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Phantom Limb: A Phenomenological Study

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Summary: Phantom limb phenomena during the post-operative period were studied in 72 amputees. All were right handed. Phantom limb was present in 86.1 per cent of the cases, significantly more commonly following amputation of the right arm. Nearly half of the phantoms developed within the first 24 hours and another quarter in the next 24 hours, appearing earlier in lower limb amputees. Movements in the phantom were felt by three-quarters of the cases, an incidence unaffected by site or side of amputation. Telescopy was present in nearly two-thirds and phantom limb pain in over two-thirds, significantly more commonly in the upper limb amputees but uninfluenced by the side of amputation. Thirty-one of the patients dreamed that their limbs were intact.

A persistent sensation of the presence of a missing limb following amputation, first labelled as 'phantom limb' by Mitchell (1872), has baffled researchers for centuries (Haber, 1955). However, there are few systematic studies of the problem. Further, as pointed out by Carlen *et al* (1978), most of the published studies of phantom limb deal with subjects who had undergone amputation years earlier.

The present communication is a part of a comprehensive study of post-amputation psychiatric manifestations, and deals with certain aspects of phantom limb phenomena in the period immediately following amputation in seventy-two consecutive cases.

Material and Methods

The details of case selection and methodology have been given elsewhere (Shukla *et al*, 1982). For this study the patients were interviewed during the post-amputation period; using an agreed questionnaire, to elicit various aspects of the phantom limb phenomenon, viz. the time of its appearance, any associated features (movements, telescopy, pain, etc.), the type of pain, and also any relieving or aggravating factors and the dreams and fantasies of the patient. An attempt was made to assess the short-term course of these symptoms, the mean follow-up period being 5.2 ± 1.1 weeks.

Observations

The general characteristics of the cases, along with the causes and sites of amputation, have been given in the preceding communication (Shukla *et al*, 1982). Description here is therefore limited to various aspects of the phantom limb phenomenon.

Phantom limb appeared in more than four-fifths (62) of the 72 cases (Table I). Amputations of the right upper limb were invariably followed by phantom limb, while somewhat under three-quarters of patients with left arm amputations had it, the difference being statistically significant ($t = 2.79$; $P < 0.01$). There was no such difference between amputations of arm and leg or between those of the left and right leg. Phantom failed to appear in five out of 56 cases with injuries, in two out of three cases with Burger's disease, in two out of seven cases of osteosarcoma and in the single case with leprosy.

In half of the cases phantom limb had appeared within 24 hours of the operation, a quarter had it between 24 to 48 hours later and six (one-tenth) had it after 72 hours. The phantom was noted somewhat earlier in lower limb amputees, of whom nearly two-thirds had developed it within 24 hours, compared with less than half of upper limb amputees. There was no appreciable difference between right and left sided amputations in this regard.

Nearly three-quarters of the 62 cases had subjective feeling of movements in the phantom. There was no difference in the frequency of movements with respect to the site and side of amputation. These movements were not under the conscious control of the patient and were at times unpleasant; for example, one patient felt as if his finger nails were being driven into his palm causing severe agonising pain. Telescopy, i.e. a subjective feeling that the phantom was getting smaller with the passage of time, was recorded in

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three-fifths of the patients with phantom. In this respect amputees with loss of the right upper limb were different from others, only half reporting telescopy in contrast to all the left upper limb amputees, the difference being statistically significant ($t = 2.77$; $P < 0.01$). Twenty-seven of the cases had dreams of a wish-fulfilling nature, i.e. they dreamt that they had normal limbs and that they were using them. However, even in the dreams patients retained the memory of amputation and were rather sceptical about the reality of the experience.

Pain in the phantom was reported by 43 of the 62 cases. This pain was different from the pain at the operation site, being referred to the now non-existent limb and of different quality. The patients with upper limb amputations had phantom limb pain significantly more often than lower limb amputees ($t = 2.44$; $P < 0.02$). Left arm amputation was associated with pain more often than right arm, though the difference failed to reach statistical significance.

The types of phantom pain described by the patients are given in Table III in order of frequency. Many patients had more than one type of pain. All but two of the 43 cases had a sensitive spot over the stump which could trigger the pain. The pain was in the form of a continuous dull ache in nearly half (24). In eight of these there were attacks of severe pain superimposed upon the dull ache. In the remaining 19 the pain was episodic with complete remission in between. Precipitating factors were noted in 18 of 27 patients with paroxysms of severe pain (8 with dull ache punctuated by severe acute pain and 19 with only paroxysmal pain). These comprised touching or approaching the stump (10), thinking about the consequences of amputation (6) or keeping the stump in a dependent position (2). The painful attacks lasted

TABLE I

Frequency of phantom limb following amputation of various limbs. (Percentages of possible totals in parentheses)

	Upper limbs			Lower limbs			
Phantom	No.	Right	Left	No.	Right	Left	Total
Present	34 (89)	24* (100)	10* (71)	28 (82)	15 (83)	13 (81)	62 (86)
Absent†	4 (11)	—	4 (29)	6 (18)	3 (17)	3 (19)	10 (14)
Total N	38	24	14	34	18	16	72

† Absent in 5 cases with injury, two each with Burger's disease and osteosarcoma and in one with leprosy.
* $t = 2.79$; $P < 0.01$.

TABLE II

Characteristics of phantom limb. (Percentage of possible totals in parentheses)

	Upper limbs			Lower limbs			
Characteristics	No. (34)	Right (24)	Left (10)	No. (28)	Right (15)	Left (13)	Total N 62
Movement	26 (76)	18 (75)	8 (80)	20 (71)	12 (80)	8 (62)	46 (74)
Telescopy	22 (65)	12* (50)	10* (100)	17 (61)	10 (67)	7 (54)	39 (63)
Dreams	16 (47)	9 (38)	7 (70)	11 (39)	5 (33)	6 (46)	27 (44)
Phantom limb pain	28† (82)	18 (75)	10 (100)	15† (54)	7 (47)	8 (62)	43 (69)

* $t = 2.77$; $P < 0.01$; † $t = 2.44$; $P < 0.02$.

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TABLE III
Types of phantom pain (N = 43)

Type of pain	No.	Percentage of total
Burning	24	56
Electric current	18	42
Throbbing	9	21
Cramps	9	21
Itching	9	21
Cutting	6	14
Jactitation	3	7
Stabbing	3	7
Tearing	3	7
Crushing	2	5

few seconds to few hours, and were relieved either spontaneously (10), by stroking the stump (7), by raising it above the level of gravity (4), by exercising it (4) or simply by diverting the patient's attention (2).

At the time of the last contact (our mean follow up period being 5.2 ± 1.1 weeks), the phantom had disappeared in a third of cases and markedly or moderately reduced in size in another third. Out of 43 cases with phantom pain, more than half were free from pain when last seen and in a further fifth the pain had become very much less, both in frequency and intensity. However, the remaining 10 cases continued to have pain of unreduced intensity.

Discussion

Phantom limb phenomena have been puzzling and poorly understood ever since Paré's description in 1551 (Handerson and Smyth, 1948; Sunderland, 1968). A feeling that the limb is still present and moving, though possibly distorted and in a peculiar position, appears to be usual after amputation of a sensate limb (Melzack, 1973; Carlen *et al*, 1978; Solomon and Schmidt, 1978; Wilson *et al*, 1978). However, there have been very few systematic studies of the problem (Haber, 1955). Further, with few exceptions (Carlen *et al*, 1978) the published studies deal with subjects who had undergone amputations years earlier. Since the phantom sensation disappears in most cases with the passage of time and since patients are rather reluctant to report it spontaneously lest they be labelled as crazy, it is only to be expected that retrospective studies would report a lower incidence of phantom limb phenomena (Cronholm, 1951; Soloren, 1962) whereas recent workers have found these to be almost invariable following amputations (De Gutierrez-Mahoney, 1970; Tooms, 1971; Carlen *et al*, 1978).

Phantom limb failed to appear in 10 (14 per cent) of our cases. Its absence in one case of leprosy and in two with Burger's disease could be explained by the fact that phantom appears only if the limb has previously had normal sensation (Wilson *et al*, 1978). But why it failed to appear in five cases with injury and in two with osteosarcoma is inexplicable. Since phantom may develop after several weeks in some cases (Carlen *et al*, 1978) it is possible that some of our cases developed it after losing contact with us.

There appears to be some connection between the incidence of phantom and the significance of the lost limb. Thus it was invariably present following the loss of the right upper limb—all the 72 cases in our series being right handed. The difference from the four-fifths incidence after amputations at other sites was statistically significant.

All the patients with phantom developed it within a week, half within a period of 24 hours and another quarter between 24–48 hours. In contrast Carlen *et al* (1978) reported that 65 per cent of their cases developed phantom within 24 hours, 33 per cent immediately after amputation. This difference may be because our patients, being educationally backward and rather unsophisticated, were slow to recognize its presence. It is rather difficult to understand how a sedated and confused patient can appreciate and report the presence of phantom immediately following amputation under anaesthesia, as is reported by Carlen *et al*.

In the present series, lower limb amputees were earlier to develop phantom, nearly two-thirds developing it within 24 hours as against only about two-fifths of upper limb amputees. There was no right/left difference in this respect. We are unable to account for the discrepancy, though it is possible that, lower limbs, being larger than upper limbs, their amputation produces a proportionally bigger phantom which is appreciated earlier.

Nearly three-quarters of the patients reported movements in the phantom, there being no difference between upper and lower limbs or between right and left side. This is in contrast to the findings reported by Carlen *et al* (1978) who recorded movements in 69 per cent of arm amputees and only 45 per cent of lower limb amputees. Telescopy, i.e. a gradual subjective reduction in the size of the phantom occurred in nearly two-thirds of our cases, right upper limb amputees manifesting it significantly less

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often. This demonstrates that the more significant a limb is for the patient the more persistent and severe is the phantom limb phenomenon. Carlen *et al* (1978) found telescopy to be more common (62 per cent) in upper limb amputees than in lower limb amputees (45 per cent).

Dreams that the amputated limbs still existed and functioned normally were only to be expected—a most vivid example of the wish-fulfilling function of dreams.

Phantom limb pain occurred in more than two-thirds of the cases. The pain occurred significantly more commonly following upper limb amputations. Carlen *et al* (1978) reported phantom limb pain in more than 90 per cent of their cases. As against this, earlier workers (Cronholm, 1951; Soloren, 1962; Melzack, 1971; and Tooms, 1971) found a very low incidence of pain. Specific questioning in the immediate post-operative period could be responsible for its higher directed incidence in recent studies because, as is apparent from our findings, phantom pain generally resolves fairly quickly.

The complexity of phantom limb phenomena is obvious when one looks at the theories offered for their aetiological explanation. Thus there are at least two major groups of theories, organic and psychological (Kolb, 1954; Carlen *et al*, 1978; Solomon and Schmidt, 1978). The organic theories can be further sub-divided into three—peripheral, central and mixed.

The *peripheral theory* proposes that the nerve endings in the stump generate impulses which are carried to the central nervous system and perceived as coming from the erstwhile innervated limb. This hypothesis gets support from the fact that electrical stimulation of the stump exaggerates phantom sensations and complete local anaesthesia of the stump abolishes phantom pain, at least while it lasts (Carlen *et al*, 1978). Further, in experimental preparations it has been seen that neuromas at the cut ends of major nerves produce an ongoing barrage of afferent impulses (Wall and Gutnick, 1974) and that active fibres making up the neuromas originate from smaller myelinated and non-myelinated fibres (Devor and Wall, 1976). Thus neuromas could be a possible source of trouble; but only occasionally, and not immediately after amputation, as they take a considerable time to form.

The *central theory* attributes phantom phenomena to conscious processes, independent of sensory impulses from the periphery, based on the patient's life-long body schema and built up from multiple postural, tactile and visual sensory impressions (Head and Holms, 1911; Jacome, 1978). Local anaesthesia of peripheral nerves produces a phantom sensation (Melzack and Bromage, 1973). Avulsion of the brachial plexus with complete removal of the dorsal roots produces a particularly vivid phantom. Jacome (1978) reported a case in which a phantom itch was relieved by scratching phantom feet, and Elliott *et al* (1976) another in which phantom pain was relieved by carbamazepine, both suggesting a central origin for the phenomenon. On the other hand, phantom disappears in amputees suffering from central nervous system lesions (Apenzellar and Bicknell, 1969) and at times phantoms are reported where limbs are congenitally absent (Weinstein and Sersen, 1961). All of these suggest not only a central basis for phantom phenomena but also their representation on an inbuilt body schema rather than as a disturbance arising from long periods of sensory stimulation (Jacome, 1978).

In the *mixed theory* both these factors are combined, in that peripheral stimuli are thought to set up reverberatory, self-perpetuating circuits through internuncial neuronal stimulation. If the resulting sensations are too strong, enduring or painful conscious inhibition is ineffective.

Psychological theories relate phantom phenomena to wish-fulfilment, resulting from the denial of loss of part of the body. Phantom pain is explained as resulting from denial of the affect associated with loss (Solomon and Schmidt, 1978). Kolb (1954) believed that chronic phantom pain represented an emotional response to loss of a body part significant in the patient's relationship with others. Parkes (1973), Frazier and Kolb (1970) and Solomon and Schmidt (1978) have reported cases and presented evidence to suggest that persisting pain in the phantom limb may result from unresolved mourning and fantasies about the amputated limb and overvaluation of it. By implication they suggest that appropriate preparation of the patient, including anticipation of such fantasies, can prevent the occurrence of these problems.

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