学 位 研 究 紹 介

Comparison of the modulatory effects on the jaw-opening reflex among the different periods of mastication in awake rabbits
覚醒下ウサギを用いた異なる咀嚼周期における開口反射の変調様式の検討

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1. Introduction

The jaw-opening reflex (JOR) is reported to be strongly suppressed in the jaw-closing phase than those in the jaw-opening phase only during rhythmic chewing.

However, the entire masticatory sequence (i.e., from food intake to just before swallow) has three functionally different masticatory periods (preparatory, rhythmic-chewing and preswallow periods). Therefore, one of the aims of the study is to investigate the modulatory pattern of the JOR in relation to the phases of the chewing cycle during each of the masticatory periods.

In addition, the modulatory effects on the JOR during mastication were investigated only for the chewing side. Therefore, the other aim of the study is to investigate if the JOR evoked in the non-chewing side is modulated in a same manner as that in the chewing side during mastication.

2. Experimental procedure

The experiments were carried out on 10 rabbits. To record the EMG, teflon-coated stainless-steel wire electrodes were implanted bilaterally on masseter and digastric muscles. To record jaw movements, a small cylindrical magnet and a jaw-tracking system consists of two magnet sensors was fixed in the chin and head, respectively. To stimulate the IAN, a pair of custom-made bipolar electrodes was bilaterally inserted into the mental foramina.

To elucidate the modulatory effect, each chewing cycle was divided into the jaw-closing (CL) and jaw-opening (OP) phases for preparatory period, the fast-closing (FC), slow-closing (SC), slow-opening (SO) and fast-opening (FO) phases for rhythmic-chewing period and CL, SO and FO phases for preswallow period.

To test effects of mastication on the JOR, amplitude (peak to peak) of the reflexly evoked EMG activity of the digastric muscle was measured and the values were compared among the masticatory periods and between the chewing and non-chewing sides.

3. Results

The JOR evoked either in the chewing or non-chewing side was modulated during mastication. The modulatory pattern on the JOR was different among the masticatory periods. First, the JOR was not modulated in a phase-linked manner during the preparatory period. In addition, the modulatory effect was variable (strong suppression to weak facilitation).

Different from the preparatory period, the JOR was generally suppressed in a phase-linked manner during the rhythmic-chewing period: the suppressive effect on the JOR was less in the FO phase. The suppression of the JOR during this period was significant in the FC and SC phases and the SO phase for both the chewing and non-chewing sides.

Like the rhythmic-chewing period, the JOR was suppressed in a phase-linked manner during the preswallow period. Except for the FO phase in the chewing side, the suppressive effect was significant throughout the chewing cycle during this period.

When the modulatory effect on the JOR for each of the jaw-closing and jaw-opening phases was compared among the masticatory periods, several significant differences were noted both in the chewing and non-chewing sides. However, the JOR evoked in the chewing side and that in the non-chewing side were equally modulated throughout the masticatory sequence (Fig. 1).

4. Discussion

4.1 Modulation of the JOR during each of the masticatory period

To explain the variability in the modulatory effect during the preparatory period, movement-generated sensory inputs and descending inputs from the central nervous system is considered. For the former, the interaction of movement-generated sensory inputs and the sensory inputs induced by the IAN stimulation may produce either facilitatory or suppressive effects on the JOR. For the latter, stimulation of the lingual nerve projection locus of the cortex may produce facilitatory effects on the JOR, whereas the stimulation IAN projection locus may produce suppressive effects on the JOR.

During rhythmic-chewing period, the JOR was generally suppressed in a phase-linked manner. However, the modulatory effect in the FO phase was more variable during cortically-induced rhythmic jaw movements than our present findings. This, large variability in the modulatory effects in the FO phase may be due to the differences in the excitability of the digastric motoneurons.

During preswallow period, the attenuation in the suppressive effects was not prominent like the rhythmic-chewing period, since the digastric activity was smaller during preswallow period.

4. 2. Modulatory pattern of the JOR in the chewing side and non-chewing side

The modulatory pattern of the JOR was consistent between the chewing and non-chewing sides, although movement-generated sensory inputs may be different between the sides during the rhythmic-chewing and preswallow periods. Considering this, the digastric motoneuronal excitability and descending inputs from the cortex may be responsible for such modulatory pattern of the JOR.

In case of the preparatory period, the movement-generated sensory inputs and descending inputs from the cerebral cortex is considered to be responsible for the modulation of the JOR, since the modulation does not correlate with digastric activity.

Reference

Mostafeezur R, Yamamura K, Kurose M, Yamada Y : Mastication-induced modulation of the jaw-opening reflex during different periods of mastication in awake rabbits. Brain Res, 1254: 28-37, 2009.

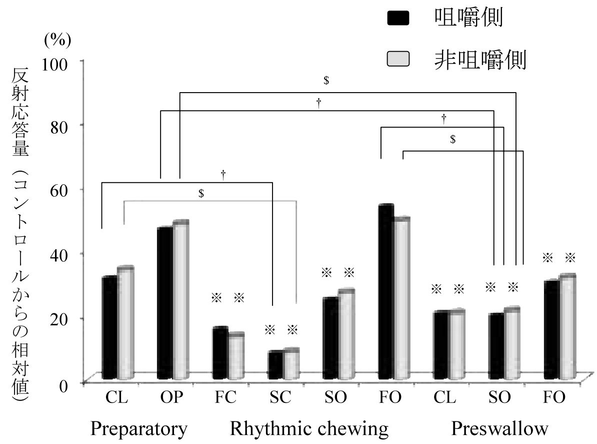

Fig. 1

The modulatory pattern of the JOR for both the chewing and non-chewing sides. The abscissa represents the chewing phases. The mean amplitude of the JOR is expressed on the ordinates. (※): the amplitude of the JOR was significantly lower than the control. (†): the amplitude of the JOR on chewing side was significantly different among the masticatory periods ($): the amplitude of the JOR on non-chewing side was significantly different among the masticatory periods