THE PHANTOM LIMB SYNDROME
A DISCUSSION OF THE ROLE OF MAJOR
PERIPHERAL NERVE NEUROMAS

KENNETH E. LIVINGSTON, M.D.*

(Received for publication January 22, 1945)

Following major extremity amputation a large proportion of patients will retain quite specific impressions of their missing limb, persisting for months, years, or as long as they live. Weir Mitchell studied a series of 90 major amputations during and after the American Civil War, and in 86 of these cases found characteristic "phantom" limb symptoms. More recently Leriche, Livingston, Bailey and Moersch and others have emphasized the frequency and uniformity of this phenomenon following amputation.

Such phantom limb symptoms become clinically important when associated with protracted or severe pain. However, of all patients with well-defined phantom limb sensation, comparatively few (probably less than 10 per cent) will have severe persisting pain referred to the phantom limb. In a majority of these cases the first attempt to obtain relief has been through resection of major nerve neuromas. Neuromas subjected to mechanical insult from muscle traction, lack of soft-tissue protection, pressure of prosthesis, etc., may become a source of real pain. In such cases removal of the neuroma and protection of the area from mechanical trauma will relieve the symptoms. This pain is always directly dependent upon the traumatic factors and is readily differentiated from true phantom limb pain. In true phantom limb pain clinical results of neuroma resection have been generally disappointing, and the role of the major peripheral nerve neuromas, both in relation to the phantom limb impression itself and in phantom limb pain, has remained confused.

The principal studies of the phantom limb phenomenon have been concerned with patients having serious pain. Attempts to determine the role that the neuroma plays in such cases is frequently difficult since any disturbance of the stump is likely to aggravate pain in the phantom limb. This aggravation may occur when the neuroma is disturbed, but it may also be set off by bumping the stump, pinching the skin, tapping the bone end, rubbing the scar, etc. However, in patients having definite and characteristic phantom limb symptoms without severe pain, the neuroma may be more readily studied, and its relation to the phantom limb impression and to phantom limb pain may be more accurately examined. This study is based on such cases.

Forty-two patients with a total of 50 major extremity amputations were

* Now Lt. (jg), M.C., U.S.N.R. Formerly Fellow in Neurosurgery, The Lahey Clinic, Boston, Massachusetts.
studied in detail.* The group is representative of amputation in civilian life. The primary causes for amputation were: vascular disease, 36 per cent; trauma, 28 per cent; infection, 16 per cent; tumor, 8 per cent; miscellaneous, 12 per cent. Age at the time of study ranged from 19 to 79 years. It is interesting to note that the two patients who had the earliest amputations, done at 9 and 12 years of age, had clearly defined phantom limbs 33 and 38 years after amputation although neither patient had had severe pain disability during that period. The longest duration of phantom symptoms in the group was 44 years.

The principal characteristics of the phantom history were carefully studied in these cases and found to conform accurately to the findings in other series. Of the 50 amputations only one was never associated with phantom limb symptoms. Seven patients with eight amputations were followed from the time of surgery particularly to record the time of onset and original pattern of the phantom symptoms.

There are certain features of the phantom limb syndrome that are important in considering the part the neuroma may play in this phenomenon. First, is the geography or pattern of the phantom limb, particularly in relation to the sensory patterns of the major peripheral nerves; second, is the time of onset of phantom limb symptoms following amputation; and third, is the relation of phantom symptoms to the mechanical and irritative disturbances in the stump that might be expected to alter the state of the neuroma.

The phantom limb is not a simple total reproduction of the amputated extremity. There is a definite patterning of the phantom limb which does not conform to the geography of the major peripheral nerves. In the upper extremity amputations the fingers are most prominent, although in many instances only the palmar surfaces of the finger tips are actually represented. The palm is less frequently felt, and the wrist and dorsum of the hand are usually not present. The forearm and upper arm are rarely perceived. Many patients give the impression that they feel “the whole thing,” but on careful questioning it is evident that the posture and presence of much of the phantom limb is inferred, often from small portions of the hand or fingers of which the patient has very specific impressions. In lower extremity amputations similar phantom patterning is found. In neither extremity does the pattern correspond to the major peripheral nerve distributions. It was not possible, for instance, to describe any of the phantom limbs as representing an ulnar neuroma or irritation, or peroneal neuroma or irritation, with resulting “ulnar” or “peroneal” phantoms. In addition there was no tendency for the phantom pattern to “spread” from a primary nerve pattern to a more complex pattern during its initial stages, in patients studied immediately following amputation. The geography of the phantom limb was not affected in any of these cases by serious local complications, such as stump sepsis or

* From the surgical and orthopedic services of Stanford University Hospitals, San Francisco, California, 1940 to 1942.