

Phantom sensations

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Phantom perception

Phantom perceptions are an intriguing mystery that captured and still captures the attention of many people: those who are amputated, their relatives, healthcare providers, and even the public. Indeed, it is a mystery: How is it possible to feel sensations and/or motions in a limb or a body part that has obviously been surgically removed? Unfortunately, there is no clear answer to this question. Phantom sensations and especially phantom limb pain remain medical nightmares. Moreover, we can currently not explain why phantom sensations occur in some amputees but do not in others. In the present chapter, we will first report on locations, characteristics, and descriptions of phantom sensations. We then will report on patho-physiological mechanisms that possibly might lead to phantom sensations. Finally, therapeutic options and possible future directions of research and treatment will be given.

Locations, characteristics, descriptions of phantom sensations

As a result of amputation of an extremity in adults, nearly all individuals experience phantom sensations in those parts of the body that are now absent. Many amputees report on a progression of their feelings over time. Immediately after amputation, most patients claim on feelings of a phantom limb that mimics the removed body part in size and detail. Sometimes, this phantom is reported to remain in an unusual position as it occurred to be as the result of the previous injury.

This phantom body part usually moves gradually into the distal end of the residual limb, a process that is called telescoping. During this telescoping, the residual limb usually progressively loses details in somatosensory detail from proximal to distal. Figure 1 illustrates this process.

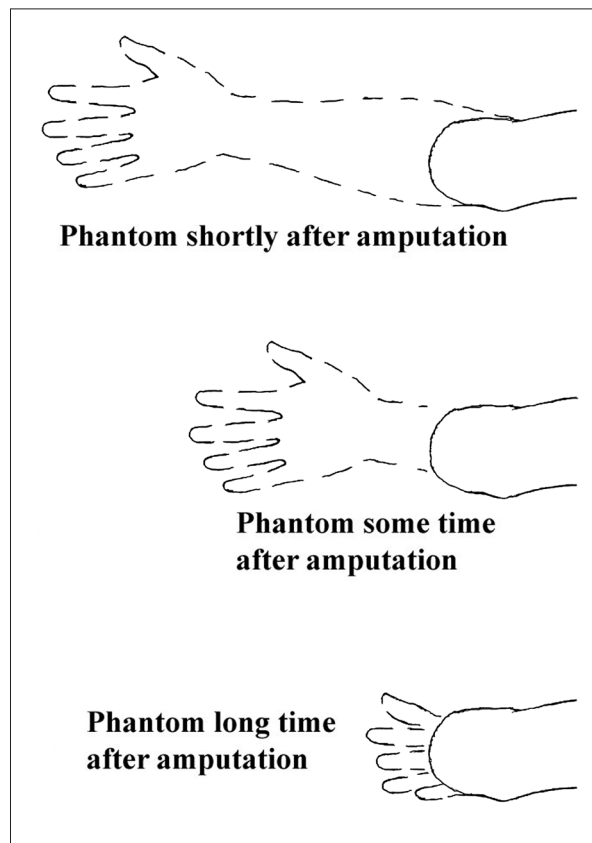


FIGURE 1. PROGRESSIVE TELESCOPING OF THE PHANTOM OF A HAND OVER TIME

Interviews revealed that telescoping occurred at some point in time after amputation in nearly two-thirds of the amputees interviewed [1, 2]. Furthermore, according to these studies, amputees reported on normal sensations of the limb including the whole spectrum of somatosensory sensations, i.e., temperature, proprioception, mechanical sensations like pressure or vibration. Moreover, most patients reported also on the perceived ability to control motion of the phantom limb. Motions could be voluntary, but spontaneous, automatic reflexive as in motions relating to losing balance [3]. However, telescoping usually does not occur in patients that report on a special phantom sensation, i.e., phantom limb pain.

50–85% of amputees [4–6] experience moderate to strong phantom limb pain within weeks after amputation that often outlasts many years and turns into chronic phantom pain. Phantom limb pain occurs in around 80% of amputees of a limb. Phantom pains have also been observed as a consequence of the loss of other body parts such as the breast or tooth [5, 7]; it also can occur as a consequence of a spinal cord injury [8].

Phantom pain has a whole spectrum of features. Some patients describe that the phantom pain is limited to simple, short-lasting and rarely occurring painful shocks in the missing body part. Other patients perceive a constant, excruciatingly painful experience during which the individual has a vivid and intense perception of the missing body part. In a survey of 5,000 amputees, Sherman et al. [4] reported that 18% of amputees had continuous phantom pain, 33% had daily episodes. The intensity of the perceived pain shows a different pattern over time as compared to telescoping: Half of the patients reported on slightly decreasing pain over time, the other half described no change or even an increasing pattern over time [5]. Phantom limb pain seems to be more severe in the distal portions of the phantom. It is described by a number of characteristics such as stabbing, throbbing, burning, cramping [4–6].

Phantom limb pain seems to be more frequent when the amputation occurs in adulthood, less

frequent in child amputees and virtually non-existent in congenital absence of a limb [9, 10]. However, different studies have presented conflicting data. Thus, Krane and Heller [11] investigated 24 individuals who underwent amputation in childhood or adolescence in a retrospective survey. These authors found a prevalence rate of 92% for phantom pain that persisted for months to years. 36% reported currently on phantom pain that does not change. The phantom pain was described as sharp, tingling, stabbing and uncomfortable, i.e., with the same adjectives that use persons amputated as adults. Additionally, while early studies [12] found no evidence for phantoms and phantom limb pain in children born without a limb, more recent studies reported on phantom limbs in individuals born with congenital absence of limbs that was existent at the time of investigation [10, 13, 14] or developed after a surgical manipulation [9]. These data provide support for the suggestion that phantom limbs represent the perceptual correlate of an innate neural substrate of the body experience [15, 16]. However, Dettmers and co-workers [17] showed that anatomical reorganisation in the primary somatosensory and primary motor cortex might occur which is coincident with the absence of phantom limb pain when amputation occurred early in life. Data from larger surveys suggest that the incidence of phantom sensations and phantom pain is lower in individuals born with congenitally absent limb as compared to adolescent amputees [16]. In summary, there are open questions to what extent the innate neural substrate will be reorganised functionally and anatomically after amputation and which factors influence on this reorganisation.

Somatosensory phenomena that can be evoked in the phantom are called referred sensations. Referred sensations are painful and non-painful sensations within the phantom that can be elicited by stimulating body areas with different stimuli (e.g., touch, vibration, warm, heat, pain). Referred sensations might even occur in patients with only relatively small amputations like the amputation of a finger [18]. Referred sensations might be evoked from body areas that