Which is the best evoked potential technique for assessing the nociceptive system? Preliminary results of a neurophysiological study in healthy humans

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Introduction: Laser Evoked Potentials (LEPs) are a widely agreed method for investigating nociceptive system. Concentric electrodes (CE) have also recently been introduced to measure Pain-Related Evoked Potentials (PREPs) and, thereby, to assess nociceptive system in patients. Although some Authors have reported that low intensity CE stimulation, by evoking pinprick sensation, selectively activates nociceptive fibers, the CE reliability in the assessment of nociceptive system is still unclear.

In this study we aimed at verifying whether low and high intensity CE stimulation selectively activates nociceptive fibers. To do so we recorded LEPs and PREPs before and after capsaicin-induced skin denervation.

Methods: To date we have enrolled 10 healthy subjects.

All subjects underwent a baseline recording of LEPs and PREPs after stimulation of the right forearm. For PREP recordings, we used a low intensity stimulation, evoking a distinct pinprick sensation, and a high intensity stimulation, evoking an electrical painless sensation. After the baseline evoked potential recordings, we applied an 8% capsaicin plaster on the right forearm. After one-two weeks, we recorded LEPs and PREPs after stimulation of the capsaicin-induced denervated forearm skin. In a small skin area spared by evoked potential stimulations we have also collected a skin biopsy for assessing the skin denervation.

EEG Analysis

EEG data were preprocessed and analyzed using Letswave 5. EEG data were segmented into epochs using a time window ranging from 1,5 s before the stimulus to 2 s after. Each epoch was band-pass filtered from 1-30 Hz (for analysis in the time domain) and from 1 to 100 Hz (for analysis in the time-frequency domain).

We measured the peak latencies of the lateralized N1 and vertex N2 and P2 components. Time-frequency analysis was performed in order to reveal electroencephalographic gamma band oscillations (GBOs) induced by nociceptive stimuli.

Results: While LEPs were suppressed after topical application of capsaicin, low and high intensity PREPs did not differ before and after capsaicin-induced skin denervation. The skin biopsy documented the skin denervation induced by the capsaicin plaster. Time-frequency analysis revealed GBOs in the baseline evoked potential recordings after laser stimulation alone.

Discussion: Our data indicate that both low and high intensity CE stimulation elicit PREPs after skin denervation, thus probably suggesting that the CE stimulation coactive non-nociceptive fibers.

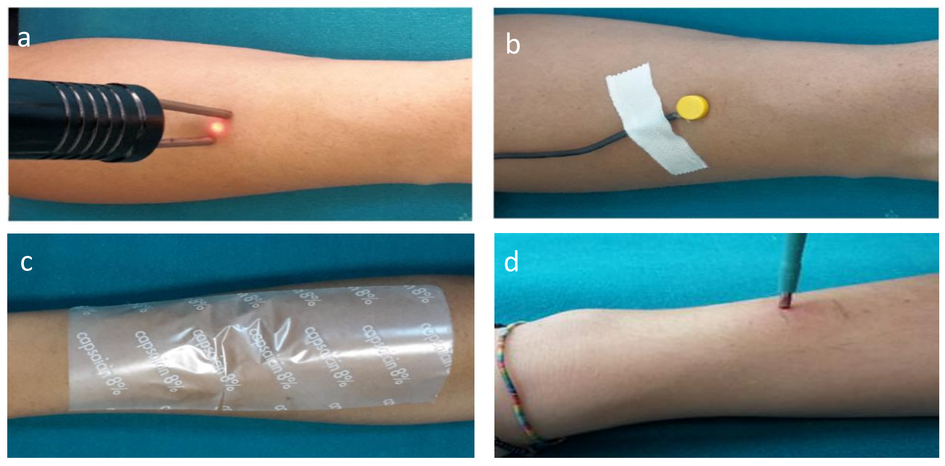

Fig. 1. a) Laser stimulation of the forearm; b) Concentric electric stimulation of the forearm; c) capsaicin plaster applied on the region investigated with Eps; d) skin biopsy of the region treated with capsaicin.

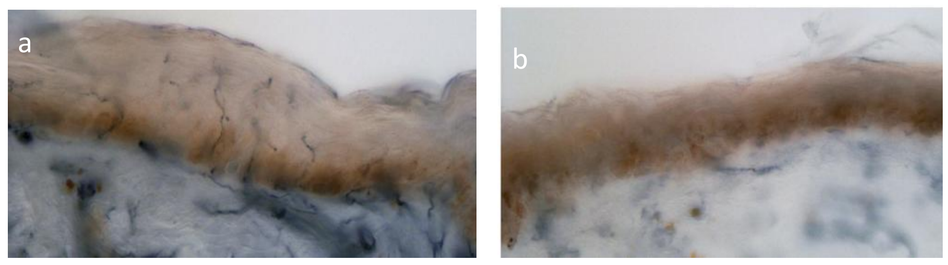

Fig. 2. a) normal skin innervation b) capsaicin induced denervation.

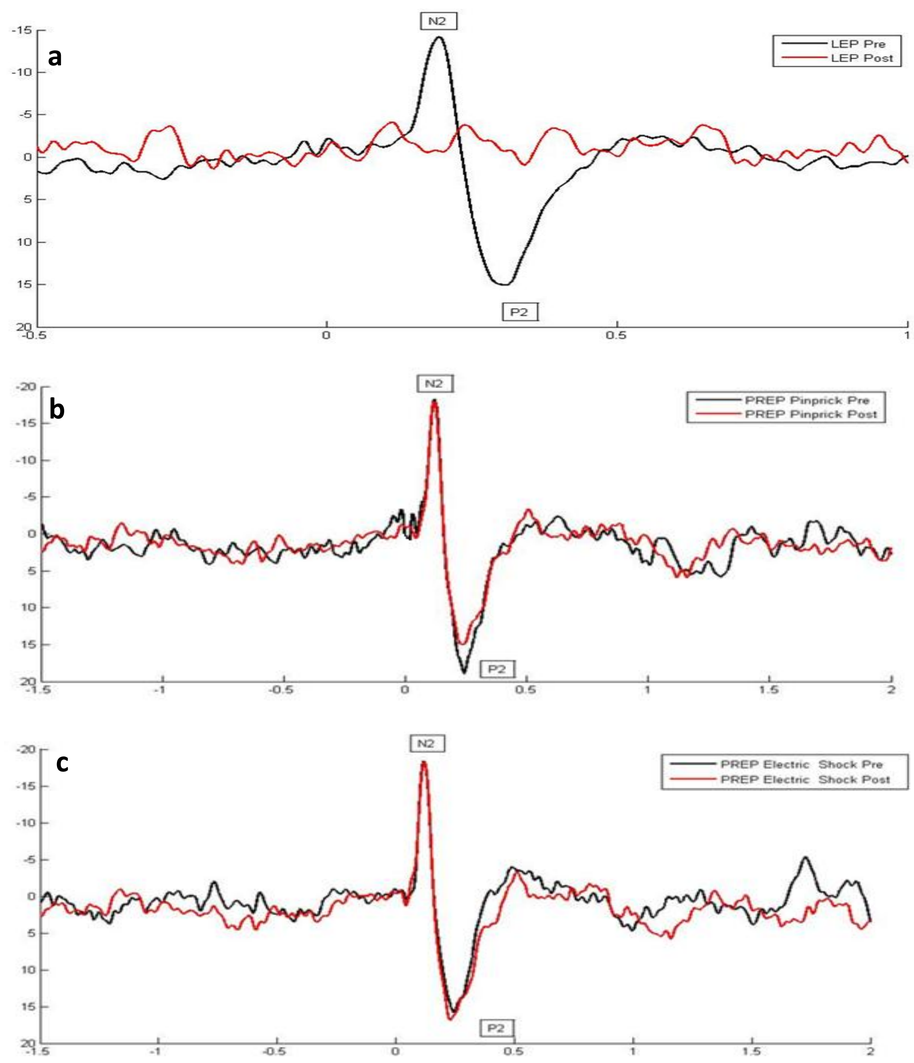

Fig. 3. a) LEPs before and after skin denervation; b) and c) PREP recordings with a low intensity stimulation, evoking a distinct pinprick sensation, and a high intensity stimulation, evoking an electrical painless sensation, before and after skin denervation.

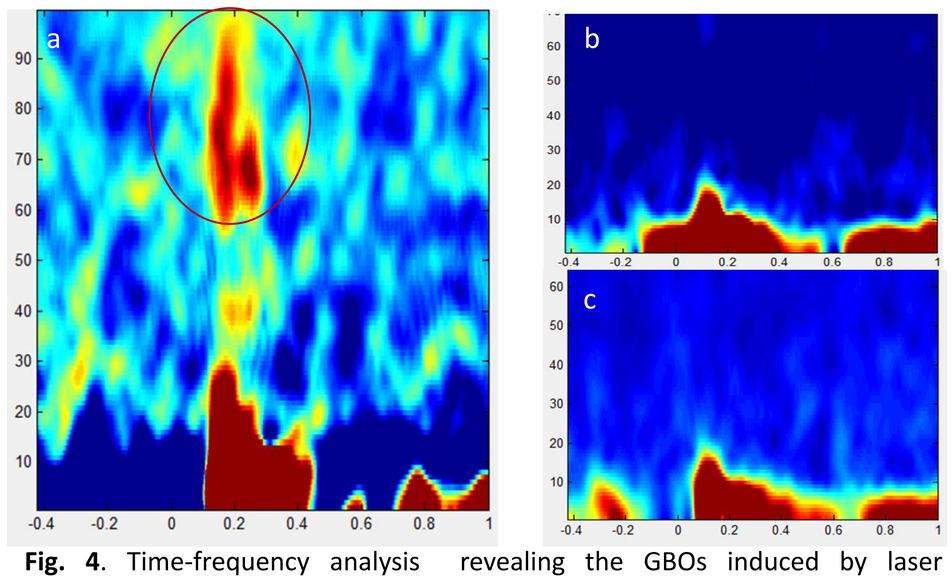

Fig. 4. Time-frequency analysis revealing the GBOs induced by laser stimulation alone. a) LEPs; b) PREPs with a low intensity stimulation; c) PREPs with a high intensity stimulation.

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