PHANTOM LIMB

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"PHANTOM LIMB" is a term which is used to designate the sensation of feeling the presence of an extremity following its amputation. Phantom syndromes also may occur following the amputation of a breast or penis, or following the extraction of a tooth. Phantom limb is of more than casual interest, since the associated pain and dysthesia may incapacitate the patient and in some instances lead to drug addiction or suicide. Nearly four centuries ago Ambrosê Paré was aware of this syndrome, but the classic description by Weir Mitchell,[7] in 1872, furnishes the most detailed information available on the subject in the English or American literature. He used the term "sensory ghost" to designate the syndrome.

MATERIAL

This paper is based primarily on a clinical study of 55 cases in which the patients registered at the Mayo Clinic for the sole purpose of obtaining relief of this syndrome. In order to facilitate the analysis of our findings these cases will be designated as group 1. In an effort to obtain additional information regarding the incidence and cause of this syndrome and the severity of the associated dysthesia we made a follow-up study in 50 cases in which patients had undergone amputation of a limb at the clinic. These will be designated as group 2. This follow-up study revealed that this syndrome followed amputation in 43 of the 50 cases (Table I).

TABLE I.

ANALYSIS OF ONE HUNDRED AND FIVE CASES IN WHICH AMPUTATION WAS PERFORMED

		Group 1	*Group 2*
Cases		55	50
Sex	Male	50	38
	Female	5	12
Limb affected	Upper	36	12
	Lower	19	38
Reason for amputation	Trauma	43	13
	Tumour	4	3
	Infection	5	5
	Vascular condition	3	25
	Miscellaneous conditions	0	4

Group 1—Includes 55 patients who registered at the Mayo Clinic on account of a phantom limb and associated dysthesias.

Group 2—Includes 50 patients who had an amputation at the Mayo Clinic and were followed by letter two to twelve years after the amputation.

INCIDENCE

Weir Mitchell's study was based on the clinical examination of 90 patients who had undergone amputation of a limb and 14 patients who consulted him because of neuralgia or choreiform movements in the stump of a limb. Eighty-six of the 90 patients experienced a phantom limb. According to Leriche,[5] this syndrome is present in about 98 per cent of cases in which a limb has been amputated. As previously stated, we have observed 55 cases of phantom limb at the clinic and a follow-up study of 50 cases in which amputation was performed disclosed 43 instances of the syndrome.

ETIOLOGY

The cause of phantom limb has received less attention than the treatment. The syndrome has been attributed to many different causes, but our study disclosed certain etiological trends.

Sex.—The incidence according to sex is not of much significance, as males are more subject to trauma and vascular disease than are females. These two conditions are the most frequent causes of amputation of a limb. Other frequent causes of amputation are tumours, infection, and a miscellaneous group of conditions including congenital anomalies. The last named causes affect the two sexes nearly equally. Fifty of the 55 cases in group 1 were males; thirty-four in group 2 were males. No factor in the selection of the cases can account for this predominance of males.

Age.—The incidence of phantom limb according to age is scarcely worthy of comment. As might be expected, most of the patients in each group of cases were between 30 and 60 years of age. The youngest patient was 11, and the oldest was 80 years of age at the time of the respective amputations.

Reason for amputation.—The condition which necessitated the amputation is of some signifi-

cance. Trauma was the cause in 43 of the 55 cases in group 1. In the remaining 12 cases in this group the causes of amputation were as follows: infection in 5 cases, tumour in 4 cases, and vascular diseases in 3 cases. In group 2 the causes of amputation were as follows: vascular disease in 20 cases, trauma in 7, infection in 7, miscellaneous conditions in 6, and tumour in 3. In group 1, that is, cases in which the patients came to the clinic solely for the relief of pain in the phantom limb, trauma was the cause of the amputation in 43, or 78.1 per cent, and vascular disease was the cause in 3, or 5.4 per cent. In group 2, that is, cases in which a limb was amputated at the clinic, trauma was the cause of the amputation in 13, or 26 per cent, and vascular disease was the cause in 25, or 50 per cent. The reversal of these two conditions as the predominating cause of amputation in the two groups of cases is not difficult to explain. In most cases in which amputation of a limb is necessary following an accident, the amputation is performed in a hospital near the scene of the accident. On the other hand, a considerable number of patients who have peripheral vascular disease are referred to the clinic for treatment.

Site of amputation. — The upper extremity was the site of amputation in 36 of the cases in group 1, and the lower extremity was the site in 19 cases. This is of some interest, as Weir Mitchell said that amputation of the upper limb is more likely to be followed by dysthesia and phantom limb than is amputation of the lower extremity. In group 2 the upper limb was the site of amputation in 12 cases and the lower limb was the site in 31 cases. The predominance of the lower limb as the site of amputation in the cases in group 2 was to be expected, as vascular disease was the most common cause of amputation in this group of cases.

Neuroma.—A neuroma could be palpated in about 20 per cent of the cases in group 1. In evaluating the etiological rôle of neuroma it is interesting to note that in the cases in group 1 removal of a neuroma was followed by relief of symptoms in less than half of the cases in which the procedure was employed.

Neurotic tendency.—The possibility that the incidence of phantom limb is greater among neurotic persons than it is among normal persons is difficult to evaluate as the symptoms produced by an amputation are likely to bring out neurotic tendencies in a relatively stable individual. Neurotic manifestations were noted in 19 of the 55 cases in group 1.

SYMPTOMS

A patient suffering from the syndrome known as "phantom limb" usually relates that following the amputation of a limb he becomes conscious of a sensation of the presence of the lost limb, and that pain in the stump or in the distal portion of the lost limb soon becomes unbearable. In addition to these symptoms the painful stump may be exceedingly hypersensitive, and there may be annoying spasms or jerking of the stump.

In 42 cases in group 1 the syndrome had been noted immediately after the amputation; in the remaining 13 cases the time that had elapsed between the amputation and the appearance of the syndrome was as follows: less than one month in 5 cases, from one month to one year in 3 cases, and more than a year in 5 cases. In many cases the patients had experienced the sensation of the presence of the lost limb intermittently for several years before the occurrence of distressing symptoms. In 4 cases in group 1 the sensation of the presence of the lost limb had been experienced intermittently for 12, 25, 27 and 29 years, respectively, before the patients came to the clinic, but in the majority of cases the average time that had elapsed since the operation was less than 5 years. This illustrates how rapidly pain becomes a real problem. In 12 cases some symptoms had been present for 5 to 10 years before the patients came to the clinic. In 4 cases symptoms had been present for 10 to 20 years, and in 6 cases they had been present for more than 20 years.

The pain usually is said to be of a burning, aching or cramping type. Many patients said that the pain had a crushing, twisting, grinding, tingling, tearing or drawing quality. Some patients experienced the feeling of the presence of a tight, wire-like band around the phantom limb. Others experienced a prickly sensation as though needles were sticking in the phantom limb. In some cases the phantom limb felt numb. In several cases the patients experienced one of the following sensations: (1) that the fingers on the phantom limb were being twisted out of shape, and (2) that the thumb was being pushed through the palm of the hand. When such sensations were present the patients experienced great difficulty in changing the position of the fingers of the phantom limb. One patient said

that this difficulty increased with time. One patient felt as though the nails of the fingers of the phantom limb were being lifted from the nail beds. In fifteen cases the pain interfered considerably with sleep.

In far more than half of the cases the patients said that the pain had been present constantly but had varied in intensity. However, in 4 cases the pain had been paroxysmal and had occurred once a month or once a year. During the paroxysms morphine had been administered to relieve the pain. After the termination of the paroxysms the patients had been free of pain for a long time.

In 8 of the cases in group 1 the patients said that the pain was aggravated by changes in the weather. This climatic influence was noted in 21 of the cases in group 2. This relationship was mentioned by Weir Mitchell and by Jacobi.[4] In the case reported by the latter it was necessary to administer more opiates and wine in cloudy, damp weather than it was when the weather was clear and dry. Inasmuch as this relationship was noted in only 8 cases in group 1, and as changes in weather affect many types of pain, it does not seem to be of particular significance.

In a few cases the patients said that the pain was worse on days when they were excited or fatigued than it was on days when they were calm and refreshed. In some cases the patients noticed a decrease in the severity of the symptoms when they were occupied. Three patients said that imbibing some form of alcoholic beverage produced relief.

The stump was the site of some distress in most of the cases. About 10 per cent of the patients were bothered by spasm or jerking (so-called choreiform movements) of the stump. In half of the cases the stump was tender or hyperæsthetic. In a number of cases, especially in cases in which a neuroma was present in the stump, pressure on the stump produced shooting pain in the phantom limb. The tenderness and hyperæsthesia were independent of the presence or absence of a neuroma.

As stated previously, nervous manifestations were recorded in 19 of the 55 cases in group 1. In some cases there were mild symptoms of a nervous disturbance; in other cases there was evidence of marked nervous instability. One patient threatened to commit suicide because of the severity of the symptoms. Leriche said that this occasionally was the outcome in cases of phantom limb. In speaking of the pain, one patient said, "I can't stand it"; another said, "It will drive me insane." According to Gallinek,[2] the symptoms of phantom limb are the same among psychotic patients as they are among other patients, with the exception that in cases of psychosis the symptoms may be coloured by the hallucinations and delusions.

In most of the cases in group 2 the phantom limb caused little discomfort; in fact, it produced severe distress in only four instances. In two cases the patients complained of movement of the stump, but in two there were no symptoms referable to the stump.

TREATMENT

It has been said that when many types of treatment are recommended for a disease no one of them is entirely satisfactory. The literature contains numerous reports of the successful treatment of phantom limb and pain in the stump, but in most cases the duration of the cure has been recorded in months rather than in years. In the cases in group 1 many of the patients had obtained relief with various types of treatment, but ultimately came to the clinic because of incapacitating symptoms. We hasten to add that our results were no better than those obtained before the patients came to the clinic. Fifteen different types of treatment were employed, either at the clinic or before the patients came to the clinic. The patients obtained scarcely more than temporary relief of symptoms. In evaluating the results of the different types of treatment we shall not attempt to distinguish between the treatment used at the clinic and that employed before the patients registered at the clinic.

Injection of alcohol into the nerves and into a neuroma in the stump produced some relief temporarily in four cases but in five other cases in which this procedure was employed it did not produce any relief whatever. The results of injection of a solution of procaine hydrochloride into a neuroma and infiltration of the brachial or sacral plexus were no better than the results of the injection of alcohol. In a case in which the syndrome had followed the amputation of a lower extremity the use of spinal anæsthesia to produce sensory anæsthesia to the level of the nipple did not result in immediate relief.

Some form of plastic operation on the stump was performed in two cases. Slight improve-

ment resulted in one case, but this was only temporary. In more than half of the cases in which a neuroma was removed the procedure did not relieve the symptoms; in the remaining cases in which the procedure was employed the benefit was only temporary. Removal of a neuroma, injection of alcohol about the nerve-endings, and anastomosis of the nerve-endings also produced indifferent results. In some cases an exploratory operation was carried out on the brachial plexus and sympathectomy, rhizotomy, or cordotomy was performed, but the patients obtained only temporary relief. In one case roentgen therapy was applied to the spinal cord and to the roots of the spinal nerves, but the treatment did not produce any relief.

Application of physiotherapy to the stump relieved the symptoms for a short time in some cases but in others it did not produce any relief. In one instance it proved satisfactory when used every three or four months.

Each of 15 patients was subjected to one operation and each of 25 patients was subjected to two or more operations; 15 were not treated surgically. The treatment of this syndrome is still unsatisfactory. In most cases the treatment has been directed mainly if not entirely along surgical lines, as first suggested by Weir Mitchell.

Molotkoff[8] found that severing the obturator nerve before it enters the obturator canal relieves the pain projected to the inner aspect of the foot. For pain referred to the external malleolus he obtained good results by cutting the lateral femoral cutaneous nerve. He mentioned treating eleven patients in this manner but did not indicate clearly the duration of relief. Leriche said that sympathectomy relieved several of his patients for a considerable time but that the treatment was of no value in cases in which the syndrome follows high amputation. Livingston[6] treated 10 patients with injection of a solution of procaine hydrochloride into the region of the thoracic sympathetic ganglia of the affected side; in 8 cases the patients obtained immediate relief of pain; in 4 the method appeared to be of definite therapeutic value. One patient remained well for three years after the second injection. Livingston pointed out that relief for even a few months is worth while when obtained by the use of such a simple procedure.

A study of our own cases and a review of the cases reported in the literature force us to conclude that the treatment of phantom limb is unsatisfactory. It is worthy of note that in many cases almost any type of procedure from physiotherapy to radical operations may produce relief for a short time.

Everyone who had studied this syndrome has been aware of the frequent use of drugs by the patients. This is, of course, to be expected. However, it is worthy of comment again that a few (two patients in our series) become morphine or codeine addicts. Seven patients used codeine or morphine frequently, and 6 had been taking barbiturates too freely. We wish to emphasize the dangers of the use of narcotics in cases of phantom limb.

COMMENT

We feel that this study would be incomplete unless some mention were made of the mechanism of the pain in the phanton limb. It should be stated at once that in the cases in group 1 pain and dysthesia in the phantom limb were the chief symptoms.

We wish to mention some aspects of the problem of phantom limb which defy explanation on the basis of any single theory. For example, pressure on the stump either in the absence or presence of a palpable neuroma may cause shooting pain in the absent extremity. On the other hand, pressure upon the sciatic nerve several inches above the stump occasionally stops the pain in the phantom limb and at the same time causes the "sensory ghost" to disappear. It is difficult to understand why slight pressure on the nerve may bring about temporary relief in one case but cutting of the sciatic nerve in another case does not result in permanent freedom from symptoms. This to our mind confounds all explanation of the pain on the basis of peripheral or central excitants. Molotkoff and Leriche have both pointed out the need for cutting more than one nerve to an extremity. This seems reasonable at first glance, but it is necessary to explain why posterior rhizotomy, cordotomy, and even complete spinal anæsthesia of as many as six to eight segments above the segmental supply of the lower limb do not produce any relief. Of course, in some cases temporary relief is produced, but one would expect these procedures to produce permanent relief if the pain is peripheral.

During the course of this study we saw a case of congenital absence of the forearm. The patient was a man, seventy years of age, who had never experienced a phantom limb. This would be expected since sensory impressions for this

part had never been recorded by the cerebral cortex. Observations on this patient prove nothing. However, it should be remembered that a small percentage of persons do not experience either pain or phantom limb following amputation, and of the large number who do have the symptoms only a small number are incapacitated in any way. This is not only generally known but is borne out by the facts obtained in our follow-up study of the 50 cases in group 2. It is interesting to consider why pain is frequently absent above the phantom wrist or foot until the stump is reached. The forearm or leg is rarely felt as a part of the phantom limb. Further, on the basis of peripheral irritation the following facts have to be explained: (1) the high incidence of this syndrome among patients who sustained trauma before amputation of a limb; (2) the high incidence of painful phantom limbs in cases in which the upper extremity has been amputated, and (3) the late incidence of severe dysthesia which occurred twenty-five years after the amputation in one case even though the "sensory ghost" had been present continuously. The severe pain and dysthesia in one case began years after the amputation, when the stump sustained a moderately severe blow. One can do no more than speculate as to the factors responsible for the late onset of pain in some cases. Twenty-five years seems late for any organic change to be taking place in the peripheral nerves or neuromas which would initiate the phantom limb syndrome and late for an obsession neurosis to be making its appearance.

That the problem is more than one of irritation of peripheral nerves in scar tissue or of dilated or constricted blood vessels either locally or in the arachnoid meninges seems by now to have passed from the stage of supposition to a foregone conclusion.

We have stated some of the conflicting evidence that tends to prove this fact in an indirect and negative fashion. We now wish to present some positive evidence to prove that cerebral (psychical) processes have to be considered. We wish to recall that the majority of the patients who had incapacitating symptoms had experienced both psychical and physical trauma, either at the time of, or just prior to, the surgical amputation. Patients whom we personally examined retained this memory very vividly, as illustrated by the following case.

A man, aged sixty-two years, came to the clinic because of symptoms entirely unrelated to his absent limb. We chanced to ask him about it. Twenty-two years previously, while he had been at work, his entire arm had been drawn into the cogs of a machine and amputation had been necessary. Following amputation he had felt the absent limb, and for a month or two he had experienced the sensation of moving the hand of the absent limb freely, but when seen at the clinic he had to use terrific force to move it. He had never seen a physician concerning the phantom limb nor had he taken any treatment. He had simply learned to live with a phantom limb of which he was more conscious than of the one present. Even more interesting was the fact that for a week prior to the accident he had had a sliver under the nail of the index finger, which had been moderately painful and annoying. He stated emphatically that he later felt the sliver in his phantom limb as it had existed before the accident. This sensation had continued for about two years. As further evidence of the psychical processes involved, we wish to mention the fact that he had ordered that the amputated limb be burned. While the hospital authorities had been burning the extremity he had felt the ashes gradually drop off the phantom limb.

Who would say that either of these experiences was due to any process active in the nerves, the spinal cord, or even the parietal cortex? However, Head and co-workers[3] had noted the disappearance of the phantom limb after injury to the parietal cortex. Surely it is of some significance that it is the distal part of the limb, that is, the hand or foot which is the main site of the symptoms and this was also pointed out by Foerster. They have the largest representation in consciousness. This was pointed out by Pick,[9] who also remarked that phantom limbs are missing in cases in which there is congenital absence of a part or in cases in which injuries take place early in childhood. In such cases the limbs have never been represented in the body image.

Arguing by analogy, we might cite the example of the sliver which had been present in the finger one week prior to amputation and which had been felt for two years. It is not unreasonable to try to explain the persistence of the absent limb for a much longer period in the same manner. Further, we doubt if it is going too far to expect that the pain associated with traumatic amputation might persist and in some instances become magnified and even exaggerated as the years go on. Everyone knows that all patients give much thought to the advice of a surgeon who recommends amputation of a limb for any reason whatsoever. They give it up grimly, and there is much folk-lore connected with the proper method of disposal of the amputated extremity.

Enough has been said to indicate that treatment must be directed in a strictly psychological

manner. Treatment may include the use of some surgical procedure in rare instances. For example, we believe that a tender painful neuroma of the stump should be removed.

SUMMARY

There can be no doubt that there is such a clinical entity as phantom limb. It is a common occurrence following amputation but incapacitating symptoms as a result of it are relatively infrequent. The surgical treatment of the syndrome is unsatisfactory to date, and we suggest that general measures of a psychotherapeutic nature are likely to be of benefit. These should be instituted immediately after amputation of a limb. The mechanism of the pain is not clear, and at present we hesitate to accept the theory of ascending neuritis or peripheral irritation. It seems more likely that its origin is central (that is, intracranial) and most probably psychic. Some of the evidence in our cases suggests the probability that it is some form of obsession neurosis.

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AN ANALYSIS OF PUBLISHED STATISTICS IN CONNECTION WITH MAMMARY CANCER*

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IN order to compare different methods of treatment and to evaluate any new form of attack accurate statistics are necessary. One is prone to remember the satisfactory results and to forget the disasters and failures of response to treatment. So the tedious, time-consuming labour of carefully kept records is thrown on all of us. These must include a description of the lesion itself, both local and metastatic, and an exact record of the type and form of treatment, and follow-up progress notes for many years.

Standardization of technique and classification of disease is needed, so that a type of treatment found to be effective in one centre may be adopted in another. Thanks to the manufacturers of therapy equipment the technical factors are standardized to an entirely satisfactory degree of accuracy. Kilovoltage, amperage, time, distance, and filters can be varied at will and any desired form of treatment exactly duplicated. Equally important in cancer of the breast is a standardized grouping into different classes and stages, depending on the extent of the disease. It goes without saying that the effectiveness of one form of treatment directed against a small localized carcinomatous nodule completely limited to the breast cannot be compared with another method which is being employed to combat a widespread advanced carcinoma with extensive secondary involvement of the regional lymph glands.

Steinthal was one of the first to describe a classification based on physical findings disclosed by routine examination of the breast and surrounding palpable lymphatic drainage areas. It is far from perfect but is widely used, with or without modification, and has done much to standardize and clarify the classification of cancer of the breast. He describes three groups or stages. The first includes those cases in which there is slow growth of a small tumour, limited to the breast, without fixation to the skin or underlying tissues and without palpable axillary glands. Into the second group fall the cases in which there is pronounced growth, adherence of the tumour to the skin, retraction of the nipple, or palpable lymph glands in the axilla. The third group embraces extensive carcinomas of the breast with adherence to the skin, fixation to the chest wall and enlarged axillary and

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