

# The Babinski Sign - A Reappraisal

S.P. Kumar, D. Ramasubramanian

*Departments of Neurology and Neurosurgery  
Madurai Medical College,  
Madurai - 625 020, India.*

## Summary

In 1896, Joseph Babinski, a French neurologist, first described the best known neurologic eponym 'the Babinski sign'. This sign is characterised by dorsiflexion of the big toe and recruitment of the extensor hallucis longus muscle, on stimulating the sole of the foot. He has emphasised from the outset, the intimate relationship between this sign and the shortening movement in other leg muscles, which form the flexion synergy of the lower limb. The Babinski sign is not a new reflex, rather it is released as a result of breakdown of the harmonious integration of the flexion and extension components of the normal defence reflex mechanism, due to pyramidal tract dysfunction. A pathological Babinski sign should be clearly distinguished from upgoing toes that may not always be a part of the flexion synergy. This article reviews the Babinski sign in detail, focusing on the historical perspectives, role of pyramidal tract dysfunction and art of elicitation and interpretation. The significance of assessing this phenomenon in the entire leg, and the clinical clues that will help to dispel the myths regarding the Babinski sign, have been emphasised.

**Key Words :** Babinski sign, Extensor plantar, Pyramidal sign.

Neurol India, 2000; 48 : 314-318

## Introduction

It was on February 22, 1896, that Joseph Francois Felix Babinski published his first report on 'reflexe cutane plantaire' [cutaneous plantar reflex] which became the sign that bears his name: 'the Babinski sign'.<sup>1</sup> However unknown to Babinski, several painters like Bortticelli, Raphael, Leonardo da Vinci had previously demonstrated this phenomenon in their paintings.<sup>2</sup> Later, Babinski asserted that if others had described the abnormal reflex before him, they found it fortuitously and did not realize its clinical implication; while he discovered it by a combination

Correspondence to : Dr. S.P. Kumar, OASIS, Post Graduate Hostel, Madurai Medical College, Madurai - 625 020, Tamil Nadu, India.

of chance, careful observation and intuition.<sup>3</sup> Babinski first differentiated between a normal and pathologic plantar response.<sup>4</sup>

## Sketch of the Man

Joseph Babinski was born in Paris and died at the age of 75 in 1932 (Fig. 1). Of reticent disposition, he wrote in a very sombre and serious tone, but his gaze, clear and calm, was penetrating and scrutinizing.<sup>5</sup> He was a devout bachelor and had two passions in his life i.e. work and his brother Henri. His objective was always to find clinical signs that permitted the authentication of the organic nature of the syndrome; and specify the localisation of the lesion responsible



**Fig. 1** : Joseph Francois Felix Babinski (1857 to 1932).

for the same. Babinski's ambition to establish a department of neurosurgery at the Hospital de la Pitie in Paris, where he did most of his work, was realised shortly after his death.<sup>6</sup>

## The Babinski sign

This eponym refers to the dorsiflexion of the great toe with or without fanning of the other toes and withdrawal of the leg, on plantar stimulation in patients with pyramidal tract dysfunction. The characteristic response is dorsiflexion of the great toe by recruitment of extensor hallucis longus (EHL) muscle. In most mammals the limbs are automatically retracted on painful stimulation as a defence reflex, which is more pronounced in hind limbs. Sherrington called it, the flexion reflex synergy, because activation of all muscles effected shortening of the limb; the toe extensors forming part of this shortening synergy. Confusion has arisen from the application of the term extensor plantar response to a movement which forms part of a flexion synergy of the lower limbs. The toe 'extensors' although named extensors by anatomists, are infact flexors in a physiological sense because their action is to shorten the limb and contract reflexly along with other flexor muscles.

The Babinski sign may be a normal occurrence in the 1st year of life, due to a brisker flexion synergy, the

toes being a part of it. As the nervous system matures and the pyramidal tract gains more control over spinal motor neurons, the flexion synergy becomes less brisk and toe 'extensors' are no longer a part of it. The toe then often goes down, instead of up, as a result of a segmental reflex involving the small foot muscles and the overlying skin. This is considered to be normal in adults and is termed - flexor plantar response. With lesions of the pyramidal system, structural or functional, this segmental downward response of the toes disappears, the flexion synergy may become disinhibited and the EHL muscle is again recruited into the flexion reflex of the leg producing the sign of 'Babinski'.<sup>7</sup>

The muscles taking part in a fully developed response include extensor hallucis longus, tibialis anterior, extensor digitorum longus, hamstring group of muscles and tensor faciae latae. The characteristic response is dorsiflexion (extension) of the big toe, which precedes all other movements. It is followed by fanning out and extension of the other toes, dorsiflexion of the ankle and flexion of the hip and knee joint. This response represents 'positive' Babinski sign. There is no such thing as a 'negative' Babinski sign.

## The role of pyramidal tract

There seems to be a close association between occurrence of the Babinski sign and impairment of voluntary foot movement. A Babinski sign can appear only if the intraspinal pathways of the flexion reflex synergy are operative, however, severe the motor deficit in the foot. The function of the pyramidal tract may not only be disturbed by structural lesions of myelin sheaths, axons, or both, but also by non-neurological conditions (Table I).

The motor neurons of the leg muscles are laminated into separate columns within the anterior horn of the cord, each of which supply proximal or distal muscles, flexor or extensor muscles. In addition, there are important pyramidal tract projections to the intermediate (interneuronal) zone. This divergence of pyramidal tract projections allows the following two explanations for the Babinski sign.

The Babinski sign might be released by dysfunction of pyramidal tract fibres that project on interneuronal zone, at least on those interneurons that subserve the flexion reflex synergy, of which the Babinski sign is a part. As these interneurons are necessarily interconnected across the segments of the lumbosacral spinal cord, a Babinski sign would always be

**Table I**  
**Non-neurological Causes of Extensor Plantar Response**

---

In children upto the age of 1 year
Deep sleep
Coma
General anaesthesia
Electroconvulsive therapy
Post-ictal stage of epilepsy
Apnoeic phase of Cheyne Stockes breathing
Narcosis
Alcohol intoxication
Hypoglycemia
Hypnosis
Physical exhaustion and marathon walking
Drugs-scopolamine, barbiturates

---

accompanied by hyperactivity in other, more proximal flexor muscles. Alternatively, this sign might result from interference with pyramidal fibres projecting directly on motor neurons of the EHL. In that case, the effector of the sign, the EHL would be less responsive to descending impulses through interneurons.<sup>8</sup>

### Types of Babinski sign

- Minimal Babinski sign* : Contraction of hamstring muscles and tensor faciae latae.
- True Babinski sign* : Includes all the components of the fully developed extensor plantar reflex.
- Pseudo Babinski sign* : One may encounter this type of response in sensitive individuals, plantar hyperaesthesia, and choreo-athetosis due to hyperkinesia. True Babinski can be clinically distinguished from the false Babinski by the contraction of hamstring muscles in the former, and failure to inhibit the extensor response by pressure over the base of the great toe.
- Exaggerated Babinski sign* : It can either be in the form of 'flexor spasm' or 'extensor spasm', depending upon the muscles i.e. whether flexors or extensors, have excess of tone. Flexor spasms occur in spinal cord disease, bilateral upper motor neuron lesion at a supraspinal level, multiple sclerosis and subacute combined degeneration of the cord, while 'extensor spasm' occurs in patients with corticospinal tract lesion when the posterior column function is normal.
- Inversion of plantar reflex* : If the short flexors of the toe are paralysed or flexor tendons are severed accidentally, an extensor response may be obtained.
- Tonic Babinski reflex* : Characterised by slow

prolonged contraction of extensors of toe, seen in frontal lobe lesions and extrapyramidal involvement.

- Crossed extensor response/bilateral Babinski sign* : Unilateral stimulation produces bilateral Babinski in patients with bilateral cerebral disease and spinal cord disease.
- Spontaneous Babinski* : In infants and children following manipulation of the foot, and in patients with extensive pyramidal tract diseases, passive extension of the knee or passive flexion of the hip and the knee, may produce a positive Babinski sign.

### The art of elicitation

The reflexogenic area for the plantar reflex is the first sacral (S1) dermatome with the receptor nerve endings being located in the skin. The afferent nerve is the tibial nerve, the spinal cord segments involved in the reflex arc being 4th and 5th lumbar and 1st and 2nd sacral.

### Position

All the leg muscles should be visible and in a relaxed state. This can be achieved by positioning the patient in a way that the knee is slightly flexed and the thigh is externally rotated. The patient should be warned that the sole is going to be scratched and ask him to try to let his limb remain as floppy as possible. The toes should not be touched at all.

### Stimulation

It is the site of stimulation, the intensity of stimulation, and even the object used for stimulation that has received by far the most attention. Any part of the leg can be stimulated, but the best technique is to stimulate the lateral plantar surface and the transverse arch in a single movement upto the middle metatarsophalangeal joint with a firm applicator lasting 5 to 6 seconds.<sup>9</sup> Difficulties are bound to arise in certain clinical situations which makes elicitation and interpretation of plantar response inconclusive. It is imperative that one realises these problems and be aware of their solutions in order to arrive at an appropriate clinical conclusion (Table II).

### Alternate methods

The late 19th and early 20th century was abound with disclaimers associated with founders of new reflex movements of the great toe. These movements are

Table II

## Different Clinical Situations and Solutions in Eliciting and Interpreting Plantar Response

Situations	Solutions
Failure of relaxation from voluntary movement due to unpleasant sensation.	Preliminary warning and avoiding traumatic stimuli.
Some patients are truly unable to tolerate the sensation.	Ask the patient to take a deep breath to allow a few moments of relaxation and slight stimulation on the outer side of the foot.
In case of 'pescavus', it is difficult to assess the movement of the big toe.	Watch the movement of metatarsophalangeal joint.
Bony deformities like 'hallus valgus' may prevent any movement of the big toe.	Observe the movement of the other toes.
Complete paralysis of the extensors of the toes makes Babinski response impossible.	Contraction of the tensor faciae latae may be taken as positive response.
In peripheral neuritis, due to hyperaesthesia there may be a reflex withdrawal that interferes with the response.	Hold the foot at the ankle.
If the patient is truly unable to feel the plantar sensation because of callosities of the feet.	Rely on alternate methods, especially, 'Bing's sign'

known by the term 'Babinski like responses'. These responses can be elicited by the following techniques, each with its own eponym.

By stroking the lateral malleolus (Chaddock's sign); squeezing the calf muscle (Gordon's sign); applying pressure along the shin of tibia (Oppenheim sign); pressing the 4th toe downwards and then releasing it with a snap (Gonda's sign); vigorous adduction of the little toe followed by its sudden release (Stransky sign); squeezing the Achilles tendon (Schaefer's sign), flexion of the toes, on quick percussion of the tips of the patients toes with the finger tip (Rossolimo's sign); flexion of the four outer toes induced by tapping the dorsum of the foot in the region of cuboid bone (Mendal Bechtrew sign); giving multiple pinpricks on dorsolateral surface of the foot (Bing's sign); forceful passive plantar flexion of the ankle (Moniz sign); pressing over the dorsal aspect of the metatarsophalangeal joint of the great toe (Throckmortan sign); application of forceful pressure over anterior tibial region (Strumpell sign); scratching the dorsum of the foot along the inner side of the extensor tendon of the great toe (Cornell sign); plantar flexion and fanning of the toes on tapping the mid plantar region of the foot or base of the heel.

## Interpretation

Incorporation of videotape and electromyography should be welcomed in the interpretation of plantar response.<sup>10</sup> The following criteria that have emerged from the comparison of clinical data with electromyographic results may be applied for interpreting a pathological Babinski sign.<sup>11</sup>

- Upward movement of the great toe is pathological only if caused by contraction of the EHL muscle.
- Contraction of the EHL muscle is pathological only if it is occurring synchronously with reflex activity in other flexor muscles.
- A Babinski sign does not necessarily imply that the concurrent activity of the other flexor muscles should be very brisk and vice versa.
- The true Babinski sign is reproducible, unlike voluntary withdrawal of the toes.

## Fallacies

An extensor response may be present when there is no damage to the pyramidal tract. A possible explanation being the excitation of the distal motor neurons and inhibition of the impulses via flexor reflex afferent

nerve fibres can be dissociated because they are mediated by different neurons, however closely linked. On the contrary, cases with proven damage to the pyramidal system have had normal plantar response. We should understand that corticospinal fibres not only originate in different parts of the cortex, but also have different terminations. Babinski sign can be expected only when 'leg fibres' of the pyramidal tract are involved. Plantar areflexia can be noted in cases with loss of sensation of sole due to lesion of the first sacral cutaneous distribution. The same can be observed in paralysis of extensors or long flexors of great toe. In spinal shock, cessation of tonic discharge of spinal neurons by excitatory impulses in descending pathways may explain its non existence. Drugs like parenteral physostigmine in physiological doses may also abolish a plantar response.

## Conclusion

Despite the continuing controversy and observer bias, clinical utility of Babinski sign remains unchallenged. The role of pyramidal system in the pathophysiology of this sign is quite clear. Pyramidal tract dysfunction releases the flexion reflex synergy, of which contraction of the extensor hallucis longus muscle forms an integral part. The most important and vital question in interpreting the plantar response is not, whether the great toe goes up or not, but is whether an upgoing toe is pathological or not. For an appropriate answer the method of observation is much more

important than the method of elicitation. Moreover, videotaping and electromyography could improve the clinical interpretation and help in settling the argument especially if it is an unexpected finding.

## References

1. Van Gijn J : Babinski sign, the first hundred years. *J Neurol* 1996; **243** : 675-683.
2. E Wayne Massey, Lynda Sander : Babinski sign in medieval, renaissance, and baroque art. *Arch Neurol* 1989; **46** : 85-88.
3. Estanol Vidal B, Huerta Diaz E, Garcia Ramos G : 100 years of the Babinski sign. *Rev Invest Clin* 1997; **49** : 141-144.
4. Bassetti C : Babinski and Babinski sign. *Spine* 1995; **20** : 2591-2594.
5. Claude Belanger : What do you know about Joseph Babinski? *Le Journal Canadien Des Science Neurologiques* 1989; **16**: 4-7.
6. Lanzino G, diPierro CG, Laws ER Jr : One century after the description of the 'sign' : Joseph Babinski and his contribution to neurosurgery. *Neurosurgery* 1997; **40** : 822-828.
7. Van Gijn J : The Babinski reflex. *Postgrad Med J* 1995; **71** : 645-648.
8. Van Gijn J : The Babinski sign and pyramidal syndrome. *J Neurol Neurosurg Psychiatry* 1978; **41** : 865-873.
9. George J Dohrmann, William J Nowack : The upgoing great toe optimal method of elicitation. *Lancet* 1973; **17** : 339-341.
10. PG HM Raijmakers, M Castro Cabezas, JA Smal et al : Teaching the plantar reflex. *Clin Neurol Neurosurg* 1991; **93.3** : 201-204.
11. Van Gijn J : Equivocal plantar response: a clinical and electromyographic study. *J Neurol Neurosurg Psychiatry* 1976; **39** : 275-282.