

## NEUROLOGICAL SIGN



**Figure 1** The sole of a newborn baby has just been stroked by the examiner's finger nail. The reflex withdrawal involves thigh, lower leg, foot and toes (courtesy of professor J. Willemse; Willemse 1961).

# The Babinski sign

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## INTRODUCTION

The plantar response is an important part of the neurological examination. Babinski discovered it in 1896, at least he discovered the important difference between the normal response and that in patients with diseases of the brain or spinal cord (Van Gijn 1996). His main aim was to find objective signs to distinguish hysterical from organic paralysis. Examining the plantar reflex is still a valuable routine. Sometimes it adds little to the history and the rest of the examination, for example in a patient with paraplegia, or with migraine (but in those cases at least doing it provides some extra time to think about possible gaps in the history). In other patients, a Babinski sign is an early and sometimes the only clue to an upper motor neurone lesion.

Not only neurologists test the plantar response but also internists, orthopaedic sur-

geons and general practitioners. It is often found among the rudiments of nervous system tests retained by non-neurologists, together with tendon jerks and pupillary responses. Stroking the sole is easy enough; the importance of the method of stimulation has been grossly overrated. But it is not so simple to determine whether the resulting toe movements are normal or abnormal, even for neurologists. Some background information is essential.

## UPGOING TOES, UPGOING LEG

Why does the great toe go up with lesions of the pyramidal (corticospinal) system? First of all, the plantar reflex involves more than just the toes. This is most evident in the newborn. If one uses a fingernail to scratch the sole of a baby, not too gently (to avoid a grasp reflex), the result is re-

traction of the entire leg. This movement involves flexion of the hip and knee, and dorsiflexion of the foot and toes, especially the great toe (Fig. 1). This combined response is the so-called *flexion synergy*. Anatomists have attached the erroneous term 'extensors' to the muscles that move the toes up. After all, the leg becomes shorter if the toe 'extensors' contract. This is most evident in the many animals that normally walk on their toes, as opposed to the flat-footed human gait.

As the baby grows older, the pyramidal system matures and increases its influence on the spinal cord, especially on the motoneurons of distal extremity muscles. For the flexion reflex of the leg this results in two changes. The first is that the synergy as a whole becomes less brisk, at least in most people. The second is that after the first year of life the toes no longer take part in the flexion synergy. After stimulation of the sole the toes move down, not up. The downward response is a local skin reflex, analogous to the abdominal reflexes.

If the pyramidal tract becomes damaged by disease, either structural or functional, the plantar reflex can revert to the 'infantile' type: the toe 'extensors' are again recruited into the flexion synergy of the leg. This is the sign of Babinski (Babinski 1896; Babinski 1898). But not every upgoing toe is a Babinski sign.

### WHEN IS AN UPGOING TOE A BABINSKI SIGN?

Three requirements need to be met:

- **The tendon of the extensor hallucis longus muscle must be active** (Fig. 2). One should not 'count': upward movements of the entire foot; an upward return of the great toe after it has gone down; or an immobile great toe while the other toes go down (false impression).
- **The upward movement of the great toe should coincide with contraction of other flexor muscles in the leg** (Fig. 3). Most normal people retain at least a remnant of the flexion synergy of the leg; with unilateral lesions of the pyramidal system the leg response may be

even brisker than on the normal side. As a rule, at least the tensor fasciae latae muscle can be seen to move the overlying skin. In addition the tendons of the hamstring muscles can often be seen or at least felt to contract.

- **It should be possible to elicit the phenomenon more than once.** Reactions of ticklish patients can be confusing. In those cases it is helpful to limit stimulation to a small part of the sole, preferably the lateral part of the dorsum (Fig. 2). A great toe that keeps pointing up for some time after the stimulus indicates (more or less) voluntary withdrawal.

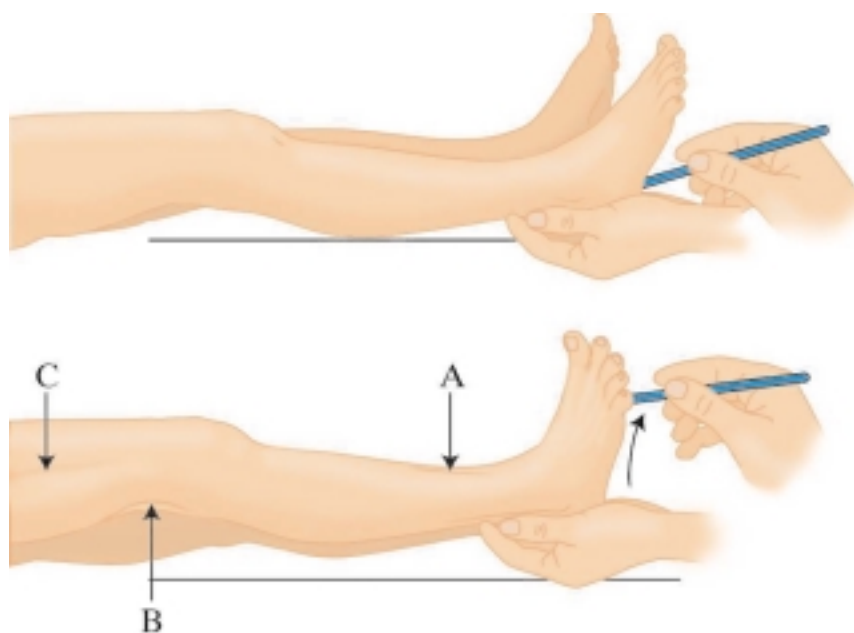
### MYTHS

Because the plantar reflex is such a venerable sign, deeply embedded in the European neurological tradition, superstition has crept in and created a number of myths and half-truths:

- **Stimulation should be painful.** In fact sometimes even light contact such as with bed-clothes is sufficient to evoke a flexion synergy of the leg (including an upgoing toe sign). Also stimulation does not have to involve the traditional 'hockey stick manoeuvre' starting under the lateral heel and ending up under the great toe; the question is not so much whether the toes can be encouraged to move down, but whether they move up.
- **When in doubt one can use Babinski-variants.** The plantar reflex is often the most

**Figure 2** The Babinski sign. The tendon of the extensor hallucis longus muscle protrudes under the skin overlying the great toe and the dorsum of the foot. Stimulation took place at the lateral border of the dorsum rather than at the sole.





**Figure 3** The Babinski sign. The upward movement of the great toe is associated with contraction of other (physiological) flexor muscles in the leg: tibialis anterior muscle (A, tendon just lateral to the shin), the knee flexors or hamstring muscles (B, tendons palpable at the back of the knee), and tensor fasciae latae muscle (C, dimpling under the skin of the lateral thigh). Not all these muscles can always be seen to contract; the activity of the tensor fasciae latae muscle is often the most obvious (courtesy of the Nederlands Tijdschrift voor Geneeskunde).

sensitive but by no means the only site on the leg from where the flexion synergy (*cum* Babinski sign) can be elicited. After Babinski's discovery in 1896 more than a handful of neurologists have tried to emulate his eponymous fame by publishing a 'new' method of stimulation, but in fact the resulting phenomenon was always the same (Van Gijn 1996).

- **Only the first movement counts.** There is no reason why some other movement of the great toe might not precede the Babinski sign and the flexion synergy of the leg: a more or less voluntary movement, or an initial downward toe response (which has not necessarily disappeared altogether).
- **A true Babinski sign includes fanning of the smaller toes.** Babinski described this 'signe de l'éventail' (fan sign) in 1903 as a separate phenomenon, but he attached no great importance to it (Babinski 1903), and rightly so.

### FORMAL 'TEST CHARACTERISTICS' OF THE PLANTAR RESPONSE

As a rule of thumb, a pathological plantar response (about which there is no disagreement) always indicates a disturbance of the pyramidal system, either structural damage or temporary disturbance due to epilepsy or intoxication. No convincing exceptions to this rule are known; in other words, the specificity of the sign is 100%.

Conversely, in patients with lesions of the pyramidal tract about 10% will show a normal or at least mute plantar response (sensitivity of 90%) (van Gijn 1978): one possible reason (not the only one) is a weak flexion synergy of the leg, which makes it impossible for the Babinski sign to emerge, so to speak (van Gijn 1978). A formal, prospective calculation of the test characteristics is not possible for want of a gold standard; predictive values in addition depend on a priori probabilities, which are vastly different between different types of practice.

The reliability of the sign, that is, the agreement between different observers, was rather poor in most studies on the subject. An important reason is that attention is so often given exclusively to the toes. The agreement between neurologists about films where only the foot was visible, in terms of kappa values (corrected for chance agreement, maximum 1.0) ranged between 0.09 and 0.28 (Van Gijn 1996). No similar study has been done in which the flexion synergy was explicitly taken into account. But at least in students this criterion leads to improved agreement (Rajmakers *et al.* 1991).

An extensor response of the toes (Babinski sign) reflects a disorder of the corticospinal system. Release of reflex activity causes the great toe to be recruited into the synergistic flexion reflex of the leg (toe 'extensors' are flexors in a physiological sense). Proper assessment of the plantar reflex therefore involves not only rating of toe movements, but also observing simultaneous contraction of other flexor muscles in the leg. Disregard of this association of the Babinski sign with the flexion synergy has given rise to several myths.

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