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Characteristics of sensing lower-jaw-position in patients with cerebral palsy during laughing gas-induced sedation

Masafumi Yoshida¹⁾, Ichiro Nakajima¹⁾, Atsushi Uchida²⁾, Taketo Yamaguchi³⁾, Haruko Yoshida¹⁾, Sawako Nakamura¹⁾, Toshiya Nonaka¹⁾, Makiko Iwasaki¹⁾, Naoto Kijima¹⁾ and Yosuke Kuroki¹⁾

1) Department of Pediatric Dentistry, Nihon University School of Dentistry

2) Department of Dentistry, Saitama Prefecture Ranzango

3) Department of Dentistry, Saitama Prefecture Kaikoen

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Abstract To clarify the effects of the applied during sedation with nitrous oxide (hereafter referred to as laughing gas) on the ability of muscles attached to the lower jaw to sense lower-jaw-position and on the sensation of muscle spindles attached to the lower jaw in patients with cerebral palsy (CP) using healthy adult subjects without functional abnormalities of the jaws and oral cavities as control subjects (hereafter referred to as healthy subjects). Experiments were performed under the following conditions: for each subject, before the inhalation of laughing gas (LG) and oxygen (air-inhalation condition: referred to as without LG inhalation) and during the inhalation of LG and oxygen (inhalation condition of LG and oxygen under LG-induced sedation: referred to as during LG inhalation). Subjects in the experiments were eight CP patients and eight healthy people as controls. The ability to discriminate lower-jaw-position was estimated by asking the subjects to determine whether the diameter of a test stick was larger or smaller than that of a reference stick after performing the following tasks: a) holding a reference stick between the central teeth of their upper and lower jaws for 5 s, and b) replacing the reference stick with a test stick and holding it at the same position for 5 s, and the test stick was then removed. The following findings were obtained.

1) In comparing discrimination ability in the absence of LG-induced sedation and that during LG-induced sedation of healthy control subjects, the rate of mis-estimation (RME) was

significantly larger during LG-induced sedation than in the absence of LG-induced sedation for a test stick diameter (10.5 mm or 11.0 mm) larger than the reference stick diameter (10.0 mm) ($P < 0.05$). No significant differences were observed for any other test sticks ($P > 0.05$).

2) In comparing discrimination ability in the absence of LG-induced sedation and that during LG-induced sedation of CP patients, RME was significantly smaller during LG-induced sedation than in the absence of LG-induced sedation, when the test stick diameter (9.5 mm) was smaller than the reference stick diameter ($P < 0.05$). No significant differences were observed for any other test sticks ($P > 0.05$).

These results indicate that neural functions are inhibited at the upper level of the central nervous system in CP patients, leading to the attenuation of sustained increase in muscle tonus that is characteristic of CP patients. In summary, it seems that the LG has some inhibitory effect on the activity of γ -motor neurons innervating muscle spindles attached to the lower jaw via the upper level of the central nervous system and that this inhibitory effect contributes to an improvement in the discrimination ability.

Key words Cerebral palsy, Laughing gas-induced sedation, Lower-jaw-position sensation, Muscle spindle, Muscle tonus

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