Abstract
Using the effect of mechanical forces affecting cellular response in the treatment of post-traumatic, postope-
rative, post-implantation conditions through the application of Endermologie® mechanotransduction represents a revolutionary solution in tissue-rehabilitation and positive target tissue influencing, with faster regeneration (1). Endermologie® is a noninvasive, painless, natural method of treatments of all connective tissue transformations, muscle and circulation pathologies. The aim of our study is investigation and explanation the mechanism of action by observing the physiological effects of Endermologie® based on human studies.

The paper is focused on monitoring of positive effect tissue regeneration using endermologie as a tools mechanostimulation improvements of systems integrity and health improvement..

Keywords
Endermologie®, connective tissue, mechanotrans-
duction, scar,

1 INTRODUCTION

More than 30 years ago, a new non-invasive and natural way to treat traumatic changes in connective tissue, skin and the like has been discovered, with a proven positive effect on the regeneration and rehabilitation of systemic tissues through mechanical cell stimulation.

End 70.r. In the 20th century, engineer Louis Paul Guitay suffered extensive skin injuries, muscles as a result of burns and scarring, resulting in increased adherence, tissue adhesion, loss of elasticity, momentum, attenuation of vascular and lymphatic circulation, increased stagnation of interstitial fluid, edema, fibrotic changes, decreased oxygenation of trophic tissues, and progression of degradation changes.

In order to streamline the therapeutic process, in order to maximize shortening of the rehabilitation and regeneration period, to standardize treatment at any time within circadian biorhythms (elimination of negative human factors such as fatigue, exhaustion, disparity in the administration of procedures by individuals within the day) Louiom P. Guitayom new system in terpai called "Endermológia®. in conjunction with mechanical forces and physiotherapy techniques to achieve a better effect, in less time and under uniform conditions than manual physiotherapy-rehabilitation techniques.

ENDERMOLOGY and LPG techniques
Endermológia® LPG® is a non-invasive, non-invasive, 100% natural, patented method of mechanical stimulation of cells, aimed at systemic tissue manipulation through application to the skin. Endermology represents interaction between the dosed vacuum and roller massage, controlled aspiratory force, frequency, controlled and controlled velocity and direction of roller movement.

Figure 1. Single motorized rollers ©LPG® Systems, 2004

LPG® cell mechano-stimulation is carried out by specific software-controlled monitored therapeutic heads, tissue-specific so- keymodules, equipped with unique rollers and flaps, allowing personalized skin care treatments using the exclusive patented Roll and Lift techniques.

The working head of the device with two completely independently driven and moving rollers (Fig. 1) creates a vacuum wave which moves forward, backward, sideways or diagonally by a self-propelled head, pulse aspirations. The rollers represent autonomous motorized units operating at their own speed and direction of movement. (Fig. 2)
Variation of combinations allows an infinite number of ways of rolling the skin depending on the type and condition, respectively. pathology of the treated tissue (Fig. 4). Depending on the method and speed of movement of the individual rollers relative to each other, and depending on the aspiration we distinguish the so-called Roll in (e.g., fat elimination, spasm, β-receptor stimulation on adipocytes, myorelaxation), Roll up (e.g., fastening, anti-dermatosis, myorelaxis), Roll out (eg elasticity, stiffness and tissue formation).

Post-transplant post-traumatic postoperative post-transplantation therapies use specific personalized protocols using LPG® Mechanostimulation with many benefits:

- 3x faster regeneration
- Non-invasive, painless, natural therapy
- Stimulation of vascular and lymphatic flow
- Increased tissue oxygenation, trophism
- Elimination of toxins, catabolites, lactic acid etc.
- Removing damages of the connective tissues, of the skin and muscles
- Elimination of edema, pain, fatigue, spasm, muscle contractions etc.

Proven effectiveness of Endermotherapy:

- Treatment of scars, burns
- Lymphedemas
- Venous insufficiency
- Fibromyalgia
- Indurations, edema, fibrosis
- Scleroderma,
- Sclerosis multiplex
- Obesity
- Increased muscular elasticity
- Detoxification of the muscles and connective tissues
- Increase in load tolerance
- Rehabilitation, regeneration, relaxation, vitality

The discovery of mechanical forces as possible cell growth regulators, respectively. degradation, and regeneration of the skeletal muscle and heart tissue are a major challenge in the field of cellular and tissue engineering. Mechanisms of mechanical signaling and cellular mechanotransduction will be explained to develop new therapies [2].

2 MECHANOTRANSDUCTION

Mechanotransduction leads to processes by which cells perceive mechanical stimuli and respond to them by converting them into biochemical signals resulting in a specific cellular response. Mechanical stimuli are known to be as important for cells as biochemical [3].

The mechanism of action of the mechanical forces affecting the cellular response that is important in the disease development process is not yet fully understood [4]. Recent studies [5] show that the mechanical stress of epithelial cells activates the transcription factors YAP1 and β-catenin, depending on the dose of cadherin, and causes cell cycle triggering with S phase progression.

Experimental findings [6] demonstrating the effect of substrate elasticity on direct directing of differentiation of human mesenchymal cells (hMSCs) into different lines (eg fibroblast osteoblastic, myoblastic) are of particular significance. There is evidence [7,8,9] that key mechanic regulators of cell adhesion, contractility, gene regulation, cell matrix interactions play actinomyosin fibers in hMSCs [7,18, 20, 21] whose structure and organization show significant differences in the early stages of mechanically induced differentiation (up to 24 hr) depending on substrate elasticity.

Recent studies [10] demonstrated, in addition to the effect of substrate elasticity on myoblast differentiation, that mechanical stimuli and possible changes in the
cytoskeletal structure play an important role in the differentiation of more than one cell type.

Experimental evidence [5, 19, 22, 23] also confirms that mechanical stimulation of cells transduces mechanical signals into transcriptional responses, and that transcriptional activity is important for cell cycle rebirth and progression.

3 SCIENTIFIC EFFECTS

The positive effect of Endermoterapie and LPG® techniques in cell and systemic stimulation processes was experimentally demonstrated in more as 140 scientific publications COSIRE (International Scientific Research Committee).

Significant progress in the treatment of classic treatment-resistant lymphoedema (MLD, manual lymph drainage) and statistically significant improvement in all parameters monitored after endermotherapy was reported in independent studies [11,12]. Micromium techniques have demonstrated the positive effect of LPG® on the superficial lymphatic network, measuring body fluid volumes demonstrated a statistically significant reduction in the size of edema, improvement in vascular and lymphatic circulation (Doppler).

In all types of endermotherapy, standardization, personification, shortening of duration and duration of treatment, permanent monitoring, prolonged positive effect were also demonstrated.

Priority applications in the treatment of burns (Fig. 5), scarring (Figures 6,7), muscles were applied in order to maximize the efficiency and shortening of treatment time, mobilization of individual traumatized tissues without pain, elimination of fibrotic barriers, adhesion, edema, elasticity, densities, oxygenation, and trophism of tissues have given rise to secondary applications in the field of endermoesthetics due to significant discoveries of increased cell proliferation of fibroblast cells and stimulation of lipolytic activity of adipocytes [14,15,16, 17].

Histologically and stereophotometrically, the positive effect of tangential enderm-stimulation of the facial skin has been demonstrated through the mechanical force induced in fibroblasts. In more than 80% of treated patients there was a significant clinical improvement in skin quality (tonus, turgor, edema and fat elimination) and structural changes in the papillary dermis (increased production of pro-collagen and pro-elastin fibers, compaction of collagen and elastin) increased elasticity, skin compactness, elimination of fibrotic changes, locally stored fat, wrinkle elimination [13, 25, 26, 27].

For over 30 years, LPG® has been the leader in connective tissue therapy. Lafontan [14, 15, 16] by microdialysis and DNA analysis of chips showed an increased lipolytic response to LPG® mechanotransduction, through increased activity by + 70% β-adipocyte receptors.

At the same time, the absence of inflammatory factors has been demonstrated, demonstrating that this highly effective therapy mobilizes fat metabolism without traumatic injury.

Humbert demonstrated that mechanical transduction of fibroblast cells stimulates their cellular activity: increases migration capacity (+ 14%), induces extracellular matrix remodeling (ECM), stimulates differentiation of fibroblasts into myofibroblasts [17, 28, 29].

Experimentally, LPG® mechanotransduction of fibroblast cells has been shown to increase significantly cellular proliferation, DNA synthesis and proteosynthetic activity + 240% collagen, + 130% elastin [24,17]. The reversal discovery was evidence of increased production of endogenous hyaluronic acid by +80, 2% (see Fig. 3) [17].

![Figure 5. Increased production of endogenous hyaluronic acid, from tissue biopsy [17]](image)

![Figure 6. Enderotherapii treatment of the scars © LPG Systems 2004](image)

![Figure 7. Inflamation scar treatment © LPG Systems 2004](image)

![Figure 8. Effect of endermotherapy in post titanium implant application before, and after 10 treatments [1] © M-Science Group](image)
CONCLUSION
Integration of engineering principles through the application of innovative technology utilizing Endermological® LPG® techniques and the mechanotransduction of tissue in the process of targeted personified post-transplantation therapy provide effective and new therapeutic tools in tissue and systems regeneration and rehabilitation.

This article was funded by the University of Žilina project APVV 15-0405 – “Complex use of X-ray diffractometry for identification and quantification of functional properties of dynamically loaded structural elements from important technical materials”

Used sources
[1] Mezencevová V., Trebuňová M., Živčák J., Endermología a LPG mechanotransdukcióna v procese biocompatibility rôznych štruktúr titánových implantátov s mezenchymálnymi kmenovými liniami, Novus Scientia, 2015
[2] Živčák, J. a kol.: Základy bioniky a biomechaniky , ManaCon 2004: 256 s.
[3] Discher, D.E., Janmey, P., Wang, Y.L.: Tissue cells feel and respond to the stiffness of their substrate. Science 2005; 310:1139-1143
[4] Baumann, K.: Adhesion forces promote transcription , Nature Reviews Molecular Cell Biology 2015; 16, 390-391
[5] Benham-Pyle, B.W., Pruitt, B.L., Nelson,W.J.: Mechanical strain induces E-cadherin-dependent Yap1 and β-catenin activation to drive cell cycle entry. Science 2015; 348:1024-1027
[6] Engler, A.J., Sen, S., Sweeney, H.L., Discher, D.E.: Matrix elasticity directs stem cell lineage specification.Cell.2006;126:677-689.
[7] Swift, J., Ivanovska, I.L., Buxboim, A., Harada, T., Dingal, P.C.D.P., Pinter, J., Pajerowski, J.D., Spinler, K.R., Shin J-W., Tewari M. et. al.: Nuclear Lamin-A Scales with Tissue Stiffness and Enhances Matrix-Directed Differentiation. Science; 2013; 341, 6149
[8] Pellegrin, S., Mellor, H.: Actin stress fibres. J. Cell Science 2007; 120, 3491-3499
[9] Rehfeldt, F., Brown, A.E.X., Raab, M., Cai, S.S., Zajac, A.L., Zemel, A., Disher, D.E.: Hyaluronic acid matrices show matrix stiffness in 2D and 3D dicta-tes cytoskeletal order and myosin-II phosphorylation within stem cells. Integr. Biol.UK: 2012; 4, 422-430
[10] Yoshikawa, H.Y., Kawano, T., Matsuda, T., Kidoaki, S., Tanaka, M.: Morphology and Adhesion Strenght of Myoblast Cells on Photocurable Gelatin under Native and Non-native Micromechanical Environ-ments. J. Phys. Chem. B.: 2013. 117, 4081-4088
[11] Revolution In the treatment of lymphoedemas, LPG Health Scientific research 2005; 6.
[12] Pillar, N.B. et al: Secondary arm lymphoedema treated with Endermologie®: A randomized trial: The effectiveness of a new Endermologie-LPG® treatment program for arm lymphoedema: Objective and subjective data from case studies. Internacional Congress of Lymphology; Sep.-Oct. 2005; Bahia, Brazil
[13] Revuz, J. e coll.: Effects cliniques et histologiques d’un appareil, le Lift 68®, utilise dans le veillissement du visage. Novu.Dermatologie 2002; 21:335-342
[14] Lafontan, M.: Use of the microdialysis technique to assess lipolytic responsiveness of femoral adipose tissue after 12 sessions of mechanical massage technique. J Eur Acad Dermatol, Venereol 2008; 1465-1470
[15] Lafontan, M.: Evaluation of the effects of Endermologie® on lipid mobilization and gene expression using microdialysis and DNA microarray analysis respectively. International Congress of Aesthetic Medicine Moscow Jan. 2010;
[16] Merques M.A., Combes, M., Roussel, B.Dupont, L.V., Thalamas, C., Lanfontan, M., Vuguerie, N.: Impact of a Mechanical Massage on Gene Expression Profile and Lipid Mobilisation in Female Glutefemora Adipose Tissue, Obesity Facts 2011; 4:121-129
[17] Humbert, P.: Clinical, biometrological and historical evaluations after mecanichal stimulation on the face with the Endermolift™ Technique. Innovation - international convention july 2013
[18] Zauskova, L., Czan, A., Saigjalk, M., Drbul, M., Rysava, Z.: Triaxial Measurement of Residual stress after High Field Milling Using X-ray Diffraction, In Proceedian Engineering – conference paper, vol. 192, 2017, pp. 982-987, ISSN 1877-7058
[19] Majani, U., Majani, A.: Tissue mechanostimulation in the treatment of scars, Acta Medica Mediterranea, 2013:29.191-192
[20] Berkovitz, B.K.B.: The Structure of the Periodontal-Ligament - an Update. Eur J Orthodont 1990; 12:51-76
[21] Reichenberg, E., Redlich, M., Cancemi, P., Zaks, B., Pitaru, S., Fontana, S. a kol. Proteomic analysis of protein components in periodontal ligament fibroblasts. J Periodontol 2005; 76:1645-1653
[22] Erickson, H.P., Bourdon, M.A.: Tenascin - an Extracellular-Matrix Protein Prominent in Specialized Embryonic-Tissues and Tumors. Ann Rev Cell Biol 1989; 5:71-92
[23] Chiquet, M., Koch, M., Tanneheimer, M., Chiquet-Ehrismann, R.: Regulation of extracellular matrix synthesis by mechanical stress. Biochem. Cell Biol. 1996; 74:737-44
[24] Ruoslahti, E.: Fibronectin. J Oral Pathol Med 1981; 10:3-13
[25] Adcock, D., Paulsen, S., Jabour, K., Davis, S., Nanney, L.B., Bruce Shack, R.: Analysisi of the effect of deep mechanical massage in the porcine Ligament. J Periodontol 1989; 12:51-76
[26] Babík,O., Czan, A., Holubják, J., Kameník, R., Pilc, J.: Tissue mechanostimulation in the treatment of scars, Acta Medica Mediterranea, 2013:29.191-192
[27] Bacci, P.A.:Endermologie®-LPG® Systems© after 15 years
[28] Czán,A., Babík,O., Miklos,M., Zauškova,L. : Assessment of surface area characteristics of dental implants with gradual bioactive surface treatment, TECHNOLOGICAL ENGINEERING, Volume XII, number 1/2015, ISSN 1336 – 5967
[29] Babík, O., Czan, A., Holubják, J., Kameník, R., Pilc, J.: Non-destructive analysis of basic surface characteristics of titanium dental implants made by miniature machining, Technological engineering, volume XIII, number 2/2016