PHYSICAL SIGNS

Functional weakness and sensory disturbance

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In the diagnosis of functional weakness and sensory disturbance, positive physical signs are as important as absence of signs of disease. Motor signs, particularly Hoover's sign, are more reliable than sensory signs, but none should be used in isolation and must be interpreted in the overall context of the presentation. It should be borne in mind that a patient may have both a functional and an organic disorder.

Symptoms considered "functional," "psychogenic," "medically unexplained," or "hysterical" account for up to one third of new referrals to neurology outpatient departments. Complaints of weakness or difficulty walking, often in combination with sensory disturbance, represent a significant subgroup of these symptoms. Despite their frequency in clinical practice, descriptions of the diagnosis and management of these problems are not easily found in textbooks of neurology. Although elements of the history may be helpful, physical signs are often of crucial importance in the diagnosis of functional weakness.

In this article, we describe what is known and what is not known about the physical diagnosis of functional weakness, functional gait disturbance, and sensory disturbance. Where evidence is available, we have referred to it. Otherwise, we have had to rely on our own clinical and research experience with these patients. We wish to emphasise the importance of the following two maxims:

- Look for positive evidence of a functional disorder as well as the absence of signs of organic disease.
- Be prepared to make two diagnoses in some cases: one of disease and one of varying degrees of functional weakness (or functional "overlay").

BEFORE THE PHYSICAL DIAGNOSIS

A careful history is essential. In particular, the presence of multiple symptoms, depression or anxiety (particularly panic), or a history of several previous functional symptoms or surgical operations without positive pathology raise the likelihood that the primary symptom is functional.[1] Childhood adverse experience, personality factors, having a model for the illness, a recent life event, secondary gain (financial and otherwise), and illness beliefs may all be relevant to management, but not enough is known about these factors to allow them to be used in making the diagnosis.

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The history of the onset of the symptoms can be particularly helpful. Patients with functional weakness will often describe symptoms suggestive of dissociation at the onset—either occurring in combination with panic, a physical trauma (often minor), or spontaneously. In this context, "dissociation" refers to the weakening or loss of the normal sense of ownership of one's actions and sensations. Descriptions suggestive of dissociation include: "the leg felt as if it was not connected to me", "I felt far away", or "I was in a place of my own".

FUNCTIONAL WEAKNESS

Preliminary observation

The physical assessment of functional weakness should begin as the patient gets up from their chair in the waiting room and end as they are leaving the consulting room (or the hospital). The primary objective is to look for evidence of *inconsistency*. It may be particularly helpful to watch the patient:

- Taking their clothes off or putting them on.
- Removing something from a bag and replacing it (for example, a list of medicines).
- Walking into the room as compared with walking out of the room (and sometimes out of the outpatient building).

Hoover's sign

The test

Hoover's sign is the most useful test for functional weakness and the only one that has been subjected to scientific study with a neurological control group.[2 3] It is a simple, repeatable test which does not require skilled surreptitious observation. The test relies on the principle that virtually everyone, whether they have a disease or not, extends their hip when flexing their contralateral hip. This finding is thought to be a result of the crossed extensor reflex, described by Sherrington,[4] which enables normal walking, and is present even in decorticate animals. The test as described by Hoover in 1908 [5] can be performed in two ways:

1. *Hip extension*—In patients with functional weakness a discrepancy can be observed between their voluntary hip extension (which is often weak) and their involuntary hip extension when the opposite hip is being flexed against resistance (which is normal). This test is illustrated in fig 1. It is important when testing involuntary hip extension to ask the patient to concentrate hard on the good leg.

2. *Hip flexion*—The opposite test, where hip flexion in the weak leg is tested while the examiner's hand is held under the good heel is also described,

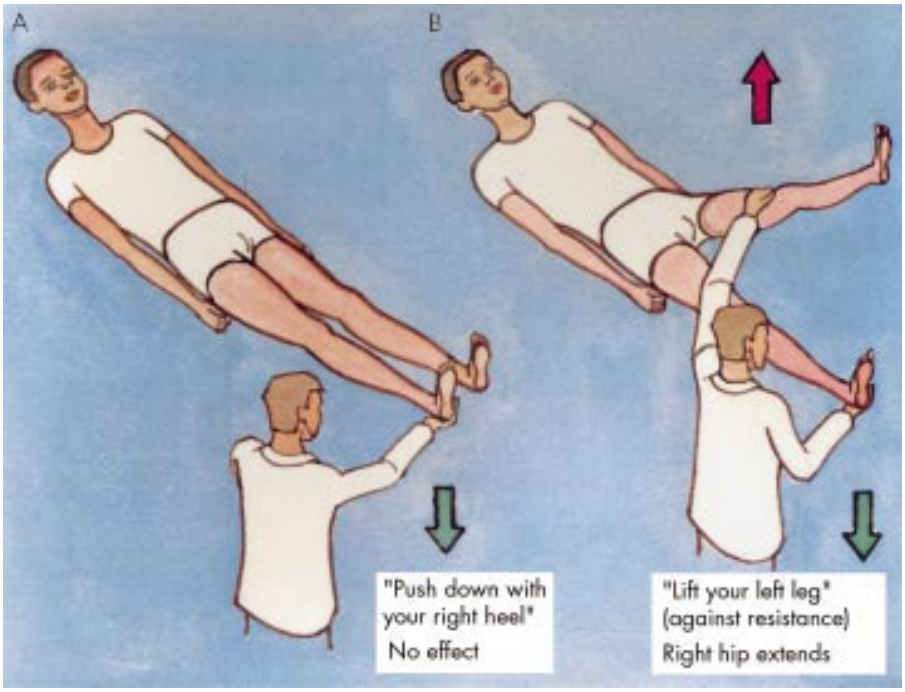

Figure 1 Hoover's sign. (A) Hip extension is weak when tested directly. (B) Hip extension is normal when the patient is asked to flex the opposite hip.

although has not been adequately evaluated. In this test the absence of downward pressure in the good leg indicates a lack of effort transmitted to either leg.

Head described an additional variant in which the patient lies on their front and is asked to extend their good hip while hip flexion is tested in the weak leg.[6]

Caveats

False positives

- Pain in the affected hip may produce greater weakness on direct than on indirect testing as a result of attentional phenomena (related to pain rather than weakness).
- A patient with organic disease may be trying to "help" you or "convince" you that they are ill.
- There are insufficient data to rule out the possibility that a similar phenomenon may sometimes occur as a direct result of organic brain disease, for example multiple sclerosis.

False negatives

The patient may not be concentrating sufficiently on flexing their good hip when you are testing involuntary extension of the weak hip. If so, you should find that flexion in the good leg is stronger when you remove your hand from under the weak leg.

The following should also be remembered:

- Hoover's test does not differentiate functional or hysterical problems from malingering or simulated weakness.
- Your patient may have a combination of organic and functional weakness. Indeed, organic disease is a risk factor for the development of functional symptoms.[7 8]

Validity

Hoover's test has been examined in two controlled studies. In the first, computer myometry demonstrated a significant difference in the "involuntary to voluntary hip extension ratio" in seven patients with non-organic weakness compared with 10 controls with organic weakness.[2] An equivalent study using simple weighing scales where nine subjects with functional weakness were compared with control groups with organic weakness, back pain, or no weakness produced similar results.[3] These studies were not blinded and do not measure the reliability of the test as used in the real world but do provide preliminary support for its use.

Hoover's test in the arms?

Hoover described a similar phenomenon of "complementary opposition" in the arms. In this test, flexion against resistance of an arm stretched out in front of the patient can produce involuntary extension of the other arm. Analysing this phenomenon, Ziv *et al* obtained results comparable to those in the legs.[2] A related test of shoulder adduction is also described based on the principle that often when shoulder adduction is tested on one side, the contralateral side will also adduct.[9]

Collapsing weakness

A common finding in functional weakness is that of "collapsing weakness," in which a limb collapses from a normal position with a light touch (or occasionally, even before your hand has touched the limb). Normal power can often be achieved transiently with encouragement. The instruction, "At the count of three, stop me from pushing down . . .." is often helpful in this respect. The intuitive explanation of collapsing weakness is that the patient simply isn't trying. While this is sometimes undoubtedly the case, in our experience the performance of most patients with functional weakness seems to get worse the more effort and attention they expend on the limb.

The problem with collapsing weakness is that, like Hoover's sign, it may also occur for reasons unrelated to functional weakness. These include an inability to understand the instruction, pain in the relevant joint, being generally unwell, and a misguided eagerness of some patients to "help the doctor" or "convince the doctor," even though they actually have organic disease.

Validity

Collapsing or "give-way" weakness has been investigated neurophysiologically.[10–12] Van der Ploeg showed that in functional weakness the force generated by a limb at the point

Figure 2 Functional monoplegic gait. In both cases the leg is dragged at the hip. External or internal rotation of the hip or ankle inversion/eversion is common.

the examiner overcomes the muscle force is unusually *high* when compared with the force generated by normal resistance.[11] Another study confirmed that patients with functional weakness produce significantly variable amounts of force in their limbs compared with controls. This study also showed that subjects with functional weakness tend to produce less force with slower movements.[12]

Collapsing weakness has not been put to the test in a "real life" controlled clinical study. Gould *et al* found that, of 30 patients with acute neurological pathology (mostly stroke), 10 had collapsing weakness.[13] They emphasised the need for caution with this sign.

Other signs of functional weakness

Co-contraction

It may be possible to feel the contraction of an antagonist muscle, for example the triceps, when the agonist muscle, the biceps, is being tested. In 12 patients with functional weakness Knutsson and Martensson showed that knee flexion was weaker than it would have been if they had just let the weight of the lower leg carry out the movement, indicating antagonist activation.[12]

The "arm-drop"

In this test, a supposedly paralysed arm is dropped over the patient's face to see if they will protect themselves from its fall. This has also been described as a test on the unconscious patient. However, the arm must be so weak for this test to be interpretable that we suggest it rarely adds information. A less aggressive variation is to watch the speed and smoothness with which arms fall down from an outstretched position on to the lap. In functional weakness, this may be slower and jerkier. This has not been validated.

Pseudo waxy flexibility

Occasionally a patient complaining of weakness may find that if their limbs are put in a certain position—for example, with the arms outstretched—they will inexplicably maintain their position even to the point that they are unable to get them down again. This phenomenon is similar to that seen in people undergoing stage hypnosis.

Sternocleidomastoid test

Recently Diukova *et al* reported that 24 of 30 patients (80%) with functional hemiparesis had sternocleidomastoid weakness, usually ipsilateral, whereas only three of 27 patients (11%) with a vascular hemiparesis had weakness of the sternocleidomastoid muscle (which is bilaterally innervated and so is rarely weak in upper motor neurone lesions).[14]

Important absent signs in functional weakness

We have emphasised the importance of looking for positive signs of functional weakness and sensory disturbance. The absence of certain signs is also important. Tone and reflexes should be normal although there may be mild asymmetry, particularly if there is attentional interference from the patient.[15] Pseudo-clonus was well described at the turn of the century as a clonus with irregular and variable amplitude.[15 16] It is rare for functional weakness to affect the motor function of the face although this is described by Janet[17] and we have observed it. Pseudo-ptosis, when overcontraction of orbicularis and apparent weakness of frontalis produce an apparent ptosis, has also been described.[18]

FUNCTIONAL GAIT DISORDERS

These are protean in their manifestations, but certain types are common. Three helpful series have been published,[19–21] but there are no controlled studies.

Perhaps the commonest gait disorder is the "dragging monoplegic gait" (fig 2). In this gait, the whole leg is dragged, like a sack of potatoes, as a single unit behind the patient. The hip circumduction found in pyramidal hemiparesis is usually absent. The hip may be rotated and the ankle may maintain an inverted or everted posture. Patients with this kind of gait often report that the leg feels as if it barely belongs to them and may also suggest that they would be better off if it were amputated. A description of other common gait phenomena as described by Lempert *et al* in 37 patients[20] is given in table 1.

It is salutary to recall that some highly unusual gait disorders have only recently found an organic home—for example, paroxysmal kinesogenic choreoathetosis. All three mistaken diagnoses in a follow up study of 64 patients with functional

Table 1 Common varieties of functional gait disorder (from Lempert *et al*, 1991[20])

	Clinical features	Description	n*
1	Monoplegic "dragging" gait	A leg that drags behind the patient, often with rotation at the hip or inversion/eversion at the ankle. Leg often hauled on to bed with both hands.	N/A†
2	Fluctuation of impairment	Variability during a 5–10 minute period, either spontaneously or provoked by distraction, for example finger-nose testing while standing	19
3	Excessive slowness of movements or hesitation	Simultaneous contraction of agonist and antagonist muscles—not related to pain in this sample. *Hesitation* refers to delayed or failed initiation of gait; small forward and backward movements of the leg while the feet "stick" to the ground; does not improve after the first step like parkinsonism.	19
4	"Psychogenic Romberg" test	(1) Constant falls towards or away from the observer, irrespective of position. Fall avoided by clutching physician. (2) Large amplitude body sway. (3) Improvement with distraction.	12
5	"Walking on ice" pattern	The gait pattern of a normal person walking on slippery ground. Cautious, broad based steps with decreased stride length and height, stiff knees and ankles. Arms sometimes abducted as if on a tightrope.	11
6	Uneconomic postures with waste of muscle energy	A gait with an eccentric displacement of centre of gravity such as standing and walking with flexion of hips and knees.	11
7	Sudden knee buckling	Patients usually prevent themselves from falling (8/10) before they touch the ground, requiring excellent muscle function. NB, knee buckling can occur in Huntington's chorea and cataplexy.	10

* Number displaying this feature in a series of 37 patients with functional gait disorder.
†Excluded from Lempert's classification but one of the most common gait abnormalities.

motor symptoms from the National Hospital in London occurred in patients who had presented with disturbances of gait.[8]

FUNCTIONAL SENSORY DISTURBANCE

Functional sensory disturbance may be noticed by the patient, or as is often the case, be detected by the examiner and come as a surprise to the patient. It typically affects all modes of sensation, either in a hemisensory distribution ("I feel as if I'm cut in half") or affecting a whole limb. In the latter, sharply demarcated boundaries at the shoulder and at the groin are common.[17 22] If the trunk is involved, the front is more commonly involved than the back. Patients with hemisensory disturbance often complain of intermittent blurring of vision in the ipsilateral eye (asthenopia) and sometimes ipsilateral hearing problems as well. If someone has functional weakness, they usually have functional sensory disturbance as well—perhaps suggesting a shared pathophysiology. While various functional sensory signs have been described, none appear to be specific and they should not therefore be used to make a diagnosis.

Midline splitting

It has been commonly assumed that exact splitting of sensation in the midline cannot occur in organic disease. The reason usually given is that cutaneous branches of the intercostal nerves overlap from the contralateral side, so sensory loss should be paramedian—that is, 1 or 2 cm from the midline. However, midline splitting can occur in thalamic stroke when a profound loss of several sensory modes can occur, in a manner similar to functional sensory loss. Recent imaging work by Vuilleumier *et al* demonstrating a functional thalamic lesion in hemisensory loss is intriguing in this respect.[23] Rolak reported midline splitting in six of 80 patients with organic disease.[24]

Splitting of vibration sense

Common sense decrees that there should be little difference in the sensation of a tuning fork placed over the left and right side of the sternum or frontal bone, as the bone is a single unit and must vibrate as one. However, in Gould's study mentioned earlier, 21 of 30 patients with organic disease showed this sign.[13] Similarly, Rolak found that 69 of 80 patients with organic disease had this sign, versus 19 of 20 with functional sensory loss.[24] Again, perhaps our model of the sensory system and its thalamo-cortical representation has been too simplistic when devising these tests.

Tests involving doctor trickery

These include, "Say 'Yes' when you feel me touch you and 'No' when you don't", and sensory examination of the hands while they are either crossed behind the back or interlocked and rotated on the chest. Forced choice procedures have also been described in which testing is made sufficiently complicated that a performance worse than chance can be achieved,[25 26] suggesting systematic underperformance. However, this finding does not discriminate conscious from unconscious intentions and is unlikely to add to the diagnosis or management. We rarely need to use these tests, although they may have a role in medicolegal assessment.

The laterality of symptoms

Despite frequent claims that left sided symptoms are more common, a systematic review of the evidence suggests that while there may be a slight preponderance of left sided symptoms over right, a form of publication bias may account for most of the perceived asymmetry.[27] The diagnosis of functional weakness should certainly not be made on the basis of the side of the symptoms.

La belle indifference

La belle indifference, or a smiling indifference to the symptom, performs poorly as a discriminator against organic disease.[28 29] It also gives the false impression that most patients with functional symptoms are not distressed by their symptoms when in fact the vast majority are both distressed and baffled by the problem. The concept of *la belle indifference*, as it was first described, also applied to patients who were unaware of sensory loss found by a doctor on examination, a common problem but quite different from being indifferent about weakness of a limb.[17]

SHOWING THE PATIENT THE SIGNS

If a patient has organic disease, a neurologist will often explain salient abnormalities of the examination or investigations and how these offer support for their diagnosis. Most of us, however, would probably not think to do so with the functional patient. We have found that explaining how the diagnosis of functional disorder is supported by the examination enhances trust between doctor and patient in a way that is often hard to achieve by other means. Hoover's sign, for example, can be used to show how the nervous system is working normally under some circumstances but not others. This is one reason why we find tests involving a high degree of deception on the part of the doctor less useful in hospital

practice. Care has to be taken that your explanation of signs does not imply to your patient that you have "caught them out" or suggest you think they are "putting on" their symptoms.

MALINGERING AND FACTITIOUS DISORDER

Neurologists, are generally good at telling whether illnesses are organic or non-organic, in that diagnoses usually remain stable over time.[8 30 31] However, discriminating between consciously produced and unconsciously produced functional symptoms is altogether more difficult. Awareness of control over symptoms lies on a continuum. Furthermore, it varies over time so that a patient may begin an illness with little awareness about what is happening but gain a degree of conscious control with time (or vice versa).

Doctors are almost certainly worse at detecting patient deception than we would like to think[20] and probably overdiagnose it to the detriment of other patients. Covert surveillance showing a *major discrepancy* in function or a direct confession are probably the only reliable methods available but are rarely obtained.[32]

Among those patients who are consciously generating symptoms and signs, it is important to distinguish between those whose aim is to obtain "medical care" and those in pursuit of material gain. Behaviour of the first kind comes under the diagnosis of factitious disorder and is a medical diagnosis analogous to that of deliberate self harm, another "conscious" act. Those who simulate for financial or other material gain are malingerers and do not have a medical condition.

CONCLUSIONS

The diagnosis of functional weakness and sensory disturbance is not easy. The "positive signs" we have mentioned are just as important as simply looking for the absence of signs of disease. Motor signs, particularly Hoover's sign, are more reliable than sensory signs, but none should be used in isolation and they must be interpreted in the overall context of the presentation. Always bear in mind the possibility that your patient may have both a functional *and* an organic disorder. It is to be hoped that the recent increase in neurological interest in this area will lead to further diagnostic refinements in the future.

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