

Phantom Illusions in Spinal Cord Lesions

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The transection of the spinal cord leads to a breakdown of communications from the periphery due to dysfunction and/or structural lesions of the afferent sensory pathways. As a consequence of this breakdown, two different phenomena are observed. The deafferented parts of the body seem nonexistent, like an amputation illusion, or they are manifested as a phantom sensation as a part of the anosognostic phenomenon.

Although phantom illusions following amputations have often been reported in the literature, there are only a few papers describing them in spinal cord lesions [1–4, 6, 8, 12]. The present study will analyze the frequency, patterns, position, and dynamics of phantom illusions and the phantom pain in spinal transection. We also investigated the significance of concomitant brain injuries. The factors responsible for the transection phantom will be discussed. This paper is based on a study by Avenarius and Gerstenbrand [1], in which phantom illusions of patients with transection of the spinal cord are described.

Patients and Methods

This study was carried out at the Neurological Clinic, University of Innsbruck, and at the rehabilitation center of the Allgemeine Unfallversicherungsanstalt, Bad Häring. Thirty-one men and four women (16–70 years of age) as well as two model cases from the study of Avenarius and Gerstenbrand [1] were studied. All the patients had suffered a spinal cord injury (time interval 7 days to 26 years). The patients were examined neurologically and interviewed using a standard protocol. Rough sketches were made of the phantom positions both by patients and investigators.

The following examples encompass four cases (cases 1, 2, 3, and 6) with characteristic phenomena from the 35 patients and, to demonstrate the wide spectrum of possible phantom sensations, two patients from the study of Avenarius and Gerstenbrand (cases 4 and 5) [1].

Case 1: 24-Year-Old Man, 15 Months After Accident

In a car crash dorsal vertebra 9 was fractured with complete spinal transection below D12. There was also frontal cerebral contusion. After recovering consciousness, the patient felt diffuse coldness in the lower extremities with a tingling sensation and frostbite-like pains. The legs felt normal as if he “could get up and walk.” The cold feeling regressed after a few days.

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Six weeks after the accident, the patient imagined he could voluntarily move his left toes, though there was only a suggestion of movement in the right toes. There was no further increase in phantom mobility. Two months after the accident, the patient experienced sensations in both legs which he described as "surges of electric current." They occurred after loud noises, such as a dog barking, clanking of glass, or slamming of a door, without the patient being startled.

Case 2: 24-Year-Old Man, 8 Months After Accident

The patient's car crashed against a lamp post, turned over, and, when after a few minutes he regained consciousness, he was squatting behind the steering wheel. There was complete tetraplegia below C5.

For 2 months he experienced phantom position illusions as in the car at the time of the accident, the arms slightly flexed at the elbows and held forward, the lower body flexed at the hips and knees (Fig. 1). For 4 months he imagined he was able to move his fingers to make a fist, but he could not voluntarily alter the phantom position of his lower limbs.

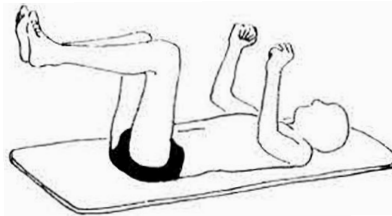


Fig. 1. Illustration of the phantom position of a car driver (case 2). Slight abduction, position of flexion of the upper and lower extremities according to the position at the time of accident

Case 3: 18-Year-Old Man, 5 Months After Accident

The patient hit his head on the bottom of a 1.5-m deep pool after diving off the 2-m board. There was an incomplete transection below C7 with complete paraplegia, though slight preservation of sensitivity. While being carried on the stretcher the patient wanted to get off and walk, as his legs felt normal: When he tried to stand he noticed the paralysis. During the first weeks following the accident, he could not feel his legs. He then experienced a floating sensation in his lower limbs, which lasted 5 days: His legs seemed to be slightly abducted and flexed at the hips and knees, as if they were floating 30 cm above the ground. The patient was unable to voluntarily alter the phantom position (Fig. 2).

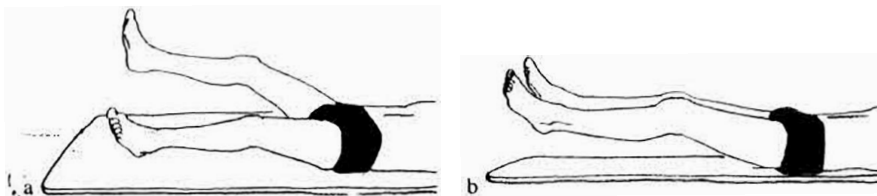


Fig. 2. Illustration of the phantom position of a patient after diving into shallow water (case 3). Floating feeling of the lower extremities with slight flexion in the hips and knees. a Spontaneous change of the phantom position as abduction b and adduction

Case 4

In this case [1], a 36-year-old man fell from the first floor onto a lawn. There was a complete transection below D8 and commotio cerebri. After recovering from a short period of unconsciousness, the patient felt a phantom illusion in his legs, which seemed to be in the same position as at the time of the accident and which seemed to get smaller towards the periphery. The intensity of the phantom illusion varied and increased with mental stimulation. The phantom could be altered by visual control. Two weeks after the accident it was possible, with great concentration, to perform phantom movements, particularly of the toes.

At 2.5 weeks after the accident, an increasing phantom stretch posture of the legs was registered, and later there was a temporary variation in the intensity of the phantom illusion. The patient made sketches of his phantom illusions (Fig. 3).

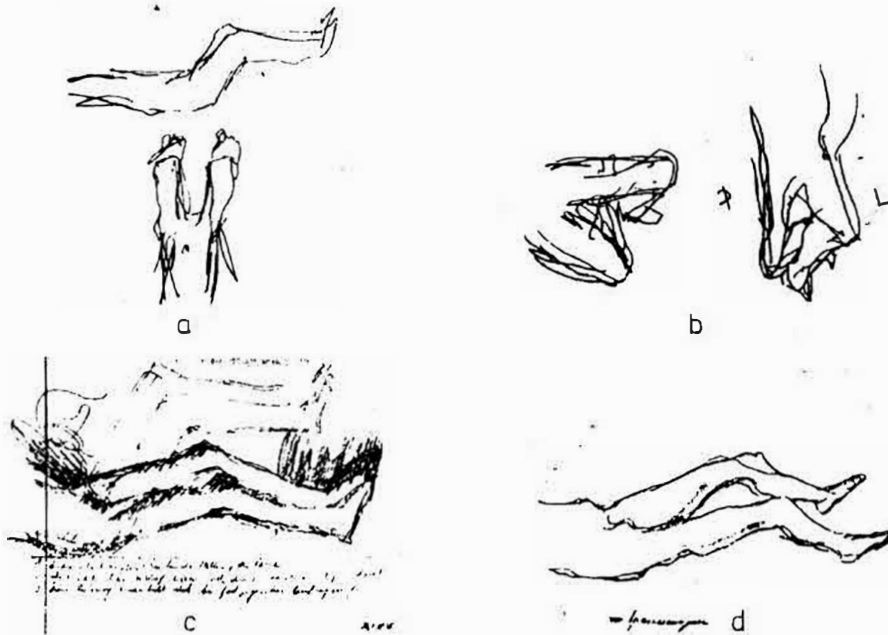


Fig. 3a-d. Drawing of the phantom by the patient himself (case 4), who is a sculptor a, b. Change of the phantom during the stay in hospital. Decrease of the position of flexion, finally only with nervous excitement c. Feeling of tension in the thighs d. From Avenarius and Gerstenbrand 1967 [1]

Case 5

In this case [1], a 23-year-old girl fell from the first floor and landed on her back on the edge of a step, fracturing dorsal vertebra 10. There was a complete transection below D7. After the accident the patient described the following phantom sensations: The left leg was crossed over the right with frequent changes of position of the legs. The feet could not be

felt. Noteworthy in this case was the strong phantom sensation in the genital area. In addition, shortly after the accident, the patient experienced orgasmic sensations which lasted for several weeks and repeatedly changed into orgasm. This functional phantom was described as agonizing and unbearable. In the early stages, the patient kept uttering obscenities, which were consistent with her profession as a prostitute. Masturbation occurred from another person, from which she allegedly gained relief, even without orgasm. The further course of her illness was marked by long-lasting, agonizing pain in her legs.

Case 6: 53-Year-Old Man, 5 Months After accident

The patient was hit on the back between the shoulders by a recoiling pipe, while working on an underground building site. Complete spinal transection below C5. Immediately following the accident he noticed the paralysis in his upper and lower limbs, but sometimes the patient thought his legs felt normal as if he could move them. Toes and ankle joints of the phantom could be moved voluntarily and then returned to midposition.

Results

Frequency of phantoms. Of 37 patients, 33 described phantom illusions. Four patients reported a missing anosognostic phenomenon. The amputation illusion was described as "being cut off," "nothing there," or "as if there were a hole."

The shape of the phantom was mainly described as the normal form of the limbs. Three patients reported shrinkage phenomena. Alterations in size of the phantom limbs were also reported "as if blown up," or "as if going to burst," and this was often associated with pain.

Phantom Position Illusions. This means changed position of the phantom limb and was reported by 24 patients. Nine patients felt that their lower extremities were "floating in the air" or were "on cotton wool". Six patients reported phantom position illusions which corresponded to the position of the patient at the time of the transection injury. A driver, suffering from a spinal cord lesion, described it as a flexed position of the upper extremities like sitting in a car (case 2). Three patients with the same mechanism of injury (dive into shallow water) and cervical transection of the spine described a floating sensation. Some patients experienced such intense phantom position sensations that they asked the nurses to alter the position of their limbs. These sensations persisted for days or weeks, and in one case for over 8 months. In concomitant head and brain injuries with long-lasting coma, no phantom position illusions were observed as reported by Ettlín et al. [6]. Of 24 patients with phantom position illusions, four reported unconsciousness lasting a few minutes, but no phantom position illusions were reported by patients with a history of a long period of unconsciousness.

A spontaneous change of position not caused by actual manipulation was reported by four patients and was without movement sensation. Voluntary alteration of phantom position was possible in one patient who also reported that there was a connection between psychogenic agitation and phantom position.

Kinetic Illusions. Twenty-two patients with phantom feelings imagined they were able to move their fingers or toes. One patient was capable of complex movements of the phantom

limbs. Rapid weariness was observed. After flexion or extension of toe or ankle joint phantoms, independent movement of the joint to the midposition was found in three cases. As far as we know, these phenomena have not been reported in the literature. A spontaneous movement of the phantom limb was found in one patient only.

Sensory Phenomena. In 15 cases sensory phenomena, and in eight cases phantom pains were found. Of these eight cases, six patients had suffered from a spinal transection below D5. There were many reports of warm sensations of the phantom limbs ("comfortably warm," "like hot coals"), cold sensations ("frozen solid"), swollen sensation ("blown up," "squashed feeling"), superficial pain ("as from sandpaper," "like a cut"), and deep-seated pain ("like an electric shock," "intermittent cramp"). In four patients pain was aggravated by loud noises, smoking, and the attempt to move the phantom limb (Table 1, cases 1, 4, 18, 31).

Visceral Phenomena. As well as somatic sensory phantom illusions, phantom feelings of the internal organs can also occur and, in the literature [3], a frequency of 25–40% has been reported, particularly for the bladder, rectum, and genital area. Our study includes eight patients who report bladder phenomena and one patient reported a penis phantom with occasional sensations of erection. The case of the prostitute (case 5) taken from Avenarius and Gerstenbrand [1] presents a rare example of phantom sensations with functional experiences in the genital area. In agreement with Becker [2], these phenomena can be assessed as functional phantoms of the genitals. However, these phenomena are rare in acute cases.

Discussion

Deafferentation of parts of the body as found in spinal transection does not allow the current modification of the body scheme. Previously programmed character, posture, and function patterns show autonomic character and they influence the phantom sensation. The personality structure, events before and after the accident, as well as passive and active manipulations have no definite influence on the somatic sensory phantom illusions, though they can influence the visceral phantoms, as shown in case 5. In cases of phantom position sensations or phantom movements, remission was observed spontaneously and independently from exogenous or intrinsic factors. The body feeling seems normal. A complete recovery of the transection phantom is brought about by restoration of sensory pathways. The presence of phantom position illusion after a spinal cord injury correlates well with the normal function of the information system during and after the accident. Ettlin et al. [6] pointed to this connection in 1980. In our experience, but not in complete accordance with Ettlin et al., we also observed phantom position illusions in cases with short concomitant unconsciousness. After long-lasting coma, amputation sensations occur in all cases. In many cases the phantom position is the same as the position of the patient at the time of spinal injury: The last "real" sensation of the limbs persist in the body image. Manipulations or amputation of the paralyzed limb [3] have no influence on the phantom limbs.

Voluntary influence of phantom position is not usually possible, though a very small number of patients are able to change the position of the peripheral part of the phantom limb, e.g., toes, with intense concentration. After the completion of the intended voluntary change of the phantom position, the original phantom dominates and the

Table 1. Summary of the investigated patients, their ages, sex, levels of transection, time after the accident in days (d), months (m), or years (y), phantom position, floating sensation, anosognosia, phantom movement, amputation illusion, phantom sensation, phantom pain and duration of unconsciousness, and visceral phantom

Case no.	Age (years)	Sex	Spinal level	Time after accident	Anosognosia	Phantom position	Floating sensation	Phantom movement	Phantom sensation	Phantom pain	Amputation illusion	Duration of unconsciousness	Visceral phantom
1	24	M	D12	15 m	x	-	-	x	x	x	-	2 h	-
2	34	F	D12	10 m	x	x	-	x	x	x	-	-	-
3	38	M	L1	23 m	x	-	-	-	x	x	-	8 d	-
4	42	M	D11	9 y	-	-	-	-	-	-	x	3 d	-
5	25	M	D10	5 y	x	x	-	-	x	x	-	-	-
6	21	M	D6	6 m	x	-	-	x	-	-	-	2 weeks	x
7	52	M	D9	6 m	x	-	-	-	x	-	-	1 m	-
8	21	M	D5	1 y	x	-	-	x	x	-	-	3 h	-
9	36	M	C5	4 y	x	-	-	-	-	-	-	1 h	-
10	21	M	C8	17 m	x	x	-	-	-	-	-	min	-
11	24	M	C5	8 m	x	x	x	x	-	-	-	min	-
12	28	M	D5	15 m	x	x	-	-	-	-	-	-	x
13	70	F	D12	26 y	x	x	-	-	-	x	-	-	-
14	40	M	C8	6 m	-	-	-	-	-	-	x	5 weeks	x
15	23	M	D4	2 m	x	x	x	x	-	-	-	-	-
16	45	M	D6	1 m	x	x	-	x	x	x	-	-	-
17	25	M	C7	1 m	x	x	x	x	-	-	-	min	-
18	16	M	D7	2 m	x	x	-	x	x	-	-	-	x
19	38	M	D12	3 m	-	-	-	-	x	-	-	-	-
20	18	M	C7	5 m	x	x	x	x	x	-	-	-	-
21	24	M	D9	5 m	x	x	x	x	x	-	-	-	-
22	20	M	L1	-	-	-	-	-	-	-	x	min	-
23	40	F	D8	-	-	-	-	-	-	-	x	6 h	-
24	53	M	C5	5 m	x	x	-	x	x	x	-	-	x
25	18	F	D9	3 m	x	-	-	-	-	-	x	2 d	-
26	66	M	D8	2 m	x	x	-	x	x	-	-	min	-
27	35	M	L1	1 y	x	-	-	-	-	-	-	-	-
28	47	M	D10	5 m	x	x	x	x	x	-	-	-	x
29	22	M	D6	25 d	x	x	-	x	-	-	-	-	-
30	46	F	C5	7 d	x	x	-	-	-	-	-	-	-
31	16	M	D10	19 d	x	x	-	x	x	-	-	-	x
32	16	M	C6	8 d	x	x	x	x	-	-	-	-	-
33	51	M	C4	1 m	x	x	-	x	x	x	-	-	-
34	34	M	C5	12 d	x	x	-	x	-	-	-	-	-
35	36	M	D8	1 m	x	x	x	x	-	-	-	min	-
36	23	F	D7	2 m	x	x	-	x	-	-	-	-	x
37	60	F	C8	6 m	x	x	x	x	-	-	-	-	-

phantom toes move to the middle position. Voluntary complex movement of a transection phantom is rare. Isolated movements of fingers and toes are more frequently observed. It can be assumed that this phenomenon is correlated to the great cortical representative fields of these body parts.

As with real pain and body sensation, the phantom pains and the phantom feelings seem to depend also on the psychogenic state. The provocation or increase of phantom sensations and pains by drinking, smoking, noise, and concentration on the phantom movements are interesting observations, but it is not possible to offer a satisfactory explanation for these phenomena. The functional phantom, as reported by a prostitute (case 5), showed a positive organ-specific influence of special stimulation.

In accordance with Riddoch [10], we found that, in cases of transections at the thoracal and thoracolumbal levels, phantom pains are more frequently observed than in cases of spinal injuries above the thoracal level. Seven of nine patients with phantom pains had a transection below D5. However, these few cases do not allow statistical conclusions.

In order to answer the question of which factors influence the phantom illusion after a spinal cord transection, we studied 37 patients and came to the following conclusions:

1. There are no phantom position illusions in cases of spinal and head injury combined with long-lasting coma.
2. The phantom position is often determined by the position of the patient at the time of spinal injury.
3. There is a possible relation between the level of transection and the occurrence of phantom pains.
4. With visceral phantoms, active manipulation can cause phantom reactions.

Summary

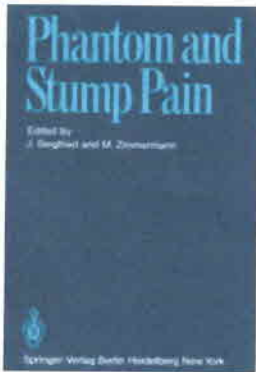
From 37 patients with spinal cord lesions, 33 reported phantom phenomena. In some cases, definite phantom positions could be described which corresponded with the body position at the time of injury. A third of the patients experienced floating sensations and there was alteration of the phantom position in 21 patients. Phantom sensations were reported by 16 patients and phantom pain by eight patients. Visceral phantoms were present in six individuals; a functional visceral phantom with orgasmic sensations was described by a prostitute.

The following conclusions can be drawn from the analysis of the cases: position phantoms do not occur after long periods of coma; the position of the phantom can represent the position at the time of injury; and there is a possible correlation between the site of the spinal cord lesion and the occurrence of phantom pain.

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References

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Phantom and Stump Pain

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