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INTRODUCTION : Conventional neurophysiology does not study the excitability of peripheral nerves. We propose a method to evaluate nerve excitability and its recovery cycle (RC), after the passage of an influx, using a conventional electrodiagnostic machine.

MATERIALS AND METHODS : The median nerve is stimulated at the wrist (surface detection on the *abductor pollicis brevis* muscle). We use the dedicated motor unit counting program of the Natus/Keypoint G3 with a complex burst stimulation allowing adjustment of the intensity of the 1st and 2nd stimulus and the inter-stimuli interval (ISI). The intensity of the 1st stimulus (conditioning) is supramaximal. The intensity of the 2nd stimulus (test) corresponds to i40 (inducing a motor response = 40% of maximum amplitude). It is the modification of the ISI between 1 and 200 ms that allows the study of the phases of the RC. Normative data (P5/P95) are established in a group of 18 healthy subjects (mean age: 38 ± 14 y.o.). This procedure is performed under basal conditions, after 2-minutes voluntary contraction effort, during and after ischemia. The technique is also applied to two patients with demyelinating neuropathy (GBS and CMT 1A). When the ISI is less than 10 ms, the consecutive responses to the conditioning and test stimuli overlap, so the test response is reconstructed by subtraction of traces (Figure 1).



Fig.1: Modification of the response to the second stimulus (test) based on the interstimulus interval (ISI) after using trace subtraction.

RESULTS : Figure 2 shows median results obtained under basal conditions (A), and median results during (B) and after ischemia (C) compared to basal conditions. Each test response amplitude is normalized as a percentage of the maximal response obtained with an ISI of 200 ms. During ischemia, which causes axonal depolarization, RC is characterized by an increase in refractory periods and a decrease in supernormal period. After ischemia, which causes axonal hyperpolarization, RC reveals a decrease in refractory periods and an increase in supernormal period. These variations in the RC are also observed after effort, with weaker differences compared to basal conditions (Figure 3).

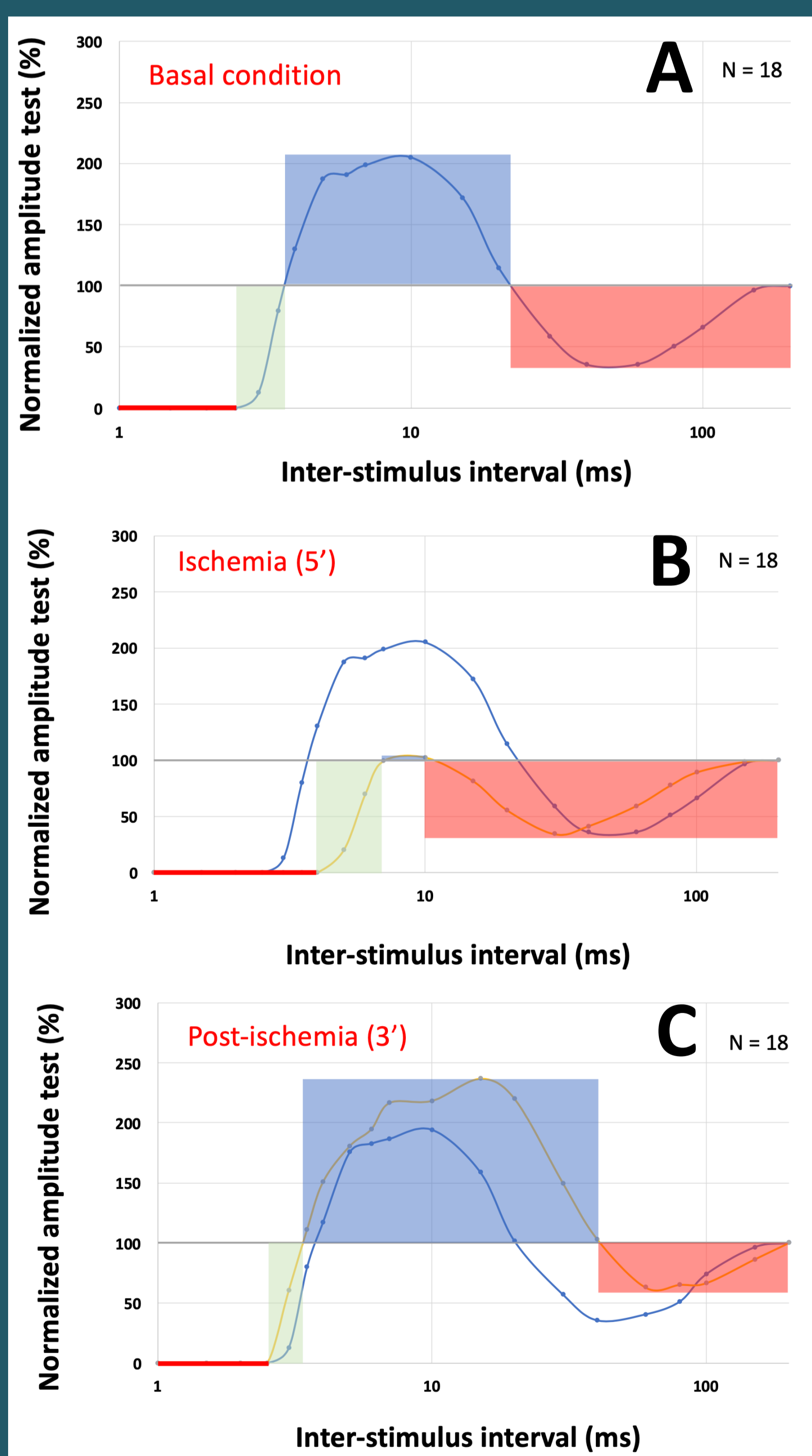


Fig.2 : Recovery cycle in basal conditions (A), during ischemia (B) and after ischemia (C).

Blue curve = basal conditions (A, B, C); yellow curve = during ischemia (B) and after (C).

Red line: “absolute” refractory period; colored rectangles: green = relative refractory period, bleu = supernormal period, red = late subnormal period.

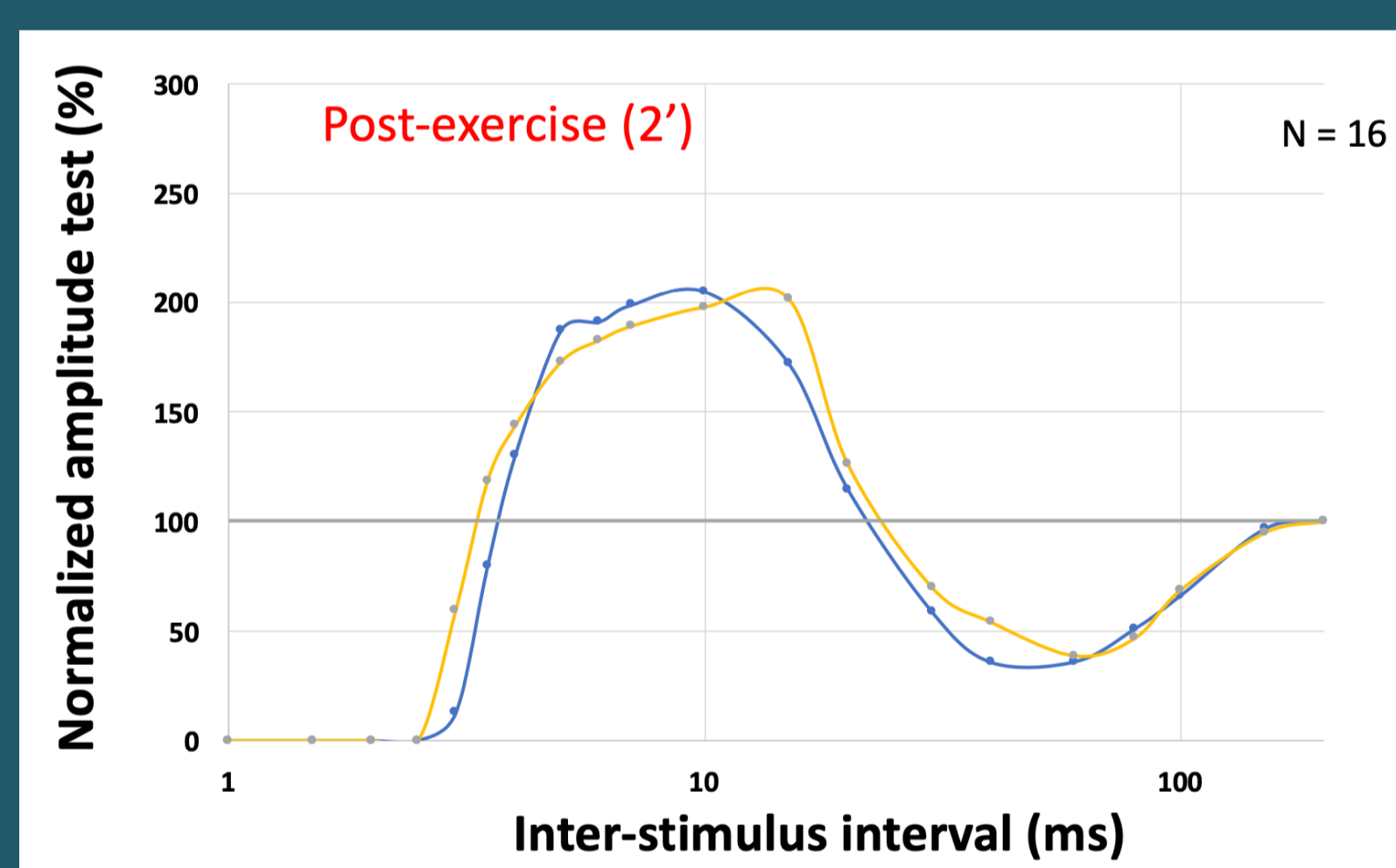


Fig.3: Recovery cycle in basal condition (blue) and after a 2-minute voluntary contraction effort (yellow).

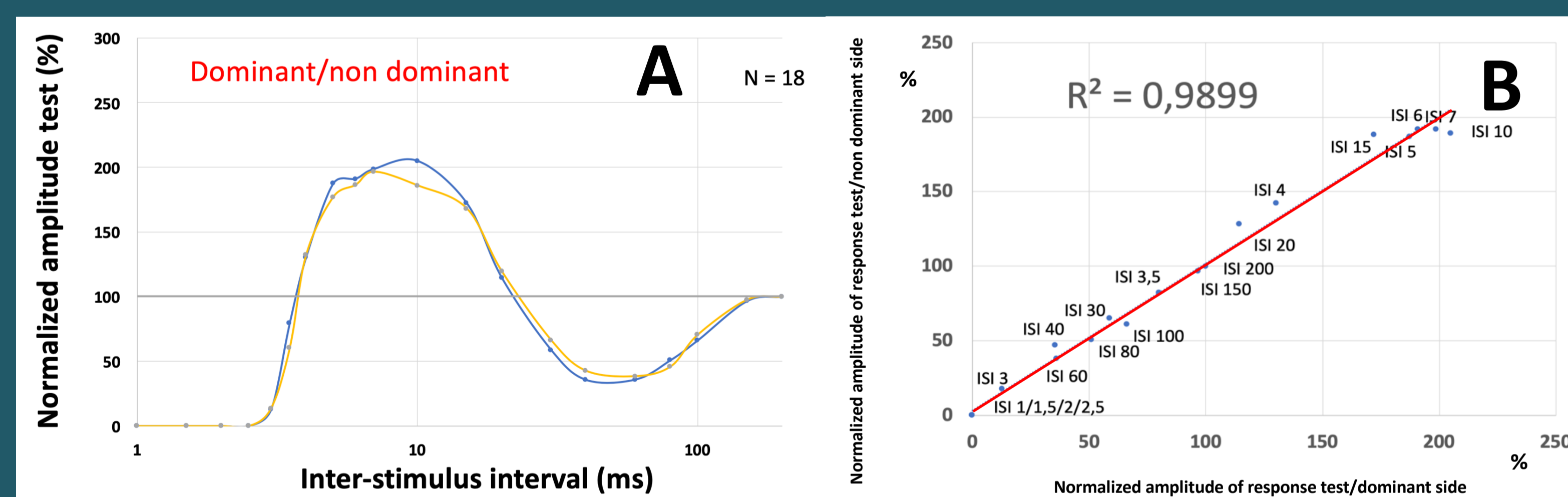


Fig.4: (A) Comparison of the results obtained in the control group between the dominant and non dominant side. (B) Strong correlation proves there is no difference between left and right sides and that the technique is reproducible.

Figure 4 indicates only small differences between dominant and non-dominant hands. RC data between the two hands are strongly correlated. These results support the reproducibility and reliability of the procedure proposed in this study.

The supernormal period is related to the influence on the Ranvier node of the internodal membrane, after the passage of the conditioning stimulus. In demyelinating neuropathies, the demyelinated internode is less capable depolarizing the node, resulting in a decrease in supernormal period, and thus a clear flattening of the curve (Figure 5).

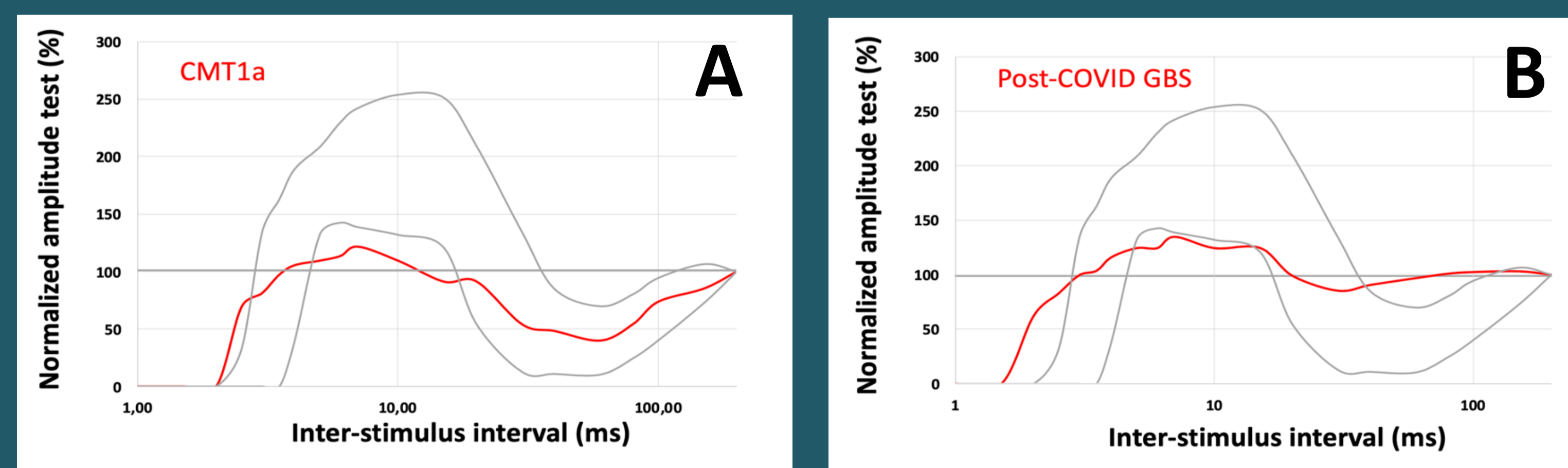


Fig.5: Recovery cycle results in patients with CMT1a (A) and post covid-19 GBS (B). The patients (red) are compared to P5/P95 in healthy subjects (grey). In both patients the supernormal period is decreased. In GBS there is also a decrease of the « absolute » and relative refractory period.

DISCUSSION – CONCLUSION : The proposed double shock technique in this work is promising. Our results corroborate literature data regarding the RC in healthy subject and highlight excitability disorders in pathological subjects. Our protocol does not require any specific device. We aim to develop a reliable, fast and easy-to-use tool, that could ultimately help in the diagnosis of various peripheral neuropathies.