic effects. The newest findings based on the molecular and electrophysiological reactivity of the connective tissue system will be discussed in the article.

Keywords: fascia, connective tissue, acupuncture, meridians, cell signalling.

Fejlődés a kötőszövetes Mátrix kutatásban

**Összefoglalás**

A fascia hálózatról feltételezik, hogy az egy információ-átvivő rendszer, mely sejtek, rostok és extracellularis matrix elemek változataiból tevődik össze és amely rendszer felelős a test diffreenciált funkcionális sejtjeinek támogatásáért és regenerációjáért, a belső környezet szabályozásáért. A "fasciológia" elmélet világít rá az olyan stimulatív terápiáknak mechanizmusaira, mint az akupunktúra és a kínai masszázs. Ezek mechanikus stimulációt fejtenek ki a szubkután fasciákra és kötőszövetre, hogy azok választ váltsanak ki a funkcionális sejtekben és ezáltal okozzanak érzékelhető terápiás hatásokat.
A közlemény a kötőszöveti rendszer molekuláris és elektrofiziológiai reaktivitásával kapcsolatos legújabb kutatási eredményeken alapszik.

Kulcsszavak: fascia, kötőszövet, akupunktúra, csúcspont, sejt jelzés

References

1. Fei L, Cheng HS, Cai DH, et al. The meridian material basis and functional characteristics of the experimental exploration and research prospect *Chin Sci Bull, 1998, 43 (06): 658-72.*

2. Langevin HM, Yandow JA. Relationship of acupuncture points and meridians to connective tissue planes. *Anat Rec, 2002, 269(6): 257-65.*

3. Palhalmi J, Bai Y, Yuan L. Integrative approaches in the research of fascial network for a better understanding of traditional Chinese medicine mechanisms. *Journal of Chinese Integrative Medicine (Zhong Xi Yi Jie He Xue Bao) February 2010, Vol.8, No.2.*

4. Dang RS, Chen EY, Shen XY, et al. The relationship between Lung meridian acupoints and connective tissue structure *Shanghai Acupunct, 1997, 16 (04): 28-9.*

5. Ding GH, Yang J, Chen EY, et al. Human tissue fluid directional flow and meridian. *Prog Nat Sci, 2001, 8: 29-36.*

6. Langevin HM, Churchill DL, Wu J, et al. Evidence of connective tissue involvement in acupuncture. *FASEB J, 2002, 16(8): 872-4.*

7. Langevin HM, Cornbrooks CJ, Taatjes DJ. Fibroblasts form a body-wide cellular network. *Histochem Cell Biol, 2004, 122(1): 7-15.*

8. Langevin HM, Rizzo DM, Fox JR, et al. Dynamic morphometric characterization of local connective tissue network structure in humans using ultrasound. *BMC Syst Biol, 2007, 1: 25.*

9. Konofagou EE, Langevin HM. Using ultrasound to understand acupuncture. Acupuncture needle manipulation and its effect on connective tissue. *IEEE Eng Med Biol Mag, 2005, 24(2): 41-6.*

10. Langevin HM. Connective tissue: a body-wide signaling network? *Med Hypotheses, 2006, 66(6): 1074-7.*

11. Wang J, Dong WR, Wang CL, et al. From meridians and acupoints to self-supervision and control system: a hypothesis of the 10th functional system based on anatomical studies of digitized virtual human. *South Med Univ, 2007, 27(5): 573-9.*

12. Bai Y, Yuan L, Soh KS, Lee BC, Huang Y, Wang CL, Wang J, Wu JP, Dai JX, Palhalmi J, Sha O, Yew DT. Possible applications for fascial anatomy and fasciaology in traditional Chinese medicine.
*Journal of Acupuncture and Meridian Studies. 2010 Jun; 3(2):125-32.*

13. Yuan Lin The theory of fasciology. *Fasciology Journal, Guangzhou University. Vol.1. July 30, 2011.*

14. Langevin HM, Churchill DL, Cipolla MJ. Mechanical signaling through connective tissue: a mechanism for the therapeutic effect of acupuncture. *Faseb J, 2001, 15(12): 2275-82.*

15. Wang J, Wang CL, Shen BL, et al. Explanation of essence and substance basis of channels and collaterals with fasciology. *Zhongguo Zhen Jiu, 2007, 27(8): 583-5.*

16. Huang Y, Yuan L, He ZQ, et al. Study on the meridians and acupoints based on fasciaology: an elicitation of the study on digital human being. *Zhongguo Zhen Jiu, 2006, 26 (11): 785-8.*

17. H. M. Langevin Connective tissue: A body-wide signaling network? *Fascia Congress 2009, Amsterdam. Pre reviewed Presentation.*

18. T. W. Myers Anatomy trains of myofascial meridians. *Elsevier Limited. 2009.*

19. A. Szent-Györgyi The study of energy-levels in biochemistry. *Nature 148 (1941) pp. 157-159*

20. F. W. Cope. A review of the applications of solid state physics concepts to biological systems.
*Jornal of Biol Phys. 3 (1975) pp. 1-41.*

21. C.T. Chen, R.P. McCabe, A.J. Grodzinsky, R. Vanderby Transient and cyclic responses of strain-generated potential in rabbit patellar tendon are frequency and pH dependent. *Journal of Biomech. Engineering. 122 (2000) (5) pp. 465-470*

22. W.M.Lai, V.C.Mow, D.D. Sun, G.A. Ateshian On the electric potentials inside a charged soft hydrated biological tissue: streaming potentials versus diffusion potential. *Journal of Biomech. Engineering. 122 (2000) (4) pp. 336-346*

23. Y.J. Kim, L.J. Bonassar, A.J. Grodzinsky The role of cartilage streaming potential, fluid flow and pressure in the stimulation of chondrocyte biosynthesis during dynamic compression. *J Biomech. 28 (1995) (9) pp. 1055-1066*

24. Ahn AC, Wu J, Badger GJ, et al. Electrical impedance along connective tissue planes associated with acupuncture meridians. *BMC Complement Altern Med, 2005, 5: 10.*

25. Lee MS, Jeong SY, Lee YH, et al. Differences in electrical conduction properties between meridians and non-meridians. *Am J Chin Med, 2005, 33(5): 723-8.*

26. Kumar A, Murphy R, Robinson P, et al. Cyclic mechanical strain inhibits skeletal myogenesis through activation of focal adhesion kinase, Rac-1 GTPase, and NF-kappaB transcription factor.
*FASEB J, 2004, 18(13): 1524-35.*

27. Qiu XZ, Li XN, Chen WY, et al. Effect of cycling stretch on the proliferation of C2 C12 myoblasts. *Chin J Clin Anat, 2006, 24(2): 183-5.*

28. Clark CB, McKnight NL, Frangos JA. Stretch activation of GTP-binding proteins in C2C12 myoblasts. *Exp Cell Res, 2004, 292(2): 265-73.*

29. Lin Yuan Acupuncture stimulation and the fascial tonus regulation. *Fasciology Congress 2010, Guangzhou, China.*
30. Rockwell WB, Cohen IK, Ehrlich HP. Keloids and hypertrophic scars: a comprehensive review. *Plast Reconstr Surg, 1989, 84(5): 827-37.*
31. Jiang XM, Yang C, Yuan L, et al. Expression of extracellular signal-regulated protein kinases in the subcutaneous fascia of rats and their changes after acupuncture. *J South Med Univ, 2009, 29(4): 623-6.*
32. Werry TD, Christopoulos A, Sexton PM. Mechanisms of ERK1/2 regulation by seven-transmembrane-domain receptors. *Curr Pharm Des, 2006, 12(14): 1683-702.*
33. Boulton TG, Nye SH, Robbins DJ, et al. ERKs: A family of protein-serine/threonine kinases that are activated and tyrosine phosphorylated in response to insulin and NGF. *Cell, 1991, 65(4): 663-75.*
34. Guyton KZ, Liu Y, Gorospe M, et al. Activation of mitogen-activated protein kinase by H2O2. Role in cell survival following oxidant injury. *J Biol Chem, 1996, 271 (8): 4138-42.*
35. Whelchel A, Evans J, Posada J. Inhibition of ERK activation attenuates endothelin-stimulated airway smooth muscle cell proliferation. *Am J Respir Cell Mol Biol, 1997, 16(5): 589-96.*
36. Inoue D, Kido S, Matsumoto T. Transcriptional induction of FosB/DeltaFosB gene by mechanical stress in osteoblasts. *J Biol Chem, 2004, 279(48): 49795-49795803.*
37. Kumar A, Knox AJ, Boriek AM. CCAAT/enhancer-binding protein and activator protein-1 transcription factors regulate the expression of interleukin-8 through the mitogen- activated protein kinase pathways in response to mechanical stretch of human airway smooth muscle cells. *J Biol Chem, 2003, 278(21): 18868-76.*
38. Yuge L, Okubo A, Miyashita T, et al. Physical stress by magnetic force accelerates differentiation of human osteoblasts. *Biochem Biophys Res Commun, 2003, 311(1): 32-8.*
39. J. Ignacio Aguirre, Lilian I. Plotkin, Arancha R, et al. A novel ligand-independent function of the estrogen receptor is essential for osteocyte and osteoblast mechanotransduction. *J Biol Chem, 2007, 282(35): 25501-8.*
40. Cheng M, Wu J, Li Y, et al. Activation of MAPK participates in low shear stress-induced IL-8 gene expression in endothelial cells. *Clin Biomech, 2008, 23 (Suppl 1): S96-S103.*
41. JIANG Xue-mei, BAI Yu, Palhalmi Janos, YUAN Lin, HUNAG Yong, DAI Jing-xing, WANG Sheng-xu, David Tai Wai Yew: Modulatory effect of acupuncture on the extracellular signal-related kinase 1/2 (ERK1/2) and p38 mitogen-activated protein kinase (p38 MAPK) signaling pathways in the subcutaneous fascia. *Fasciology Journal, Guangzhou University. Vol.1. July 30, 2011.*
42. Boris Hinz: Masters and servants of the force: The role of matrix adhesions in myofibroblasts force perception and transmission. *Fascia Congress 2009, Amsterdam. Pre reviewed Presentation.*
43. Bai Yu, Janos Palhalmi, Huang Yong, Yang Chun, Lin Yuan: Research methods in fasciaology: implications for acupuncture meridianology. *Fasciology Journal, Guangzhou University. Vol.1. July 30, 2011.*
44. Li H, Han Y, Guo Q, et al. Cancer-expanded myeloid derived suppressor cells induce anergy of NK cells through membrane-bound TGF-beta 1. *J Immunol, 2009, 182(1): 240-9.*
45. Malays Mok PL, Cheong SK, Leong CF. In vitro differentiation study on isolated human mesenchymal stem cells. *J Pathol, 2008, 30(1): 11-9.*
46. Chu CY, Chang CC, Prakash E, et al. Connective tissue growth factor (CTGF) and cancer progression. *J Biomed Sci, 2008, 15(6): 675-85.*
47. Nonaka TS, Fujita T, Takahashi T, et al. TGF-beta1 and CTGF mRNAs are correlated with urinary protein level in IgA nephropathy. *J Nephrol, 2008, 21(1): 53-63.*
48. Iatridis JC, Wu J, Yandow JA, et al. Subcutaneous tissue mechanical behavior is linear and viscoelastic under uniaxial tension. *Connect Tissue Res, 2003, 44(5): 208-17.*
49. Langevin HM, Churchill DL, Wu J, et al. Evidence of connective tissue involvement in acupuncture. *FASEB J, 2002, 16(8): 872-4.*
50. Langevin HM, Vaillancourt PD. Acupuncture: does it work and, if so, how? *Semin Clin Neuropsychiatry, 1999, 4(3): 167-75.*
51. Leask A, Parapuram SK, Shi-Wen X, et al. Connective tissue growth factor (CTGF, CCN2) gene regulation: a potent clinical bio-marker of fibroproliferative disease? *J Cell Commun Signal, 2009, 3(2): 89-94.*
52. Wang Y, Maciejewski BS, Soto-Reyes D, et al. Mechanical stretch promotes fetal type II epithelial cell differentiation via shedding of HB-EGF and TGF-alpha. *J Physiol, 2009, 587(8): 1739-53.*
53. ZHANG Xue-quan, YANG Chun, DAI Jing-xing, QU Rong-mei, YUAN Lin: Effect of tensile load on cell proliferative activity in rat loose connective tissue. *Fasciology, Vol.1, July 30, 2011*
54. Dehnavi E, Soheili ZS, Samiei S, et al. The effect of TGF-beta2 on MMP-2 production and activity in highly metastatic human bladder carcinoma cell line 5637. *Cancer Invest，2009, 27(5): 568-74*
55. Janos Palhalmi: The scientific basis of acupuncture. *International congress of the Integrated biological regulation system (IBR Sys.) 2007 and 2008. Budapest.*