Major Limb Amputation: Overcoming Phantom Limb Sensations and Pain

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Dunlap et al presented a retrospective chart review of the effect of peripheral nerve repair (PNR) on phantom limb pain (PLP) associated with pain reduction and improvement in the quality of life of patients with amputated limbs.[1] Even though lower extremity amputation (LEA) is one of the oldest surgical methods, going back to Hippocrates and beyond, it is still a part of many medical specialties' everyday routines.[2]

Causes of LEA vary between nations and geographic locations. In the Western world, diabetes mellitus (DM) and peripheral arterial disease (PAD) account for up to 75% of all LEAs.[3] It has been reported that 115,000 people undergo LEA in the United States annually; 65% of them have DM and 85% PAD.[4] Trauma, infection, and malignancies are the leading causes of amputations in developing nations.[5] Even though amputation is an agonizing decision to save a patient's life, unfortunately, re-amputation is needed for 10% of amputated feet; 17% of patients die in hospital after LEA.[6] Population-based statistics reveal that major amputation rates have been dropping in Europe and across the world in recent decades, whereas minor amputation rates have increased.[3,7] In general, major amputations are those that occur close to or through the ankle joint, whereas minor amputations occur farther away from the joint.

Most of the research described above is concerned with LEAs caused by DM or PAD. These disorders comprise the biggest category and therefore have the greatest impact, particularly in light of the rising global incidence of DM.[8] Implementation of effective treatment strategies for DM and PAD may reduce the number of amputations. Interventional novelties in the field of angiology, improved recanalization techniques for PAD, and better DM disease prevention programs, as well as specialized diabetic foot care, have led to this success.[9] Despite this improvement, limb-preserving activities are still required; the goal of reducing DM-related amputations by half within 5 years, set in the St. Vincent's Declaration of 1989, has yet to be met.[10]

Limb loss can have a negative impact on all aspects of life, including appearance, performance, lifestyle, and autonomy.[11] Lower-limb amputees on prostheses might ambulate with poor muscle and kinematic coordination, lower stability and endurance, a higher level of fear, and risk of falls.[12] Compensatory gait adjustment could induce muscle atrophy, back pain, and osteoarthritis.[12] In addition, more than a quarter of amputees experience symptoms of depression, with perceived social stigma and impaired self-efficacy in body image.[13] Body image especially is associated with an intention to engage in physical activities, and thus general health.[13] It has also been reported that 78% of amputees quit their jobs because of their amputation, and this unemployment triggered a worse health experience.[14] It is therefore necessary to establish a multidisciplinary team (doctors, neurologists, psychologists, physiotherapists) to develop intelligent interventions aimed at reducing the negative effects of amputation and allowing patients to return to their activities of daily living. In this regard, a self-psychological perspective can help to better distinguish the psychological needs of individuals in relation to their adaptive functioning. In addition, this approach may be useful in informing family members, caregivers, and health professionals about how an empathic understanding of the patient's experience can manage appropriate responses and thus provide a better environment for further restoration of the patient's autonomy.

Phantom limb pain (PLP) is a common and debilitating neuropsychiatric condition among amputees.[15] The term "phantom limb" was first described by Mitchell[16] as the continued feeling of the presence of the amputated (or absent) limb. PLP may include unpleasant sensations such as searing, sharp, cramping, electric shooting, stabbing, and throbbing pain or non-painful feelings such as tingling, touch, numbness, warmth, itching, and pressure.[15] The mechanism of PLP is not well understood as it proposes a potential relationship with the maladaptive plasticity of the central

nervous system. Regardless, the discomfort and sensation of PLP can cause psychological anguish, worry, and despair in amputees, interfering with their adjustment to life following amputation. Management of PLP is one of the critical elements of amputee care, despite there being no consensus and no effective first-line treatment.[15] Nonetheless, patients with PLP are administered conventional treatments such as pre-emptive analgesia and anesthetics, acetaminophen and nonsteroidal anti-inflammatory drugs, opioids, antidepressants, anticonvulsants, and calcitonin. Surgical interventions, such as lesioning of the dorsal root entry zone or stimulation on the spinal cord or motor cortex could be the last resort when other treatments fail.[17]

Another option to decrease PLP is prosthetics. Prosthetic devices can be used to treat PLP because they have direct touch with the amputation site. New prosthetic technologies that trigger nerves may pave the way for prostheses that feel like a natural part of the body, alleviating the PLP that amputees regularly endure. Furthermore, smart bandaging and shrinker socks distribute equal pressure to the remaining leg, perhaps reducing or alleviating PLP.

Surgical therapies for PLP have been published in the literature with encouraging outcomes. Targeted muscle reinnervation and regenerative peripheral nerve interface are two types of PNR that focus on successfully reusing transected peripheral nerves to enhance neuronal regeneration, lowering the risk of developing PLP.[18] Nevertheless, PLP is not solely a physical phenomenon; it also involves significant neurological and psychological components. PLP encapsulates the complex spectrum of pain, both physical and psychological. It serves as a reminder of how deeply interconnected our minds and bodies are and how the presence of pain can persist even in the absence of a physical cause. Understanding and treating PLP requires a holistic approach that considers the intricate interplay between the brain, body, and mind. This integrated perspective helps provide more comprehensive and effective relief for those experiencing this challenging condition. Therapeutic approaches may include medications such as pain relievers, antidepressants, or anticonvulsants, physical therapies such as mirror therapy and transcutaneous electrical nerve stimulation, and psychological interventions such as cognitive-behavioral therapy.

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