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Editorial
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Recovery of Locomotor Functions: One Footstep at a Time

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Abstract

A variety of central nervous system (CNS) and non-CNS conditions leads to mobility impairment. In most cases, recovery and health benefits will critically depend upon regaining at least some mobility. However, after chronic immobilization or significantly impaired mobility problems, metabolic, cardiovascular, and muscular challenges are generally found. Among all therapeutic approaches that could be proposed, seeking a restored way of stepping on both feet is undoubtedly the first objective to be looking for. Foot skin health and integrity play a pivotal role in locomotion – it is the largest organ of the body and its constitutive structures and mechanisms are controlled by CNS and non-CNS systems. Some of these mechanisms become dysregulated after chronic immobilization, paralysis or mobility problems. Here, I summarize the main pathological conditions and cellular mechanism that could lead to dry foot skin problems and related-locomotor and rehabilitation concerns.

Editorial

The skin is the largest organ (1.6 – 2.0 m^2) of our body and its first line of defense. The control of water content levels is pivotal in maintaining skin health and integrity. Dysfunctional skin moisture is in fact associated with several debilitating dry skin problems such as xerosis, atopic dermatitis, psoriasis, and rosacea – capable, in all cases, of impairing locomotor capabilities. In mammals, the skin is composed of four layers –epidermis, basement membrane, dermis and subcutaneous (hypodermis). The epidermis – stratum corneum (SC) contains no blood vessel per se [1]. The dermis harbors mechanoreceptors, thermoreceptors and nociceptors for cutaneous sensory information– e.g., hot/cold, pressure/touch, pain, vibration, or chemicals as well as vasocontraction, vasodilatation, body temperature regulation, barrier function, secretion, growth, differentiation, cell nutrition, nerve growth, inflammatory and immune responses, apoptosis, proliferation, and wound healing [1]. The inner milieu of our body consists of about 70% water (gender- and age-based differences ranging from 55-75%) [2]. Two main mechanisms affect water content at the systemic level – 1) water transport from inner layers towards the epidermis and, 2) water transport and evaporation from epidermal layers towards the external environment. To increase water content levels, water transport activity from inner layers, including from blood vessels, will carry water molecules towards the dermis and, hence, the epidermis SC layer. From there, water is eventually being lost to evaporation. To decrease water content losses, it is thus imperative to limit evaporation and sweating in some conditions. Aquaporin channels, supported by water-binding molecules such as glycerol, expressed on vascular endothelial cells, facilitate water exchange and transport between blood and dermis [3]. Blood volumes, circulating flow levels and regional distribution are directly affecting water transport levels [4]. Actions upon these systems critically depend upon complex neural mechanisms–i.e., hypothalamic-pituitary-adrenal axis (e.g., arteriovenous anastomoses) raphe nucleus, medulla oblongata, preoptic area, hypothalamus, pons and periaqueductal gray matter [5-9]. Sudoriferous glands, the eccrine subtype, are the main structure of the skin responsible for thermoregulation in humans –a large proportion of sympathetic nerve activity for instance during heat stress has been shown to be sudomotor in nature. Cholinergic, muscarinergic, α- or β-adrenergic, neuropeptidergic systems are also involved [10-12]. Sebum secretion is also pivotal for normalmoist skin. It also possesses an innate antibacterial activity and has a pro- and anti-inflammatory function that may improve healing [13]. The human skin and its sebaceous glands express corticotropin-releasing hormone, transient receptor potential vanilloid-1, melanocortins, β-endorphin, vasoactive intestinal polypeptide, neuropeptide Y, substance P, and calcitonin gene-related peptide [13]. Dysregulation of some of these mechanisms is bound to alter water content levels and skin health. For instance, substance P and vasointestinal peptide levels, if altered, play a determinant role in acne vulgaris [13-15]. Among the main pathological conditions known for altering some of these cellular mechanisms, we found diabetes (type II), aging, brain

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swelling, glaucoma, epilepsy, obesity, malnutrition and cancer [16-21]. Unfortunately, most related mechanisms are, as of now, only considered as future cellular targets for next-generation CNS or non-CNS products against specific dry skin problems. It will be important for scientists to rapidly identify and develop potent therapies adapted to each condition for ensuring that dry foot skin, restored function, locomotor recovery and rehabilitation strategies, all point in the same direction.

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