

## Withdrawal response in healthy adults

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### Abstract

**Background:** Withdrawal response was used to explain extensor plantar response in population without pyramidal dysfunction but there is lack of data characterizing this response in normal population. **Objective:** To characterize withdrawal response from pain and tickle sensation in population without any neurological deficit. **Methods:** The study was carried out using four different stimuli, namely heat-induced pain, cold-induced pain, electric-induced pain using electromyography stimulator and ticklish sensation using superworm (*Zophobas morio*), applied to normal subjects in University Malaya Medical Centre, Kuala Lumpur. **Results:** Heat-induced pain resulted in flexion of the big toe (61.1%), other toes (62.3%), ankle dorsiflexion (82.6%), knee flexion (83.9%) and hip flexion (83.9%). Electric-induced pain showed flexion of the big toe (27.7%), other toes (28.3%), ankle dorsiflexion (51.0%), knee flexion (76.0%) and hip flexion (76.0%). Ticklish sensation showed flexion of the big toe (14.8%), other toes (14.8%), ankle dorsiflexion (22.7%), knee flexion (21.9%), and hip flexion (21.9%). There was significant correlation between fear and ticklish sensation induced withdrawal responses and extension of big toe. Cold induced pain resulting in big toe flexion (6.4%), other toes (6.9%), dorsiflexion of ankle (7.1%), flexion of knee (6.9%), and hip flexion (6.9%). Females were more responsive to heat, males to electrical stimulation. The prevalence of big toe extension ranged from 11.0% (electrical), 6.3% (ticklish), 4.8 (heat), to 0% (cold), a mean of 5.2% overall. **Conclusion:** Withdrawal response caused by nociceptive and ticklish sensation consists mostly of big toe flexion and of other toes, ankle dorsiflexion and flexion of the knee and hip. Extension of the big toe is seen in about 5% of all the stimulation.

### INTRODUCTION

The plantar reflex (also known as plantar response) is a nociceptive segmental spinal reflex that functions, to protect the sole of the foot.<sup>1</sup> However, interpretation of the plantar reflex remains an art. When flexion of the big toe is observed (which is usually accompanied by flexion and adduction of other toes), it is termed flexor plantar reflex, which is interpreted as a normal response. If extension of big toe is observed (which is usually accompanied by extension and abduction of other toes), this is termed extensor plantar reflex or Babinski's sign.<sup>1-3</sup> Babinski's sign is well accepted as a sign of upper motor neuron lesion. Babinski's sign may also be obtained in states of unconsciousness, profound sleep, deep anaesthesia or drug intoxication, and after electroconvulsive therapy.<sup>4</sup>

There are several Babinski's mimickers, which can present with extension of big toe. (1) Pseudo Babinski's sign can be seen in patients with choreoathetosis, in which the extension of big toe is due to hyperkinesia.<sup>5</sup> (2) In patients with inversion of plantar reflex, in which the

short flexors of toe are paralyzed or the tendons severed, extension of great toe is obtainable.<sup>5</sup> (3) Extension of the big toe can be a withdrawal response, and is hypothesized to be caused by ticklish and nociceptive sensation.<sup>4</sup>

Patients who are found to have extension of the great toe on plantar stimulus, with no apparent pyramidal dysfunction, are commonly interpreted to have a withdrawal response by the clinician. In fact, withdrawal response is often referred to as the flexor withdrawal reflex, flexor reflex or nociceptive reflex, which consists of flexion of the ankle, knee, and hip when the foot is painfully stimulated. Dejong referred to it as voluntary withdrawal response.<sup>4</sup> Though there is variability in the definition of the withdrawal response, it is mainly used to explain extensor plantar responses in populations without pyramidal dysfunction. This response is believed to be a voluntary movement, caused by nociceptive or ticklish sensations<sup>4</sup>, and often confused with Babinski's sign. The examiner is required to repeat the stimulus more gently while holding the foot